The Basic Needs in Games (BANG) Model of Video Games and Mental Health

Untangling the Effects of Games with Open Science

by

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Abstract

How do video games affect mental health? Despite decades of research and widespread interest from policymakers, parents, and players, in most cases the best answer we have is: it depends. I argue that our limited success stems largely from (1) a lack of theories that explain more than small portions of the varied evidence base, and (2) methodological limitations related to measurement, self-report data, questionable research practices, and more.

In this thesis, I present the Basic Needs in Games (BANG) model. Building upon self-determination theory, BANG offers a novel theoretical account that provides mechanisms for both short- and long-term effects, positive and negative, resulting from quality or quantity of gaming. Under BANG, the primary mechanism through which games impact mental health is via need satisfaction and frustration: the extent to which both games, and players' life in general, provide experiences of control and volition (autonomy), mastery and growth (competence), and connection and belonging (relatedness).

To generate BANG, I conducted semi-structured interviews, finding that need-frustrating experiences within games have important effects on player behavior, likelihood of continuing play, and expectations for future experiences (Study 1). In a mixed-method survey, I show that some—but not all—players are successful in compensating for frustrated needs in daily life by playing games (Study 2).

These findings informed the validation of the the Basic Needs in Games Scale (BANGS), as previous instruments either did not measure need frustration or were not designed for gaming contexts. Across 1400 participants and various validity analyses, I show that the questionnaire is suitable for wide-ranging use (Study 3).

Finally, I collected 12 weeks of digital trace data using a novel method of monitoring the Xbox network, and combined this with 6 biweekly surveys measuring need satisfaction and frustration alongside three mental health constructs (Study 4). Across 2000 responses (n = 400), I find partial support for BANG: there is strong evidence to rule out a meaningful relationship between playtime and subsequent mental health. However, players who felt more need satisfaction than usual in games also reported higher than usual need satisfaction in general, which in turn related to better mental health.

My results help push the field beyond simplified notions of playtime by offering a framework that can systematically account for a wide variety of observed gaming effects. I hope that this work can serve as both a call to action and an illustrative example of how games research can be more productive.

The most up-to-date version of this thesis is available at https://nickballou.com/files/thesis.pdf.

Details of Collaboration and Publications

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Contents

Abstract ii

Preface iv

List of Figures vii

List of Tables viii

1 Introduction 1
- 1.1 Video Games, Mental Health, and Why You Should Care . . . 1
- 1.2 Why Haven't We Made More Progress? . . . 2
- 1.3 A Modest Attempt at Change . . . 5
- 1.4 Thesis Outline . . . 6

Part I: Background 9

2 A Manifesto for More Productive Psychological Games Research 10
- 2.1 Introduction . . . 10
- 2.2 Two Caveats . . . 11
- 2.3 A Brief History of Unresolved Questions . . . 11
- 2.4 A Path Forward . . . 13
- 2.5 Discussion . . . 23
- 2.6 Conclusion . . . 23

3 Games and Mental Health 25
- 3.1 Introduction . . . 25
- 3.2 What is Mental Health? . . . 26
- 3.3 The Empirical and Theoretical Landscape of Gaming and Mental Health . . . 29
- 3.4 Zooming Out: Deficits in Gaming and Mental Health Theory . . . 38
- 3.5 Conclusion . . . 39

4 Basic Psychological Needs and Games 40
- 4.1 Introduction . . . 40
- 4.2 Self-determination Theory . . . 41
- 4.3 SDT and Video Games . . . 45
- 4.4 Measurement of SDT Constructs . . . 51
- 4.5 Discussion . . . 54
- 4.6 Conclusion . . . 55

5 Present Thesis 57

Part II: Theory Generation 59

6 Study 1: What Does Need Frustration in Games Look Like? 60
- 6.1 Introduction . . . 61

6.2 Method . . . 61
6.3 Results . . . 63
6.4 Discussion . . . 68
6.5 Conclusion . . . 70

7 Study 2: Do People Use Games to Compensate for Frustrated Needs During Crises? 72
7.1 Introduction . . . 73
7.2 Method . . . 74
7.3 Results . . . 77
7.4 Discussion . . . 83

8 The Basic Needs in Games (BANG) Model 88
8.1 Introduction . . . 88
8.2 The BANG Model . . . 89
8.3 Discussion . . . 98
8.4 Conclusion . . . 99

Part III: Model Validation 100

9 Study 3: Development of the Basic Needs in Games Scale (BANGS) 101
9.1 Introduction . . . 102
9.2 Development Process Overview . . . 102
9.3 Item Generation . . . 104
9.4 Study 3a: Exploratory Factor Analysis (Situational Level) . . . 105
9.5 Study 3b: Confirmatory Factor Analysis (Contextual Level) . . . 106
9.6 Study 3c: Confirmatory Factor Analysis (Particular Game) . . . 107
9.7 Study 3d: Measurement Invariance . . . 109
9.8 Study 3e: Discriminant/Convergent/Criterion Validity . . . 110
9.9 Discussion . . . 111
9.10 Conclusion . . . 113
9.11 Acknowledgements . . . 113

10 Study 4: Longitudinal Relationships Between Logged Xbox Gaming and Mental Health 114
10.1 Introduction . . . 115
10.2 Design . . . 117
10.3 Study 4a: Playtime and Mental Health . . . 120
10.4 Study 4b: Basic Needs in Games Model . . . 126
10.5 General Study 4 Discussion . . . 134
10.6 Conclusion . . . 135
10.7 Acknowledgements . . . 135

Part IV: Sense-making 136

11 Discussion 137
11.1 A Summary of Findings . . . 137
11.2 Implications . . . 138
11.3 Limitations and Next Steps . . . 148
11.4 Conclusion . . . 150

12 Appendix 170
A1 Supplementary Materials For All Thesis Studies . . . 171
A2 A2. Interview Study Script . . . 172
A3 Basic Needs in Games Scale - Full Item Pool Exploratory Factor Analysis . . . 173
A4 Concurrent Relationships in the BANG Model . . . 174

List of Figures

1.1 Overview of the BANG model of video game play and mental health . . . 5
1.2 Overview of each study in the thesis and how they relate to each other . . . 7

2.1 Model-estimated distribution of individual relationships between having passively used social media in the last hour and happiness as reported by Beyens et al. (2020) . . . 16

3.1 Taxonomy of mental health as targeted in the current thesis . . . 28

4.1 Motivational spectrum proposed by SDT and Organismic Integration Theory . . . 42
4.2 Core, simplified model of SDT . . . 43

5.1 Repeated overview of each study in the thesis and how they relate to each other . . . 58

6.1 Grounded theory of need frustration in games . . . 64

7.1 Relationship between autonomy in games and global autonomy . . . 78
7.2 Relationship between competence in games and global competence . . . 80
7.3 Relationship between relatedness in games and global relatedness . . . 81

8.1 Repeated overview of the Basic Needs in Games (BANG) model of video games and mental health 89

9.1 Correlation plot for constructs in Study 3c . . . 108

10.1 Overview of the study design . . . 117
10.2 Histograms depicted the distribution of playtime and session length . . . 121
10.3 H1: Relationship between playtime and subsequent mental health . . . 124
10.4 H2: Relationship between mental health and subsequent playtime. . . . 124
10.5 Structure of Model 1 in Study 4b . . . 127
10.6 Structure of Model 2 in Study 4b . . . 127
10.7 Multilevel path model results for Model 1 . . . 129
10.8 Multilevel path model results for Model 2 . . . 130
10.9 Between-person variability in each relationship investigated across Models 1 and 2 . . . 132

11.1 Possible types of effects and their lag relations . . . 144

List of Tables

1.1 Practices I recommend for more productive psychological games research, and how they feature in my thesis 6

2.1 Methods of accessing objectively-tracked digital trace data on video game play 20
2.2 Selected practices encouraged by the open research movement, and their benefits for research on games 22

6.1 Example interview questions and prompts targeting different components of the Study 1 model 62
6.2 Interviewee details 63

7.1 Descriptive statistics 76

9.1 Study details 102
9.2 Items in the final version of BANGS 104
9.3 Top 15 most commonly-mentioned games in Study 3a, out of a total of 201 titles. 105
9.4 CFA Model Fit in Each Primary Data Study 106
9.5 Sub-scale Reliability in Each Primary Data Study 107
9.6 Measurement invariance across different contexts (session, one game, gaming in general) and across two different surveys waves. 109

10.1 Demographic characteristics of the participants in Study 4 118
10.2 Descriptive statistics and reliability for primary measures in Study 4. 119
10.3 Most popular games among Study 4 participants by total playtime 121
10.4 Study 4b Multilevel Structural Equation Models (ML-SEM) and Multilevel Models (MLM) Results 130

1

Introduction

Chapter Contents

1.1 Video Games, Mental Health, and Why You Should Care . . . 1
1.2 Why Haven't We Made More Progress? . . . 2
1.2.1 Theory Crisis . . . 2
1.2.2 Quality of Evidence Crisis . . . 4
1.3 A Modest Attempt at Change . . . 5
1.3.1 Better Theory . . . 5
1.3.2 Better Methods . . . 6
1.4 Thesis Outline . . . 6
1.4.1 Background . . . 7
1.4.2 Theory Generation . . . 7
1.4.3 Theory Validation . . . 8
1.4.4 Sense-making . . . 8

1.1 Video Games, Mental Health, and Why You Should Care

After more than a half century of research, evidence about when and how video games affect mental health[1] remain decidedly mixed, and public debates continue to rage fiercely. We have rich and varied evidence that video gaming—defined here as any interaction with digital games on a computer, console, mobile phone, or any other device—has positive effects on many players. Games can support positive emotions (Jones et al., 2014), develop social capital (Mandryk et al., 2020), help users actively cope or manage difficult life circumstances (e.g., Iacovides and Mekler, 2019; Kowert, 2020; Reinecke and Eden, 2017), and more. On the other hand, we have equally strong evidence for negative effects of games on some players. Gaming can at times displace other important activities (Drummond and Sauer, 2020), lead to dysregulated or disordered use (Przybylski and Weinstein, 2019a), expose players to toxicity, harassment, or extremism (Kordyaka et al., 2020; Kowert et al., 2022), or prey on vulnerable user's finances (Petrovskaya and Zendle, 2021). Despite these numerous examples that games *can* affect mental health, it appears many players experience only minimal positive *or* negative effects: recent evidence supports the absence of any meaningful relationship between time spent playing games and mental health—both at an aggregate population level and for the majority of individuals (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022).

This creates a seeming paradox: data supports both positive and negative impacts of gaming on mental health on certain individuals, but often zero impact at an aggregate population level. I argue that this is an

[1] See Section 3.2 for a complete definition for this deceptively complex term, which comprises hedonic wellbeing, eudaimonic wellbeing, and illbeing.

inherent property of the pastime: The positive experiences games offer inescapably create opportunities for negative effects as well, sometimes even simultaneously. With every conquered boss comes an opportunity—a small, but ever-present one—to encounter a toxic community, to be intensely frustrated by poor design, or to neglect important real-world responsibilities. A player's goal, therefore is to achieve digital (gaming) wellbeing—to successfully balance gameplay within their life such that they experience maximal benefits with minimal harm (M. M. P. Vanden Abeele, 2020). To the extent that some people succeed in this endeavor, while others fail, we will continue to see results at the population level that trend towards null, obscuring subgroups of players that do experience important positive and negative effects.

Unfortunately, at present, we lack a coherent framework for helping people achieve digital wellbeing. While we have a wide range of piecemeal findings, we lack robust, replicable, and generalizable evidence that can help us either predict who will experience positive vs negative effects, or make recommendations on where to intervene in society or in a player's life to ensure that gaming is in line with digital wellbeing.

Figuring out when, why, and how games affect players is of great interest to a wide range of groups. Parents are looking for actionable guidance about how to manage their children's play (Lieberoth and Fiskaali, 2021). Players of all ages are looking for ways to monitor their own play behavior, and to ensure that they to regulate it effectively alongside other responsibilities (e.g., https://playtracker.net). Game developers are looking for design guidelines that produce more engaging games for a wider audience, without pushing into the realm of so-called dark patterns that harm players (Aagaard et al., 2022). Policymakers are looking for evidence that can shape decisions about how to regulate technology companies, and in some cases even whether individuals should be limited in their ability to play (Colder Carras et al., 2021). Clinicians are looking for ways to recognize when gaming has become problematic for players, and how to treat that effectively without unfairly maligning the hobby for healthy players (Aarseth et al., 2017; Greenfield, 2018). However, until we better resolve the paradox of positive, negative and null effects, we remain highly limited in our ability to make recommendations to these various stakeholders.

Answering these questions is even more critical in light of the fact that the digital technology revolution has only just begun. While video game play as a widespread hobby dates back to the emergence of home game consoles in the 1980s and therefore dates back over 40 years, this is likely but a tiny glimpse of the future in which video games are likely to continue growing into one of the most dominant forms of entertainment for children and adults across the world. Already, the global gaming industry has grown to encompass an estimated 3 billion players, almost US$200b in revenue (Newzoo, 2023a), and 118 billion hours/year logged in games produced using just one of dozens of game engines (Unity; Zendle, Flick, Halgarth, et al., 2023). The task for researchers in this domain is therefore not just to determine how games and related technologies are already affecting people and society, but to lay the foundation for policy and design long into the future. Psychology has the potential to play a crucial role in maximizing the good that accompanies the digital revolution, and minimizing the bad (Orben, 2019).

1.2 Why Haven't We Made More Progress?

After the collective investment of tremendous amounts of time and research funding, many questions about the effects of video game—even seemingly simple ones—continue to lack clear answers. Where detected at all, effects are nuanced, inconsistent, and generally small in magnitude. As a result, many researchers hold deeply divided opinions about the trustworthiness or importance of the current evidence base (Klecka et al., 2021).

Throughout this thesis, I[2] will describe, and later begin addressing, two reasons why we have not made as much progress as the research community might have hoped: (1) poor theory and (2) low quality evidence stemming from limitations of the common methods and practices (e.g., using self-reports to collect behavioral data) used in the field.

1.2.1 Theory Crisis

There have been many theories and models put forth to answer the question 'for whom and under what conditions do games and other entertainment media affect mental health?' However, I will argue in Chapter 3 and throughout this thesis that these theories, and the empirical evidence that underlie (or exist in parallel to) them, have limitations that have hindered our ability to reach conclusive answers.

[2]For consistency readability, I will use first-person pronouns throughout this thesis, but will acknowledge the contributions of my supervisors, collaborators, and colleagues at the beginning of each chapter, and want to emphasize that pronouns aside, nothing you are about to read would have been possible without their support.

For decades, psychologists have expressed concerns that vague verbal theories leave numerous questions about how they can be converted into a quantitative test (Harris, 1976). Such underspecified theories risk becoming unfalsifiable, as any unexpected results can be explained away by decisions in the study design, measurement, or analysis approach (Wallach and Wallach, 2010). At worst, this results in a so-called degenerate research line where modifications are made to accommodate failed predictions without improving the theory's predictive success (Lakatos, 1978). Unfortunately, underspecified theories with dubious empirical success are common in psychology, leading some researchers to describe the current state of affairs as a 'theory crisis' (Eronen and Bringmann, 2021; Oberauer and Lewandowsky, 2019).

A lack of strong theory is not unique to research on video games and media, but our field has incontrovertibly suffered from these problems. In research on media effects, researchers have criticized weak theory for leaving open the potential to abuse the fact that media effects are inherently *moderated*, occurring in some contexts but not others. Without a theory to carefully enumerate possible moderators, however, any hypothesized effect is insulated from empirical results—either we find evidence for the effect, or we do not find evidence, but only because we do not yet understand the correct moderators (Coenen, 2023; Valkenburg and Oliver, 2019). In the related field of human-computer interaction, researchers have noted that theories based on laboratory studies struggle to generalize to 'in the wild' experiences and behaviors in the user's natural context (Rogers, 2011), and that many others are underspecified with regard to prominent constructs (e.g., embodiment) or relations between constructs (2012). Communications researchers have levied similar critiques of the slow pace and unsystematic nature of theory development (DeAndrea and Holbert, 2017).

To resolve long-standing debates and make improved predictions about precisely what it means to play games in harmony with digital wellbeing, therefore, a primary goal for the research community is to generate strong and comprehensive theory. To the greatest extent possible, such theory should be able to account not just for individual effects, but larger portions of the diverse range of empirical results in the literature. Existing theories are limited in this regard: they address either positive or negative effects; give a mechanism for effects in one direction (gaming affecting mental health) but not the other (mental health affecting gaming); address quality of gaming (i.e., the subjective impressions and emotions that a player experiences during play, known as 'player experience') but not quantity (i.e., the raw time spent gaming); and/or are not sufficiently well-specified to be falsifiable.

One theory stands out among the crowd as a promising foundation for a specific model of video game play and mental health: self-determination theory (SDT; Ryan and Deci, 2017)—a macro-theory of human motivation and wellbeing that counts among the most well-validated and well-specified theories in social and motivational psychology. SDT research has shown that the activities that are most motivating, enjoyable, and supportive of mental health are those that satisfy three basic needs—autonomy (the need to feel a sense of control and volition over one's actions), competence (the need to feel a sense of effectiveness and mastery), and relatedness (the need to feel connected to and cared for by others). SDT is applicable to both positive and negative effects of activities on mental health, is present in gaming research on both quantity and quality of play (Johannes et al., 2022), and provides potential mechanisms for both effects of gaming on mental health as well as effects of mental health on gaming. It has been used fruitfully in nearly two decades of research on video game play, and has served as the basis for at least two derived theories that are specific to media use and mental health (Reinecke and Rieger, 2021; F. M. Schneider et al., 2022).

However, SDT in general—and in particular its application to research on video games—is not without opportunities for improvement. I discuss these at length in Chapter 4. Perhaps the most promising area for growth is the incorporation of need *frustration*: the experience of basic psychological needs being actively thwarted, which manifests as feelings of coercion (autonomy frustration), failure (competence frustration), and loneliness (relatedness frustration). In recent years, research has demonstrated that need frustration is distinct from, and 'more than' the absence of need satisfaction. Need frustration appears applicable to games in multiple ways: people often play to compensate for deficiencies (i.e., need frustrations) in their day-to-day life (Allen and Anderson, 2018; Mills, Milyavskaya, Heath, et al., 2018), and they may also experience need frustration during the gaming itself, leading to negative experiences such as boredom or anger, and negative outcomes such as churn or even disordered play (Kosa and Uysal, 2021; Pusey et al., 2021). However, the exploration of need frustration in games is a recent development, and there remain many open questions about how exactly need frustration occurs in games, what effects it has on motivation and player experience, and whether games are successful in compensating for frustrated needs in daily life.

There are other limitations that, if addressed, could equally help SDT-informed research on video games move forward. Much of SDT research in games is fragmented, with individual hypotheses being tested but little systematic integration of different findings to generate a single comprehensive set of predictions (i.e., a

fleshed-out theory for the video games domain). Without this integration in place, researchers have lacked the tools to engage fully with causal modelling and the falsification opportunities it provides (Rohrer, 2018). Later, I will also discuss how SDT research can better acknowledge levels of generality from situational to global—which in turn has implications for the timescales on which effects might occur. A final challenge for SDT is to differentiate positive and negative effects of compensatory behavior.

1.2.2 Quality of Evidence Crisis

Simultaneously with the theory crisis (and indeed, contributing to it in a negative feedback loop) is the replication crisis and the various knock-on effects identified in its aftermath, which together I refer to as a 'quality of evidence' crisis. While the theory crisis describes a lack of attention paid to developing clearly-specified, falsifiable theories, the quality of evidence crisis describes the use of methods combined with publication biases and incentive structures, that surface flashy but ultimately untrustworthy results (Scheel, Schijen, et al., 2021). As a result, many previously published findings cannot be consistently reproduced—both in psychology, where the replication crisis originated, and in many other fields (Baker, 2016; Camerer et al., 2018; Ioannidis, 2005). In a landmark study of prominent psychology studies, less than half successfully replicated (Open Science Collaboration, 2015). This crisis has eroded confidence in the reliability of psychological research.

In the wake of this reckoning, greater attention has begun to be paid to a wide range of issues that have undermined the quality of the evidence base. These include, but are not limited to, statistical power, publication bias, 'measurement schmeasurement', open data and analysis code, and much more. Using measurement as a first example, there are concerns that many measures are not sufficiently assessed for validity, or are not precise enough about the constructs they intend to measure and how it differs from others. This can result in instances where researchers inappropriately conclude that two instruments measure the same construct because they have the same name (i.e., the jingle fallacy), or measure different constructs because they have different names (i.e., the jangle fallacy) (Fried and Flake, 2020). Alongside issues of measurement sit issues with statistical errors—results that either show the presence of an effect despite there not being one in reality (false positives), or that fail to detect an effect despite one being present (false negatives). Seemingly-innocent but ultimately problematic behaviors known as questionable research practices—such as reporting only one of a set of related dependent variables, optionally controlling for covariates, and collecting more data after a non-significant result—can lead to substantially inflated rates of false positives (Ioannidis, 2005; Simmons et al., 2011). Low statistical power, wherein sample sizes are too small to reliably detect an effect of a reasonable magnitude for that domain, can produce high rates of false negatives. When untrustworthy results make it into the literature, they can be difficult to identify, in part because researchers rarely share data, materials, or code that would allow independent researchers to reproduce their results, or assess the likelihood of mistakes and/or misrepresentation of results. Until recently, as few as 2% of studies shared data publicly (Hardwicke et al., 2022).

Unfortunately, it is incontrovertible that the issues identified throughout the replication crisis affect video games research as well. Video game effects research has seen a slew of retracted papers (Ferguson, 2020), and even seemingly robust findings such as the relationship between action video game play and executive control fail to hold up under closer meta-analytic scrutiny (Hilgard et al., 2017; Hilgard, Engelhardt, Rouder, et al., 2019; Hilgard, Sala, et al., 2019). Vornhagen et al. (2020) show that the games researchers frequently apply null hypothesis significant testing even in the absence of specific statistical hypotheses or research questions, and that many papers report p-values that are incompatible with the reported test statistics.

Measurement is an especially relevant issue for the games domain. One key shortcoming has been that most research to date has, in large part out of necessity, relied on self-report measures of behavior. Evidence suggests that self-report estimates are poor proxies for objective playtime (Johannes, Vuorre, and Przybylski, 2021; Kahn et al., 2014), consistent with meta-analytic results showing that self-report estimates of other types of technology use, such as social media and phone use, are only moderately correlated with logged data (Parry et al., 2021). Inaccuracy might not be random noise, but systematically influenced by social desirability biases and potential confounds with mental health—at least one study has shown that people with more depressive symptoms are more likely to overestimate their social media use (Sewall and Parry, 2021). Related issues affect the measurement of psychological variables: games-related studies frequently fail to disclose important variations in scoring procedures (Elson, Breuer, et al., 2014), justify their use of a particular questionnaire (Hughes and Cairns, 2021), or define constructs of interest (Aeschbach et al., 2021).

In sum, the quality of the evidence in both the broader psychology literature and the research on video games and mental health is oftentimes poor. This has limited the trust we can put in findings, and our ability to use individual studies as building blocks towards broader, coherent explanations of when and why games

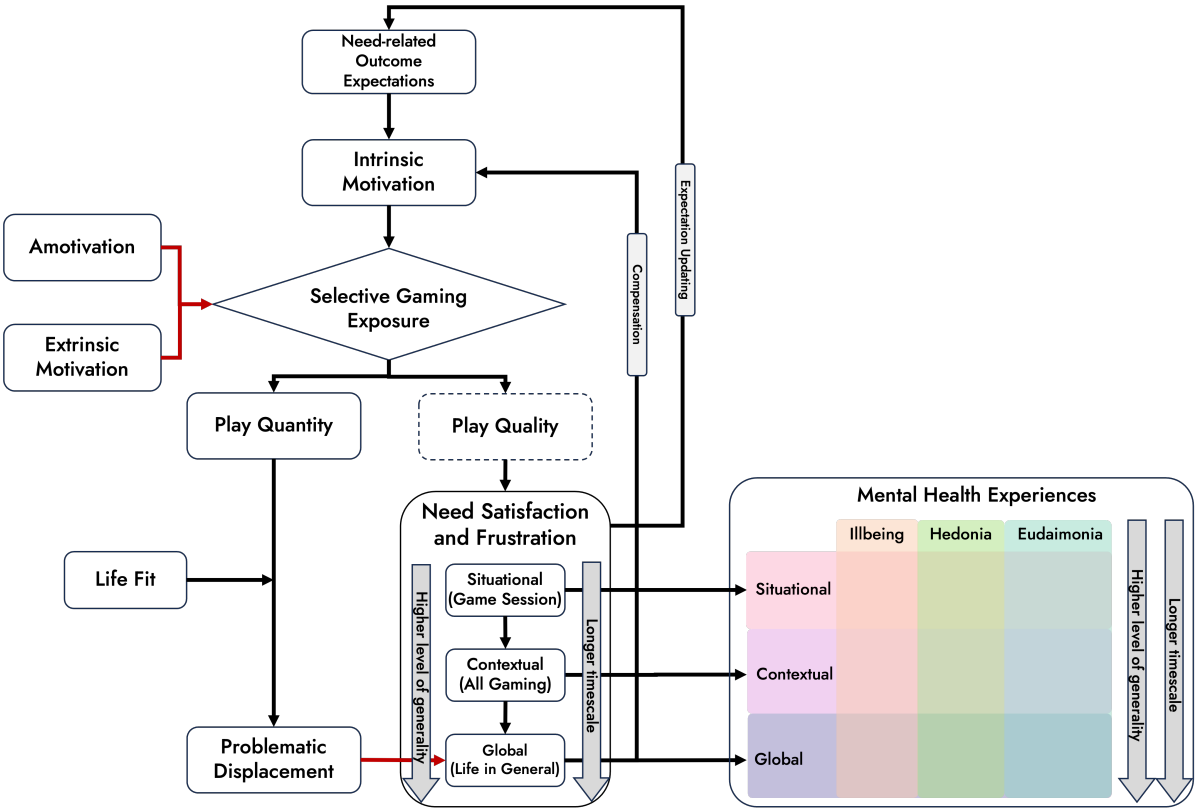

Figure 1.1: Overview of the BANG model of video game play and mental health. Red arrows reference hypothesized negative effects. Details are provided in the full presentation of the theory in Chapter 8.

affect mental health. Fortunately, we are not without recourse.

1.3 A Modest Attempt at Change

These problems—weak theory, and methods leading to low quality evidence—are the key factors underlying our inability to resolve the seeming paradox of coexisting positive, negative, and null findings about games and mental health. They therefore comprise the two broad challenges I try to address throughout this thesis. By leveraging recent innovations in digital trace data collection and statistical analysis, I attempt to develop and evidence a new theory of gaming and mental health, grounded in SDT.

1.3.1 Better Theory

With regard to poor theory, I will present a series of studies that culminate in the development and validation of the Basic Needs in Games (BANG) model of video game play and mental health, depicted in in Figure 1.1. Building upon the core SDT principle that any action's impact on mental health is mediated by basic psychological needs, I fill several theoretical gaps to generate a model that more precisely specifies how basic needs and gameplay interact to produce mental health effects.

BANG has several strengths compared to existing theories. By incorporating and expanding upon SDT and the growing research on need frustration, BANG is able to account for both positive and negative potential impacts of gameplay, thereby explaining a greater portion of prior literature. BANG differentiates between *quantity* of play and *quality* of play—helping explain findings that playtime itself is largely unrelated to mental health, but that some players do experience meaningful benefits or harms in relation to their video game play. It makes explicit causal predictions, and thereby readily lends itself to falsification. And while BANG's roots are firmly within SDT, it also integrates aspects of other prominent theories such as uses and gratifications (Ruggiero, 2000), mood management theory (Zillmann, 1988), and social cognitive theory (Bandura, 1986).

Table 1.1: Practices I recommend for more productive psychological games research, and how they feature in my thesis

Productive Research Practice	Application in my thesis research
Strengthen the theoretical derivation chain	Study 1 uses grounded theory methods to flesh out an 'empirically empty' construct from SDT—need frustration—and understand how it appears and operates in the domain of video games
	Study 4 uses the BANG theory to explicitly test for the hypothesized absence and presence of certain effects, lay out (causal) assumptions, and inform statistical modelling
Attend to inter-individual effect size variation	Study 4b asks 'what is the distribution of within-person relationships between playtime, need satisfaction, and mental health?', analyzing and reporting the estimates of how many people exhibit positive vs. negative relationships.
Prioritize longitudinal, within-person studies	Study 4 follows players for 12 weeks, collecting detailed data on their play throughout, and linking this with 6 survey waves where they report on various aspects of mental health
Avoid questionable measurement practices	Study 3 follows psychometric development best practices to create a new, validated, and theoretically-grounded questionnaire for measuring need satisfaction and frustration in games
Hardness digital trace data	Study 4 uses a novel method to collect people's play activity directly from Xbox using the friends list, rather than asking them to self-report play
Adopt open research principles	All studies throughout the thesis have fully open data, materials, and code
	Study 2 and Study 4 were preregistered; the latter was also published as a registered report to protect against p-hacking and publication bias

1.3.2 Better Methods

In a second thread that runs through the whole thesis, I will present a vision for a more constructive field of psychological games research. I describe six research practices that can help us overcome the challenges we face:

1. **Strengthen the theoretical derivation chain**: Being clear about the relationship between conceptual models and statistical models, the circumstances under which you would consider a hypothesis falsified, and assumptions under which findings hold
2. **Attend to inter-individual effect size variation**: Recognizing that different people experience different effects of play on mental health, and that by incorporating this in our statistical modelling, we can better understand the moderating factors
3. **Prioritize longitudinal, within-person studies**: Being conscious that while cross-sectional studies are invaluable, there is no such thing as a between-person 'effect'; to understand causality, within-person change over time allows us to make causal inference with fewer assumptions
4. **Avoid questionable measurement practices**: Defining constructs of interest and position these against ones that may be similar, assessing validation evidence to ensure measures assess the actual construct of interest, and being transparent about ad hoc changes
5. **Harness digital trace data**: Where possible, collecting logged behavioral data to better understand actual, rather than perceived behavior in digital environments
6. **Adopt open research principles**: Making the research process as transparent as possible to reduce biases and opportunities for 'data dredging', enabling the reuse of data for the same or different purposes, and building collaborations across large groups and varied regions for robust and generalizable results

Throughout the presented studies, I implement these practices, thus using my research as a worked example of the steps required to implement them, and the benefits they can have. Table 1.1 describes how each of the six recommended practices is illustrated by one or more of the studies in my thesis.

1.4 Thesis Outline

Summing up, the goals of this thesis are to develop and provide initial validation for an SDT-based theoretical model of video game play and mental health, integrating the latest research on need frustration and drawing

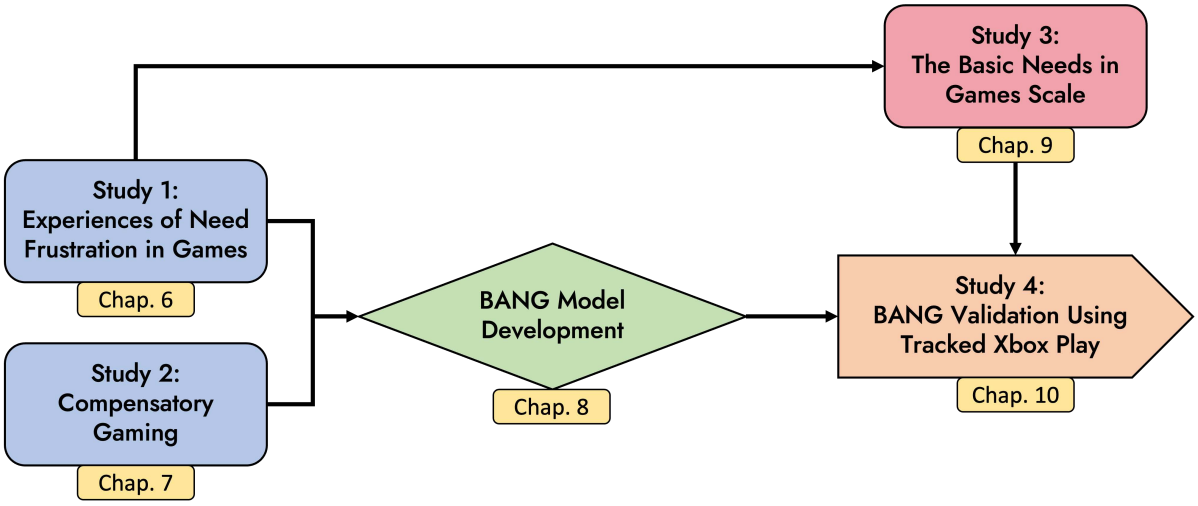

Figure 1.2: Overview of each study in the thesis and how they relate to each other. Studies 1 and 2 are qualitative, and help shape the construction of the Basic Needs in Games (BANG) model. Validation of the BANG model necessitates the development of a new measurement instrument (Study 3), itself also informed by the experiences of need frustration described in Study 1. With the theory and necessary measurement in place, I test the key tenets of the new model in Study 4.

from related theoretical models to develop a model that is comprehensive, falsifiable, and specific to video game play. In doing so, I hope to convincingly demonstrate the value of certain methodological reforms on the quality of evidence. This takes place in four parts.

1.4.1 Background

In the background section, I describe in more detail the current landscape of research on video games and mental health. Beginning with Chapter 2, I briefly overview some of the questions in video game effects research that remain frustratingly unanswered after years or decades of study. I then draw out the aforementioned series of six methodological opportunities that can make the field more successful (Table 1.1). I attempt to make these recommendations as practical as possible, offering resources and guidelines for implementing them in future work.

In Chapter 3, I turn to gaming and mental health research specifically. I summarize a wide range of effects that have been demonstrated in previous research, which span the full gamut: positive, negative, and null effects; short- and long-term effects; effects relating to both quality and quantity of playtime; and of gaming on mental health and mental health on gaming. I connect these to an overview of existing theories in the field, and argue that these previous theories have not yet accounted for more than small pockets of observed empirical effects. This motivates the need for improved theory to enable more systematic progress.

In Chapter 4, I zoom in on one theory, SDT, that I argue is a particularly strong starting point for handling this range of gaming effects. I describe the key tenets of SDT, namely that satisfaction and frustration of three basic psychological needs are universal determinants of motivation, behavior, and the effects of our actions on our mental health. I then point out several opportunities where SDT can be built on to more explicitly specify mechanisms and circumstances in which games have negative, positive, or null effects on mental health. With the context of those previous chapters, Chapter 5 provides a brief overview of the studies that will follow.

1.4.2 Theory Generation

In the theory generation part of the thesis, I use qualitative and mixed method approaches to dive deeper into areas where SDT has yet to provide clear answers about how basic psychological needs during play relate to engagement with video games and mental health. An overview of the theory generation and validation parts of the thesis, and how they relate to each other, is shown in Figure 1.2.

In Chapter 6, I use semi-structured interviews to investigate if and when players experience need frustration in games. I demonstrate that need frustration is a common and impactful experience in video games, offering clues about both what causes players to disengage or quit, and one route via which games might have a negative impact on players. These results underscore previous calls for greater attention paid to need frustration in games as distinct from need satisfaction. My findings also point at a heretofore unappreciated role of

expectations beyond simply stimulus-reaction.

One of the other key unanswered questions in the SDT and media use literature concerns compensatory usage. While empirical results correlate need-compensating or coping use of video games with both positive and negative impacts on players, the processes that lead to these separate outcomes remain poorly understood. Thus, Chapter 7 reports on a study of compensatory gaming—when and why players turn to games for frustrated needs in daily life, using Covid-19 as a unique contextual factor that may have caused elevated need frustration. I show that compensatory video game play is relatively common and often successful: many participants reported experiencing need frustration in their daily life, and that they could seek out those missing experiences during video game play. However, quantitative results indicated that the general pattern was in the opposite direction—rather than experiencing more autonomy satisfaction in games when general autonomy was frustrated, for example, people tended to show a 'rich get richer, poor get poorer' relationship. This presented an empirical puzzle with multiple explanations, informing both the development of BANG and motivating the need for longitudinal research to better tease out causal links.

Chapter 8 describes the development of the new theory of video gaming and mental health, the Basic Needs in Games (BANG) model. The model builds upon the findings in the previous two chapters, existing SDT evidence, and other frameworks to offer a novel theoretical account of when and why games affect players' mental health. I describe several strengths of the BANG model compared to previous theory.

1.4.3 Theory Validation

Next, I seek to validate parts of the BANG model.

Validation of the model relies on accurate assessment of need satisfaction and frustration in games. As I will show, existing questionnaire options were not fit for purpose. Thus, Chapter 9 develops and validates a new measurement tool, the Basic Needs in Games Scale (BANGS), for assessing need satisfaction and frustration in games with a degree of rigor not available from existing scales. Specifically, the BANGS improves upon existing SDT and games questionnaires by assessing need frustration using domain-appropriate items (which are informed by the interview study in Chapter 6). The BANGS further accounts for more varied experiences of social connectedness in games than previous scales, by allowing players to report on experiences of relatedness both with other human players and with in-game characters and worlds.

With both the theory and the tools to validate it in place, Chapter 10 puts the full picture together and provides an initial testing of the model. To do so, I conduct a longitudinal study of Xbox play involving a novel method of collecting playtime data through the Xbox friends list. This method collects data at the platform level, improving upon previous strategies that captured gaming behavior from just one game. The study comprises data from 400 adults over a period of 3 months reflecting more than 100,000 hours of logged playtime and 6 survey waves. In the first part of Study 4, I use a recent innovation in statistical practice, equivalence tests, to provide some of the strongest evidence to date that there is no meaningful relationship between playtime and mental health (nor between mental health and playtime). In the second part, I show qualified support for several BANG model hypotheses—results support that need satisfaction is a strong predictor of platform-level playtime; that one circumstance when gaming undermines mental health is when players experience need frustration while playing; and that one circumstance when gaming supports mental health is when they experience need satisfaction during gaming, which contributes—as one domain of life among many—to their global sense of need fulfillment and mental health.

1.4.4 Sense-making

In an attempt to synthesize takeaways from a long and windy journey (both for me and—for those of you reading this cover-to-cover—for you), Chapter 11 summarizes and discusses the thesis as a whole. I reflect upon what the thesis contributes to the literature, next steps for the BANG model, and how the methodological decisions I took might provide useful examples for other researchers in the endless pursuit of improving the information value of our research.

Throughout the 174 pages of this thesis, I attempt not only to advance our knowledge on an important empirical topic in the form of video games and mental health, but also to serve as a case study in how we can do more effective games research. Together, I hope to give the field some tools to better resolve the high stakes research questions that to date have remained out of reach.

Part I: Background

2

A Manifesto for More Productive Psychological Games Research

Chapter Contents

2.1 Introduction . . . 10
2.2 Two Caveats . . . 11
2.2.1 Audience . . . 11
2.2.2 Structural Context . . . 11
2.3 A Brief History of Unresolved Questions . . . 11
2.4 A Path Forward . . . 13
2.4.1 Strengthen the Theoretical Derivation Chain . . . 13
2.4.2 Attend to Inter-Individual Effect Size Variation . . . 15
2.4.3 Prioritize Longitudinal, Within-person Studies . . . 17
2.4.4 Justify Measurement Decisions . . . 18
2.4.5 Harness Digital Trace Data . . . 20
2.4.6 Adopt Open Research Principles . . . 22
2.5 Discussion . . . 23
2.6 Conclusion . . . 23

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2.1 Introduction

As hinted at in the introduction, questions about the relationship between gaming and mental health (operationalized in various ways) continue to lack satisfactory answers. This, I acknowledge, is a sweeping characterization of a large and diverse field, but I hope to demonstrate shortly that it is largely fair.

It is against this backdrop that I position my thesis. While I intend for my research to make a substantive contribution to our knowledge of video games, I equally hope that it can serve as a case study in more productive

psychological research practice. The practices I will shortly recommend—and later empirically implement—are the product of careful notation of the limitations of previous work. To reflect how they were identified, this section therefore serves as both a literature review as well as my meta-scientific/methodological contribution to the field.

Individually, none of the practices I will recommend are new—instead, my goal is simply to collate them in a document specific to research on games, and to add actionable guidance. I draw particular inspiration from Parry et al. (2022) and Griffioen et al. (2020), who each discuss partially-overlapping methodological visions for future research on social media and mental health.

2.2 Two Caveats

2.2.1 Audience

The forthcoming recommendations are not equally applicable to all disciplinary and methodological approaches. Games research is highly diverse: researchers may identify with the humanities, qualitative social sciences, communications, quantitative media effects, human-computer interaction, engineering, and so on (Melcer et al., 2015). Instead, this article is primarily targeted at research that uses quantitative psychological methods, an area threatened by numerous identified 'crises', including the theory crisis (Eronen and Bringmann, 2021), replication crisis (Open Science Collaboration, 2015), and generalizability crisis (Yarkoni, 2022). Although researchers disagree about the seriousness of these, there is nonetheless widespread agreement that quantitative psychological research is substantially less trustworthy than we would like it to be (Hardwicke et al., 2022). While the chapter will be most useful to researchers working in this area, I hope that portions of my recommendations will be relevant to readers from any background seeking to understand how players are affected by games.

2.2.2 Structural Context

The problems that psychological games research—and the entire research ecosystem—face are not solvable through raising awareness and individual action alone. There are deeply embedded traditions and incentive structures in hiring/promotion, grant funding, publication and more that constrain what is possible, realistic, and efficacious for any individual researcher or research community (Christensen et al., 2019). These recommended practices will not lead to widespread consensus on polarizing research topics by themselves, but I believe they can meaningfully improve the quality of our evidence, are actionable enough for researchers to begin implementing immediately, and are therefore worth pursuing alongside other structural reforms.

2.3 A Brief History of Unresolved Questions

To set the stage for the importance of these six practices, I need to first briefly review some key debates that have shaped the landscape of psychological research on games. The following examples are by no means exhaustive, but serve to illustrate how despite tremendous resource investment, certain questions are yet to be satisfactorily resolved. In Chapter 3, I will unpack the debates most relevant to the current thesis in more detail.

Do Violent Games Cause Aggression?

Among the earliest topics of interest in psychological games research was whether games cause real-world aggression or violence. After nearly four decades of study, debates continue to smolder. Findings supportive of a link between violent video game play and subsequent aggressive thoughts or behaviors continue to proliferate, and are regularly invoked as a possible cause of violent tragedies like school shootings—particularly when the perpetrator is white (Markey et al., 2020). Other studies find null effects (Przybylski and Weinstein, 2019b), argue that statistically significant effects are likely not practically significant, or question whether laboratory measures of aggression are valid indicators of real-world violence even if meaningful effects were confirmed (Drummond et al., 2018). Even meta-analysis has proved incapable of fully resolving these differences: a series of 'warring' meta-analyses reached markedly different conclusions (C. A. Anderson et al., 2010; Ferguson, 2015; Hilgard et al., 2017).

Are Video Games Addictive?

At the time of writing, one of the most active areas of research on games concerns dysregulated play (variously conceptualized as [internet] gaming disorder, pathological gaming, problematic video game use, and video game addiction)—with nearly 600 papers containing one of those terms in the abstract published in 2021 alone according to an August 2022 Scopus search. There is widespread agreement that a small fraction of players experience negative life consequences in relation to their gaming, but substantial disagreement about whether problematic use constitutes a behavioral addiction or other mental health disorder (Ferguson and Colwell, 2020). Constituent areas of controversy include (a) whether dysregulated gaming is a symptom of other mental health conditions, a cause of them, or both (N. Weinstein et al., 2017), (b) whether certain types of games are inherently more addictive (Lemmens and Hendriks, 2016), (c) whether the current approaches to measurement and diagnosis are appropriate (Aarseth et al., 2017; Ballou and Zendle, 2022), and (d) the degree of harm that formalizing gaming-related disorders could have for healthy players (Aarseth et al., 2017).

Do Video Games Harm or Improve Mental Health?

This question is addressed at length in the follow chapter. As a brief overview, however, several studies report that playtime is negatively associated with certain mental health constructs such as depressive symptoms (Burke and Lucier-Greer, 2021), sleeping problems (Wenzel et al., 2009), and anxiety (Lo et al., 2005), with at least one meta-analysis finding a small negative link with overall psychological wellbeing (Liu et al., 2019). Other studies find associations only for certain ages (Loton et al., 2016); or small and nuanced negative associations among highly engaged players only (Allahverdipour et al., 2010; Colder Carras et al., 2017; Przybylski and Weinstein, 2017). Yet others have found null or negligible associations (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022). Results are similarly mixed for hypothesized positive effects: for example, one systematic review found that playing massively multiplayer online (MMO) games was positively associated with social wellbeing (Stavropoulos, 2021), contrasting with a longitudinal study of social gameplay which found no positive or negative relationship between play and offline social health (Domahidi et al., 2018).

Do Action Games Have Cognitive Benefits?

Some research suggests that video games, in particular action games, can have cognitive benefits such as improved executive function. Again, conclusions are inconsistent and contentious even at the meta-analytic level: Bediou et al. (2018) find that action game play is associated with improved top-down attention and spatial cognition with large effect sizes, but Hilgard, Sala, et al.'s (2019) results suggest that their results may be largely attributable to publication bias. Relatedly, some meta-analytic results find that video game play is associated with improved cognitive health in older adults (Vázquez et al., 2018), while others show small relationships between video game play and updating memory, but none for other cognitive functions (Mansor et al., 2020).

Other Questions and Outlook

While the above examples are among the most prominent, they are by no means the only ones to fall short of conclusive answers. Researchers continue to debate highly-studied topics such as whether exposure to sexualized (female) game characters affects body image (Lindner et al., 2020), the contexts in which gamification is and is not successful (Dicheva et al., 2015), whether serious games can be an effective mental health intervention (Abd-Alrazaq et al., 2022), and much more.

To be clear, my intention in reviewing these examples is not to support 'bothsidesism': in the above conflicts, more weight should be given to more rigorous, larger sample, transparently conducted studies—those that adopt many of the practices I will shortly recommend. Neither, however, does this mean that all conflicting results are invalid or the result of false positives. While it is undoubtedly true that elements of moral panic are present in debates around games and digital technology use more broadly (Markey and Ferguson, 2017; Orben, 2020), researchers should be able to acknowledge this without dismissing all results that conflict with our own beliefs about the medium.

In short, results in a huge variety of research topics have been definitively mixed. Researchers are regularly unable to reach consensus on seemingly basic (but ultimately impossibly complex) questions, and it appears unlikely that current approaches to research will settle these debates in the foreseeable future.

2.4 A Path Forward

It should hopefully be slowly becoming clear that the current status quo of psychological games research is at best inefficient, and at worst incapable of fully answering the key questions that parents, players, and policymakers have about the ever-growing role of video games in daily life. Below, I describe six practices research on video games can adopt to resolve these debates more effectively: 1) strengthening the theoretical derivation chain, 2) attending to inter-individual effect size variation, 3) prioritizing longitudinal, within-person studies, 4) avoiding questionable measurement practices, 5) harnessing digital trace data, and 6) adopting open research principles.

2.4.1 Strengthen the Theoretical Derivation Chain

The core aspiration of most psychology disciplines is to generate theories, defined as 'an integrated set of propositions about latent (not directly observable) mechanisms, processes, and variables, and their causal relations to each other and to manifest (observable) variables' (Oberauer and Lewandowsky, 2019, p. 1597). By understanding the mechanisms of some phenomenon, theories allow us to generalize to different contexts and stimuli, predict what will happen before needing to observe it, and ultimately provide us frameworks with which to understand the world.

Theory development generally proceeds via the hypothetico-deductive model: researchers select or generate a theory about how the world works, derive a prediction based on that theory, and then devise a means of testing whether that prediction holds true (see e.g., Jhangiani et al., 2019, for a basic overview). To get from a theory to a concrete prediction, researchers engage the 'derivation chain': the conjunction of theoretical and auxiliary premises necessary to predict observable outcomes, which translate a theoretical claim into a highly specific (statistical) prediction (Meehl, 1990).

Recalling my earlier description of the theory crisis (Eronen and Bringmann, 2021), most theories are underspecified—they typically consist of broad, verbal statements, and leave substantial ambiguity about measures, statistical models, the size of the effect, boundary conditions, and more (Meehl, 1990). In other words, the derivation chain is weak and subject to constant reinterpretation. Insufficiently specific theories risk becoming unfalsifiable (Wallach and Wallach, 2010).

As mentioned earlier, these are not just problems for colleagues in other disciplines to deal with. Previous researchers have identified various problems with the use of theory in the various fields connected to psychological games research (e.g., media psychology, human-computer interaction, and communications). These includes concerns about ecological validity (Rogers, 2011), poor specification of key constructs (2012), integration of findings from different researchers (DeAndrea and Holbert, 2017; Shaw et al., 2018), and tenuous connections between the cited theory and the actual (statistical) tests (Tyack and Mekler, 2020; Vornhagen et al., 2020). Interestingly, despite self-determination theory (SDT) being one of the most well-specified theories used in games HCI research, Tyack and Mekler (2020) find that even SDT is often used superficially, as background context or a plausible explanation largely separate from the data at hand. More broadly, media effects scholars have raised the concern that weak theories allows proponents to explain away any result with unaccounted moderators/mediators—a study either finds evidence for an effect, or does not find evidence but can implicate a never-ending list of additional potential moderators (Coenen, 2023; Valkenburg and Oliver, 2019). This contrasts with strong theory that enumerates and constrains possible moderators, and systematically falsifies those that do not hold up to scrutiny.

With this background, it is imperative that games research works to strengthen the derivation chain and build stronger theories. Scheel, Tiokhin, et al. (2021) provide a useful overview of inputs to the derivation chain, as well as research activities that can strength it. I summarize these steps here, and illustrate them with an example from gaming disorder research.

Define Constructs(s)

On the journey from theory to statistical hypothesis, researchers first need to clearly define the construct of interest, ensuring that they are coherent and differentiated from other, potentially similar concepts. The DSM-5 defines internet gaming disorder as 'persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by five (or more) [of a set of nine criteria] in a 12-month period' (American Psychiatric Association, 2013, p. 795). Implicit in this definition is a theory: gaming characterized by 5/9 of the DSM-5 criteria will lead to clinically significant impairment or distress. In adopting this definition, researchers may need to differentiate internet gaming disorder from gaming disorder as defined in the ICD-11, for example, which uses different criteria (World Health Organization,

2018).

Measure
Next, the concepts will need to be measured. In the case of psychology, this is often done using a questionnaire—one that needs to be sufficiently valid for use in that context. Unfortunately, discussions of validity are regularly omitted in games research (Hughes and Cairns, 2021) and psychology more broadly (Flake and Fried, 2020). For gaming disorder, there exist over 30 different questionnaires (King, Chamberlain, et al., 2020), with varying degrees of empirical support. Evidence shows that these measures differ substantially with regard to prevalence and overlap with each other (Karhulahti, Vahlo, et al., 2022), but not necessarily in the strength of their relation to other health measures (Ballou and Van Rooij, 2021). Resources for validating measures are mentioned below in Section 2.4.4.

Specify Relations and Boundary Conditions
Next, the relationship between these measured concepts must be specified; the theory should provide a model that includes key confounding variables with the potential to obscure or bias the relationship. We may need to specify situations where the theory does not hold, or boundary conditions. For example, Billieux et al. (2017) propose that gaming behavior not be classified as disordered if it is 'the result of a temporary coping strategy as an expected response to common stressors or losses' [p. 1723]. Gilbert et al. (2021) provide an example of how empirical research can be framed so as to identify and test boundary conditions.

Enumerate Auxiliary Assumptions
We then need to adopt a set of auxiliary hypotheses—claims not directly derived from the theory, but that are necessary from translating from theory to observable entities. For example, a test of whether gaming disorder leads to clinically significant distress requires that participants respond honestly (not a given for gaming disorder; Przybylski 2016), that participants define what qualifies as gaming similarly, and that the distress measure is applicable to all participants, among numerous other assumptions.

Formulate Statistical Test
Finally, these components—constructs, measures, relations, auxiliaries, confounds, etc—need to be converted into a statistical test. Questions about what effect sizes are practically meaningful (see e.g., Ballou and Zendle, 2022, for a gaming disorder example of differentiating statistically significant and practically significant relationships), the shape of the relationship (our statistical tests are overwhelmingly linear, but this may not always be appropriate), whether prior beliefs should be incorporated, and more need to be answered. Without this, the statistical test may not be sufficiently 'severe'—it may lack capacity to falsify the theoretical prediction (Mayo, 2018).

Laid out before us, it is clear that these steps are not always followed diligently. By attending closely to the steps above and being explicit about decisions at every stage, researchers will improve their ability to create better-specified and more falsifiable theories.

Eventually, theory-building can progress into highly formalized causal relationships. A clearer causal theory constrains analysis decisions, reducing opportunities for (intentional or unintentional) p-hacking and improving falsifiability (Smaldino, 2019). Without strong theory linked to clear causal models, psychology researchers often end up including large lists of covariates under the mistaken belief that these will improve (and not substantially worsen) the resulting model (Achen, 2005; Spector and Brannick, 2011). Causal models are also a key step towards computational models of 'formal' theories, where relationships are specified at the level of equations, providing a tight link between theory and statistical predictions (O. Guest and Martin, 2021). van Rooij and Baggio (2021) demonstrate how formal theories can even be tested in advance of collecting empirical data. However, computational models and formal theories have yet to make meaningful inroads in research on games and mental health.

This process will be more successful if the research community is able to integrate the achievements of one theory with those of others in order to build more generalizable and predictive models (Gigerenzer, 2010). At present, this rarely happens: as Watkins (1984) put it, using someone else's theory 'is a bit like someone else's toothbrush—it is fine for that individual's use, but for the rest of us...well, we would just rather not, thank you' (p. 86). Rather than maintaining dozens of competing theories for any single phenomenon, an alternative approach seeks to take the empirical successes of one theory, and combine them with the successes of others while modifying or discarding their failed predictions (Gigerenzer, 2010).

In other cases, however, *it may not be necessary to test a hypothesis at all*. Given our current lack of knowledge about the derivation chain, a purely confirmatory approach to many research questions is ill-advised—we simply lack nuanced enough theory to make specific predictions (Scheel, Tiokhin, et al., 2021). Instead, we can make greater use of descriptive work and exploratory data analysis. Both of these can have crucial benefits in theory generation: identifying new effects to be tested, developing a shared understanding of a particular phenomenon, honing terminology and methods best practices, fleshing out existing theory by establishing boundary conditions, and more. Qualitative work can also be especially valuable here; Petrovskaya (2022), for example, attempts to refine the criteria used in the internet gaming disorder theory by analyzing reports from players. The importance of descriptive research is well-appreciated in some communities: the *Journal of Quantitative Description: Digital Media* (A. Guest et al., 2021) was recently launched to promote such work.

In sum, it is crucial for the progress-oriented games researcher to think carefully about their use of theory, and how we can increase the specificity of our predictions. I encourage readers to read further about the relationship between theory, hypothesis, and model (e.g., O. Guest and Martin, 2021; Scheel, Tiokhin, et al., 2021), review the basics of causal modeling (Rohrer, 2018), and consider conducting more explicitly descriptive or exploratory studies (for a tutorial, see e.g., Szabelska et al. 2021; for varied examples, see e.g., DeCamp 2017; Festic et al. 2021; Karakus et al. 2008).

2.4.2 Attend to Inter-Individual Effect Size Variation

One powerful way to evaluate the verisimilitude of a theory and diagnose its problems is by investigating how the strength of an effect varies across different people. There is increasing recognition that small, nuanced, and inconsistent effects in a general population may hide substantial variation in effects for any given individual (e.g., Johannes, Masur, et al., 2021; Valkenburg et al., 2022). This may be one of the key factors underlying the inconsistent-but-trending-toward-null findings reviewed in Section 2.3.

Consider the example of video games and mental health. Higher-quality evidence has largely converged on relationships that are either null or too small to matter at the population level Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022. Hypothetically, however, if one half of a sample experiences a negative effect of video game play on mental health, while the other half experiences a positive effect, the standard statistical toolkit will show that there is no overall effect. Such findings are valuable—a null effect of this nature would provide evidence against the effectiveness of a global playtime restriction, for example—but are very different from the result 'for any given player (or the majority of players), there is no meaningful effect of gaming on mental health.'

It therefore may not always be productive—or even tractable—to ask 'do video games cause X?'. That question represents a nomothetic approach; i.e., a generalized law that applies to the 'average person' across an entire population, without necessarily describing the psychology of any actual person. Given evidence supporting both the existence and non-existence of almost all gaming-related effects, a strictly nomothetic approach will be limited. Instead, some—perhaps even all—questions would be better framed as 'for whom, and under what circumstances, do video games cause X?'

I am by no means the first to recognize this tension between the dynamic and situated nature of media effects, and researchers' desire to understand generalized laws. Research on media effects has long been mired in a pattern of frequent 'hedging': scholars are in agreement that media are complicated stimuli, and any effects—to the extent that they occur—are volatile, contingent on context, content, and subject (Coenen, 2023). The field is constantly demanding more nuance in the form of moderators and mediators that explain *for whom* and *in what context* media effects occur. But unless moderators are hypothesized and tested in a principled way, they risk being used a 'protective belt' for unsubstantiated predictions: they allow researchers to explain any result, either positive or negative, without necessarily damaging the underlying theory, by appealing to known or unknown potential moderators.

To build toward theory that balances the demands for predictive power, parsimony, and falsifiability, we may wish to attend more closely to *effect size variation*. Related to a family of approaches sometimes called 'person-specific', 'idiographic', or 'individual-level' (Beltz et al., 2016), modeling effect size variation seeks to understand how intraindividual processes may differ between people. Rather than (exclusively) setting out to show that an effect across a population is 0 (which for cross-sectional studies it never is exactly; Cohen, 1990), modeling effect size variation provides a platform to test what proportion of people, or what particular individuals, exhibit effects of a certain magnitude.

How to best do this without losing sight of the broader goals of understanding groups, and generalizing from sample to population remains a point of contention (cf. Johannes, Masur, et al., 2021; Valkenburg et al., 2022; Vuorre, Johannes, and Przybylski, 2022). Luckily, evaluating variability around an average effect is neither

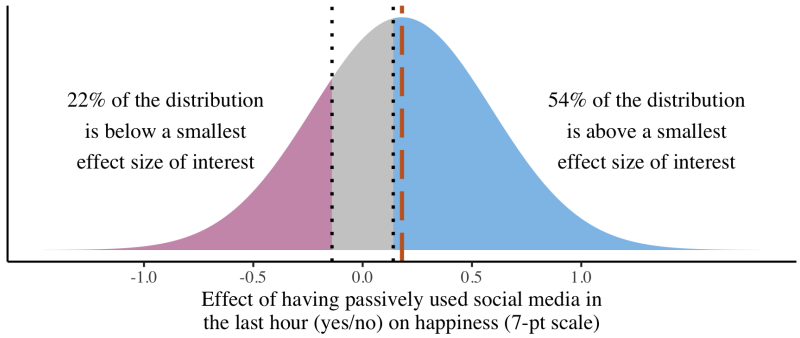

Figure 2.1: Model-estimated distribution of individual relationships between having passively used social media in the last hour and happiness as reported by Beyens et al. (2020). Grey area represents portion of the distribution within the bounds of a smallest effect size of interest (SESOI), a change in happiness of .14 points (on a 7-point scale) (24% of curve). Red area denotes estimates below the SESOI (22% of curve); blue area denotes those above (54% of curve). Note that this graph depicts the distribution of point estimates, but each individual's estimate is also subject to uncertainty (Vuorre, Johannes, and Przybylski, 2022).

a new challenge nor one unique to the study of media effects. Several informative papers have dealt with (statistical) handling of variation in experimental effects (Bolger et al., 2019), in between-group vs within-person effects (A. J. Fisher et al., 2018), and in personalized medicine (Senn, 2018). Following Johannes, Masur, et al. (2021), the challenge for media effects researchers is not to reinvent the wheel, but to integrate prior work and translate it to a principled approach for studying effect variation in our field. A recent paper proposes a framework, in part inspired by medical research, to unify these aims (2021). Emphasizing that effects in the social sciences will always vary to some extent from individual to individual, the authors suggest specifying a 'region of practical equivalence', or ROPE, that differentiates *meaningfully large* variation from *unimportant* variation. Where variation in effects is meaningfully large, this warrants further examination, often in the form of identifying moderators that (in part) determine who experiences more positive relationships, and who experiences more negative ones.

Initial attempts to apply this analysis approach—though not fully aligned with the ROPE procedure—are underway in media psychology, which can serve as a first port of call for games researchers interested in learning more. Beyens et al. (2020), for example, find that the average relationship between having passively used social media during the previous hour and happiness was an increase of .18 (note that this is not significant, 95% CI [−.03, .25]) on a 7-point scale. However, the standard deviation of this relationship as estimated from the 63 adolescents in the study was .41—this means that the association for any given adolescent varies substantially, with some participants exhibiting negative relationships, some neutral or negligible, and some positive (Figure 2.1).

Results such as this one immediately beg the question 'is this degree of variation meaningful?' Psychology will likely never find a uniform effect across individuals: cognitive processes and behavior are simply too diverse, with people leveraging different psychological processes to accomplish the same behavioral outcome, or the same psychological processes to accomplish different behavioral outcomes (Richters, 2021). If researchers decide that the degree of variation in effects across individuals is meaningful, however, it opens the door for additional investigation to establish what distinguishes these groups from each other. This mantle is taken up by Valkenburg et al. (2021a), who find that social media-induced envy and enjoyment may be moderators that differentiate those who experience positive vs. negative relationships between passive social media use and wellbeing.

In sum, modeling effect size variation can help us develop more targeted predictions about how video games affect individuals. To get started with such approaches, I recommend reading Johannes, Masur, et al. (2021)'s pedagogic description and papers from related fields that have used this approach (e.g., Beyens et al., 2020; Verbeij et al., 2022). Readers may also wish to familiarize themselves with the families of statistical models most common in media research for analyzing effect size variation: multilevel models (e.g., Brown, 2021), the random-intercept cross-lagged panel model (Hamaker et al., 2015), and dynamic structural equation models (McNeish and Hamaker, 2020). For a compelling critical commentary about the pitfalls of focusing on individual-level effects without a strong theoretical framework, see Coenen (2023).

2.4.3 Prioritize Longitudinal, Within-person Studies

The most prominent study design in the literature on games is cross-sectional. In cross-sectional research, data are collected from a group of people at a single moment in time; this is contrasted with longitudinal research, in which data are collected from the same people at multiple time points, or continuously over a certain period. Though I am not aware of exact figures, a July 2022 Scopus search of 'video games AND (survey OR cross-sectional)' returned 3,964 results; a search of 'video games AND (panel OR longitudinal)' returned just 845.

While there is nothing inherently problematic about cross-sectional studies, an overreliance on them can have negative consequences. First, cross-sectional studies—especially in the absence of strong theory—require strong assumptions to support causal relationships, a key goal of our field and the social sciences more broadly (evidenced by the common lamentation at the end of papers that the current study is cross-sectional, with a call for future longitudinal work to be done). A finding that video game play and mental health negatively correlate, for example, is interesting but leaves us unsatisfied—the result could equally be the result of video game play causing worse mental health, worse mental health causing greater play, or an unknown third variable influencing both.

Second, causality is fundamentally a within-person inference. We cannot apply a treatment that would make one person become another person; a causal effect of video game play on mental health, for example, means 'if person A plays more games, their psychological health will be [better/worse] than it was before'. While within-person comparisons are neither necessary nor sufficient for estimating causal effects (between-person comparisons can also be used in some cases), they allow us to relax several assumptions relative to between-person analyses and are thus an invaluable tool for causal inference (Rohrer and Murayama, 2021). To estimate within-person associations, it is necessary to collect multiple data points from the same person—inherently the opposite of a cross-sectional design.

The last problem is that cross-sectional studies, by definition, capture a single moment in time (perhaps with some element of recalled past experiences). In the real world, games are often played over periods of weeks, months, or years. The effects that games have on players are unlikely to be fully visible in such snapshots. Unless our methods can reflect this ongoing engagement, our results will always be heavily qualified. A recent meta-analysis, for example, found that just two longitudinal studies had been conducted linking exposure to sexualization in games to misogyny and/or mental health, and note that this severely limits their ability to draw conclusions about how effects may accumulate over time Ferguson et al. (2022).

It is therefore crucial that we embrace longitudinal (or 'repeated measures') designs and aim to identify causal, within-person, and temporally relevant effects where possible. While it would be unfair not to acknowledge the 'publish or perish' incentive structures that motivate cross-sectional studies, I am encouraged by the fact that longitudinal research is becoming ever more accessible. In particular, I want to highlight examples and resources for two variations of longitudinal studies: ecological momentary assessment/experience sampling method (EMA/ESM) designs, and non-intensive longitudinal panel designs.

Ecological momentary assessment is a type of intensive longitudinal study that involves repeatedly asking participants to report on their thoughts, feelings, or behavior at that particular moment, often several times per day. A full description of EMA is well beyond the scope of this paper, but it has been used fruitfully, if sparsely, in research on games. For example, one study examined how the time of day when people play *Pokemon GO* relates to their physical activity (Marquet et al., 2018), and another how mood improvement after playing violent games relates to aggression (Kersten and Greitemeyer, 2022). There now exist numerous applications that support experience sampling research, including some fully open source ones such as ExperienceSampler (experiencesampler.com; Thai and Page-Gould, 2018) and PACO (pacoapp.com).

Non-intensive longitudinal studies, on the other hand, involve collecting fewer data points per participant, typically spaced further apart. Panel studies in particular are relatively common in the games literature, especially in research on disordered play. Some examples include N. Weinstein et al. (2017), who found a bidirectional relationship between disordered gaming and need satisfaction over two time points separated by six months, and Molde et al. (2019), who found that disordered gaming was linked to greater problem gambling two years later, but not the converse.

There is no sugarcoating the fact that longitudinal studies place high demands on researchers, but there are some resources to help. Ployhart and Ward (2011) provide some initial tips on conducting longitudinal research. Platforms such as Prolific.co have been designed with longitudinal research in mind, and have guides on how to conduct longitudinal work on their platform with easy recruitment and minimal dropout[1]. Longitudinal studies

[1] https://researcher-help.prolific.co/hc/en-gb/articles/360009222733-How-do-I-set-up-a-longitudinal-multi-part-study-

may require smaller sample sizes to achieve sufficient statistical power, potentially balancing out financial costs. Educational resources and statistical methods for dealing with attrition and missing data, common struggles in longitudinal research, are becoming more accessible thanks to platforms like *R-miss-tastic* (Mayer et al., 2021) and packages such as `missMDA` (Josse and Husson, 2016).

If it remains unfeasible for researchers to participate in their own longitudinal data collection, one alternative is to (re)use existing longitudinal data sets. As data sharing slowly becomes more commonplace (and required by certain agencies; Kozlov, 2022), data capable of answering one's research question may already exist. For example, landmark work on social media use and wellbeing used existing panel data from the Monitoring the Future, Youth Risk and Behaviour Survey, and Millennium Cohort Study surveys (Orben and Przybylski, 2019). Exploring publicly available data, for example on Google Dataset Search (datasetsearch.research.google.com) or the Open Science Framework (osf.io/search), has the potential of saving countless hours of work. Even when data is not publicly available, it may be possible to request access by contacting researchers directly (Ballou and Zendle, 2022).

Finally, the simplest thing researchers can do, whether they are in a position to conduct non-cross-sectional studies or not, is to actively consider the value of within-person evidence when reviewing previous work. During literature reviews, appending 'longitudinal', 'panel', 'experience sampling', or similar to searches can help identify work that involves a temporal component. This, in turn, can uncover research that has greater potential to support the (causal, within-person) arguments researchers may be making. Ensuring that readers recognize the evidential value of longitudinal studies—and cite them whenever appropriate—rewards researchers' efforts in conducting them. This in turn incentivizes those researchers and others to do more work along those lines.

To summarize, there are various strategies games researchers can use to conduct or support longitudinal research, to the benefit of the entire field:

- Seek out and cite non-cross-sectional work, particularly when it better supports causal claims
- Investigate available resources for facilitating intensive and non-intensive longitudinal designs (see examples above for starting points)
- Review the differences between within-person and between-person associations, with implications for causal modeling (Grosz et al., 2020; Rohrer and Murayama, 2021)
- Search for existing (longitudinal) data capable of addressing one's question (see also the following section on Digital Trace Data)

Ultimately, these steps can help us foster a generation of researchers with more skills in conducting non-cross-sectional studies, and who are rewarded for the challenge of carrying them out.

2.4.4 Justify Measurement Decisions

One of psychological games research's primary challenges is, unsurprisingly, measuring psychological characteristics of players. As over 150 years of psychometrics research can attest, this is not a trivial task—psychological constructs are rarely directly observable, and instead require a difficult process of *construct validation* to establish that our instruments measure what we think they measure. If this process is glossed over or ignored, it can undermine a study's *validity*: how well its results reflect reality (a detailed discussion of validity is beyond the scope of this thesis, but see Drost, 2011 for an overview).

Unfortunately, a 'measurement schmeasurement' attitude—which describes the intentional or unintentional enactment of so-called 'questionable measurement practices' that raise doubts about a study's validity—is common across psychology (Flake and Fried, 2020). Available evidence suggests that it is similarly a problem in research on games (Aeschbach et al., 2021; Hughes et al., 2023). It is therefore essential that researchers are aware of these questionable measurement practices (Flake and Fried, 2020). While the original authors describe six of these, I focus on three of them here: failing to disclose or properly justify one's choices of a) construct, b) measure, and/or c) scoring procedure.

Fortunately, a simple solution goes a long way toward avoiding questionable measurement practices: transparency. Increasing transparency places minimal additional burden on authors, while providing readers with much better information with which to evaluate the trustworthiness of claims. This is an area in which we have clear room for improvement—reviews by Hughes et al. (2023) and Aeschbach et al. (2021) show that measurement transparency standards in psychological games research are generally poor. Below, I briefly overview the three decisions about which researchers should be transparent, and highlight examples of potential consequences when we are not.

Define and Justify Constructs

First and foremost, researchers need to define the constructs they wish to study (see principle #1). Though seemingly simple, there are frequently several competing definitions for any given term, and differences may have important implications for both how the constructs relate to theory and how they could be measured. Where authors are not sufficiently clear, this can lead to researchers talking at cross purposes; while they appear to be studying the same thing, there are actually crucial differences. In games research, for example, definitions of terms such as 'immersion', 'enjoyment', or 'fantasy' vary substantially, and the resulting bodies of literature on those constructs become difficult or impossible to synthesize (Mekler et al., 2014; Calleja, 2011, chap. 1; López-Fernández et al., 2020). Researchers should therefore be clear about what the construct of interest is, how it is defined, why they chose it, and how it differs from other, similar constructs.

Justify Choice of Measure

Once the constructs are defined, researchers will need to choose a means to measure them. With some luck, others will have done so previously, and researchers can select from one or more existing measures. This, however, is a double-edged sword: researchers may need to select from dozens of options (e.g., there exist more than 30 gaming disorder questionnaires, King, Chamberlain, et al., 2020; and at least 18 player motivation questionnaires, Hughes et al., 2023). The benefits of one or another are not always obvious, especially if the initial validation of the measures was sparse or completed in a different context than currently intended. Further, researchers can easily fall prey to the *jingle* fallacy (assuming two instruments measure the same construct because they have similar names), or the *jangle* fallacy (assuming that two instruments measure different constructs because they have different names). Selecting the wrong measure can cast doubt on results; for example, the prominent Game Experience Questionnaire was later shown to have several psychometric problems, placing limitations on earlier results (Johnson, Gardner, et al., 2018).

To manage this flexibility, researchers should consider existing evidence of validity as a key factor in decisions about which measure to use, and report this evidence to justify their decision. Hughes et al. (2023) advise that authors include at least one example item, so readers can make their own assessment of whether the instrument measures its intended construct. Good practice can also include confirming the factor structure of a measure in one's own sample, a relatively simple procedure that can be done quickly in software like *R* or the open source GUI-based statistics tool *JASP* (JASP Team, 2022).

If no suitable measure exists, the picture is more complicated; researchers will need to go through an arduous process of development and validation, or risk their results being uninformative (for a thorough discussion of measure development and validation, see Kline, 2014).

Justify Scoring Procedure

For analysis, researchers will need to convert participants' responses into a score. There are numerous ways to go from responses to scores: taking the sum or mean of items, standardizing scores, fitting a factor model to estimate a latent variable score, or grouping participants into categories. This flexibility is at the core of longstanding debates in games research: the competitive reaction time task (CRTT), commonly used in violent video games research, has been scored in at least 10 different ways across different studies, with authors generally providing minimal justification for their procedure (Elson, Mohseni, et al., 2014). This not only raises questions about the robustness of each CRTT study's results, but also compromises the usefulness of meta-analyses based on those effects.

Scoring procedures should therefore be justified with reference to alternative possibilities. Potential justifications mentioned by Fried and Flake (2020) include citing a validation study that shows empirical evidence for a certain scoring approach and conducting one's own psychometric evaluation using the current sample data. Researchers may also consider trying multiple procedures as a 'sensitivity analysis' to assess whether their results are contingent upon a particular scoring method.

In short, measurement validity should be at the forefront of all our minds as we design, conduct, and analyze studies. Following Flake and Fried (2020)'s reporting checklist can be an easy, but important first step in making measurement decisions more transparent and easier to vet. For readers who want to dive deeper, Fried and Flake (2020) have curated a list of reading material on measurement in the psychological sciences, with topics ranging from reliability, factor analysis, measurement theory, and more. For a relatively accessible psychometrics textbook with worked examples in *R*, I recommend Mair (2018).

Table 2.1: Potential methods for games researchers to access objectively-tracked digital trace data on video game play, with their associated pros and cons

Method of Accessing Digital Trace Data	Pros	Cons	Examples of Research or Available Tools
Industry collaboration	– Offers possibility of receiving very large datasets all at once – Data is provided directly from the platform in question	– Requires individually brokered agreements, often limited to a single game – More accessible to wealthy, well-connected, and prestigious research groups	– Vuorre, Johannes, Magnusson, et al. (2022) – Johannes, Vuorre, and Przybylski (2021) – Kokkinakis et al. (2017)
User-facing tracking tools	– May be pre-installed on hardware, particularly for mobile devices – Custom-built tools can target particular types of behavioral data	– Can be restricted by terms of service agreements	– iOS Screen time – Rescue Time Android location tracker (Geyer et al., 2019) – Purchase history logs
Data donation	– Data from months or years can be accessed in a single request – Data is provided directly from the platform in question	– Users are only legally guaranteed a copy of their data in certain regions – Process may be slow and bureaucratic	– Boeschoten et al. (2020) – Playstation (sony.co.uk/eu/pages/privacy/en_GB/privacy_policy.html)
APIs and data dumps	– Easy to access – Provides access to very large datasets	– Only available for select games/platforms – May be fully anonymous, and thus not be easily linkable to survey data	– Open Dota (opendota.com) – RoyaleAPI (royaleapi.com) – Slay the Spire data dump (u/pants555, 2020)
Data-as-byproduct	– (Typically) publicly posted or available online – Reflective of diverse aspects of player behavior and interaction	– May lack granularity – Ethical concerns about use of data beyond intended purpose of sharing – Difficult or impossible to link with survey data	– Game reviews (e.g., Lu et al., 2020; Petrovskaya et al., 2022) – Forum/social media posts (Jørgensen and Bogers, 2020, e.g.,) – Trophy trackers (e.g., psnprofiles.com, trueachievements.com) – Automatic transcripts (from e.g., Twitch, Youtube)

2.4.5 Harness Digital Trace Data

In trying to understand the impact of any gaming behavior on a particular outcome, research is governed by the 'garbage in, garbage out' rule: if our measures do not reflect the actual phenomenon of interest, our studies will not be informative. Endorsement of internet gaming disorder criteria may not reflect actual dysregulation (e.g., King et al., 2018); responses to a questionnaire in one gaming context may reference completely different experiences or constructs than in another context (Gundry and Deterding, 2019); laboratory measures of aggression may not reflect actual verbal or physical aggression in the real world (Adachi and Willoughby, 2011).

In the previous section, I discussed this with regard to *psychological* measurement. Here, I discuss it in terms of *behavioral* measurement. One of the most straightforward metrics of behavior ends up serving as the most glaring example here: playtime, or the raw amount of time that a player spends engaging with games. Evidence is rapidly accumulating that self-report measures of digital technology use are often inaccurate (Parry et al., 2021), and that this is true of games in particular (Johannes, Vuorre, and Przybylski, 2021; Kahn et al., 2014; Mok and Anderson, 2021). The degree of inaccuracy may even be related to mental health, creating a possible confound for certain research questions (Sewall et al., 2020).

In addition to potential issues with external validity, players can typically only self-report simple, global measures of behavior. With players often unable to accurately recall even the total amount of time played in a recent session or day, it is unlikely that reports of yet more detailed behaviors—e.g., the number of chat interactions, the proportion of time spent idling, the win-loss rate over time—could be trusted.

The primary solution to better understanding playtime and various other indicators of true behavior is *digital trace data*, a term closely related to (and sometimes used interchangeably with) objective behavioral data, logged play data, and telemetry data. Digital trace data refers to any records of activity carried out using

digital technology (Stier et al., 2020), and is widely collected by most software, and extensively in most games. In games research, the analysis of digital trace data often lies within the field of game analytics, which uses telemetry data ('data collected at a distance' Seif El-Nasr et al., 2013, p. 5) to understand how users interact with games and support business decisions.

Digital trace data has several beneficial properties for research purposes. It eliminates the potential for biases in participants responses—due to demand characteristics, self-image, distorted memory, or any number of other factors—and replaces this with automatically collected behavioral logs. Trace data is collected non-intrusively, potentially reducing demand characteristics in environmental settings, and scales easily (Stier et al., 2020).

We are fortunate to work in an era where collecting digital trace data is becoming increasingly accessible. I am aware of at least five ways researchers might do so, each with their own strengths and weaknesses (Table 2.1).

The first is through industry collaborations. Some research groups have negotiated data sharing agreements with game developers and/or publishers to conduct research on their players, using data that the companies hold (Johannes, Vuorre, and Przybylski, 2021; Kahn et al., 2014; Kokkinakis et al., 2017; Vuorre, Johannes, Magnusson, et al., 2022). Such agreements can provide extremely large and rich datasets, in line with the detailed data kept by most tech companies. However, industry collaborations restrict analysis to the (likely small) number of games and players for which companies have made data accessible—and importantly, to data on individual players' playtime for an individual game, which may constitute only a small part of someone's total gaming.

Second, researchers can use third-party tracking tools and existing time/behavior tracking systems. These are apps or features designed to record some aspect of a person's behavior, such as the Android Digital Wellbeing menu for showing device usage and Apple's Health app to record physical activity. To date, these have been more commonly used for research studies on global screen time or social media on mobile devices (Ohme et al., 2021; Sewall and Parry, 2021)—but are no less potentially powerful for gaming, and mobile gaming especially.

Third, in certain regions, players have the legal right to request a copy of their own data from companies, which they can then 'donate' for research purposes. For example, GDPR affords residents of the European Union the right to request copies of the data held by data processors; a similar right exists under the California Consumer Privacy Act (CCPA). Such rights, where they exist, extend to all or nearly all game developers, publishers, and platforms who hold data over customers in some form—creating an access point to extremely detailed behavioral data. At the time of writing, I was unable to find any examples of research using data from data requests, though grants have begun to be awarded to build infrastructure to support this (Araujo, 2021). In the meantime, however, I illustrate the power of data donation by sharing my own Playstation data, returned via such a request in December 2021 (see osf.io/f9m8b/). The provided spreadsheet from Sony contains data on every play session (with duration), download, trophy, transaction and much more since the creation of my account—an extraordinarily rich dataset compared to those typically seen in games research. I encourage readers to investigate their own favorite games' or platforms' privacy agreements to explore their options for requesting data. In the future, a standardized framework for players to quickly request this data from various companies and share it with researchers could revolutionize how we investigate gaming (cf. http://gameplay.science).

Fourth, there exist a handful of publicly available APIs or data interfaces that provide access to in-game data, such as OpenDota (opendota.com) for *Dota 2* or RoyaleAPI for *Clash Royale*. These APIs often record data from individual matches, including decisions made, match results, time/duration, and more. Relatedly, some games have made 'data dumps' available in the form of large downloadable data sets with in-game data (u/pants555, 2020).

Finally, I include a broad category of data generated as a byproduct of other player or community activities. Researchers can collect game reviews (Lu et al., 2020; Petrovskaya et al., 2022) or forum posts (Jørgensen and Bogers, 2020); more generally, webscraping with tools like Scrapy (scrapy.org)—where permissible—can generate large amounts of data about how players are behaving or engaging with games. Related data can include Twitch viewership and chat logs (Diwanji et al., 2020), or fan wikis where players aggregate information about and 'theorycraft' for games (Mittell, 2009).

In short, as gaming companies continue to collect ever more data, researchers have the opportunity—obligation, even—to seek access to similar data. Luckily, recent innovations mean that researchers have access to behavior at an extremely granular level. This can play a vital role in answering questions about how video games affect players, and we should seize the opportunity.

Table 2.2: Selected practices encouraged by the open research movement, and their benefits for research on games

Open Research Practice	Benefit to Games Research	Resources for Learning or Applying
Preregistration	– Differentiates exploratory vs confirmatory research – Encourages researchers to think more thoroughly about theory and potential boundary conditions	– Przybylski and Weinstein (2019b) – OSF's practical guide to preregistration osf.io/2vu7m/
Registered Reports	– Alleviates the file drawer effect, where null results are less likely to be published – Allows studies to receive feedback before its too late to implement	– Przybylski and Weinstein (2019b) – Karhulahti, Vahlo, et al. (2022)
Replication studies	– Provides invaluable information on the trustworthiness, consistency, and generalizability of effects – Can be a valuable pedagogic tool for levels from undergraduate to PhD	– Zwaan et al. (2018) – Brandt et al. (2014) – Wagge et al. (2019)
Open data	– Creates opportunity for future reuse, saving drastically on effort needed for certain studies – Allows readers and reviewers to detect potential errors in analysis or reporting	– Soderberg (2018)

2.4.6 Adopt Open Research Principles

Research is only as useful as it is trustworthy and transparent in the way it is conducted and shared. Unfortunately, we have reason to believe that the status quo of research in the social sciences does not meet the standards for robustness we would like it to.

Meta-research demonstrates how so-called questionable research practices—such as reporting only one of a set of multiple dependent variables, optionally controlling for covariates, and collecting more data after a non-significant result—can balloon the false positive rate in the literature well beyond the nominal 5% (with a $p < .05$ significance level) (Ioannidis, 2005; Simmons et al., 2011). Results produced through questionable research practices and 'p-hacking' (misuse of data analysis to find patterns in data that can be presented as statistically significant) will not reflect true effect, and therefore are unlikely to be replicable: a prominent project was only able to replicate 36 of 97 high-profile psychological studies, with replication yielding effect sizes half as large on average (Open Science Collaboration, 2015). This becomes even more problematic when we consider publication bias, which occurs when the outcome of an experiment or study biases the decision to publish it—typically in favor of positive results. Meta-analyses on video game effects often show substantial evidence of publication bias, suggesting that many studies with non-significant results have not been published—a phenomenon known as the file drawer effect.

Together, this means that the current literature is likely both biased towards particular types of results, and that many of the results that are represented are unverifiable, do not transparently reflect the analysis process used to find them, or are outright fraudulent. We have strong evidence that this is a problem in research on games, with studies finding that statistical reporting is often poor (Vornhagen et al., 2020), and that many topics are characterized by substantial publication bias (Hilgard et al., 2017; Hilgard, Sala, et al., 2019).

The current leading movement to address these issues of questionable research practices, publication bias, and more is commonly known as 'open research' or 'open science'. The tenets of the open research movement are too varied to discuss exhaustively here (but see Munafò et al., 2017, for an overview). Instead, I highlight some of the key practices and the benefits they can have for games research and by extension, my own work (Table 2.2).

The first practice is *preregistration*: specifying one's research plan in advance of the study, and submitting it to a timestamped registry. The Center for Open Science summarizes the benefits, writing 'Preregistration separates hypothesis-generating (exploratory) from hypothesis-testing (confirmatory) research. Both are important. But the same data cannot be used to generate and test a hypothesis, which can happen unintentionally and reduce the credibility of your results' (cos.io/initiatives/prereg). Engaging in preregistration can have positive effects for the theory crisis: to make predictions in advance, researchers are forced to think more thoroughly about boundary conditions, measures, confounds, and more.

Registered reports extend preregistration into a new publishing format that emphasizes the importance of the research question and the quality of methodology rather than the results themselves by conducting peer

review prior to data collection. High quality protocols are then provisionally accepted for publication if the authors follow through with the registered methodology. This ensures that results will be published regardless of what they show—eliminating incentives to fish for positive or significant results—and allows reviewers to catch problems in the study design before it is too late to correct them.

Replications are studies designed to test an existing finding in a new, analogous dataset. Replications give us information about the robustness and generalizability of a particular finding, and help separate true effects from false positives. Replication studies double as an excellent pedagogical tool, having been successfully applied to research methods education as early as the undergraduate level (Wagge et al., 2019).

Finally, *open data* is the practice of making all data underlying the conclusions of a manuscript available freely and publicly at the time of publication. The benefits of open data are myriad: it increases confidence in findings by allowing others to reproduce values and potentially detect errors, enables reuse of the data to answer related research questions, ensures that those funding research (often the public) have access to its outputs, and can lead to greater collaboration and goodwill among researchers.

While the implementation of some open research practices continues to be debated (e.g., Szollosi et al., 2019), the movement as a whole nonetheless provides our best set of tools for increasing the rigor and accuracy of the research literature.

2.5 Discussion

Above, I described the sometimes frustrating present state of psychological research on video games, in which answers to broad questions about the effects of games are scarce. I then described six ways we can reform our research practice to understand how players and games interact more successfully: (1) Strengthen the theoretical derivation chain, (2) Attend to inter-individual effect size variation, (3) Prioritize longitudinal, within-person studies, (4) Justify measurement decisions, (5) Harness digital trace data, and (6) Adopt open research principles. It is my aspiration that this thesis generate high-quality evidence in accordance with these principles, and also serve as an illustrative 'case study' in how to apply them. In the studies to come, I apply each one of these principles at least once (see overview in Table 1.1).

Again, I am by no means the first to identify these practices nor apply them (alone or in combination)—my goal has simply been to collate them and add actionable guidance. There exist numerous examples of studies following these practices, and they form in my opinion some of the strongest evidence in our field. For example, work has found that preregistered studies (Principle #6) on violent video games and aggression, though few in number, have tended to find null effects (Ferguson, 2020). A study using digital trace data (Principle #4) following players over six weeks (Principle #3) similarly found no evidence for an effect of violent games on subsequent aggressive affect (Johannes et al., 2022). A preregistered (Principle #6), longitudinal (Principle #3) study with a clearly-defined theoretical derivation chain (Principle #1) identified a crucial boundary condition in the relationship between mobile media use and wellbeing in the form of goal conflict (Gilbert et al., 2021).

As these examples highlight, these six strategies are synergistic—the usefulness of each practice can be amplified through combination with others. A custom-designed game can collect a wide range of digital trace data. A longitudinal study can be submitted as registered report, allowing reviewers to identify opportunities for a more informative design or analysis. Modeling effect size variation can be a valuable exploratory step that helps us better specify the boundary conditions or moderators in our theories.

2.6 Conclusion

Psychological games research has been less efficient than we would like it to have been, with concrete and generalizable answers to high-stakes questions about how games affect people proving elusive. As our knowledge of the limitations of our research designs, (statistical) analyses, and structures in the research ecosystem has advanced, however, the path forward has become clearer. We will benefit from paying more attention to how effect sizes vary across individuals, using this to inform our theories and link them more closely to our hypotheses, and from using data that reflects actual, rather than perceived, behavior. Promisingly, that road has also become better paved in recent years: there exist many more tools for running intensive or longitudinal studies, collecting digital trace data, and adopting open research practices that increase the trustworthiness of results.

I would like to emphasize that I have focused here on actions that individual researchers can take, and that I therefore have the ability to implement in my own thesis research. However, I want to make it very clear that this needs to be accompanied by large, top-down structural changes to the way we evaluate researchers

and research impact, to how industry shares data, to the kinds of skills that digital technology researchers are taught, and much more. For example, I fully recognize that the relative lack of longitudinal research is not simply due to a lack of researcher interest: the focus on relatively easy to conduct, relatively fast to publish cross-sectional research is a byproduct of 'publish or perish' culture of academia and how we evaluate researchers (Fanelli, 2010). Rather than alleviate the need for large-scale changes to the research ecosystem, I hope that pursuing research along the six lines described above can empower the research community, making clear the potential gains as these practices and others become integrated into our work, and using that as a platform to push for even greater change.

3

Games and Mental Health

Chapter Contents

3.1 Introduction . . . 25
3.2 What is Mental Health? . . . 26
3.2.1 Future Directions in Mental Health and Entertainment Media Research . . . 28
3.3 The Empirical and Theoretical Landscape of Gaming and Mental Health . . . 29
3.3.1 Short- and Long-term Effects . . . 29
3.3.2 Playtime and Displacement . . . 30
3.3.3 Gaming as a Mental Health Resource . . . 32
3.3.4 Games and Basic Psychological Needs . . . 33
3.3.5 Dysregulated and Obsessive Gaming . . . 34
3.4 Zooming Out: Deficits in Gaming and Mental Health Theory . . . 38
3.5 Conclusion . . . 39

3.1 Introduction

In the previous chapter, I explored some of the reasons why progress in psychological research on games has been frustratingly ineffective. From here, I move on to the specific topic of research in which my thesis sits. Within the wider context of psychological games research asking 'how do video games affect people (and how do people affect games)?', I am concerned with the (sizable) subset of this work that asks 'how do video games affect players' mental health?'

The landscape of existing research into gaming and mental health is characterized by results that are at best difficult to synthesize, and at worst in opposition to one another. There can be short- and long-term impacts, immediate and indirect impacts, and positive and negative impacts, arising from quality and quantity, and from gaming to mental health as well as from mental health to gaming. In many cases, these effects are null in the aggregate—evidence suggests that for most gaming experiences and most players, any effects of gaming on mental health are small and nuanced (Ferguson et al., 2022; Hilgard et al., 2017; Hilgard, Sala, et al., 2019; Vuorre, Johannes, Magnusson, et al., 2022)—but certain kinds of experiences do reliably impact certain players.

This presents a series of challenges for theories of gaming and mental health. To explain more than isolated corners of the existing literature, a theory needs to account for various discrepancies. Of the numerous theories and frameworks that address the relationship between entertainment media (which includes games alongside other media such as social media, television, and virtual reality experiences) and mental health, in my view none fully meet these (admittedly lofty) ambitions. While a complete review of existing empirical findings and theory on entertainment media and mental health is beyond the scope of this chapter, I do my best to provide an overview here. For further details, I refer readers to Meier and Reinecke (2021) and Valkenburg and Oliver (2019) as fruitful starting points.

Throughout this review, I highlight the limitations that I discussed in abstract terms in the previous chapter. In doing so, I make the argument that we have a largely piecemeal understanding of games and mental health, and that the methods and practices that researchers have used hindered our success in making this understanding more holistic.

3.2 What is Mental Health?

To this point, I have neglected to specify precisely what I mean by mental health. Imprecision around mental health and its subcomponents has been a source of difficult-to-integrate results in research on games and mental health. Researchers have investigated the full gamut of mental health constructs: depression, affect, anxiety, vitality, appreciation, life satisfaction, to name but a small sample. The differences between these constructs has not always been appreciated, with at times a lack of clear definition and justification of concepts and measures, as discussed in Section 2.4.4.

To try and offer more clarity on this issue, I adopt a conception of mental health governed by three distinctions from previous literature: wellbeing vs illbeing (Meier and Reinecke, 2020), hedonia vs eudaimonia (Huta and Waterman, 2014), and the situational vs global level of generality (Vallerand, 1997). An overview of my model of mental health is presented in Figure 3.1.

Mental health, according to the World Health Organization, is 'a state [...] in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community' (World Health Organization et al., 2005, p. 2). Under the Extended Two-Continua Model of Mental Health proposed by Meier and Reinecke (2020), mental health can be thought of as consisting of two related, but partially independent components: psychological *wellbeing* (henceforth simply wellbeing), and psychopathology or *illbeing*.

(Mental) wellbeing is defined as 'vitality, awareness, access to, and exercise of one's human capacities and true self-regulation' (Ryan and Deci, 2017, p. 241). Illbeing, on the other hand, is defined as 'any pattern of behavior—broadly defined to include actions, emotions, motivations, and cognitive and regulatory processes—that causes personal distress or impairs significant life functions, such as social relationships, education, work, and health maintenance' (Lahey et al., 2017, p. 143). Much empirical and theoretical work argues that wellbeing and illbeing are partially independent outcomes that should be measured and analyzed separately (Greenspoon and Saklofske, 2001; Keyes, 2005; Ryff et al., 2006; although see Zhao and Tay, 2023 for a dissenting opinion).

Wellbeing can be broken down into further categories. Most prominently, entertainment media researchers differentiate hedonic wellbeing (*feeling good*) and eudaimonic wellbeing (*doing well*)—a distinction dating back millennia (Aristotle, reprinted in 2014). Hedonia describes the presence of pleasure, enjoyment, or fun (positive affect), and the absence of pain or discomfort (low negative affect). Combined with a cognitive appraisal element of satisfaction, hedonic wellbeing is also referred to as subjective wellbeing (Diener, 2000). Common hedonic constructs include positive and negative affect, enjoyment, fun, or carefreeness (Huta, 2016).

Eudaimonia, on the other hand, describes a life that is meaningful and actualized—what might be considered 'a life well lived'. Under self-determination theory, which will be discussed at length in the following chapter, eudaimonic wellbeing is defined thusly:

> Wellness is better described in terms of thriving or being fully functioning rather than merely by the presence of positive and absence of negative feelings. Thriving is characterized by vitality, awareness, access to, and exercise of one's human capacities and true self-regulation. [...] They can be spontaneous and not constrained or holding back their interests or powers of orientation. They [display] creative adjustment—an ability to be open, welcoming of novelty, and reflective—able to integrate inner and outer inputs into coherent actions. (p. 241) [...] In wellness, one is free of debilitating inner conflicts and able to operate with awareness, vitality, and integrity. (Ryan and Deci, 2017, p. 100)

Operationally, eudaimonia is a wide umbrella, having been measured in at least 60 different ways (Martela and Sheldon, 2019), but typically includes authenticity/autonomy, excellence/virtue, growth/self-actualization, and meaning/contribution (Huta and Waterman, 2014). In a state of high eudaimonic wellbeing, people have energy to direct toward valued goals, can experience the full spectrum of emotions and capabilities, and are reflective, showing an ability to integrate internal and external factors into coherent actions.

Eudaimonic perspectives on wellbeing recognize that thriving and experiencing life in its full richness and breadth may not always be characterized by positive emotions—the ability to deeply grieve a loved one is

an indication of wellbeing, for example, but not of hedonia. That is not to say, however, that happiness and hedonism are unrelated to eudaimonic wellbeing. Instead, happiness is conceived of as a *symptom* of wellbeing (Ryan and Huta, 2009)—when one is flourishing in the eudaimonic sense, happiness often follows, but so too do many other positive aspects of the self. Based on both theory and evidence, there is a consensus in contemporary positive psychology that both hedonia and eudaimonia are necessary components of wellbeing, a good life, or flourishing (Huta and Ryan, 2010).

Even after differentiating hedonia and eudaimonia, however, there remain numerous components of wellbeing, and by extension ways to define and measure it. Here, I draw upon on a taxonomy from (Huta and Waterman, 2014) that specifies four categories of wellbeing:

- **Orientations**: personal priorities, reasons, motives, values, and goals behind a person's chosen behaviors (e.g., seeking to grow and mature as a person, seeking pleasure).
- **Behaviors**: specific behaviors a person engages in, including actions and thoughts (e.g., planning personal goals, attending big parties).
- **Experiences**: subjective emotions, feelings, and cognitive-affective appraisals (e.g., feeling of meaning/-value, feeling of positive affect).
- **Functioning**: abilities, accomplishments, and healthy habits, often acquired after an extended period of eudaimonic/hedonic orientation and behavior (e.g., self-regulation, having the capacity to savor).

Huta (2016) argues that orientations and behaviors fundamentally represent *ways of living*—what a person chooses to do in life—while Experiences and Functioning represent *wellbeing outcomes*. Given that the current thesis is focused on the outcomes of video game play, I therefore elect to focus on mental health *experiences* (see Section 3.2.1 below on this decision).

Lastly, I draw an important distinction regarding the level of generality where mental health operates. Adopting Vallerand (1997)'s Hierarchical Model of Intrinsic and Extrinsic motivation, Huta (2022) argues that wellbeing can be measured at three broad levels of generality[1]:

- **Global** (akin to trait level): reports on one's life as a whole
- **Contextual** (aka domain-specific): reports on a specific area of one's life such as work, exercise or video games
- **Situational** (akin to state level): reports on a relatively narrow window in time, such as the immediate moment or previous day

The games and mental health literature is rife with empirical evidence about situational and global effects. Experimental evidence reviewed demonstrates effects of gameplay on short-term *situational* mental health in the form of negative affect (Hartmann and Vorderer, 2010), vitality (Tyack et al., 2020), and more. The class of studies that look at broader influences of gaming on e.g., depressive symptoms (Ostinelli et al., 2021) or life satisfaction (Vuorre, Johannes, Magnusson, et al., 2022) longitudinal studies target mental health at the *global* level. These findings are discussed in more detail below.

Despite receiving minimal attention to date, contextual mental health also has clear relevance here. Contextual mental health is closely related to a recently-introduced concept called *digital* wellbeing (M. M. P. Vanden Abeele, 2020), defined as follows:

> Digital wellbeing is a subjective individual experience of optimal balance between the benefits and drawbacks obtained from mobile connectivity. This experiential state is comprised of affective and cognitive appraisals of the integration of digital connectivity into ordinary life. People achieve digital wellbeing when experiencing maximal controlled pleasure and functional support, together with minimal loss of control and functional impairment (2020, p. 7).

Digital wellbeing, therefore, refers to (both hedonic and eudaimonic) wellbeing in the life domain of one's technology use—i.e., the contextual level. To achieve digital wellbeing is to have technology use be in balance with other activities, such that people experience the most benefits and the least drawbacks of their engagement. With gaming as an analogous life domain to mobile technology use, I find this a valuable framing for our purposes as well. As mentioned in the introduction, the positive potential effects of games (e.g., feelings of

[1]Though she acknowledges all three levels, Huta (2022) only measures situational and global wellbeing in that study, noting that the notion of contextual wellbeing and appropriate instruments for assessing it remains a work in progress.

	Illbeing Experiences	Wellbeing Experiences	
		Hedonic	Eudaimonic
Situational	• State negative affect • Worry • Emotional exhaustion	• State positive affect • Carefreeness • State stress • Mood	• State meaning • Elevation • Flow
Contextual	• Dysregulation/loss of control • Withdrawal symptoms	• Affect derived from life domain • Healthy daydreaming	• Meaning derived from domain • Balance • Domain identification
Global	• Depression • Anxiety • Hopelessness	• Trait positive affect • Life satisfaction	• Trait meaning • Trait elevation • Transcendence • Authentic pride

Figure 3.1: Taxonomy of mental health as targeted in the current thesis. Specifically, I seek to understand mental health *experiences* (subjective emotions, feelings, and cognitive-affective appraisals), as distinct from Huta and Waterman's (2014) orientations, behaviors, and functioning categories. Each box lists example constructs that could be measured for that category.

mastery and growth) are inevitably intertwined with the potential negative effects (e.g., feelings of frustration or failure). To experience contextual-level digital or gaming wellbeing is therefore to engage with technology such that, to the greatest extent possible, one's use contributes positively to one's global sense of mental health.

Levels of generality allow us to account for the fact that experiences can vary in how localized vs all-encompassing they are. They also provide a complementary tool for understanding the timescale of a potential effect—situational behaviors should have short-term, localized experiential and functional outcomes (e.g., in the moment), while repeated, accumulative, or generalized behaviors are expected to lead to longer-term, global experiential and functional outcomes. Despite this potential value add, however, levels of generality are rarely specified or compared in research on gaming.

Putting this all together, previous research has adopted highly varied conceptions and measures of mental health, and investigated these across many different time and generality scales. Models of media use and mental health will benefit from differentiating (1) wellbeing vs illbeing, (2) hedonia vs eudaimonia, (3) the levels of generality (and, by extension, timescale) at which effects are predicted. These goals closely mirror points raised in previous reviews (Meier and Reinecke, 2021). My model of mental health is depicted in Figure 3.1, and includes example constructs for each category.

3.2.1 Future Directions in Mental Health and Entertainment Media Research

The mental health model adopted here does not attempt to account for the full taxonomic divisions described above. Specifically, the omission of *functioning* outcomes, and the fact that illbeing remains undifferentiated (in contrast to wellbeing, which is broken down into hedonic and eudaimonic aspects), reflects the immaturity of this research area.

Although all four of the wellbeing categories described by Huta and Waterman (2014) (orientations, behaviors, experiences, and functioning) are undoubtedly part of the picture of how games and mental health relate, experiences—operationalized with measures of life satisfaction, positive and negative affect, and so on—have dominated the landscape. This points to a need to consider these other aspects with equal rigor, but this also implicates larger challenges in positive psychology: for example, Huta and Waterman (2014) note that hedonic functioning is a tenuous construct, and that it is possible that positive functioning falls fully within the concept

of eudaimonia. Nonetheless, it is a worthwhile goal for future work to consider how mental health might be either supported or co-constituted by (1) particular orientations or in-game motivations and (2) in-game behaviors; and (3) how video game play can contribute to functioning and the formation of healthy habits and abilities.

Second, there remain questions about if and how to differentiate aspects of illbeing. At present, research into the mental health effects of media use has mostly differentiated positive mental health and left the illbeing side to established psychopathology/psychiatry. In those fields, researchers differentiate between different illnesses such as psychoses, externalizing problems such as substance abuse, emotional dysfunction and more (Kotov et al., 2021). In research on games, 'illbeing' has yet to be carefully conceptualised. Instead, gaming itself is framed as a potential illness or disorder (disordered gaming, see Section 3.3.5) or excessive gaming is explained as a symptom of another underlying mental illness, like depression (Karhulahti, Siutila, et al., 2022). The two-continua model of mental health (Meier and Reinecke, 2020) has not been integrated with Huta and Waterman's 2014's model, which leaves open questions about whether illbeing can be divided into experiences and functioning similarly to wellbeing.

For these reasons, a full integration of the models presented above, alongside decades of psychopathology research, is not attempted here. I instead adopt a more limited model focused solely on mental health *experiences*, as relates to hedonic wellbeing, eudaimonic wellbeing, and illbeing.

3.3 The Empirical and Theoretical Landscape of Gaming and Mental Health

With a model of mental health in place, we can now move on to a review of empirical results in this area. But before talking about the effects and theories that *are* relevant to this thesis, I want to quickly make note of a class of findings and theories that are *not* relevant here. A large body of work on video games targets proximal experiential effects, rather than mental health *per se*. While this class of work may invoke downstream mental health effects to justify the importance of these proximal effects, they are less able to provide a clear mechanism for mental health impacts. This category includes a broad class of media effects models that focus on belief, attitude, or behavior change, such as the General Learning Model (Buckley and Anderson, 2006), Framing Theory (Entman, 2007) and the Reinforcing Spiral Model (Slater, 2007). Other models target the reasons why people choose certain media, but do not directly tie these to mental health outcomes, such as Uses and Gratifications theory (Ruggiero, 2000) and models of gaming motivations (Daneels et al., 2023; Possler et al., 2023; Yee, 2006). Thus, for the sake of keeping this review tractable, I will focus specifically on research findings and theoretical approaches where player mental health is central.

In the following sections, I will first discuss a cross-cutting concern about timescales to keep in mind while reviewing all potential effects of games on mental health (Section 3.3.1). I will then review literature about play *quantity* (Section 3.3.2), before moving on to gaming and recovery (Section 3.3.3), gaming, social experiences, and basic needs (Section 3.3.4), and a closing section on dysregulated or disordered play (Section 3.3.5).

3.3.1 Short- and Long-term Effects

Identifying the correct timescale of effects has to date been an underappreciated issue in work on video game play and mental health. It is plausible (indeed, likely) that certain patterns of video game play have short-term effects on mental health but not long-term, or the converse.

Existing research has looked at a wide range of potential timescales. Experimental designs show that a ~30-minute gaming session can lead to immediate changes in stress (Russoniello et al., 2009), negative affect (Hartmann and Vorderer, 2010), aggressive affect (Przybylski et al., 2014), vitality (Tyack et al., 2020), and more. Observational panel studies have to mental health to play over the course of the previous 2 weeks (Vuorre, Johannes, Magnusson, et al., 2022), 1 month (Sibilla et al., 2021), 6 months (Lemmens et al., 2011; N. Weinstein et al., 2017) or 1 year (Kowert et al., 2015). It is worth noting that longitudinal studies have trended towards null or practically inconsequential relationships—noting that causality is harder to pin down than in the experimental ones, given that is typically impossible or impractical to randomize participants into different game-playing groups. However, some studies that focus on longer-term qualitative aspects of play rather than playtime do support effects: various studies indicate that longer-term qualitative factors such as identifying as a gamer (Kaye, 2019), accrued social capital in games (Mandryk et al., 2020), or so-called gaming contingent self-worth (Beard and Wickham, 2016) do relate to mental health. To cite just a few examples from dysregulated gaming research—a prominent qualitative description of play—more dysregulation is associated

with loneliness and depression over the course of 1 year (Krossbakken et al., 2018), friendship quality over 21 months (Willoughby, 2008).

Despite this variation in findings between between shorter- and longer-term effects, existing theory has tended to either focus on just one timescale, or has glossed over timescales entirely. Relevant examples here include Mood Management Theory (Zillmann, 1988), and Flow theory (Csikszentmihalyi, 1990), which have both featured prominently in research on media and wellbeing. Though both have shown promising in explaining short-term immediate impacts of media use, neither model has a fully-developed explanation for longer-term impacts of gaming use on mental health. Oliver (2022) similarly notes that very little of the research on social media use and eudaimonic wellbeing has investigated longer-term mental health outcomes. One theory that is a notable exception in specifying both short- and long-term impacts is the aforementioned R^2EM model (Reinecke and Rieger, 2021), which describes how selective exposure to media can lead to short-term recovery experiences on either a hedonic or eudaimonic level, and that these short-term recovery experiences lead to the development of long-term protective and promotive resiliency.

Potential discrepancies between short- and long-term effects are implicated throughout the entirety of the findings reviewed in this chapter, and I therefore do not belabor this point any further here. Suffice to say, paying greater attention to the timescale of effects may help resolve the tension between superficially conflicting results wherein researchers sometimes find positive or negative relationships between (certain kinds of) gaming and mental health, and other times null effects.

3.3.2 Playtime and Displacement

Media, parents, policymakers, and scholars have intensely debated the impact of time spent playing video games ('playtime') on players' mental health. Like the wider 'screen time' debates (Kaye et al., 2020), such debates implicitly treat all gaming as equal, and are interested in whether raw time spent engaging with games has negative impacts on players. These discussions have high stakes: multiple governments have considered or enforced limits on people's playtime out of concern for negative impacts that video games may have on mental health (Király et al., 2017).

As discussed, however, research on the links between playtime and mental health paints a decidedly mixed picture. On the one hand, several studies report that playtime is negatively associated with mental health (Boxer et al., 2015; Burke and Lucier-Greer, 2021; Wenzel et al., 2009), with some framing this as potentially mediated by problematic or 'disordered' play (Ballou and Zendle, 2022). Others find associations only for certain ages or mental health constructs such as anxiety (Loton et al., 2016); or small negative associations between playtime and mental health among highly engaged players (those playing more than approximately 2–4 hours per day) (Allahverdipour et al., 2010; Colder Carras et al., 2017; Przybylski and Weinstein, 2017). Yet others have found null or negligible associations between playtime and depression, academic achievement, affective wellbeing, and more (Brunborg et al., 2014; Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022).

Much of the variation in observed associations between playtime and mental health may be due to differences in mental health constructs, demographics, contexts, and experiential quality of gaming (e.g., Allen and Anderson, 2018; Koban et al., 2021; Mandryk et al., 2020). Following Chapter 2, however, there is good reason to believe a substantial portion is methodological—namely due to data quality issues stemming from the low validity of self-report measures of playtime (Johannes, Vuorre, and Przybylski, 2021; Parry et al., 2021). At present, the vast majority of studies that investigate playtime have used self-report measures, largely out of necessity. As described in the previous chapter, digital trace data offers a more accurate self-report measures of playtime, but is usually only accessible to the games' developers, publishers, or distribution platforms, who have been hesitant to share it with researchers (Seif El-Nasr et al., 2013). As a result, only a few studies have investigated links between such objective playtime measures and mental health (Billieux et al., 2013; Brühlmann et al., 2020).

Two recent studies stand out as landmark exceptions in which researchers successfully collaborated with industry to collect objectively-logged playtime data. Together, these studies provide the strongest evidence yet that playtime and mental health are not meaningfully related for the majority of players. In a first study, Johannes, Vuorre, and Przybylski (2021) use data provided by Electronic Arts and Nintendo, and find players with more playtime in *Animal Crossing: New Horizons* and *Plants vs. Zombies: Battle for Neighborville* report no meaningful differences in wellbeing than those with less playtime. In a follow-up study, Vuorre, Johannes, Magnusson, et al. (2022) expand the pool of games to 7[2] and 3 time points spaced 2 weeks apart, enabling them

[2] *Animal Crossing: New Horizons*, *Apex Legends*, *EVE Online*, *Forza Horizon 4*, *GT Sport Outriders*, and *The Crew*)

to look at within-person effects and temporal precedence. Here, they draw even stronger conclusions: not only is playtime not meaningfully related to subsequent life satisfaction or affect, but analysis of the variation in effect size across the 7 games indicates that it is likely that the majority of all games have no meaningful relationship between playtime and wellbeing.

While improving over previous designs, these two studies share one major limitation, namely that the data received by industry partners include just one game per player. Although little is known about how varied gaming 'diets' are (Orben, 2021), a large scale database of Steam users indicates that many players log time on multiple games in a given 2-week period (O'Neill et al., 2016). This is corroborated in community posts, where players discuss regularly playing multiple games and switching between them in the course of a day or week based on their mood, available time, and social context (see e.g., u/LyzbietCorwi, 2017 for an example). Furthermore, any given game for which we have data (such as Animal Crossing) may not be the predominantly played game for any given player. Thus, playtime in particular games may not tell us much about overall playtime of a particular player, and hence, how overall playtime—that is, gaming at the contextual level—affects wellbeing.

In addition to issues with self-reports, the majority of the literature (including the studies referenced above, with the notable exception of Vuorre, Johannes, Magnusson, et al., 2022) have been cross-sectional, and thus require significantly stronger assumptions to support causal inferences (Rohrer and Murayama, 2021). Observed correlations between playtime and mental health have multiple potential causal explanations: players who play more might experience changes in mental health, but so too might players who are feeling poorly seek out games as a coping mechanism (Iacovides and Mekler, 2019; Tyack et al., 2020).

Further, these effects, if they exist, may operate on a range of timescales, with no strong guidance by prior theory or evidence on which time scales to expect (and test) effects of mental health on playtime or vice versa. As highlighted above, some studies assess short-term momentary effects (e.g., positive and negative affect; (Petralito et al., 2017; Przybylski et al., 2014), while others ask about feelings over the previous week, 2 weeks, or longer (Allen and Anderson, 2018; Brunborg et al., 2014). This issue is compounded by a structural limitation of cross-sectional self-report playtime data: players can only self-report playtime retrospectively, and thus studies without multiple time points are unable to investigate any effect mental health might have on subsequent playtime, focusing instead on effects of playtime on mental health.

Although the highest-quality evidence in the field indicates that playtime and mental health are not meaningfully related, this should not be understood as an indication that quantity of gameplay *never* affects mental health. Most commonly, the mechanism proposed for negative effects of playtime and mental health comes from the displacement hypothesis.

The *displacement hypothesis*—that time spent on a media activity zero-sum displaces other, more psychosocially beneficial activities—is long-standing in media research, dating back to television research in the 1950s (Mutz et al., 1993), but re-emerging with new media, including video games (C. C. Fisher, 2012). The literature contains numerous examples of gaming problematically displacing other life domains, with the most extreme examples involving player death after multiple days of uninterrupted gaming (i.e., all-encompassing displacement) (Kuperczko et al., 2022). More typical examples involve time spent gaming leading to lost sleep (Guo et al., 2022), lower performance at work or school performance (Drummond and Sauer, 2020), or the inability to maintain social relationships (Kowert et al., 2014). Critiques are similarly long-standing, including that people's time budgets are flexible; that activities typically 'displace' similar activities, thereby serving the same psychosocial functions; or that the hypothesis often surfaces adults' normative views of about what kinds of activities children and young people *should* engage in, regardless of whether these activities are actually most developmentally appropriate or psychosocially beneficial (Mutz et al., 1993).

The quality of evidence in empirical studies of displacement is generally low. Few studies have integrated digital trace data or longitudinal designs (e.g., ESM or daily diaries) that would better capture both true gaming behavior, and how changes in play affect other areas of life. Without this, we continue to lack basic descriptive information about what activities are most likely to be displaced, and under what circumstances this might be problematic. In part, this is likely a symptom of the same theoretical void: despite evidence in favor and the widespread research interest in the topic of time (e.g., Altintas et al., 2019; Sauter et al., 2020; Vuorre, Johannes, Magnusson, et al., 2022), I am not aware of any theories that make specific predictions about what effects play quantity does or does not have on players. In other words, the displacement hypothesis lacks well-specified moderators or mechanisms that would square observation of intense gameplay and case reports with the population-level null findings discussed above.

3.3.3 Gaming as a Mental Health Resource

Having discussed play quantity above, I now turn to the qualitative aspects of video game play that may or may not affect mental health, specifically the use of games as a resource for managing one's mental health. Substantial research has investigated the potential therapeutic benefits of video game play as a recovery experience for stress, mood enhancement, coping, and mental health more broadly. This topic implicates a new causal arrow: in addition to games affecting mental health, so too can players' mental health status affect what games they choose to play and how—which may in turn then affect their mental health.

Much of this work is conducted under the heading of mood management theory (Knobloch-Westerwick, Sylvia, 2013; Zillmann, 1988), which describes how media use might affect hedonic wellbeing by focusing on media-based mood regulation processes. Mood management theory draws on the so-called circumplex model of affect, in which feelings are characterized by their valence (how positive or negative they are), and arousal (the degree of excitement or energy present)—anger, for example, has similar negative valence to depression, but higher arousal. Mood management theory argues that the active selection of particular entertainment media can be a (conscious or subconscious) regulatory strategy to bring valence and arousal levels back into balance, thus increasing hedonic wellbeing. Research finds, for example, that bored individuals tend to choose exciting TV programs, while stressed individuals prefer to watch relaxing and uplifting TV programs (D. R. Anderson et al., 1996).

Mood management theory has been influential in games research. Work by Bowman and Tamborini (2012, Bowman and Tamborini) found that high task demand—the amount of attention and mental effort required to physically interact with a medium—supports the ability of games to relieve stress and negative mood. As predicted, they found boredom-induced participants were more likely to select high task demand game, whereas stress-induced participants were more likely to select a moderate task demand version of the same system. Another study applying mood management theory to aggression research found that players misinterpreted the mood benefits of playing (violent) games as a cathartic reduction in aggressive feelings, despite the fact that their mood improved while their actual levels of aggression did not change (Kersten and Greitemeyer, 2022).

A portion of literature on mood management has adopted an self-determination theory lens, which I discuss in the upcoming dedicated SDT chapter. Here, however, I want to mention The Recovery and Resilience in Entertaining Media use Model (R^2EM) (Reinecke and Rieger, 2021). This model posits that media use (selective exposure) can lead to short-term recovery experiences on either a hedonic or eudaimonic level, and that these short-term recovery experiences may be associated with the development of long-term protective and promotive resiliency factors. The authors differentiate 'light' media content (media likely to result in hedonic entertainment via homeostatic regulation and alliesthesia—the process by which stimuli are perceived as more or less pleasurable based on the current state/needs of the individual) and 'challenging media' (media that provide eudaimonic entertainment experiences via the provision of challenges: cognitive challenges such as complex new knowledge, emotional challenges such as empathic distress, or behavioral challenges such as hand-eye coordination).

Complementing these potential shorter-term mood management effects, a related body of work shows that games can be used to successfully help players cope with more persistent life difficulties (Helsby et al., 2023; Iacovides and Mekler, 2019). An influential qualitative survey by Iacovides and Mekler (2019) found that gaming can offer players respite from intense difficulties in one's daily life, ranging from examples such as terminal illness of a family member to unemployment to chronic pain and more. The authors report five positive themes and one negative theme that captured how gaming featured in players' attempts to manage these difficult life circumstances:

(+) **Needed respite**: games provide chances for complete focus, flow states, distraction and escape, disrupting negative thought processes

(+) **Connection - no one should be an island**: games provide opportunities to form and nurture relationships with other players and, importantly, valued in-game characters

(+) **Dealing with feelings**: games allow for players to deliberately engage in uncomfortable experiences in order to come to terms with emotions, offering safe environments to test one's limits and catharsis through destruction or violence

(+) **Prompting personal change and growth**: games help build confidence in the real world, teaching life and social lessons

(+) **Gaming as a lifeline**: games offer an alternative to more destructive or maladaptive behaviors, give a sense of meaning, and present players with achievable goals in the face of seemingly impossible ones

outside of games

(-) **Gaming as an obstacle to living well**: gaming can become dysregulated, players may struggle to reconcile positive experiences with social conceptions of productivity

A wave of research on this topic emerged in the aftermath of the Covid-19 pandemic, exploring play as a potential coping mechanism for the stresses of lockdowns and other restrictions. A wide range of studies lent support to the idea that gaming could be a vital source of social connection and psychological healing for players (Barr and Copeland-Stewart, 2021; Kleinman et al., 2021; Marston and Kowert, 2020; Yuan et al., 2021), across various demographics and kinds of games.

Simultaneously, however, compensatory behaviour has been linked with negative effects such as obsessive use (Allen and Anderson, 2018; Vansteenkiste et al., 2020). Gaming can develop into a maladaptive behavior and paradoxically worsen the original issue (Di Blasi et al., 2019). The majority of research on this topic looks at Internet Gaming Disorder (discussed in detail below), with studies showing that certain coping styles (e.g., withdrawal and emotion-focus coping, which contrast with approach and problem-focused coping) can lead to addiction-like engagement with games that ultimately harms mental health (Loton et al., 2016; Maroney et al., 2019; L. A. Schneider et al., 2018). More detail about why compensation sometimes succeeds and other times does not will follow in the next chapter.

Closely related to coping (see e.g., the needed respite theme from Iacovides and Mekler, 2019) is escapism, or the act of shifting one's attention from an unpleasant reality to a pleasant non-reality. Escapism is consistently among the foremost motivations for engaging with games and other entertainment media: people value the ability of media to distract from day-to-day stress, worries, or interpersonal conflicts. This is an explicit motive for many players—among player motivation typologies, escapism is a staple construct, appearing in models such as the Digital Games Motivation Scale (De Grove et al., 2017; De Grove et al., 2016) and the Motives for Play in Online Games model (Yee, 2006).

Similarly to coping, escapism can be either adaptive or maladaptive for the player. In Stenseng et al.'s (2021) model of escapism, the authors differentiate escaping *from* ('self-suppression') and escaping *to* ('self-expansion'). Self-suppression is characterized by a desire to inhibit negative emotions, block ruminations, and avoid critical self-evaluation. Difficult life circumstances may enforce self-suppression because they provoke an uncomfortable state for the individual, who will accordingly seek ways to modify or escape from it. Self-expansion, on the other hand, is characterized by 'a focus on anticipated positive psychological outcomes that the activity engagement may bring, such as mastery, positive affect, or self-growth' (p. 2). Self-expansive escapism is linked with higher quality motivation, greater need satisfaction, and 'upward spirals' of psychological growth; self-suppressive escapism is linked with lower wellbeing and problematic engagement with technology consistent with a lesser ability to self-regulate behavior (Stenseng and Phelps, 2016). The type of escapism may therefore be a key factor differentiating healthy players from those experiencing negative consequences of their gaming.

A common question running through these topics—gaming for recovery, coping, and escapism—therefore concerns what makes gaming a successful or unsuccessful mental health resource. Some evidence suggests that relevant determinants of the direction of effects include *timescale* (compensatory behavior and coping are more likely to temporarily address the player's negative state via escapism and cognitive absorption than to contribute to long-term emotional growth—though both are possible; Reinecke, 2017), *life fit* (coping becomes maladaptive if the compensatory behavior displaces other wellbeing-supportive activities; Maroney et al., 2019), and *motivational quality* (inflexibly compensating using games because the player feels they have no other valued options will be less successful than a volitional choice to use games to address one's emotional state; Verstuyf et al., 2012).

At present, however, these moderators are not well-integrated into theoretical models. Models such as R^2EM and mood management account for positive compensation effects, but do not address possible negative ones. An important task, therefore, is to better predict (1) which players will engage in compensatory behavior, and (2) what factors determine their ultimate success or failure in doing so.

3.3.4 Games and Basic Psychological Needs

One of the most well-researched areas of gaming and mental health, as well as research on player experience and motivation, revolves around SDT's three basic needs. I touch upon games and basic needs only briefly here—given their centrality to this thesis, they are explored in more detail in a dedicated chapter (Chapter 4). Briefly, basic psychological needs theory states that humans have three basic needs for *autonomy* (to feel in control over one's life and volitional in one's actions), *competence* (to act effectively and exert mastery in the

world), and *relatedness* (to feel that one is valued by others and values them in return). These needs can be satisfied or frustrated in any activity one undertakes throughout life, including when engaging with digital media.

The core notion of the theory, and its application to media psychology research, is that basic needs are a primary determining factor of media's influence on mental health outcomes (Jones et al., 2014). Satisfaction of basic needs has been shown to be a strong predictor of enjoyment and the experiential outcomes of both interactive and non-interactive media (Tamborini et al., 2011), including virtual reality applications (Reer et al., 2022), television (Adachi et al., 2018), esports viewership (Qian et al., 2022), and social media (Sheldon et al., 2011).

Video games are especially well-poised to satisfy basic needs (Rigby and Ryan, 2011). Games are usually designed to offer challenge scaling with the player's skill and abundant success feedback, supporting the need for competence. They give players considerable freedom to (dis)engage with the game at will (contextual autonomy support; Deterding, 2016), as well as to decide what in-game goals to pursue, how to play, or whom to embody, supporting the need for autonomy. Finally, they may support social relationships both in-game (with real people in a multiplayer game or in parasocial relationships with non-player characters) and outside of the game in peer interaction, supporting the need for relatedness. Satisfaction of needs in-game has been shown to correlate positively with game enjoyment (Ryan et al., 2006; Tamborini et al., 2010; Tamborini et al., 2011). When games satisfy basic needs, they are more motivating, and linked more strongly with player mental health (Adinolf and Türkay, 2019; Oliver et al., 2016; Tamborini et al., 2011).

Relatedness in particular appears to hold particularly strong potential for understanding one of the foremost positive effects of gaming cited by players: social bonding. Simply put, people play games because games give them opportunities to connect with others, whether that be in-person, through synchronous online play, or even with virtual others such as one's avatar or in-game companion (Bowman et al., 2022; Trepte et al., 2012). In focus group interviews, Kaye and Bryce (2012) find that positive social experiences in games were supported by factors such as the exhilaration of seamless teamwork, shared locus of attention, and the ability to demonstrate knowledge of others' task-relevant skills. This is well-reflected in models of gaming motivations, wherein people frequently endorse items such as 'it's important to me to play with a tightly knit group' (Kahn et al., 2015). Social experiences are by no means exclusively positive, however: players report social frustration after being beaten by known others, encountering toxicity or unfriendly communities (Türkay et al., 2020), or confronting ignorant others (Kaye and Bryce, 2012).

Bowman et al. (2022) provide a brief overview of existing research on social video gaming and wellbeing, classifying three areas of research that inform our understanding of social play: social play during gaming itself, social play and recovery experiences, and emerging technologies for social play. However, the authors acknowledge that many of the effects they describe are either 1) underlain by poor evidence quality (e.g., have been tested only in cross-sectional surveys, are based on small effect sizes, or do not consider the potential displacement of other social activities), or 2) purely speculative, noting that this is a potential mechanism but that empirical demonstrations are lacking.

Social gaming (and its potential operationalization via relatedness) is its own large and varied research topic, so I do not attempt to capture its full breadth here. Rather, my goal is simply to draw attention to the fact that fulfilling social experiences are an incontrovertible moderator between play and mental health, and this warrants capturing in any theory that seeks to predict the full range of gaming-related mental health effects. The concept of relatedness is one promising lens of incorporating these social experiences. An in-depth treatment of SDT (games) research and its limitations will follow in Chapter 4.

3.3.5 Dysregulated and Obsessive Gaming

Dysregulated gaming describes the phenomenon in which some players lose the ability to control—that is, regulate—their gaming in a healthy way, such that gaming becomes excessive and eventually is accompanied by significant psychological distress and/or functional impairment. There is widespread agreement that a small fraction of players experience negative life consequences in relation to their gaming, but substantial disagreement about how best to conceive of that phenomenon—as a mental health condition, a coping mechanism for other mental health conditions, a sub-clinical problematic behavior, or something else entirely (Aarseth et al., 2017; Ferguson and Colwell, 2020). In other words, dysregulated gaming lacks strong theory (Section 2.4.1). For these reason, I adopt the term 'dysregulated' in the hope of distancing the core phenomenon of poorly-controlled play with negative life consequences from ongoing scientific debates about the validity of dysregulated gaming as an officially-recognized disorder, and to avoid the stigma associated with addiction and mental health conditions.

Although dysregulation is not the primary interest of my thesis research, it is one of the foremost topics in the psychology of games, and therefore serves as both important context and a peripheral construct of interest in the studies to come. Given that vastness of the dysregulated gaming literature, I do not attempt to summarize in exhaustively here. Instead, I simply give a brief overview of two important and relevant bodies of work: [Internet] Gaming Disorder, which has sought to formalize dysregulated play into a diagnostic category, and obsessive passion, an SDT-informed framework for understanding problematic play.

[Internet] Gaming Disorder

One nexus of research on dysregulated play uses the lenses of Gaming Disorder and Internet Gaming Disorder. For decades, both the public and scientists have been concerned about people developing pathological relationships with gaming (King and Delfabbro, 2019). This is a recent entry in a long line of concerns (sometimes considered moral panics) around new forms of media such as radio and television (Orben, 2020), likely amplified in this case by the high amounts of time that players were seen investing in a single game such as *World of Warcraft* (Blinka and Smahel, 2007). In response to this, the American Psychiatric Association defined 'internet gaming disorder' (IGD) in the DSM-5 as a condition for future study. Shortly thereafter, the World Health Organisation included 'Gaming Disorder' (GD) in the ICD-11 (World Health Organization, 2018), with the two conditions sharing significant conceptual overlap but key differences in diagnostic criteria.

In the DSM-5 definition, which to date has seen somewhat greater uptake, IGD is defined as 'persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by 5 (or more) of the following [9 criteria] in a 12-month period' (American Psychiatric Association, 2013, p. 795). The aforementioned 9 criteria, originally adapted from the criteria for pathological gambling in the DSM-IV (in turn adapted from substance use disorders) are:

- **Preoccupation:** thinking about previous gaming activity, anticipating future play, gaming as dominant activity in one's life
- **Withdrawal:** irritability, anxiety, or sadness felt when gaming is taken away
- **Tolerance:** a need to spend increasing amounts of time engaged with gaming
- **Loss of control:** unsuccessful attempts to control the participation in games
- **Loss of interests:** a lack of desire to engage in previous hobbies and entertainment besides games as a result of games
- **Continuation despite problems**: ongoing excessive play despite awareness that it is leading to psychosocial problems
- **Lying/deception:** deceiving family members, therapists, or others regarding the amount of gaming
- **Escapism:** use of games to escape or relieve a negative mood (e.g., feelings of helplessness, guilt, anxiety)
- **Problems/jeopardization:** jeopardization or loss of a significant relationship, job, or educational or career opportunity because of participation in games

The definition of gaming disorder (GD) in the ICD-11 is similar: 'A persistent pattern of gaming behaviour [...] manifested by all of the following:

- **Impaired control** over gaming behaviour (e.g., onset, frequency, intensity, duration, termination, context)
- **Increasing priority** given to gaming behaviour to the extent that gaming takes precedence over other life interests and daily activities
- **Continuation or escalation** of gaming behaviour despite negative consequences (e.g., family conflict due to gaming behaviour, poor scholastic performance, negative impact on health)

They continue: 'The pattern of gaming behaviour may be continuous or episodic and recurrent but is manifested over an extended period of time (e.g., 12 months), is not better accounted for by another mental disorder (e.g., Manic Episode) and is not due to the effects of a substance or medication. The pattern of gaming behaviour results in significant distress or impairment in personal, family, social, educational, occupational, or other important areas of functioning.' (World Health Organization, 2018, 6C51 Gaming disorder).

Gaming associated with both versions of these disorder criteria is associated with various forms of impairment/distress. For example, [I]GD has been linked in cross-sectional studies with greater likelihood of skipping school and worse grades (Rehbein et al., 2015), depression and loneliness (Ballou and Zendle, 2021), social

problems (Müller et al., 2015), lower self-esteem (Ballou and Zendle, 2021), and obesity (Ko et al., 2020). A minority of studies have found different results. Some researchers have failed to find a negative relationship between IGD and wellbeing (Scharkow et al., 2014), whereas another study interpreted effects as too small to be meaningful (Przybylski and Weinstein, 2019a).

As hinted at, however, the preponderance of evidence showing that IGD symptoms are negatively related to wellbeing does not necessarily mean that it constitutes a genuine mental health disorder. There are flaws with both the evidence base and the inferential logic underlying [internet] gaming disorder.

For one, researchers may have fallen into the fallacy of assuming that because something it measurable, it exists and is meaningful. Fried (2022) writes that 'Our natural tendency to essentialize mental disorders and flawed inferences from measurement ("we have a commonly used measure for diagnosis X; hence X exists") and external validation ('diagnosis X correlates with external constructs; hence diagnosis X exists') provide fertile ground for this vicious cycle of reification' (p. 5). This sentiment could hardly be more applicable to research on gaming disorder: as mentioned in the previous chapter, there are at least 32 distinct measures of problematic gaming with dozens of validation studies, and these are often invoked to support the existence and importance of the disorder category. One satirical paper showed that similar measure validation approaches could also demonstrate psychometric validity for a meaningless construct, 'offline friend addiction' (Satchell et al., 2020). Only recently has research looked more carefully into how measures may differ in terms of prevalence, specificity, or ontology (Ballou and Van Rooij, 2021; Karhulahti, Vahlo, et al., 2022).

More serious, in my opinion, is the lack of theory. Gaming disorder research has been hindered by a lack of theory development. The causal direction of the relationship between mental health and dysregulated play has been heavily debated, with some evidence suggesting that dysregulated gaming may be better understood as a symptom of an underlying disorder or disorders (Van Rooij et al., 2018). To establish the presence or absence of causality, however, we require strong theory: in a topic where which experimental designs are impossible, data alone—even longitudinal data—will always leave open multiple causal pathways. This is especially true for gaming disorder, where effects are almost certainly bidirectional—when people are feeling poorly and things are going poorly in their life, they may be more likely to play in a dysregulated way, and when people play in a dysregulated way, this will likely further compromise other areas of their life. Nonetheless, to test whether one of these directions is stronger than the other (for certain types of players) requires us to understand the confounds that might be at play—factors that might be influencing both functional impairment and gaming disorder simultaneously. While there has been some research adopting this lens (Andreetta et al., 2020; C.-Y. Wang et al., 2017), progress will be faster if confounds are enumerated and tested systematically (rather than being proposed and tested ad hoc in disconnected papers) to falsify them effectively. Similarly, studies will be more informative if confounds are tested longitudinally, in conjunction with digital trace data (and potentially physiological and neurological evidence; A. Weinstein and Lejoyeux, 2020) to better unpack how gaming behavior and mental health unfold together over time.

Finally, there remain major challenges with differentiating highly-engaged, non-problematic players from dysregulated ones. Not all highly-engaged players will exhibit signs of impairment (Deleuze et al., 2018; Griffiths, 2010; Van Rooij et al., 2011), leading to repeated calls for more work on differentiating high-engagement vs disordered patterns of play (Billieux et al., 2019; Deleuze et al., 2017; Ferguson et al., 2011). Some prior research has distinguished 'core' (inherently problematic and likely to have negative consequences for players, such as feelings of withdrawal) vs 'peripheral' gaming disorder criteria (those that are not inherently negative, but might signal an unhealthy relationship with games, such as preoccupation when not playing) (Brunborg et al., 2015; Charlton and Danforth, 2007). A better understanding of how both healthy and dysregulated players respond to these items can be an important step in better understanding these groups, and avoiding pathologizing healthy players.

To truly understand (1) how highly-engaged non-problematic play differs from dysregulated play, (2) what different patterns of dysregulated play might exist, and (3) the most precise and sensitive criteria for identifying dysregulated players, I argue for a return to exploratory and qualitative research (Section 2.4.1). Such research has seen hints of a revival: for example, a recent interview study comparing treatment-seekers with highly-engaged, healthy players found that disordered play stems from gaming *interfering* with what one wants to be, do, and have, whereas highly-engaged non-problematic players report that gaming experiences *represent* what they want to be, do, and have (Karhulahti, Siutila, et al., 2022). Another study analyzed the experiences of players who self-identified as dysregulated, finding that some of the DSM-5 and ICD-11 criteria were commonly reported by players, but others such as tolerance were not mentioned (Petrovskaya, 2022).

Given the wide range of biological, psychological and ecological factors that can contribute to the development of dysregulated behavior, previous research on problematic phone use and problem gambling

has adopted a 'pathways' approach, which describes different subgroups for whom dysregulated behavioral patterns may be similar, but result from distinct underlying developmental processes (Billieux et al., 2015; Blaszczynski and Nower, 2002). Blaszczynski and Nower (2002) distinguish behaviorally conditioned problem gamblers and emotionally vulnerable problem gamblers for whom gambling 'is viewed as a means of producing emotional escape through the effect of dissociation on mood alteration and narrowed attention' (p. 493), with the latter group also potentially influenced by neurological and neurochemical factors that increase their susceptibility to dysregulated behavior. In the context of games, using games as a maladaptive coping mechanism for other mental health problems may be a separable phenomenon from both non-problematic high game engagement and less-comorbid dysregulated gaming. More research into gaming disorder pathways would undoubtedly improve our understanding of how to recognize and treat problematic play behaviors. I would argue, however, that we still lack sufficient qualitative evidence to enumerate the various pathways that might exist.

Dualistic Model of Passion

Closely related to dysregulated gaming is a construct known as obsessive passion. Obsessive passion derives from a SDT-informed theory known as the dualistic model of passion (DMP) (Vallerand, 2008; Vallerand et al., 2003), which has been used as a complementary lens to SDT in understanding motivation and psychosocial wellbeing outcomes in many fields, including gaming.

In this model, passion is conceived of as a strong inclination toward an meaningful and self-defining activity, and this passion is shaped by two kinds of motivational contingencies. Full, autonomous internalization translates into *harmonious passion* for activities, while incomplete, controlled internalization results in *obsessive passion*. In this way, although harmonious and obsessive passion are similar conceptually (i.e., they both reflect a love for and investment in an activity by individuals), they diverge in the quality of the motivation, their presentation, and their effects on wellbeing. The DMP draws upon SDT, proposing that the continued satisfaction of the three basic needs facilitates passion development.

Research suggests that the difference between harmonious and obsessive passion may result in part from imbalance in needs satisfaction at the global level, leading to over-reliance on (i.e., obsessive passion for) certain activities to meet those needs (Lalande et al., 2017). Paralleling some research on need satisfaction and frustration, research on the dualistic model of passion has supported links between harmonious passion and a variety of wellbeing outcomes, including life satisfaction (Lafrenière et al., 2013), successful adjustment to retirement (Houlfort et al., 2015), and romantic relationship quality and stability (Ratelle et al., 2013). Obsessive passion, in turn, has been linked with illbeing in the form of lower self-esteem (Stenseng and Dalskau, 2010), poorer relationships with work colleagues (Philippe et al., 2010), and—in an interesting intersection with violent video games research—aggression towards opponents and opposing fans at a sports event (Donahue et al., 2009). The dualistic model of passion has also been valuable for understanding gambling addiction. This is a particularly useful overlap, because as noted above, gaming disorder criteria in the DSM-5 were lifted and lightly adapted from the gambling addiction criteria, which was formerly the only codified behavioral addiction.

The DMP has seen some use in games research, albeit it to a lesser extent than SDT. One of the earliest studies (C.-C. Wang and Chu, 2007) found that obsessive passion was strongly related to a measure of dysregulation ($r = .75$), Young's Internet Addiction Test (Young, 1998), which suggests strong overlap or perhaps even measurement of the same underlying construct. A subsequent study by Przybylski et al. (2009) showed that players who exhibit harmonious passion for their favorite video games are likely to have higher wellbeing and lower weekly playtime than those showing obsessive passion; they further show that the variance in wellbeing can be accounted for almost entirely by global need satisfaction of the players, and not motivation itself. Another study found that higher global need frustration was associated with greater obsessive passion for video games, whereas higher global need satisfaction was associated with greater harmonious passion (Mills, Milyavskaya, Mettler, Heath, et al., 2018a).

The DMP thus serves as a useful framework for understanding the difference between highly-engaged non-problematic use, and potential dysregulation. Players who experience high intrinsic motivation in games, satisfaction of their basic needs, and a greater sense of harmonious passion are expected to experience greater psychosocial wellbeing and more adaptive outcomes of their play. On the other hand, players with less internalized motivation, higher need frustration, and greater obsessive passion are expected to experience maladaptive outcomes of video game use and possible functional impairment.

To briefly summarize, [internet] gaming disorder and the dualistic model of passion are two related ways to conceive of an unhealthy relationship between a player and gaming, with negative consequences for mental

health. However, the former remains theoretically underspecified with regard to moderating factors, etiological pathways, and causality.

3.4 Zooming Out: Deficits in Gaming and Mental Health Theory

Let's take a step back and review the findings reviewed above.

- **Games can have both positive and negative effects**: Effects do not arise linearly from quantity of play; time spent playing games can, but will not always, displace other important life domains. Similarly, players use games to compensate for, or escape from, difficulties in their daily life, and are often but not always successful.
- **Effects can arise from both *quantity* and *quality* of play**: play quantity can lead to effects such as displacement, whereas qualitative player experience factors such as basic psychological needs or escapism can lead to mental health effects such as successful coping.
- **Effects of gameplay can be short-lived or long-term:** Previous literature has found stronger evidence for short-term effects, such as recovery and mood management experiences, but also in some cases for long-term effects, such as the development of valued social capital with a gaming community.
- **Video games can affect hedonic wellbeing, eudaimonic wellbeing, and/or illbeing**: Previous literature has found (and in some cases failed to find) relationships between gaming and hedonic wellbeing (e.g., positive affect), subjective wellbeing (e.g., life satisfaction), eudaimonic wellbeing (e.g., vitality and meaning), and illbeing (e.g., depression and dysregulation).
- **Not only can gaming affect mental health, but so too can mental health can affect gaming:** How players engage with games can differ depending on their mental state, with players seeking out particular experiences when trying to cope, compensate, escape from, or escape to.

At present, the landscape of games and mental health theory is poorly equipped to handle this degree of diversity. Existing theoretical approaches may handle one or a couple of these sources of diversity, but none to my knowledge is able to accommodate all of them, or even the majority. For example, theories such as flow, mood management theory, the Recovery and Resilience in Entertaining Media Use (R^2EM) model (Reinecke and Rieger, 2021), and models of eudaimonic experiences (Daneels et al., 2023; Possler et al., 2023; Stevens and Dillman Carpentier, 2017; Tamborini et al., 2011) do not offer a mechanism for negative effects. Other frameworks such as the displacement hypothesis only explain negative effects. With the notable exception of the R^2EM (Reinecke and Rieger, 2021) and IM^{3}UNE models (F. M. Schneider et al., 2022), theories such as mood management and flow—at least as commonly applied in the games domain—tend not to make clear distinctions between different aspects of mental health. Theories that do implicate mental health tend to explain how media use affects short-term cognitive and emotional states, but are not clear about if and how longer-term impacts arise. I am similarly unaware of any theories that identify the mechanisms governing when and how adaptive coping with video games 'flips' and becomes maladaptive.

To be clear, my intention is not to dismiss theories or models that do not have this degree of comprehensiveness or causal specification. More constrained models are undeniably useful; for example, they may enumerate categories of factors that determine the effects media have on users or identify an effect to be explained by future theory. In this research area, such frameworks include the people-game-play model Johnson et al. (2013) (which proposes that the wellbeing effects of games are a product of player characteristics, game features and player experiences), Hartanto et al.'s (2021) review of five contextual factors that might moderate the relationship between video game play and wellbeing (who, what, when, why, and how much), and the Differential Susceptibility to Media Effects model (Valkenburg and Peter, 2013). Similarly, researchers have proposed a host of mediators that might determine when and why media use affects mental health without these being linked to a particular theory (e.g., self-control Hofmann et al., 2017, passion Przybylski et al., 2009, emotional self-efficacy Calandri et al., 2022, and social connectedness Colder Carras et al., 2017). These too can serve as explanada or guiding forces for future theories. My point is merely that these models and atheoretical findings are building blocks toward formal causal explanations for the effects in which we are ultimately interested.

In my opinion, one theory stands out as uniquely well-suited to begin addressing the majority of the desired qualities of a theory of entertainment media use and mental health: self-determination theory (SDT; Ryan and Deci, 2000; 2017). This is the subject of the next chapter.

3.5 Conclusion

From the above review, we can take away that games *can*: help players cope adaptively with difficult life circumstances; displace other important life activities such as work or personal relationships (perhaps as a result of disordered play); help recover from stress or low mood, sometimes as a result of distraction or escapism; and foster strong interpersonal connections. So too can play be dysregulated, having negative impacts on players' work or school performance, other hobbies, physical health, or relationships with family and friends. However—all together unsurprisingly—none of these effects are reliable across games, contexts, and players. In other words, *it depends*.

Depends on what? That is the fundamental question, and the one our theories should seek to answer as fully as possible. In the next chapter, I will introduce self-determination theory, and use it to argue that two key factors are (1) how much the gaming experiences satisfy or frustrate the players' basic needs, and (2) how much gaming supports or undermines the player's ability to derive need satisfaction in their life overall. Self-determination theory will give us an integrated starting point for what effects depend *on*.

4

Basic Psychological Needs and Games

Chapter Contents

4.1 Introduction . . . 40
4.2 Self-determination Theory . . . 41
4.2.1 Organismic Integration Theory . . . 41
4.2.2 Basic Psychological Needs Theory . . . 42
4.3 SDT and Video Games . . . 45
4.3.1 Levels of Generality in Basic Needs and Motivation . . . 45
4.3.2 Organismic Integration Theory and Games . . . 46
4.3.3 Basic Psychological Needs and In-Game Experiences . . . 47
4.3.4 The Interaction of Gaming and Global Needs . . . 49
4.4 Measurement of SDT Constructs . . . 51
4.4.1 Player Experience of Need Satisfaction (PENS) . . . 51
4.4.2 Ubisoft Perceived Experience Questionnaire (UPEQ) . . . 52
4.4.3 Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) . . . 53
4.4.4 Balanced Measure of Psychological Needs (BMPN) . . . 53
4.4.5 Player Experience Inventory (PXI) . . . 53
4.4.6 Motivation Scales: Intrinsic Motivation Inventory (IMI), Gaming Motivation Scale (GAMS) and the User Motivation Inventory (UMI) . . . 54
4.5 Discussion . . . 54
4.6 Conclusion . . . 55

4.1 Introduction

Having now established the range of empirical findings that a comprehensive theory of gaming and mental health needs to accommodate, as well as some broader qualities that are desirable in all psychological theories, I will now give an overview of self-determination theory (SDT; 2000; 2017). Basic psychological needs, which derive from SDT, are one of the foremost constructs used to understand how players are affected by and interact with video games (Tyack and Mekler, 2020), and the starting point from which my thesis intends to make its theoretical and empirical contribution. I discuss the strengths that make it a suitable basis for deriving a 'sub-theory' that addresses the needs of games and mental health research identified in the previous chapter. However, as with other areas of video games and mental health research, there are important limitations to the existing literature on basic needs and games, which leave open valuable opportunities to build towards more integrated and predictive theory, while also applying the ideas proposed in Chapter 2.

4.2 Self-determination Theory

Self-determination theory (SDT) is a theory of human motivation, growth, and wellbeing, originating in work by Edward Deci (Deci, 1980) and Richard Ryan (Deci and Ryan, 1985). SDT takes as a starting point that human development is characterized by a tendency toward growth, and that people strive to act in ways that are authentic and in harmony with their other beliefs and values. SDT posits an innate human propensity to seek out inherently interesting or enjoyable activities (intrinsic motivation), and an organising tendency to internalize and integrate social and cultural regulations into the self (organismic integration).

SDT consists of six mini theories, of which two are directly relevant here: Organismic Integration Theory, and Basic Psychological Needs Theory. The other four (Cognitive Evaluation Theory, Goal Contents Theory, Relationships Motivation Theory, and Causality Orientation Theory) are less obviously pertinent here and are omitted for scope, but may have other important implications for games (Tyack and Mekler, 2020).

4.2.1 Organismic Integration Theory

Humans have an innate and pervasive tendency to engage in spontaneous activity. At their healthiest, people are 'inquisitive, curious, playful, active creatures who explore and assimilate their inner and outer worlds' (Ryan and Deci, 2017, p. 102). This unprompted behavior reflects *intrinsic motivation*, defined as energy directed towards spontaneous activity, and sustained by the satisfactions inherent in the activity itself. Intrinsically motivated activity has an *internal perceived locus of causality*: one experiences oneself as the origin of action. Experientially, intrinsic motivation is characterized by feelings of ongoing interest in and enjoyment of a given activity (Csikszentmihalyi, 1975).

However, SDT acknowledges that life's various activities can never be exclusively intrinsically motivated. From birth, there are certain activities that—while not necessarily inherently enjoyable—we do to achieve some separable outcome, whether because someone tells us to, because we feel it something that we 'should' do, or because it is something that aligns with our values and goals. Activities that are performed for instrumental purposes—i.e., as a means to an end—as known as *extrinsically motivated*, where extrinsic motivation is defined as energy directed toward behaviours tied to consequences separable from the activity itself. Extrinsically motivated activities have an *external perceived locus of causality*: phenomenologically, people experience these behaviors not as chosen, but rather as compelled or impelled by either external or introjected ('inflicted upon the self') forces. Extrinsic motivation is characterized by feelings of pressure and internal conflict.

Not all extrinsically motivated activities are equal. Under Organismic Integration Theory, extrinsic motivation can differ in its level of *internalization*—the degree to which a person has taken in values, beliefs, or behavioral regulations from external sources and transformed them into one's own. For example, walking the dog each day might begin as something that a child only does because their parent requires it of them, but over time they internalize this as an important and valued activity for maintaining the health of the pet. Internalization thus describes the processes through which extrinsic behaviors become an established aspect of people's minds and motives. SDT posits that this internalization of external pressures is an inherent tendency that ultimately supports the cooperation and the cohesive functioning of groups, enhancing adaptive advantage at both individual and group levels of analysis (Ryan and Deci, 2017, Chap. 8).

Together, intrinsic motivation, extrinsic motivations with varying degrees of internalization, and a third category, amotivation form a motivational spectrum (shown in Figure 4.1). From least to most self-determined[1]), the sub-types of motivation put forth by Organismic Integration Theory are:

- **Amotivation**: lacking energy to perform a behavior, not perceiving any value in the activity or ability to perform it
- **External regulation**: motivated by receiving a reward or avoiding a negative consequence separable from the activity itself
- **Introjected regulation**: motivated by a separable psychological reward or punishment given by oneself; for example, the behavior may be done in order to feel a sense of pride or avoid a sense of guilt
- **Identified regulation**: motivated by consciously appraised and endorsed value or worth of the activity
- **Integrated regulation**: motivated by consciously endorsed value of the activity that is also consistent with the person's greater goals, values, identity, and dispositions
- **Intrinsic motivation**: motivated by the enjoyment and pleasure inherent to performing the activity itself

[1]SDT uses the terms autonomous [motivation], relative autonomy, self-determination and perceived locus of causality roughly interchangeably, all referring to the degree to which one experiences oneself as the origin and cause of an action. This can create some terminological confusion, not least because 'autonomy' also refers to the basic need (see below).

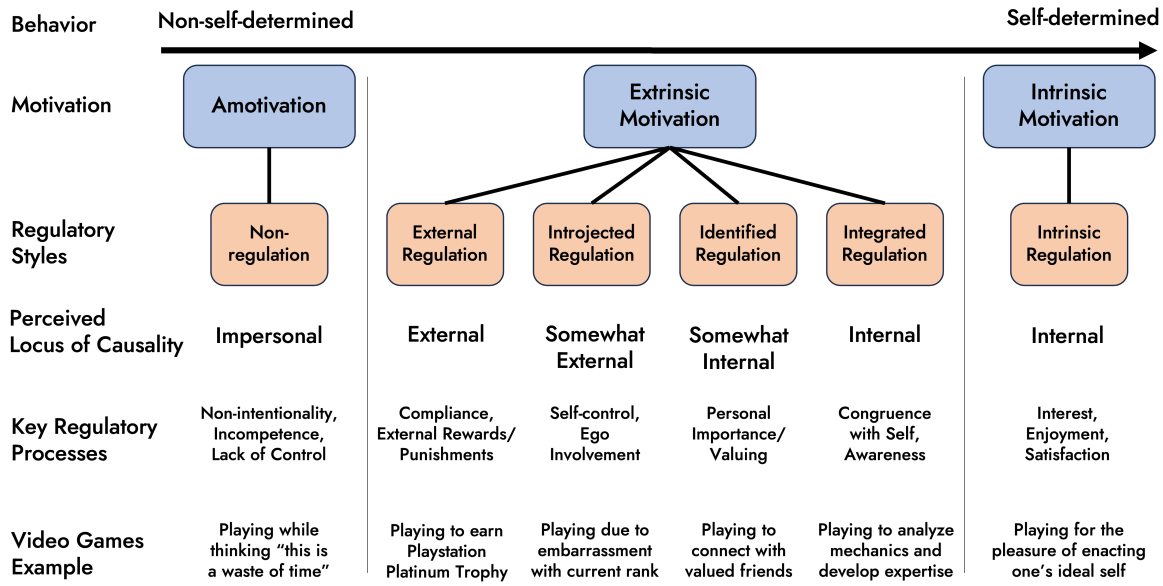

Figure 4.1: Motivational spectrum proposed by SDT and Organismic Integration Theory. Adapted from Ryan and Deci (2017).

Under SDT, behaviors motivated by less self-determined regulation styles (those that are less internalized and have a more external perceived locus of causality) will be more halfhearted or dutiful, and there will be a greater experience of internal conflict. On the flip side, activities that are undertaken with more self-determined motivations (those that are more internalized and have a more internal perceived locus of causality) will result in greater persistence and flexibility in the behavior even in the absence of rewards or punishments, and a greater feeling of authenticity and integration—that is, that one is doing something that is important and in line with their values). Through this, self-determined activity is linked with better performance, more complete engagement with individuals' talents, abilities, and energies, and ultimately with improved mental health.

Empirical results have supported these predictions both observationally (Niemiec et al., 2006) and causally (Gagne et al., 2003) across multiple timescales (Kasser and Ryan, 1999; Kins et al., 2009). This evidence is so broad as to have spawned a range of meta-analyses across various domains (narratively reviewed in Ryan et al., 2022). For example, a study of 223,000 students found strong support for Organismic Integration Theory propositions (Howard et al., 2021): both intrinsic and identified motivations were related to higher academic performance and better mental health. Introjected regulation was only weakly predictive of persistence and performance goals, and was negatively associated with a number of mental health outcomes. External regulation was generally unrelated to performance, but did relate to poorer mental health. Another meta-analysis supported these relationships in the work domain: more self-determined regulation was associated with lower burnout, stress, and turnover intention, and higher job satisfaction, proactivity, and performance (Van Den Broeck et al., 2021).

4.2.2 Basic Psychological Needs Theory

Having shown that more self-determined motivation leads to a range of better behavioral and mental health outcomes, there are two obvious questions: (1) What produces self-determined motivation? (2) *Why* is self-determined motivation linked with greater mental health? The answer to both these questions lies in the concept of Basic Psychological Needs, modelled in Basic Psychological Needs Theory.

Under SDT, humans have three innate and universal psychological needs: the need for *autonomy* (to feel in control over one's life and volitional in one's actions), *competence* (to act effectively and exert mastery in the world), and *relatedness* (to feel that one is valued by others and values them in return). Basic psychological needs are referred to as such because they are theorized to be vital nutriments required for a person to live a fully functional life. Across all the environments we inhabit and activities we perform, these needs can be either satisfied or frustrated.

These three basic needs are the driving force behind both motivation, and mental health—relationships summarized in Figure 4.2. SDT argues that in need-supportive environments (for example, those in which people are given a meaningful rationale for actions they must perform, have their feelings acknowledged, or

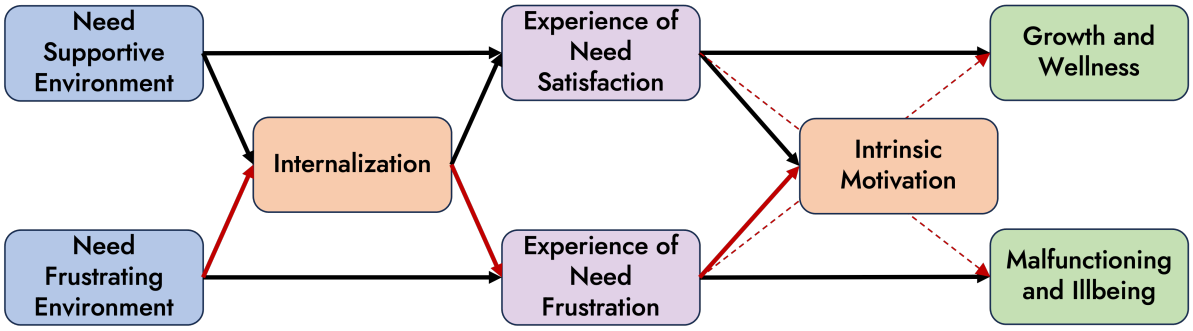

Figure 4.2: The core, simplified model of SDT, arguing that the environment shapes our experience of basic needs, and that our basic needs shape both motivation and our mental health

are provided with informative feedback about their performance), people are more likely to internalize the values, attitudes, and behaviors that begin as less autonomously motivated. Drawing again from the breadth of meta-analyses conducted in an SDT framework, we have strong evidence to support these predictions. Slemp et al. (2018) show that having more autonomy-supportive leaders at work leads to greater autonomy satisfaction, and more internalized motivation to perform work responsibilities. Autonomy-supportive physical education teachers produce children who are more intrinsically motivated to be physically active (Lochbaum and Jean-Noel, 2016).

As internalization increases, people then experience greater need satisfaction in the performance of those actions. This is obvious (and even bordering on tautological) for autonomy: when someone's motivation to go to work is more self-determined, for example, they will experience a greater sense of volition while working, and thereby greater autonomy satisfaction. However, SDT argues that this relationship is similarly true for competence and relatedness. For example, as individuals internalize familial or cultural values, they will experience a greater sense of participation and belonging in social groups, satisfying their need for relatedness. People who have more self-determined motivation for playing a sport will be better able to persist through setbacks and failure, thereby satisfying their need for competence (Ryan and Deci, 2017).

Need-satisfying environments, and the experience of need satisfaction they produce, are thus fundamental to the development of both well-internalized *extrinsic* motivations, as well as *intrinsic* motivation (Deci et al., 1999; Deci et al., 1996). However, here I diverge slightly from core SDT theory in conceiving of intrinsic motivation not just as an outcome of need-satisfying environments, but as co-constituents. Ryan and Deci (2017) write 'intrinsically motivated activities were said to be ones that provide satisfaction of basic psychological needs' (p. 118), hinting at a one-to-one mapping of these concepts: to the extent that an activity is need-satisfying, it is therefore intrinsically motivating. This aligns partially with recent literature that has criticized the concept of motivation, arguing that it is better understood as a psychological construction of underlying mental computational processes (Murayama and Jach, 2023). Informed by these critiques, I conceive of need satisfaction as not just an antecedent, but a component part of intrinsic motivation—intrinsic motivation is, at least in part, the experience of *expecting* very high need satisfaction from an activity (and thus directing energy toward it), and the experience of *deriving* need satisfaction while performing the activity (and thus feeling enjoyment or interest towards it). Given, however, that there may be other factors that further co-constitute the mental construction of intrinsic motivation, I depict this in Figure 4.2 with a causal arrow from need satisfaction and frustration to intrinsic motivation.

Together, therefore, basic needs are both antecedents and outcomes of self-determined motivation. This, however, is just the first link. The further importance of basic needs comes from SDT's prediction that they are the fundamental ingredients of wellbeing and mental health. But before discussing that, I need to introduce the other half of the basic needs spectrum: need frustration.

Need Frustration

As SDT has matured, it began to contrast the *satisfaction* of basic psychological needs with their *frustration* (sometimes referred to as need thwarting). Need frustration is not simply the absence of need satisfaction, but a separate construct referring to feelings of being controlled or coerced (autonomy frustration), failure and self-doubt (competence frustration), or loneliness and exclusion (relatedness frustration). Need satisfaction and need frustration are distinct experiences that can coexist to varying degrees (Allen and Anderson, 2018; Warburton et al., 2020): an actively autonomy-frustrating experience is 'more' and different than the

mere absence of autonomy-satisfying experiences (Sheldon and Hilpert, 2012; Vansteenkiste et al., 2020). Vansteenkiste and Ryan (2013) describe the difference as follows:

> [I]f plants do not get sunshine and water (i.e., low need satisfaction), they will fail to grow and will die over time; yet, if salted water is thrown on plants (i.e., presence of need frustration), they will wither more quickly. Thus, whereas low need satisfaction likely yields costs over time, the deteriorating process will be accelerated when needs are actively frustrated. (p. 265)

The distinction between need satisfaction and frustration is an intuitive one: An environment in which someone experiences an absence of autonomy, say when doing tedious chores around the house, is very different from an environment that actively thwarts their autonomy, as when a controlling boss demands the completion of inane tasks. Need satisfaction and frustration stand in an asymmetrical relation to each other, as the absence of need satisfaction does not necessarily imply the presence of need frustration, whereas the presence of need frustration denotes the absence of need satisfaction (Vansteenkiste et al., 2020).

Need frustration is theorized to be linked with negative motivational and mental health outcomes above and beyond the absence of need satisfaction (2020). However, alongside negative outcomes, SDT also argues that need frustration should play an important signaling function, potentially mobilizing corrective behavior and (adaptive) coping responses (Roth et al., 2019). As we will see in the following section, these claims have been well-supported in the empirical evidence that followed need frustration's theoretical emergence.

Basic Needs and Mental Health

Need satisfaction and frustration are theorized to be the key mediator between a person's environment and actions, and their impact on mental health. SDT predicts that failure to satisfy any of these needs will be manifested in diminished growth, integrity, and wellness; and that active thwarting of needs will result in greater illbeing and more impoverished functioning. This is predicted to hold regardless of whether or not people explicitly desire or value the needs, and regardless of sociocultural context, at both within- and between-person levels (Ryan and Deci, 2017). Under SDT, therefore, to live a full and flourishing life is to act orientated towards basic psychological needs (Martela, 2023; Ryan et al., 2008).

That these predictions hold is built in to the very definition of a basic need. Under SDT, to be considered a basic psychological need (BPN), a need must meet the following criteria (Vansteenkiste et al., 2020):

- BPNs are *psychological* (i.e., not concerning physical functioning)
- BPNs are *essential* - need satisfaction is necessary feature of growth, wellbeing, and adjustment; need frustration is a necessary feature of problem behavior, illbeing, and psychopathology
- BPNs are *inherent* - there is a plausible evolutionary explanation for their development, and clear adaptive advantages associated with need satisfaction
- BPNs are *distinct* - their emergence is not contingent upon or derivative from frustration of other needs (for example, a 'need' for power arising as a result of someone feeling unfairly subordinated at work)
- BPNs are *universal* - their satisfaction and frustration predicts thriving and illbeing of all individuals, regardless of socio-demographics, personality, or cultural background

Currently, only the aforementioned three basic needs—autonomy, competence, and relatedness—have met this standard of evidence. SDT's predictions about the universal role of basic needs in determining mental health outcomes have been upheld in an enormous range of life domains, cultures, and environmental circumstances—including, for example, sports psychology, work and organizational psychology, education, and many others. Across all of these, basic psychological needs have been demonstrated to mediate the relationship between a person's activities and environment, and their effects on the person's wellbeing (Laporte et al., 2021; Sheldon and Elliot, 1999; see Ryan and Deci, 2017, chap. 10 for a broad overview).

To cite just a few examples, Reis et al. (2000) found in a diary study that satisfaction of all three needs explained a significant portion of within-person fluctuations in hedonic and subjective wellbeing. Another study showed that need satisfaction predicts secure attachments in relationships and positive models of self and others (La Guardia et al., 2000). Need satisfaction is associated with more prosocial behavior (Martela and Ryan, 2016), fewer physical symptoms like aches or digestion problems (Ryan et al., 2010), and higher life satisfaction (Leversen et al., 2012). Cross-cultural comparisons have found that these effects hold across countries and regardless of explicit value placed on satisfying each need (Chen et al., 2015; Deci et al., 2001; Van Assche et al., 2018).

As expected, the consequences of need frustration mirror those of need satisfaction: whereas need satisfaction leads to wellbeing, need frustration leads to illbeing (Vansteenkiste and Ryan, 2013). Need frustration has been linked with poorer work and school performance, more illbeing (e.g., disordered eating, burnout, depression, and negative affect,), worse physical health, and more (Bartholomew, Ntoumanis, Ryan, Bosch, et al., 2011; Ryan et al., 2016; Vander Elst et al., 2012; Vansteenkiste et al., 2020). This supports a distinction in which need frustration is deficit-based and more strongly linked with illbeing and psychopathology, while need satisfaction is more strongly linked with wellbeing and flourishing.

In some conceptualizations, need satisfaction and frustration are not just antecedents of mental health, but co-constituents. Under the model proposed by Martela and Sheldon (2019), psychological need satisfaction is understood to be itself one component of eudaimonic wellbeing—eudaimonic wellbeing is, in part, the experience of having one's needs satisfied. Separately, need satisfaction then causes greater hedonic and subjective wellbeing, as a effectively a 'symptom' of eudaimonic wellbeing. In this view, basic needs become the 'connective tissue' explaining both eudaimonia (by virtue of co-constituting it), and hedonia (which is a symptom and consequence of 'doing well').

This duality between need satisfaction (predicting wellbeing, and underlying both hedonia and eudaimonia) and need frustration (predicting illbeing) makes SDT exceptionally well-suited to handling the broad conception of mental health I discussed in the previous chapter.

4.3 SDT and Video Games

Having reviewed the basic tenets of SDT, I can now return to our specific area of interest, video games. I will discuss how video game play relate to motivation, basic needs, and mental health, with particular focus on the emerging research on need frustration.

First, I will briefly reintroduce the hierarchical model introduced in the previous chapter, showing that it applies not just to mental health constructs, but also to motivation and basic needs. This sets the stage for how games (i.e., a contextual level) interact with life in general (i.e., the global level) to produce pervasive mental health effects.

Afterwards, I mirror the structure of the general introduction to SDT by first discussing Organismic Integration Theory and how motivational quality in gaming relates to mental health, before discussing basic psychological needs in games. With regard to basic needs and games, two lines of research are worth bearing out: the first concerns how needs might be met or frustrated during the act of gaming itself (i.e., at the contextual and situational levels), and the second concerns how need need frustration in daily life (i.e., at the global level) might interact with the way people engage with games.

4.3.1 Levels of Generality in Basic Needs and Motivation

In the previous chapter (Section 3.2), I introduced the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997). That model had been used to differentiate aspects of mental health, ranging from situational (roughly, state-like) constructs such as momentary positive affect, to global (roughly, trait-like) aspects of mental health such as life satisfaction.

The hierarchical model equally applies to (and in fact was originally developed to address) motivational quality as described by Organismic Integration Theory, and need satisfaction and frustration as described by Basic Psychological Needs Theory. Under the hierarchical model, people can experience different degrees of need satisfaction, and different qualities of motivation, across the same three levels as they can experience mental health outcomes: the *global* (motivation and basic needs experienced across life as a whole), *contextual* (motivation and basic needs experienced in a particular life domain, such as gaming or school), and *situational* levels (motivation and basic needs experienced during a relatively narrow window in time, such as the immediate moment or the previous day).

To illustrate these levels of generality in a gaming context, let us take a fictional example of a young adult named Sammy. In life as a whole, Sammy generally finds meaning and contentment in their day-to-day responsibilities of keeping up with work, taking care of their cat, and maintaining physical fitness—their *global motivation* is generally quite self-determined, thanks to high *global autonomy satisfaction*. The occasional bout of loneliness, however, indicates some *global relatedness frustration* at play. In one effort to combat this, Sammy plays a couple hours of video games every few days, and although they sometimes feel video games are a waste of time, they conscious value the opportunities for social interaction and challenge that they get by trying to compete at a high level with friends—their *contextual motivation* for might be characterized by a small amount of amotivation, high identified regulation and moderate intrinsic motivation, driven by high

contextual competence and *relatedness satisfaction*.

On a particular Sunday night, they fire up *Borderlands 3* with three friends, hoping that today will be the day they finally beat Captain Truant on the deadly 'Mayhem 10' mode. The feeling of incremental improvement with each attempt to defeat the boss (*situational competence satisfaction*) is inherently enjoyable, but Sammy is also hoping for a rare item to drop, so their *situational motivation* for this session includes a mix of intrinsic motivation and external regulation. After several boss attempts, however, the party feels stuck and each try becomes worse than the previous one. The friends begin to bicker (signaling some *situational competence and relatedness frustration*), leaving Sammy with no real desire to keep playing, but they do so anyway due to high *situational introjected regulation*: if they were to leave the party early, they would feel guilty for letting down their friends. On their last boss attempt of the night, the party redoubles their resolve, wanting to end the day on a high. They accept that they might not get the boss down tonight, but recognize the fun of trying and take pride in having persisted despite difficulties—a reappearance of *situational intrinsic motivation and identified regulation* as the session comes to close. With a heroic last stand, Sammy gets the final blow to finish off the boss, and bathes in a wave of *situational competence satisfaction* before signing off for the night.

Having already discussed the hierarchical model in the previous chapter, I content myself here to simply issue a reminder that levels of generality apply not just to conceptions of mental health, but to motivation and basic needs as well. Although the hierarchy is well-established in broader SDT research, and is implicated in key SDT-derived hypotheses about gaming, such as the need density hypothesis (cf. Allen and Anderson, 2018; Rigby and Ryan, 2011), levels are rarely stated and even more rarely compared, leaving us with an incomplete understanding of localized vs pervasive psychosocial effects of gaming.

4.3.2 Organismic Integration Theory and Games

Video game play is generally considered an intrinsically motivated activity (Ryan et al., 2006): for most people, most of the time, they play because they want to and because it is inherently enjoyable. People do not generally feel they *have* to play games, but rather than they want to and *choose* to. This is supported by a wide range of player experience studies reporting high mean scores for intrinsic motivation (typically approximately 5 on a 7-pt Likert scale; Brühlmann et al., 2020; Johnson, Klarkowski, et al., 2018; Peng et al., 2012; Tamborini et al., 2010—see Section 4.4.6 for a description of the scales used in this research).

Though gaming is indeed a prototypical intrinsically motivated activity, to only consider this form of motivation would be to miss substantial nuance. Reports from video game players—and indeed a small amount of introspection from the average player—indicate that all types of motivation feature in video game play at certain times. Allen (2020) gives example of what each category might look like:

> Someone who is *intrinsically motivated* to play games may play because they find games stimulating, feel competent while playing, and enjoy trying out new game experiences. Someone with *integrated regulation* may play because gaming feels like an extension of the self—an activity that is aligned with personal values and has become an important part of life. Someone with *identified regulation* may find gaming personally significant and believe it a good way to develop social skills, intellectual skills, or other aspects of the self. Someone with *introjected regulation* may feel compelled to play regularly to feel good about themselves or to avoid feeling bad about themselves. Someone with *external regulation* may play to gain in-game rewards (such as high-quality equipment or virtual currency), to gain in-game awards (such as trophies, achievement points, or character levels), or to be respected by other gamers. Finally, someone who is *amotivated* may still play but question whether it is good for them or no longer feel that they have good reasons for playing. (p. 7)

A small, but compelling group of studies lends empirical support to the relevance of regulation styles beyond intrinsic motivation. Evidence indicates that the six regulation types have the same relationships with ill- and wellbeing in games as found in the other domains described above, such as work and education. In one series of studies, introjected regulation and amotivation were found to be most strongly associated with dysregulation (itself then linked with psychopathology and various other negative psychosocial effects; Mills and Allen, 2020; Mills, Milyavskaya, Heath, et al., 2018). In another, *League of Legends* players with an 'amotivated' or 'external' profile derived less enjoyment, experienced more negative affect and tension during gaming, and scored lower on vitality than those with an 'intrinsic' profile. (Brühlmann et al., 2020). The amotivated profile accounted for 29% of the sample, indicating that amotivated gaming experiences are prevalent, at least among certain gaming populations.

Although there exists a moderate body of work looking at OIT in games (often by applying the Gaming Motivation Scale; Lafrenière et al., 2012), use of the mini-theory remains underdeveloped. In a review of 96 human-computer interaction conference papers that used SDT, Tyack and Mekler (2020) write 'despite [the popularity of SDT], certain core concepts and mini-theories, such as relatedness or organismic integration, have received little to no attention [...] while many works resort to SDT-based questionnaires to analyse the player experience, few papers engage with SDT beyond merely descriptive accounts' (p. 2). While core ideas of intrinsic and extrinsic motivation are common, research appealing to SDT often considers neither the full spectrum of behavioral regulation nor the specific consequences that are expected to accompany more (or less) self-determined motivation, such as wellbeing and behavioral persistence. In one example of misusing Organismic Integration Theory, researchers used a sum score of all six types of motivation as a predictor of engagement—implicitly assuming that each type of motivation has the same impact on behavior (Sterling, 2017).

4.3.3 Basic Psychological Needs and In-Game Experiences

First, I discuss research on the experience of need satisfaction and frustration felt during one's gaming experiences. This therefore includes experiences in one particular gaming session (the situational level), up to the experiences across one game over time or all games a person plays (the contextual level).

Need Satisfaction in Games

Dating back to pioneering papers by Ryan et al. (2006) and Przybylski et al. (2010), there has been substantial research into how games and other entertainment media can support basic psychological needs. Given that, under SDT, basic needs underlie both motivation and wellbeing, research has unsurprisingly looked at both of these outcomes. In each case, studies are myriad and conclusive: games are adept at satisfying all three basic needs; games that better satisfy needs are more engaging; and having one's needs satisfied during gaming is associated with better mental health outcomes during and after play (Reer and Quandt, 2020; Tyack and Mekler, 2020; Vella and Johnson, 2012).

A wealth of research looks at the factors that support need satisfaction. Peng et al. (2012) found that avatar customization, skill upgrades, and dialogue options supported the need for autonomy during playtesting of an exergame. Tamborini et al. (2010) showed that playing *Brunswick Pro Bowling* in multiplayer mode (as opposed to single-player) was associated with greater relatedness satisfaction. Features cannot simply be transported from one game to another and be expected to have reliable effects, however; while points and leaderboards can be sources of intrinsic motivation, Mekler et al. (2017) showed that when performing a gamified image annotation task, points, levels, and leaderboards did not support need satisfaction and were therefore better construed as extrinsic motivators (but interestingly were associated with greater performance). The fact that individual features do not always have the same effect follows from the fact that games are a systemic-emergent medium—game features interact with each other to produce new dynamics (Hunicke et al., 2004).

It is not just the game itself (or its constellation of features) that supports the satisfaction of basic needs, but also the context in which play occurs. In addition to the obvious relevance of social context for relatedness satisfaction (e.g., playing with a friend spectating), players also arrange their environment (e.g., 'clearing their calendar') such that they have the earned freedom to engage at will with games, supporting autonomy (Deterding, 2011; 2016).

In line with the research on non-gaming topics reviewed above, satisfaction of each need in games has been linked to greater intrinsic motivation and higher mental health across gaming genres (e.g., Adinolf and Türkay, 2019; Oliver et al., 2016; Tamborini et al., 2011). To cite just a few examples, need satisfaction in games was linked with higher harmonious passion (Formosa et al., 2022), which the authors argue had particular wellbeing benefits during the Covid-19 pandemic. Players of both casual games and first-person shooters who reported higher autonomy and relatedness satisfaction also reported greater psychological wellbeing (Vella et al., 2015). When evaluating a recently-played game, autonomy and competence satisfaction were linked with greater enjoyment (roughly, intrinsic motivation), whereas relatedness satisfaction was associated with greater feelings of appreciation and meaning in the game (Oliver et al., 2016).

A more recent line of research has shown that experiencing need satisfaction leads to improved mental health immediately after play. One study by Tyack and Wyeth (2021) found that a brief session of *Spore* led to greater autonomy satisfaction and lower autonomy frustration, and these changes were larger for people who had had their autonomy actively thwarted in a pre-play activity. These need-related recovery experiences were then linked to greater post-play wellbeing and vitality. A related study bolsters this mechanism: participants

who completed a need-satisfying word-finding task and then played a stealth platform game, *Mark of the Ninja* exhibited only minor changes in affect and need satisfaction (Tyack et al., 2020). Those who completed a need-frustrating word-finding task and then played the same game, however, showed quite large (1–2 scale points on a 5-pt scale) changes in affect, need satisfaction, and vitality, bringing them approximately back to baseline levels.

Reinecke et al. (2012) combine mood management theory and SDT, proposing that the mood repair mechanisms of entertainment media may equally be able to address deficits in need satisfaction. In this false feedback study, participants who were told they performed poorly on an emotion recognition task (inducing competence frustration) were more likely to select a game with higher user demand than participants who were told they performed well. After finishing the gaming session, groups did not differ in mood or need satisfaction—in other words, playing an actively-selected, highly-demanding game had 'need repair' effects for the thwarted need.

In one of the rare studies to use digital trace data, experiences of autonomy, competence, relatedness and intrinsic motivation in games positively predicted affective wellbeing, whereas extrinsic motivations were negatively associated with it (Johannes, Vuorre, and Przybylski, 2021). Satisfaction of each need was also linked with higher playtime during the previous two weeks, though the size of each correlation was small (roughly .07 for each need).

In short, games are adept at satisfying basic needs, and need satisfaction explains a high degree of video game enjoyment and motivational quality. Players who report higher in-game need satisfaction are more likely to report improved wellbeing outcomes, both in general (Vella et al., 2015), and in the pre- to post-play shifts after a session (Tyack and Wyeth, 2021). This makes the need satisfaction a solid basis for theories of video game play and mental health. To build on that foundation, the next step is to integrate need frustration.

Need Frustration in Games

While games are frequently very effective at supporting need satisfaction, this is not universally the case. The emerging research suggests that need frustration is a salient experience in games and other media with impacts that are separate and distinct to those of need satisfaction. For example, games may frustrate autonomy by teasing players with something that resembles an open world, but where in reality the player is forced to follow a fixed path; frustrate competence by pitting players against opponents with unfair advantages; or frustrate relatedness by exposing players to toxicity and harassment from other players. Research on need frustration in media use aligns with a long-standing tradition in media effects research which acknowledges that digital technologies often lead to negative experiences, disengagement, and adverse impacts (Valkenburg and Oliver, 2019).

Early work found that need frustration in games is linked to strong negative affective reactions (Przybylski et al., 2014). The authors show in a series of studies that competence frustration, rather than a game's violent content, predicted post-play aggression, pushing back strongly against the claim that violent video games cause aggression. Kosa and Uysal (2021) found in a MTurk survey study that need frustration correlated more strongly with negative constructs (dysregulation, escapism, stress, and thoughts of quitting), while need satisfaction correlated more strongly with positive constructs. Notably, they found that need satisfaction did not predict intention to quit, while need frustration did—evidence that need frustration might be a better predictor of churn/disengagement than absence of satisfaction. In interviews with playtesters, Pusey et al. (2021) find that need frustration resulted in less enjoyment and were more likely to quit—and interestingly, that need preferences might interact with the need-satisfying and -frustrating affordances of certain genres to produce genre preferences. An influential study by Allen and Anderson (2018) found that need frustration in games predicted dysregulated play symptoms, and predicted them most strongly when global need frustration was also high. The authors interpret these results as evidence that, for some players, dysregulated gaming involves obsessive passion and persistent play even in the face of in-game need frustration.

In sum, emerging evidence indicates that need frustration is a common experience in video game play, and may be a predictor of key behavioral outcomes like disengagement or aggression. None of the work to date, however, deals very much with the specificity of how need frustration occurs in naturalistic play (although Pusey et al., 2021 do share some anecdotal evidence, for example from a player who describes the autonomy frustration of not being able to approach a puzzle in the way they want). Further, I am not aware of any research on need frustration in games that has used large-scale behavioural data, or looked at longitudinal, within-person effects of in-game need frustration. There are also concerns about measurement (see Section 4.4): current need satisfaction questions either do not assess need frustration in games, or do so in a way that may not be appropriate for the domain.

Need Frustration and Other Conceptualizations of Frustration

Need frustration (in games and elsewhere) is theorized by SDT to be distinct from other conceptualizations of frustration relevant to gaming and media use, such as consumer frustration with a service or product in marketing psychology (González-Gómez et al., 2021), computer user frustration in human-computer interaction (e.g., Bessière et al., 2006), affective computing work on automatic frustration detection (e.g, Wolterink and Bakkes, 2021), or the frustration-aggression hypothesis (Dollard et al., 1939) in psychology. The latter posits that frustration—defined as interference with goal-directed behavior—is a necessary precursor to aggressive behavior, and has been influential media use and violence research (Breuer et al., 2015). In games, Gilleade and Dix (2004) have drawn a distinction between *in-game frustration* (failure to know how to complete a challenge) and *at-game frustration* (failure to operate the input device), which was found to be more frustrating than the former (Miller and Mandryk, 2016).

While varying, these literatures broadly construe frustration as the appraisal of impeded goal attainment, which generates subsequent arousal and negative affect. This has some extensional overlaps with competence frustration (see also Przybylski et al., 2014). That said, without empirical descriptions of psychological need frustration in games, it is hard to say whether it captures different phenomena than 'frustration' in other literatures. This conceptual entanglement is compounded by the fact that 'frustration' is also a colloquial word used by players to describe certain negative experiences: players are known to 'ragequit', throw controllers, experience low mood after playing, and more. However, this frustration at times appears to be associated with a high quantity of motivation; players may paradoxically enjoy frustration and willingly expose them to it by playing 'unfair' or intentionally difficult games like *Getting Over It*, and they often continue to repeatedly try and overcome obstacles, sometimes long after these attempts are particularly enjoyable.

Experiences of *frustration* thus do not necessarily imply that users also experienced *need frustration*. However, they may overlap at times, and the 'venn diagram' of when they do and do not might be informative for player experience and media effects. This highlights the importance of careful construct definition to avoid jingle/jangle fallacies (Section 2.4.4).

Derived Theories of Basic Needs in Media Use

Without rehashing content reviewed in the previous chapter, it is worth reminding ourselves of two models of entertainment media use and mental health introduced earlier that are derived, at least in part, from basic psychological needs and other SDT constructs. This work demonstrates the value of SDT as a theoretical 'jumping off point'. Throughout SDT's long history, researchers have produced several derived models, and worked to integrate their predictions into core SDT tenets when empirical evidence supported their results (e.g., the Hierarchical Model, Vallerand, 1997; or the Eudaimonic Activity Model, Martela and Sheldon, 2019). This demonstrates a rare ability for a theory to iterate and accommodate findings from other theoretical traditions, and for a research community to work together in improving it.

In the specific case of media use, the Recovery and Resilience in Entertaining Media Use (R^2EM) model (Reinecke and Rieger, 2021) draws upon SDT to generate their notions of mastery and control recovery experiences. The model proposes that people with depleted needs may actively choose media that provide recovery experiences of mastery (roughly, competence). A second model, the Integrative Model of Mobile Media Use and Need Experiences (IM^{3}UNE) model (F. M. Schneider et al., 2022) takes SDT predictions about how mobile media demands affect mental health, and adds a predicted moderator in the form of sense of coherence—a trait-like, global orientation to embrace life as comprehensible, manageable, and meaningful. IM^{3}UNE proposes that sense of coherence moderates both (1) the appraisal of need-supportive or -thwarting contexts as ultimately need-satisfying/-frustrating, and (2) the relationship between need experiences and wellbeing outcomes. Both models thus take core SDT predictions, but add precision for the media effects domain.

4.3.4 The Interaction of Gaming and Global Needs

In the previous section, I discussed the antecedents and effects of basic needs as experienced within games (the situational level) or with regard to gaming as a general hobby (the contextual level). From here, I move on to how the experience of basic needs at the *global* level might interact with gaming behavior. Broadly, this body of work is concerned with compensation—players consciously or subconsciously gaming in a way that offers them (need-related) experiences they feel are lacking in their day-to-day life. This compensation has the potential to be both adaptive, or maladaptive, and I discuss each of these in turn.

Adaptive Compensatory Gaming

SDT researchers variously predict that if people experience need frustration in their everyday life, they will actively seek out compensatory activities that promise to replenish the frustrated need (Vallerand, 1997; Vansteenkiste et al., 2020). This is an important component of SDT's claim that basic psychological needs are evolutionarily adaptive (Ryan and Deci, 2017; Vansteenkiste and Ryan, 2013)—if frustrated needs do not prompt a change of behavior, they would be unlikely to have any benefit to the organism. Evidence suggests that this does occur, at least in some contexts; Sheldon and Gunz (2009), for example, found that unaddressed needs were associated with greater motivation to acquire those missing experiences.

Video games are one activity that people can use to compensate for need deficits. This compensatory play can have important benefits for players. A large body of previous work shows that players can successfully use games to cope with difficult life circumstances and restore well-being by distracting them from worries, offer relaxation and entertainment, replace blocked routines and activities, and more (Iacovides and Mekler, 2019; Reinecke and Rieger, 2021; Türkay et al., 2022). Tyack et al. (2020) show that games can replenish frustrated needs after a short play session, reducing stress. A renewed wave of research on adaptive compensatory gaming came during the the Covid-19 pandemic, finding that although the hypothesized widespread relatedness and autonomy need frustration and/or other deleterious effects on wellbeing did not appear as clearly as expected, games were nonetheless a valued means of dealing with need-thwarting policies restricting social contact, available activities, and work environment (Barr and Copeland-Stewart, 2021; Kleinman et al., 2021; Türkay et al., 2022). Türkay et al. (2022) show particularly strong compensation for relatedness and competence—for example, playing games to combat social isolation, or for achievement due to feeling a lack of progress in life. Autonomy, on the other hand, was more speculative, and often backfired by virtue of gaming being the only available option. As a result, the authors theorize that some players developed a harmonious, while others developed obsessive passion (see Section 3.3.5.2).

However, while evidence shows that people *may* compensate for frustrated needs with games, the prevalence of this and factors that determine who ultimately makes selective exposure decisions with conscious or subconscious compensatory motives are not clear. Past research has looked into effects of gameplay on need satisfaction, not of need states on media selection. Related work on such 'selective exposure' has mainly focused on *mood* management not *need* management (K. T. Luong and Knobloch-Westerwick, 2021), despite the predictions of models like R^{2}EM (Reinecke and Rieger, 2021). Following from the ambivalent positive and negative effects discussed in the previous chapter, a crucial unanswered question for compensatory gaming research, therefore, is to identify the circumstances in which people indeed actively choose games and gaming styles to compensate for thwarted needs.

Maladaptive Compensatory Gaming and The Need Density Hypothesis

Some scholars have argued that using games to compensate for global need deficits is not always a productive strategy, and in some cases, can lead to negative effects on the individual—effectively creating a negative feedback loop where people use games as an outlet for problems, but end up worsening the original problems (or creating new ones). SDT scholars argue that need frustration produces three outcomes: illbeing, compensatory behavior, and a third concept known as need substitutes[2] (Vansteenkiste and Ryan, 2013). Here, I focus on compensatory behavior as being most directly relevant to how global needs interact with gameplay.

Under SDT, compensatory behavior has problematic correlates in the form of rigid behavior patterns, whereby people compulsively enact certain behaviors because they provide a sense of structure, predictability, and security (2013). Such rigid behaviors can bring relief and short-term satisfaction, but the inflexibility that characterizes this mode of functioning may direct attention away from the deeper causes of need frustration (2013). By virtue of being less flexible and freely chosen, compensatory behavior increases the likelihood of selecting activities that do not align with longer-term goals (Vansteenkiste et al., 2020), or that are less likely to offer the need satisfaction that the individual is seeking. A study of general entertainment media use supports this link, finding that higher stress correlated with less eudaimonic (roughly, need-satisfying) media use (Eden et al., 2020).

The notion of gaming as a maladaptive compensatory behavior for frustrated global needs is especially common in the literature on gaming disorder (e.g., Kardefelt-Winther, 2014; Teng et al., 2020; Tóth-Király et al., 2019). Here, researchers investigate potential negative feedback loops in which a player lacking satisfaction in their daily life turns to games as a means of finding those satisfactions; however, their (excessive) engagement with games reduces the tools available to them for finding need satisfaction in other life domains. For example,

[2] SDT holds that the persistent experience of need frustration engenders feelings of insecurity, which makes individuals search for external indicators of worth, such as the pursuit of extrinsic goals (e.g., popularity, materialism; Deci and Ryan, 2000).

the player may find themselves falling behind at work or at school, struggling to maintain social relationships, or neglecting their physical health.

The 'need density hypothesis' (Rigby and Ryan, 2011; 2016) formalizes this idea of maladaptive compensatory gaming using SDT constructs. The need density hypothesis posits that (well-designed) video games deliver need satisfaction with a higher density and reliability than everyday life, inviting their compensatory use in need-frustrating life situations. As above, some players compensate adaptively and successfully, but others do not. Therefore, dysregulated gaming is most likely to occur when a person is experiencing high need frustration at the global level alongside high need satisfaction at the contextual level (during gaming; or, potentially, other contexts). The need density hypothesis has been applied to both gaming disorder (Allen and Anderson, 2018; Bender and Gentile, 2019) and obsessive passion (Lalande et al., 2017; Mills, Milyavskaya, Mettler, Heath, et al., 2018b), as distinct but related conceptualizations of problematic play.

A growing number of studies have tested the need density hypothesis, and results generally, but not exclusively, support its predictions. An early appearance can be traced back to Wan and Chiou (2006), whose interview study of Taiwanese adolescents found that dysregulated gaming may be a compensatory activity for individuals whose needs are being thwarted in everyday life. In a wide-sweeping study, Allen and Anderson (2018) found that interactions between frustration of a given at the global level and satisfaction of that need at the contextual level (in gaming) significanty predicted of gaming disorder symptoms (autonomy β = 0.15; competence β = 0.48; relatedness was not significant). Mills, Milyavskaya, Mettler, and Heath (2018) have overlapping results, finding again the interaction of need satisfaction in games and global need frustration was positively associated with dysregulated gaming, thereby supporting the need density hypothesis. Similarly, Johnson et al. (2021) finds that need satisfaction in video games is associated with both harmonious and obsessive passion, but that people with lower global need satisfaction were more likely to exhibit obsessive passion (see also Formosa et al., 2022, who find that need frustration in work/study predicts obsessive passion for games).

The need density hypothesis is a promising explanation of dysregulation—so far, descriptive between-person evidence suggests that it is a valid one, but predictive within-person evidence is still lacking. Longitudinal evidence will be particularly crucial for untangling dysregulation as *cause* vs. dysregulation as *effect*. While these may be intertwined in a feedback loop, scholars have argued both ways: some posit that continued use of games displaces other real-world activities and may alter brain structure, leading to psychosocial problems; while others suggest that dysregulation is a (maladaptive) response to existing problems in life (Aarseth et al., 2017). The need density hypothesis formalizes one possible direction of this relationship (that is, a positive negative loop beginning with need frustration in daily life), and ultimately helps guide the target of interventions.

In short, there is evidence that gaming can compensate for frustrated needs, with possible positive and negative follow-on effects. Recent work is exploring potential moderators (like stress, social vs. solitary play styles, or harmonious vs. obsessive engagement) to explain when and why compensatory gaming may have positive or negative effects (Koban et al., 2021), but is in early stages.

4.4 Measurement of SDT Constructs

To test the hypotheses of SDT and Basic Psychological Need Theory, games researchers have used a range of measures with varying evidence of validity. Here, I overview these SDT-related measures and outline the constructs they measure, the level of generality at which they have been used, the evidence (or lack thereof) supporting their use, and their usefulness to my own research goals. Ultimately, this section will motivate the need to develop a new measure of need satisfaction *and frustration* for games—a mantle I take up in Chapter 9.

4.4.1 Player Experience of Need Satisfaction (PENS)

The Player Experience of Need Satisfaction scale (PENS, Ryan et al., 2006) was the first SDT scale drafted specifically for use with games, and remains the most widely used measure of basic psychological needs in the player experience literature. Although highly influential in the rise of SDT in games research (Tyack and Mekler, 2020), PENS has a few limitations.

PENS was developed prior to the emergence of need frustration as a separate construct, and therefore only includes satisfaction of each basic need. PENS also adopts a narrow view of relatedness satisfaction, implicitly focusing only on other human players despite evidence that player derive deep meaning from interactions with virtual characters and worlds (Tyack and Wyeth, 2017). While some items are ambiguous with regard to whether they refer to other human players or non-human characters ('I find the relationships I form in

this game fulfilling'), one of the three items ('I don't feel close to other players') is limited to experiences in multiplayer games. Some have tried to adapt PENS to ameliorate this; Bender and Gentile (2019), for example, added an additional item to assess parasocial relationships with characters: 'I care about the game characters and enjoy being involved with them.' However, this additional item was not itself validated, and an implication of their scale is that participants who experience moderate relatedness satisfaction from both other players and in-game characters will score higher than players who experience very strong relatedness satisfaction from just one source.

A handful of further problems with PENS have been documented at the psychometric level as well. First, statistical evidence for the factor structure of the scale is limited and inconsistent, with some follow-up studies finding better support for a four-factor structure than the proposed five-factor one (Johnson and Gardner, 2010; Johnson, Gardner, et al., 2018). PENS subscales have also shown low internal consistency at times, particularly for autonomy: although the basic need subscales are only 3 items long, which will negatively affect Cronbach's α, results are regularly below the 0.7 heuristic for acceptability (Kline, 2014), and have been as low as 0.63 (Ryan et al., 2006). Mills, Milyavskaya, Mettler, and Heath (2018) find that the three-factor structure of PENS need satisfaction only holds with the inclusion of a second-order factor. These problems may be symptomatic of the fact that the development of this scale was only a secondary aim of the original article in which it was published.

Another conceptual challenge stems from the inclusion of two subscales that do not directly derive from SDT, namely presence/immersion and mastery of controls. Mastery of controls was found in the above independent validation to load onto the same factor as competence, and while the presence/immersion factor was largely intact, many immersion scholars view immersion as a multidimensional construct (Jennett et al., 2008), and thus PENS may not be well-suited to capturing the nuance of this aspect of player experience.

A final, minor point to note is that PENS is proprietary. While the scale is widely distributed for free academic use, this nonetheless places certain constraints on open sharing of materials and scale items, and may obscure differences across different versions of the questionnaire, which has been updated over time.

4.4.2 Ubisoft Perceived Experience Questionnaire (UPEQ)

The second most prominent scale designed to measure need satisfaction in video games is UPEQ (Azadvar and Canossa, 2018). Similar to PENS, UPEQ measures need satisfaction in games, but does not include need frustration.

UPEQ's initial validation had notable strengths, including a large sample and a test of criterion validity showing that UPEQ subscales significantly correlated with game rating and objectively logged days of playtime among players of *Tom Clancy's The Division*. However, the validation lacked psychometric depth—the authors retained all 21 items tested, potentially suggesting a lack of experimentation and item diversity. This factor structure was not explicitly tested in the second study of the paper, which instead relied on reliability in the form of Cronbach's α to provide evidence of psychometric validity, which has the well-established limitation that high values may obscure multidimensionality (Stanley and Edwards, 2016). The validation did not include cognitive pretesting, convergent or divergent validity, or measurement invariance analyses. Some UPEQ items do not pass face validity tests: an autonomy subscale item, 'My actions had an impact on the game', does not describe autonomy as theorized in SDT (and in fact is more closely related to competence).

The authors do not explain their rationale for developing an alternative to PENS, but one way in which UPEQ extended PENS was by including relatedness satisfaction items that refer to non-human characters—a need that they say arose while conducting interviews with players during the item generation process. UPEQ elected to use separate items for relatedness from multiplayer experiences (e.g., 'Other players are friendly towards me') and experiences with non-player characters (e.g., 'I was bonding with some of the characters'). However, these are presented as part of a single subscale, which means that players who derive high relatedness satisfaction from their gaming but from only one of these sources would score medium to low on the overall subscale, creating challenges in analysis and interpretation. There is no a priori reason to expect relatedness from one source to be lesser or worse than the other, so ultimately the important factor is the player's overall sense of connection and caring from the game—whether derived from other players, in-game characters, or a combination.

The UPEQ suffers from further problems. First, the statistical evidence for its factor structure is equivocal, with only limited detail provided and some equivocal results from their principal components analysis about the underlying number of factors. To my knowledge, no subsequent validation work has been published, but I find in Chapter 7 that the intended factor structure of UPEQ exhibited poor model fit—with the relatedness subscale results being particularly problematic.

To improve upon UPEQ's limitations, therefore, a new measure should include need frustration, attempt to phrase items that allow players to derive relatedness satisfaction from *either* other human players or non-player characters, and undergo a more extensive psychometric validation procedure in line with best practices (Kline, 2014).

4.4.3 Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS)

The BPNSFS (Chen et al., 2015) is presently the best-validated and most widely used scale for measuring *global* need satisfaction and frustration. Designed to capture need satisfaction and frustration in everyday life, the BPNSFS has been validated in multiple cultural contexts. Variants of the BPNSFS have also been widely used at the contextual level for domains like exercise and education[3], with the recognition that some original BPNSFS items do not readily work when applied to particular life domains.

Lacking validated measures for need frustration in games, some researchers have attempted to use the global BPNSFS instead. Two such studies modified the BPNSFS by either pre-pending 'when I play video games' to each item (Allen and Anderson, 2018), or adding 'in [my current favorite online game]' in the middle (Kosa and Uysal, 2021). While overall model fit indices were acceptable, there were nonetheless clear limitations of this measure. Though model fit was good, confirmatory factor analysis results from (Allen and Anderson, 2018) found large differences in the satisfaction-frustration correlations in the original BPNSFS vs the modified games variant. In the original scale, satisfaction and frustration of each need conformed to theoretical predictions and were strongly negatively correlated. In the modified games variant (the contextual level), on the other hand, they were weakly correlated (and in the case of autonomy, even positively correlated). This led the authors to conclude that 'need satisfaction and need frustration in video games appear to be distinct, unrelated dimensions' 2018, supplementary materials. But while a partial degree of orthogonality is expected, a complete lack of association runs counter to theoretical predictions—satisfaction and frustration should be moderately negatively correlated, given that low need satisfaction is a necessary feature of need frustration. In Chapter 6, I will show that the BPNSFS also misses certain need frustration experiences specific to the video games context.

Similar to PENS, the relatedness items in the modified BPNSFS implicitly refer only to satisfaction and frustration derived from other human players. This appears to create some measurement challenges: Kosa and Uysal (2021) needed to remove 3 items due to low factor loadings (e.g., 'I have the impression that people I spend time with dislike me'), suggesting that certain items are not straightforwardly applicable to games.

Overall, therefore, a measure seeking to improve upon the BPNSFS for games research should ensure that items map coherently onto a games context, allow a broader conceptualization of relatedness, and undergo more extensive validation than the brief ones done as relatively peripheral parts of the studies presented by Allen and Anderson (2018) and Kosa and Uysal (2021).

4.4.4 Balanced Measure of Psychological Needs (BMPN)

The BMPN (Sheldon and Hilpert, 2012) is something of a precursor to the BPNSFS, and was developed in order to fix problems with ambiguous (dual-loading) items and unbalanced subscale lengths in a yet earlier scale, the Basic Psychological Need Satisfaction Scales (Gagne et al., 2003). The BMPN is notable for being one of the first scales to measure need frustration (though this was referred to need dissatisfaction at the time), with factor structure evidence strongly supporting the distinction between satisfaction and frustration. The BMPN has seen occasional use in games research, but does not appear to be well-suited to games contexts without additional adaptation (e.g., an internal consistency of only .42 in Hui et al., 2019).

4.4.5 Player Experience Inventory (PXI)

The PXI (V. Vanden Abeele et al., 2020) is a broader player experience measure that assesses 10 constructs related to both functional and psychosocial consequences. While not specifically an SDT measure, the PXI does include subscales for autonomy and mastery (which is roughly equivalent to competence), and has been subjected to an extensive validation approach. The PXI is therefore a strong candidate for use in studies that wish to measure autonomy and competence satisfaction only, but does not meet the needs of SDT researchers interested in either relatedness or need frustration.

[3] see https://selfdeterminationtheory.org/basic-psychological-needs-scale/ for an overview.

4.4.6 Motivation Scales: Intrinsic Motivation Inventory (IMI), Gaming Motivation Scale (GAMS) and the User Motivation Inventory (UMI)

It is worth emphasizing that measures of basic psychological needs are not the same as measures of motivational self-determination, though both are derived from SDT. In games, three questionnaire have most commonly been used to measure aspects of players' motivation.

The Interest/Enjoyment subscale of the Intrinsic Motivation Inventory (McAuley et al., 1989) has been the most common measure of intrinsic motivation used in research on video games (Tyack, 2019), and in many other domains. The IMI does not measure any other motivation types, such as extrinsic motivation.

For measuring concepts like introjected regulation, researchers have used the Gaming Motivation Scale (GAMS; Lafrenière et al., 2012). The 18-item GAMS questionnaire measures all 6 types of motivation, with validation results supporting theoretical predictions in that intrinsic, identified, and integrated were moderately correlated with need satisfaction in games (mean $r = 0.29$), while amotivation and extrinsic were weakly or uncorrelated (mean $r = 0.03$).

To broaden the applicability of GAMS to a wider range of potential technologies, Brühlmann et al. (2018) developed the User Motivation Inventory (UMI). The UMI showed good evidence of measurement validity for all 6 motivational sub-types, and was able to detect differences in motivation for people who consider abandoning a technology compared to those who do not question their use.

The IMI, GAMS, and UMI are all of value in connecting basic psychological needs to the motivational outcomes they are predicted to incur. However, these are separate constructs, and thus unrelated to the limitations of existing need satisfaction and frustration measures for games.

4.5 Discussion

To summarize, the satisfaction and frustration of basic psychological needs is a crucial determinant of the quality of motivation for play, and the mental health outcomes of that play. However, as pointed out by Tyack and Mekler (2020), research on basic psychological needs and video games remains at times superficial and poorly integrated. This leaves open several opportunities for growth in SDT's application to games research, which together stimulate the need for an expanded SDT model for games. I summarize each of these below.

Strengths of SDT for Gaming and Mental Health Research

SDT has several important strengths for the purposes of this thesis. First, as highlighted throughout the respective discussions of both Organismic Integration Theory and Basic Psychological Needs Theory, SDT is uniquely *integrative*, explaining motivation, behavior, and mental health outcomes of our activities. Given the wide range of effects detailed in the previous chapter, which implicate individual differences, behavioral aspects of gaming, and player experience aspects, SDT thus has potential to encapsulate a much larger portion of the existing literature than competing theories.

Second, SDT is well-integrated with the model of mental health described in Section 3.2. While SDT's original focus is on eudaimonic wellbeing, SDT-based studies (both broadly and in the games domain) have also looked at hedonic wellbeing aspects—conceived of as symptoms of eudaimonic wellbeing—and, more recently, illbeing. Similarly, SDT was the original basis of the hierarchical model, and as a result has substantial literature in which researchers have distinguished the global, contextual, and situational levels of generality to understand local vs pervasive impacts (Vallerand, 1997). This in turn has been one basis for comparing shorter- vs longer-term effects (Blanchard et al., 2007; Guay et al., 2003). Together, SDT thus aligns with all nine aspects of the mental health taxonomy presented earlier (hedonia, eudaimonia, and illbeing; at the global, contextual, and situational levels).

While part of SDT's success in surviving to this level of maturity and breadth has been its empirical successes, another part has been its iterative nature. Rather than a fixed theory set forth in one paper and left to live or die as a single unit, SDT has instead been the subject of substantial iteration by the research community—the six mini-theories were developed over multiple decades (Ryan and Deci, 2017), new basic needs have been proposed and remain under examination (González-Gómez et al., 2021), and predictions that have not held have been updated. This communal ownership and 'living' nature of the theory has given researchers the opportunity to use SDT a jumping off point for derived sub-theories specific to media use. For my purposes, the R^2EM (Reinecke and Rieger, 2021) and IM^{3}UNE F. M. Schneider et al. (2022) models serve as particular sources of inspiration in looking at how broad SDT predictions can be applied more precisely in the entertainment media context.

These strengths motivate the adoption of SDT as a starting point for the BANG model to come. SDT has the potential to be a 'unifying' theory that connects illbeing, hedonic wellbeing, and eudaimonic wellbeing (Vansteenkiste and Ryan, 2013), across timescales, and to be a 'motor theme' that coordinates research activity across varied topics throughout media psychology, human-computer interaction, and player experience research (Ballou, Deterding, Tyack, et al., 2022). As we have also seen, however, there is still work to be done to realize this potential.

Weaknesses of SDT for Gaming and Mental Health Research

The limitations of SDT-informed games research as reviewed above can be distilled into five areas where I believe SDT in games can become both more comprehensive and more specific, and thereby better predict when and why games and other entertainment media affect mental health.

First, SDT games research has not yet fully leveraged need frustration as a separate construct from need satisfaction, and the predictive and explanatory benefits it may bring. Understanding need frustration may be valuable above and beyond need satisfaction for designers and developers trying to understand when and why players disengage with games, and to motivational psychologists in investigating the relationship between entertainment media and well- or ill-being. However, while research into need frustration and games is emerging, it remains in its early stages (cf. Allen and Anderson, 2018; Kosa and Uysal, 2021; Pusey et al., 2021). Hence, there is a need for descriptive, naturalistic observation of what causes need frustration in games, and the effects that has.

Second, SDT games research has yet to coherently explain when compensatory play is successful in addressing globally frustrated needs, and when it instead leads to obsessive passion or other maladaptive outcomes. SDT-informed games research, drawing in part upon the need density hypothesis, has the potential to help unite these separate potential outcomes, but further work is needed to understand the mechanisms that drive need-related coping behaviors.

Third, SDT games research has engaged in lots of isolated hypothesis testing, for example of the need density hypothesis (Bender and Gentile, 2019), or of the relationship between basic needs and situational mental health outcomes (Tyack et al., 2020). However, such studies draw from shared set of largely verbal models, and are not always comparable. I argue that greater integration would be beneficial—tests of individual hypotheses are more valuable insofar as they inform a larger theoretical explanation of the ultimate effects of interest. This has the ancillary benefit of supporting causal modelling by virtue of clearly specifying moderators, confounds, and potential colliders (Rohrer, 2018). Hence, there is a need for well-developed models that integrate empirical findings and tests, and help the field progress more systematically.

Fourth, we lack well-developed measures for need satisfaction and frustration in games. In Section 4.4, I showed that existing games measures such as PENS and UPEQ lack need frustration, and that global measures such as BPNSFS and BMPN that include need frustration miss important games-related experiences and may not be appropriate for use in a games context. Thus, for assessing the potential effects of need frustration in games, there is a need for improved measurement tools.

Fifth and finally, though evidence quality has been high in many SDT games studies (e.g., Allen and Anderson, 2018; Przybylski, 2014; N. Weinstein et al., 2017), there remains room for further improvement. Relatively few studies of need satisfaction and frustration in games have investigated the within-person relationships that are more closely related to causal effects (Rohrer and Murayama, 2021), and fewer still have applied digital trace data to capture true behavior as opposed to coarse and potentially biased self-reports (cf. Johannes et al., 2022).

These five opportunities form the basis of the thesis to come: I will first naturalistically describe need frustration (Chapter 6), then attempt to shed light on successful vs unsuccessful compensation (Chapter 7), use these findings to develop an integrative SDT-derived theoretical model (Chapter 8), before developing an improved measure of need satisfaction and frustration (Chapter 9) and testing this with high-quality longitudinal trace data (Chapter 10).

4.6 Conclusion

To sum up, I argue that basic psychological needs form the most compelling construct currently available to causally connect gaming to illbeing and hedonic/eudaimonic wellbeing, at situational and global levels. However, there are also gaps in SDT that can lead to better predictions about player mental health. My focus, therefore, is to take a leading area of theory development and empirical testing in the form of SDT and add rigor and specificity for the games domain. Though the field is not yet mature enough to constructing a 'grand

theory of games and mental health', the model I present also integrates aspects of other non-SDT theories—a topic I return to in the discussion.

5

Present Thesis

In the background chapters, I hope to have established the following points:

- We currently lack integrative theory that can accommodate the various empirical findings that exist in the literature on games and mental health, and therefore can benefit from generating theory that accounts for the wider range of existing empirical effects
- Self-determination theory offers a promising platform for building such an integrative theory, but its use in the media domain lacks specificity in certain areas, including recent theoretical developments related to need frustration and accommodating the successes of previous theories
- Certain common methods have substantial limitations that leave our work less able to reach conclusive answers about the effects of games as researchers might hope. We can therefore benefit from basing theory generation and validation attempts on high-quality evidence produced using methodological best practices (e.g., using digital trace data, and looking at within-person effects)

These are the challenges laid out before the current thesis—ones that are far too large for any one researcher to tackle, but to which I hope to make some small contribution. So, with that context in mind, let us briefly review to the research outline discussed in Chapter 1. For convenience, I have copied the figure that outlines the structure of the thesis studies in Figure 5.1.

In Chapter 4, I argued that need frustration is a compelling construct with the potential to improve our understanding of video games, mental health, motivation, and (dis)engagement. However, I showed that research on this construct is in its infancy, with many unanswered questions about the prevalence of need-frustrating experiences in games, the precise circumstances in which they arise, and the effects they might have on players. To that end, I begin with basic naturalistic description of need frustration in games in Study 1. I report on an interview study of 12 players with diverse gaming interests, showing that each of them could easily recall frequent experiences of need frustration. These experiences often led them to either change their in-game behavior or to disengage. In that process, I identify an underappreciated role of outcome expectations, with players not simply reacting to the emotional stimuli they experience, but using this information to update prior predictions for future gaming experiences.

In Section 3.3.3 and Section 4.3.4, I showed that games could be used either successfully or unsuccessfully to cope with difficult life circumstances, or to compensate for need-related deficits in daily life. However, the relationship between global need frustration and in-game need satisfaction is a recent topic of inquiry, and warrants further investigation. To that end, Study 2 reports on a mixed-methods study of compensatory gaming during the Covid-19 pandemic. Results juxtapose anecdotal reports that users intentionally and successfully using games to compensate for frustrated global needs with quantitative results that show a distinctly different pattern—those who report higher global need satisfaction also report higher in-game need satisfaction, with an identical pattern for need frustration. This indicates that while compensation does occur for some players, the likelihood of this happening and/or the ultimate success of the player in doing so is moderated by other factors.

Having used qualitative evidence to help shed light on some of the unanswered questions in SDT-based media research (summarized in Section 4.5.0.2), Chapter 8 describes the development of the the Basic Needs in Games (BANG) model, an initial attempt at deriving a SDT-informed theory of gaming and mental health. I

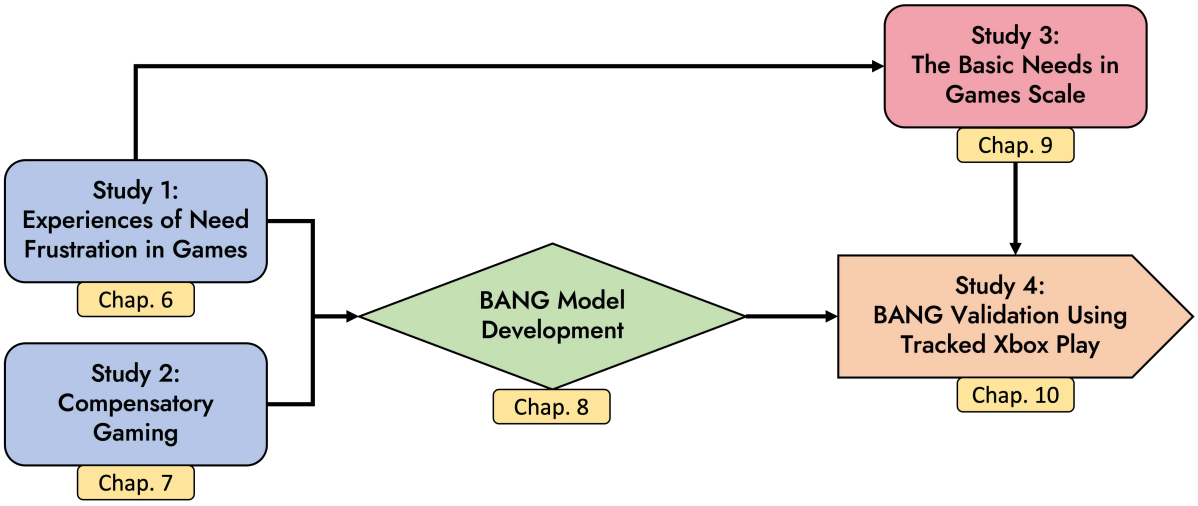

Figure 5.1: Overview of each study in the thesis and how they relate to each other. Studies 1 and 2 are qualitative, and help shape the construction of the Basic Needs in Games (BANG) model. Validation of the BANG model necessitates the development of a new measurement instrument (Study 3), itself also informed by the experiences of need frustration described in Study 1. With the theory and necessary measurement in place, I test the key tenets of the new model in Study 4.

discuss some of the theory's strengths, including its ability to account for a larger portion of the varied findings from earlier.

In Section 2.4.4 and Section 4.4, I described how measurement concerns can undermine large portions of the psychological games literature, and how existing measures for assessing need frustration in games (and, to a lesser degree, need satisfaction in games as well) do not adequately capture the construct. Thus, in Study 3 I develop a new questionnaire for measuring basic psychological need satisfaction and frustration in games: the Basic Needs in Games Scale (BANGS). I show that this measure captures both types of need-related experiences with good construct validity and is suitable for use at both the situational and global levels.

Last but certainly not least, the time comes to (partially) validate the model. In Chapter 2, I described a range of methodological best practices that would help our empirical studies be more informative: using longitudinal within-person designs, collecting digital trace data, and following open research practices, among others. In Study 4, I apply all of these practices. Using a novel method of capturing digital trace data on the Xbox platform using web scraping, I conduct preregistered analyses comparing 3 months of gaming behavior with 6 biweekly survey waves in which participants reported their need satisfaction and frustration and multiple indicators of mental health. By making use of a powerful statistical technique, equivalence testing, I provide strong evidence to support our predictions that there is no direct meaningful relationship between playtime and mental health. There is, however, evidence to support some of the mediated pathways hypothesized in the BANG model.

Without further ado, let us proceed to the evidence.

Part II: Theory Generation

6

Study 1: What Does Need Frustration in Games Look Like?

Chapter Contents

6.1 Introduction . . . 61
6.2 Method . . . 61
6.2.1 Data Collection and Analysis Approach . . . 61
6.2.2 Procedure . . . 62
6.2.3 Ethics . . . 63
6.2.4 Participants . . . 63
6.3 Results . . . 63
6.3.1 Need Frustration . . . 63
6.3.2 Expectations . . . 66
6.3.3 Play Behavior . . . 67
6.3.4 Extrinsic Motivation . . . 68
6.4 Discussion . . . 68
6.4.1 Need Frustration and Player Experience . . . 69
6.4.2 Measurement, Testing and Design . . . 69
6.4.3 Expectations . . . 69
6.4.4 Other Conceptualizations of Frustration . . . 70
6.4.5 Limitations . . . 70
6.5 Conclusion . . . 70

Publication Information and Data Availability

The following study is based on content published as:

Ballou, N., & Deterding, S. (2023). 'I Just Wanted to Get it Over and Done With': A Grounded Theory of Psychological Need Frustration in Video Games. *The Annual Symposium on Computer-Human Interaction in Play - CHI PLAY '23*. https://doi.org/10.1145/3611028

All data, code, and materials associated with this project are available on the Open Science Framework (https://osf.io/mwpqc).

6.1 Introduction

As noted in the literature review and previously by others (e.g., Tyack and Mekler, 2020), *how* games afford need frustration and how this may shape play behavior and experience remain largely unexplored. This knowledge is of great relevance to designers who wish to avoid negative experiences that lead players to disengage or churn, and want to be able to distinguish 'positive', engaging forms of frustration from negative ones—a common design goal (Frommel, Klarkowski, et al., 2021; Petralito et al., 2017). While we have (largely correlational) evidence that need frustration is linked with lower media engagement, it is not clear that this is the only behavioral consequence, nor what processes give rise to these experiences.

Most current research on need frustration is quantitative and 'top-down'—applying existing general definitions and measurement instruments of need frustration that may lack sufficient domain specificity (Allen and Anderson, 2018; Kosa and Uysal, 2021). But since we lack basic naturalistic descriptive work, game-related need frustration is currently a largely 'empirically empty' construct, which risks low construct or content validity of imported measures aimed at capturing it (Lasch et al., 2010). That measures are not sufficiently grounded in players' lived experiences is not a new concern in work on games and self-determination theory: For example, Tyack and Wyeth (2017) noted and Kayser et al. (2021) later confirmed that existing need satisfaction questionnaires did not capture all forms of relatedness satisfaction characteristic of games.

Existing correlational, quantitative evidence thus leaves open how, if at all, need frustration empirically manifests in gaming, captured in my first research question:

> **RQ1**: What kinds of need-frustrating experiences, if any, do people report in games?

If I find that players can report salient need-frustrating experiences in games, the next open question is how they function:

> **RQ2**: What are the antecedents, processes, and engagement effects of need-frustrating experiences in games??

6.2 Method

To answer these questions, I chose a qualitative, theory-generating approach. Specifically, I conducted semi-structured interviews with 12 video game players from various backgrounds for efficient access to rich and varied recalled events, using constructivist grounded theory methods (Charmaz, 2006) to develop an empirically grounded model. While traditional grounded theory (particularly in the Glaserian tradition) suggests to 'bracket' theoretical preconceptions, contemporary approaches recognize that ingoing theoretical concepts are an unavoidable and indeed productive part of the abductive process of generating grounded theory (Goldkuhl and Cronholm, 2010; Thornberg, 2012). As Kelle (2019) notes, 'theoretical categories with low empirical content drawn from grand theories are often ideally suited' to grounded theory generation, as they 'do not force the data' (p. 84): this precisely describes my aims to see if need frustration as abstractly conceived in self-determination theory occurs in video game play, and if so, how it manifests and operates. To quote the original *Discovery of Grounded Theory*, 'categories can be borrowed from existing theory, provided that the data are continually studied to make certain that the categories fit' (Glaser and Strauss, 1967, p. 36-37).

6.2.1 Data Collection and Analysis Approach

I constructed interview prompts from descriptions of need frustration from the most recent and comprehensive self-determination theory handbook (Ryan and Deci, 2017) and wordings from the most widely used and well-validated questionnaire for assessing need frustration, the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) (see supplementary materials). Participants were asked to retell in detail recent experiences of need frustration, prompted by interview questions such as those presented in Table 6.1. I further included prompts using the colloquial word 'frustration' to remain open to potential experiences of need frustration not captured in prior conceptualizations. Responses to these questions were only coded as need frustration if players clearly described feelings of being controlled/coerced (autonomy frustration), failure/self-doubt (competence frustration), and disconnection/exclusion (relatedness frustration). While using autonomy, competence, and relatedness frustration as initial codes, I remained open to merging or discarding these categories if they did not fit the data. I did not impose any further specific preconceptions in data collection or coding.

Table 6.1: Example interview questions and prompts targeting different components of the model. The full semi-structured interview script is available in Appendix A2.

Model Component	Example Interview Question
Colloquial Frustration	Can you describe a recent situation when you felt frustrated by a game?
Autonomy Frustration	Can you remember a time when gaming that you felt you were being 'forced' to do something?
Competence Frustration	Can you think of a time when gaming that you felt ineffective or incapable as a player?
Relatedness Frustration	Can you think of a time when playing a game that you felt socially excluded or disconnected from other players?
Expectations	Had you expected to encounter a situation like this?
Play Behavior	Was there a moment when you thought about continuing to play/picking up the game again?
(Extrinsic) Motivations	When you chose to play the game, what were you hoping to get out of it?

True to grounded theory principles, I iterated between data collection, coding, and memoing: interviews were conducted, transcribed, and coded one at a time, and I repeatedly altered the interview script or redirected participant sampling in response to ongoing theorizing. The initial four participants were sampled to maximize variety in demographics (age, gender) and game genre preferences (as expressed in favorite titles); subsequent data collection was governed by theoretical sampling, aiming to enrich or challenge evolving categories.

I continued data collection until I reached theoretical saturation for the two primary aspects of the model: the categories of need-frustrating experiences (RQ1), and the core expectations–experience–behavior loop (RQ2). Other aspects of the model may not be fully saturated, and are left for future development. I judged need-frustrating experiences to be saturated after the 10th interview (all new data could be accommodated by the existing need frustration categories), and the engagement process to be saturated after the 12th interview (all new data could be accounted for by the proposed causal model). Prior work and a recent systematic review on saturation in qualitative research indicate that saturation for well-specified questions and homogeneous populations is reached around 9–12 (G. Guest et al., 2006) or 9–17 interviews (Hennink and Kaiser, 2022), which broadly aligns with the sample here. I return to potential limitations of the sample (size) in the discussion.

I undertook three coding cycles, corresponding to the key stages in constructivist grounded theory (Charmaz, 2006). I began with initial incident-by-incident coding (exploratory, descriptive), then focused coding (using the most significant and frequent codes to sift through data; integrating codes into categories; deciding which codes make the most analytic sense to fully categorize the data), then finally selective coding (specifying possible relationships between categories developed in focused coding). After the model was completed, I discussed the model with two interviewees to assess whether they found it to accurately characterize their experiences, with both expressing support for my findings.

I was the sole coder for all cycles, and regularly consulted with a second researcher[1] (SD) about model development and the coherence of codes. From the perspective of constructivist grounded theory, analysis inescapably requires interpretation influenced by the author's own subjective experience, and will be affected by the analyst's biases. Similar to reflexive thematic analysis, constructivist grounded theory generates a *subjective* theory that may become *intersubjectively viable* in follow-on theory-testing work (2006, p. 130–131). By extension, 'using multiple coders does not guarantee against collective idiosyncrasies, nor does it necessarily increase validity [...] two or more coders may agree because they share the same peculiar or limiting assumptions' (Cornish et al., 2014, p. 81).

Bias, in this view, is not something that can be eliminated, but reflected upon and foregrounded. Thus, rather than having multiple coders, I elected to use a second researcher in an 'auditor' role to guard against unconstrained or unsystematic analysis, to disclose our respective positionality (see supplementary materials), and to make the data openly available so that others can re-analyze it should they find the analysis unconvincing.

6.2.2 Procedure

I recruited participants on Prolific and via snowball sampling to first complete a screening questionnaire and, if invited, a subsequent video interview. The screening questionnaire was built in Qualtrics and asked participants about demographics (age, gender), their gaming history and preferences (preferred genres), and their interest in potentially being invited for an interview. I also asked for, but ended up not using, information on global need frustration and distress (if any) experienced in relation to gaming.

[1] Ballou, N., & Deterding, S. (2023). 'I Just Wanted to Get it Over and Done With': A Grounded Theory of Psychological Need Frustration in Video Games. *The Annual Symposium on Computer-Human Interaction in Play - CHI PLAY '23*. https://doi.org/10.1145/3611028

Table 6.2: Interviewee details

Participant	Age	Gender	Country	Favorite games/series
P1	27	Male	UK	League of Legends, Legends of Runeterra, Dark Cloud
P2	21	Male	Portugal	League of Legends, God of War, Rocket League
P3	32	Female	Spain	Final Fantasy 8, The Witcher
P4	30	Female	UK	Kingdom Hearts, Assassin's Creed, Skyrim
P5	18	Male	Chile	Cuphead, Stardew Valley, Fallout
P6	23	Female	UK	Undertale, Life is Strange 2, The Sea Will Claim Everything
P7	21	Female	Canada	Minecraft, Warframe, Call of Duty
P8	42	Non-binary	UK	Mass Effect, Resident Evil, Assassin's Creed
P9	20	Male	Poland	Mass Effect 3, Life is Strange, Minecraft
P10	31	Female	South Africa	Tony Hawk, Grand Theft Auto, Need for Speed
P11	27	Male	Netherlands	Darkest Dungeon, Red Dead Redemption 2, The Witcher 3
P12	31	Prefer not to say	UK	LittleBigPlanet 2, Apex Legends, Hollow Knight

From those who opted in, I sampled participants to invite for an approximately 1-hour semi-structured interview. Invited participants could book a suitable time with Calendly and then participate in an interview over Zoom, and could decide whether they wanted the camera on or off. Screening and interviews took place between February 2021 and May 2022.

All interviews were recorded and transcribed using Zoom's cloud recording service. I reviewed each transcript alongside the audio to correct mistakes of the automated transcription, and removed any potentially identifying information. I then coded each pseudonymized transcript using MaxQDA (VERBI Software, 2020). Supplementary materials with full interview guide, anonymized data, and coding tree can be found at https://osf.io/mwpqc.

6.2.3 Ethics

The study received ethical approval from Queen Mary University of London (QMERC20.084). Participants were paid £0.50 for the 5-minute screening questionnaire. Those selected for an interview were paid £12/hour for the duration of the interview, which ranged from 39 to 78 minutes. Participants completed separate informed consent forms for screening and interview, the latter including permission to record and share pseudonymized data.

6.2.4 Participants

Participants (n = 12) ranged in age from 18 to 42 (Table 6.2). Interviews lasted between 39 to 78 minutes (total: 110,000 words). Players resided in a variety of countries, and varied in their gaming history, preferred genres, and the importance of gaming in their life.

6.3 Results

Figure 6.1 presents the resulting grounded theory with four key components. Players approach a game with (1) (unconscious) expectations for the kind and degree of autonomy, competence, and relatedness experiences that play will afford. Based on these expectations, players make decisions about (2) play behavior. Felt need frustration occurs when a (3) need-thwarting situation arises that is *more salient or intense than expected*—this could be autonomy, competence, or relatedness frustration, or some combination. Over time, repeated, sufficiently salient or intense frustration experiences update players' expectations for future need-related experiences. Expectation shifts result in changes in (2) play behavior aimed to reduce exposure to need frustration, such as 'rushing' through a frustrating section, taking breaks, or quitting the game entirely. Such frustration-reducing adaptations can be inhibited by (4) extrinsic motivations—reasons to continue playing despite expecting it to be need-frustrating.

I discuss each of these components in more detail below, beginning with need-frustrating experiences themselves.

6.3.1 Need Frustration

I found substantial evidence that players regularly experience need frustration during gaming. Almost every interviewee easily recalled instances of autonomy, competence, and relatedness frustration during gameplay.

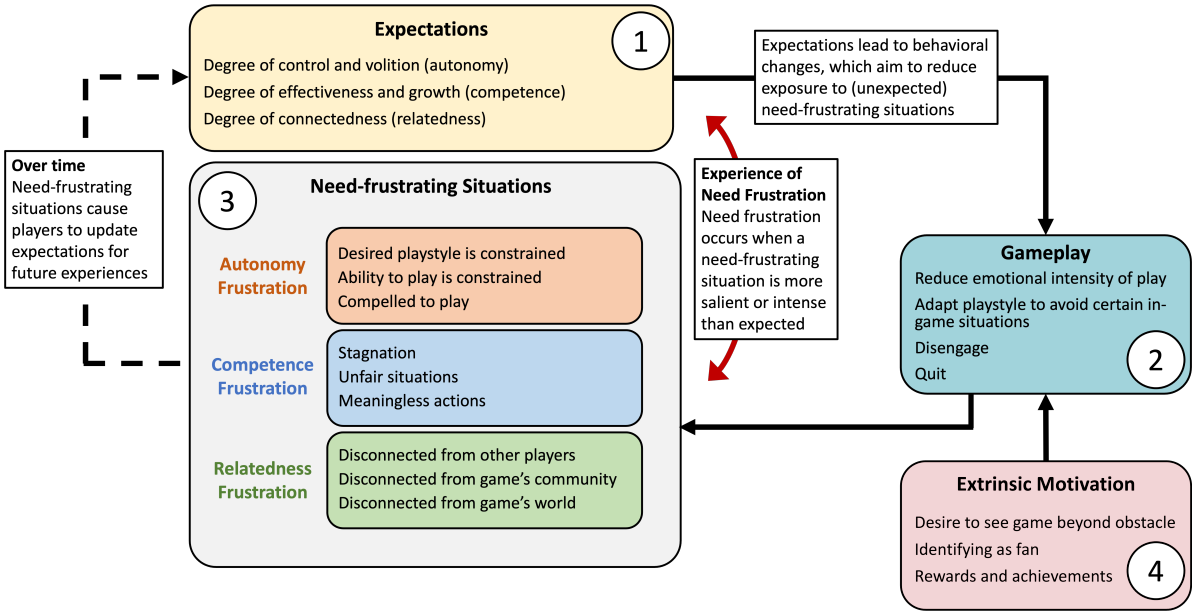

Figure 6.1: *Grounded theory of need frustration in games*. Need frustration occurs when players' (1) need-related expectations are negatively violated during (2) gameplay by an (3) unexpectedly salient or intense need-frustrating situation. Over time, need frustration experiences update players' expectations, which in turn prompts alterations to play behavior aimed at reducing future need frustration—unless (4) extrinsic motivations overpower these. The red arrows between (1) expectations and (3) need frustration represent an ongoing comparison process, rather than a causal flow: players constantly evaluate their gaming experiences with reference to their expectations.

Need frustration occurred when an unexpected (or unexpectedly intense) need-frustrating situation arose.

Experiences of need frustration were also associated with certain emotional 'signatures'. Some of these, such as disappointment and annoyance, were shared across all needs, while others were distinct to autonomy, competence, or relatedness. For space reasons, and because the diversity of emotional descriptions limited my ability to saturate these categories, I do not describe emotional signatures here, but these can be found in the supplementary materials.

Below, I describe the categories of situations that gave rise to frustration of each need in turn.

Autonomy Frustration

I constructed three categories of autonomy-frustrating situations: when a *desired playstyle is constrained*, when the *ability to play is constrained*, or when *players are compelled to play*. The first was the most common: something prevented players from playing how they wanted to play at that moment—e.g., playing a particular character, using particular equipment or abilities, or taking certain in-game decisions. Constraints could arise from other players (e.g., having one's favorite champion or role taken in *Overwatch*), or from the game itself:

> *Destiny* was definitely [a game that restricted my sense of choice or freedom]. [...] You're called Lightbringer. You're expected to be good. [...] the whole premise of the game is that you're going to save everyone. So if you choose anything remotely negative you either don't get as much bonus as you would have or you get penalized. (P8)

Games could also thwart desired playstyles with unskippable segments, such as tutorials or story lines that the player is not interested in:

> Nowadays in [*Assassin's Creed* games], when you are pulled out the Animus, it's by force. And they then sort of force you to just do a few sort of mundane actions in the real world [...] And I'm just like 'why are you making me do this? I don't want to do this, just can I go back in the Animus, please?' (P4)

A players' *ability to play is constrained* when constraints on their schedule, hardware availability, finances, or similar prevent them playing a game (when) they want to:

> It was too expensive for me to buy [*Mass Effect* Legendary Edition] when it was first released, and I was really disappointed. [...] I love the gameplay and the character interactions [...], but the cost was just too much. (P8)

Lastly, autonomy was frustrated when players felt *compelled to play*. Participants reported this for multiplayer games where there are social pressure or punishment mechanics for early leavers:

> We are playing and my mother calls me or I get a phone call, and I really have to go, so I lose interest on [sic] the game, but I keep playing it because I can't go AFK [... as] that will result in a ban. [...] I'm playing the game [...] but I'm not willing to play the game. I don't want it. (P2)

Competence Frustration

Three categories of competence-frustrating situations emerged: *stagnation*, *unfair situations*, and *meaningless actions*.

Stagnation describes situations where players feel unable to complete a desired or required action, stifling their progression. This was afforded by an underlying expectation that progress *should* be possible:

> I'm like 'I can play this game, I know how to play it' but, for whatever reason, every game I go into I just- I can barely get a kill. And I'm just constantly, you know, lowest on the leaderboard and in those moments I do, I feel frustrated at myself. And a little frustrated at the game, because I'm just like 'I can do this. Why can't I do it now?'

Players describe *unfair situations* as moments where external forces make a desired action or goal attainment practically impossible in a way that violates players' expectations of being given equal or sufficient means to make winning or losing an expression of their skill. This could be an AI opponent having artificial bonuses, having key information withheld, or playing against significantly stronger opponents or with significantly weaker teammates:

> The friend group that I played with, were very, very, like hardcore *Counter Strike* players. [...] And playing *Counter Strike* with them was horrible. [...] I couldn't do anything, you know. Like, I would spawn into the game, and I'd just die instantly. (P1)

In many cases, feelings around unfair situations were directed outward—at other players, the situation, or the game, rather than at themselves:

> At first, I thought it was just my ability in games sort of wasn't good enough to get past a fight that was made [...] for a player at a difficulty level higher than mine. But when I did keep going and nothing seemed to be making a difference, and then I did kind of change over to the view that [...] the game had just made an enemy that was too hard. (P6)

Finally, some participants reported competence frustration from *meaningless choices*—situations in which the game allows players to make decisions, but these do not have the expected scale of impact, or no impact at all:

> [*Outer Worlds*] tended to give you choices between, say, this colony or this corporation, but you can't save both. [...] And it didn't matter what you did, you still ended up with the same result. But you know, it made you feel awful, because they get you emotionally invested in the colony, they get you emotionally invested in the corporation and it's like 'why can't you guys work together?' (P8)

Relatedness Frustration

I found three categories of relatedness-frustrating situations: being *disconnected from other players*, *disconnected from the community at large*, and *disconnected from the game's characters or world*.

Being *disconnected from other players* arose when players had disagreements with their teammates, felt that a skill mismatch made for unequal in-game status, and—most commonly—when players were harassed by other players:

> As soon as anybody finds out you're a female gamer [in *Call of Duty*], it's sort of immediately like, you know, just preconceived jokes. [...] So it kind of makes it hard to feel included, even on your own team. (P4)

In other cases, relatedness frustration was more generally about being *disconnected from the community*, which could be players of a particular game, or a subset of those players:

> There are communities that I felt like I couldn't be part of [...] It's like, in *Apex Legends*, I can easily compete in the top 1% players, the top like 0.5%. But there's always like an exclusive group of like the top 500 players in the world [...]. It can be very, like, cliquey in that space. (P12)

Being *disconnected from the game world* comprises experiences where a game's characters or environment made a player feel alienated, uninterested, or disappointed:

> *Battlefield* might be a good example of that. I really normally don't like a setting that is a battlefield. [laughs] Obviously *Battlefield* is in a battlefield. But war-themed stuff is not normally my kind of thing and it just feels like- it feels like I'm out of place. It's like, 'why am I playing this game, if this isn't a setting I enjoy to be in?' (P6)

6.3.2 Expectations

Expectations describe what players anticipate from ongoing or future play and shaped need frustration in two ways: serving as a point of reference that determined the salience of need-frustrating situations, and forming the decision-making basis for selecting games and/or in-game behavior.

First, need frustration became salient when play experience violated or negatively deviated from player expectations. Rather than need-frustrating situations necessarily having an immediate negative effect on player experience or motivation, players described interpreting their experiences relative to their ingoing expectations. Violated expectations could be conscious or subconscious and positive or negative: players could expect certain kinds or frequencies of game interactions that ordinarily support autonomy, competence, and relatedness, which then did not occur (such as perceived impact of meaningful choices, a degree of progress and effectiveness, or fairly matched opponents). Similarly, players could expect some (or no) degree of need frustration, which gameplay then negatively exceeded:

> [Losing items irretrievably in *Valheim*] definitely blindsided me [...] I should have expected it and anticipated it, but I think I was just sort of so in the zone and kind of enjoying the whole experience and the learning and the things that I gathered and how far it progressed. I think that's what made it more upsetting when it did happen and I knew there was no chance of retrieval at that point. (P4)

These expectations were shaped by prior experiences with that game, similar games, or other knowledge of games more generally:

> I played [*Genshin Impact*] for the first month that it came out. And it got to a point where I was kind of logging in just to do kind of like daily stuff. [...] From my experiences with *Dragalia* [a similar mobile game], I was like, I don't want to get into this again. I don't want to just do this daily stuff for no reason. (P1)

Expectations were also set during gameplay by perceived signals from the game. For instance, lack of control over in-game story events would be experienced as less frustrating if the game set the expectation that the story was pre-scripted:

> [In *Cyberpunk 2077*], there was a character that died and it felt like I couldn't do anything about it. It felt like he only died to advance the plot, and not even in a very meaningful way at that. [Whereas in *Red Dead Redemption 2*] I'm not here to necessarily decide the story. So there isn't that kind of false promise of 'okay, yes, supposedly I'm supposed to decide the story, but really we're just going to do whatever the developer wants me to.' (P11)

By the same token, when need-frustrating situations were correctly anticipated, expectations would reduce the salience of felt frustration and could mitigate its impact on play behavior. Players who foresaw upcoming need-frustrating experiences could autonomously choose to play regardless. This can create opportunities for positive deviations and pleasant experiences of surprise. One player describes their frustration over lacking Black representation in avatar customisation:

> The best thing they've been able to do is change the skin color and maybe the hair, which is not even still close enough. [...] I guess it doesn't make me frustrated again because it's expected, it's not 'oh, really, I'm so heartbroken.' No, it's expected. I expected it from the beginning. But if they do have it in the game, I'll be more encouraged to play or buy. (P7)

Second, expectations played a key role in shaping future gaming behavior. Players tended not to immediately change play behavior in response to a need-frustrating experience. Instead, *repeated experiences* of need frustration shifted their expectations for the enjoyment of future play over time, and these updated expectations then informed their decision-making about future gaming behavior. If the anticipated need frustration outweighed the anticipated enjoyment (facilitated by the anticipated satisfaction of basic needs), players would choose to alter their behavior:

> So if I found that, like, two hour process of beating a boss in *Elden Ring* frustrating, and I really didn't enjoy it, then I'll be thinking 'well I've played this one, so I don't have to feel like I was beaten by it, but do I want more of that? Do I want to have to go through that process again and again to clear this game? And will I enjoy that?' (P12)

While the above example shows expectation and behavioral shifts from session to session, they could also happen during a single game session, especially for competence frustration. Here, negative affect would build up over repeated need-frustrating events, counter-balanced by expectations that some degree of frustration was normal; players changed play behavior (and in the worst case, quit the game) when they felt that continued or repeated attempts would not result in a different, less frustrating outcome:

> When you first notice [an overpowered character you feel you have no counterplay against], you're like 'oh, that character is pretty strong.' But the more often you see it, the frequency with which they appear, it gets to a point where it's grating. And it's like 'oh my god, another one', right? And it builds and builds and after a certain point, I straight up just stop playing the game. (P11)

In sum, expectations shape need frustration experiences and resultant behavior: felt need frustration results from the negative delta between expectation and observed situation, while expectations—not immediate emotional responses—steer player behavior.

6.3.3 Play Behavior

In response to current and expected future need-frustrating experiences in the game, participants might alter their behavior to reduce or eliminate their exposure to need frustration in one of four ways. The first was to *reduce the emotional intensity of play*. Players would, e.g., rush through a segment, expending minimum time and attention until they pass the need-frustrating situation:

> Yeah, because you just rush through it, just to get it over and done with. Get the achievement that you completed the game, and that's all. It's not like 'Oh, let's do every single side quest and get distracted from the main quest.' [...] I just wanted to get it over and done with. (P3)

Second, players may *change their in-game behavior* to reduce the prevalence and/or salience of need-frustrating events, taking actions such as circumventing or exploiting challenges, moving to a different in-game location, or interacting with others in a different way:

> I always did pick up groups [in *World of Warcraft*]. [...] I never stuck with specific people because I didn't want [...] to be known as that person who always held the group back. That was my own assessment of how I played and it wasn't necessarily true to life, and so when I got- when I went in a raid with a pickup group I would be quiet, I would follow instructions. (P8)

Third, players might *disengage*. At the mildest end, players would simply step away or take a break from the game. Where need-frustrating experiences were more salient, or more frequent and immovable, players may de-prioritize the game, playing less frequently or only due to strong countervailing motives:

> [My friends] would ask me to come play [*Counter Strike*] with them. I'd be like, 'please don't make me do this, I don't want to play this game.' And they would keep asking, and then like, you know, I would try one more time, and then get destroyed again, right. [...] And like that- the length of time between, you know, me refusing to and me saying 'yes, okay, I'll play one more time' gets longer and longer, until I just don't play again. (P1)

Fourth, in response to the strongest or most persistent need-frustrating experiences, many players chose to *quit the game* entirely:

> [In *Zuma*] you're shooting bubbles [...] and it's just coming so quickly that you can't do it. And I remember being super frustrated at that. [...] You know, it shouldn't be that hard. But yeah, that was one I had to put down and not pick up again because I just- it made me feel incapable. A failure. (P8)

6.3.4 Extrinsic Motivation

As can be seen in the above *Counter-Strike* example, players sometimes reported persisting play despite repeated need frustration. Often, that was because pressures or anticipated rewards external to the need-frustrating gameplay 'outweighed' undesirable frustration. Three categories stood out: *a desire to see the game beyond the obstacle*, *identifying as a fan*, and *rewards and achievements*.

The most prevalent extrinsic motivation was *a desire to see the game world beyond*—due to appealing characters, an interesting narrative, beautiful visual design, or other positive qualities players had positive expectations for future portions of the game, and would push through the temporary need frustration:

> Like going through a Water Temple in *Zelda* or something, right? [laughs] Like no one, no one likes that shit. But the rest of the game is beyond this Water Temple. So you kind of have to slog through it. (P1)

In other cases, players persisted because they *identified as a fan* of a franchise and felt some obligations towards gaming stemming from that identity. In the following example, expected future positive gameplay and fan identity mix:

> But I had to [finish *Final Fantasy XIII*], because I felt like I was obliged to as a *Final Fantasy* fan [...] And play the sequel which is also very bad, and get to the end of that. [...] It's more of like, to see if it suddenly becomes better or to fulfill your duty as a fan. (P3)

Lastly, participants reported being extrinsically motivated by in-game *rewards and achievements*:

> [In Subway Surfer] you have to find different shells [...]. So whilst playing, it was quite frustrating when the actual shells will be up, but I couldn't jump as high. But it kept motivating me because I knew that if I got the shells, I will be able to get a prize or a mystery box or something. (P7)

While these categories do not exhaust the extrinsic motivators I observed, they demonstrate that need frustration does not singularly determine play behavior; rather, play behavior results from a conscious or unconscious weighing of actual current and expected future consequences.

6.4 Discussion

At the broadest level, results support that need frustration is an important recurring experience in video game play that impacts experience and behavior. Players easily recalled a variety of autonomy-, competence-, and relatedness-frustrating situations that linked to distinct negative experiences and subsequent play adaptations via changing expectations. These findings furnish empirical content to game-related autonomy, competence, and relatedness need frustration, and show that these are indeed separate: each was triggered by distinct situations, and showed some distinct experiential signatures.

I hope the model can make a contribution in a few distinct areas of games HCI research and design practice: (1) highlighting the importance of need frustration above and beyond need satisfaction in predicting player retention and in-game behavior; (2) informing more domain-appropriate questionnaires and specific follow-on work; (3) identifying expectations as a crucial, to date largely unformalized factor in both design and user experience research; and (4) expanding general HCI work on user frustration, offering a potential way of differentiating desirable, motivating frustration from negative, demotivating frustration. Each of these is discussed in turn below.

6.4.1 Need Frustration and Player Experience

First and foremost, my data lends method-triangulating support to prior quantitative (Allen and Anderson, 2018; Kosa and Uysal, 2021) and case study (Pusey et al., 2021) work showing that need frustration is indeed a distinct player experience separate from need satisfaction, with a distinct, separable impact on player behavior and engagement. Participants indicated that need frustration was an important factor in selecting games and in-game activities, beyond simply the absence of need satisfaction. Designers interested in player retention may therefore wish to prioritize the avoidance of need-frustrating interactions separately from the well-established goal of affording need satisfaction. This might similarly be a way of analyzing and understanding the player experience impact of design decisions post-release. For example, the impact of the well-publicized tendency of allies in *God of War: Ragnarök* to solve puzzles on the player's behalf after only a short delay (Kennedy, 2022) might be understood as a trade-off between reduced autonomy and competence satisfaction among players who were likely to solve the puzzle imminently and averted competence frustration among players who were truly stuck.

6.4.2 Measurement, Testing and Design

Prior work on need frustration has remained at the general level of establishing *whether* need frustration impacts experience and behaviour. Here, the model fills in the *how*, identifying nine types of need-frustrating situations and some processes through which these arise and impact gameplay.

This empirical content highlight the aforementioned limitations of existing measures of need frustration in games. Existing research has used a modified version of the Basic Psychological Need Satisfaction and Frustration scale (Chen et al., 2015), either pre-pending 'when I play video games' to each item (Allen and Anderson, 2018), or adding 'in [my current favorite online game]' in the middle (Kosa and Uysal, 2021). While many of the scale's frustration items abstractly match experiences reported by the players here, players also reported need-frustrating experiences not captured in these items, like perceived unfairness, meaningless actions, or having one's desire to play or desired playstyle constrained. Other items, such as the autonomy frustration item 'My [daily] activities feel like a chain of obligations', do not nearly map onto the experiences described by players. In other words, results suggest that current scales lack content validity for the domain of video game play. This points to a need for domain-appropriate measurement instruments, and suggest that the model might be a useful foundation for operationalizing the full range of possible need-frustrating situations in quantitative form.

The grounded theory presented here makes more specific predictions about gameplay-related need frustration that invite and require rigorous hypothesis-testing work—the present work is, after all, theory-*generating*, not theory-*testing*. I note that the need-frustrating situations I constructed are emergent products of individual, game design, and gaming context factors. Future research could increase the 'resolution' of these factors and their interaction to make more precise predictions about when need frustration will occur. I see this path as being full of intriguing research opportunities, such as experimental comparisons of differing versions of a mechanic to see which one is associated with greater need frustration (e.g., how do different implementations of a stun mechanic in hero shooters affect opponents' competence or autonomy frustration, related to prior expectations of unrestricted movement?) By the same token, researchers could investigate what characteristics affect need frustration felt among players of the same game—for example, what big 5 personality traits are associated with experiencing relatedness frustration more intensely in a team-based game like *League of Legends*?

6.4.3 Expectations

These results identify a heretofore understudied role of expectations as a key determinant of need frustration. Foregrounding the role of expectations aligns with previous models that have looked at outcome expectations of media use (Kocak Alan et al., 2022) as well as broader cognitive science models that place prediction, rather than stimulus-reaction, at the fore of human experience (Clark, 2016). To my knowledge, only limited SDT research (either in games or more broadly) has addressed the difference between anticipated and felt experiences head on. Studies that have touched upon this intersection, however, find that the confirmation of beliefs (i.e., expectations) that users have before adopting a technology is an important predictor of continuance intentions (Sørebø et al., 2009). This role of expectations is expanded upon in Chapter 8, and unpacked further in the general discussion of this thesis.

6.4.4 Other Conceptualizations of Frustration

Finally, while not the focus of this study, findings also indicate that need frustration does not equate to previous conceptions of general, consumer, or computer user frustration (Bessière et al., 2006; Dollard et al., 1939; González-Gómez et al., 2021). Frustration as impeded goal-directed action 'fits' a range of the autonomy- and competence-frustrating situations I found; for example, the categories of constrained playstyle and unfair situations overlap with appraisal theory-informed findings that consumer frustration is occasioned by perceived lack of personal control and unfairness (2021). However, other situations (such as compulsion to play and disconnection) do not fit, and many of the negative feelings characterising need frustration are not reported in other frustration literatures. As need frustration was near-universally experienced as negative, I believe that need frustration could offer an explanatory mechanism for differentiating negative and positive experiences of frustration, which are frequently reported in video game play (Frommel, Klarkowski, et al., 2021; Petralito et al., 2017). Perceiving one's goal-directed action to be impeded *without* feeling controlled, ineffective, or excluded (i.e., *need*-frustrated) may set apart the positive, motivating experiences of wanting to get past a difficult obstacle from negatively valenced instances where goal attainment *and* needs are frustrated. Similarly, need-frustrating frustration may be more likely to induce aggression (supported, e.g., by Przybylski et al., 2014).

6.4.5 Limitations

Despite purposive sampling for variety, the sample remained relatively homogeneous: all participants were between 18 and 42 years of age and all but two came from the Global North. Participants' stated favorite games were exclusively commercially successful console and PC games; participants did discuss mobile games during interviews, but none listed one as an all-time favorite. While I do not expect that cultural and game platform differences would challenge the grounded theory's core process model, different contexts might give rise to additional, distinct categories of need-frustrating situations.

During coding, I uncovered evidence of several mitigating and exacerbating factors that affected the salience of need-frustrating situations, such as having a preexisting low mood during play or consciously devaluing the experience. These were highly varied within and across participants, thus preventing me from theoretically saturating them as categories; for this reason, I did not specify them in the model. I am confident, however, that they are moderators rather than core processes, and that their under-saturation therefore does not impact the validity of the core expectations-play behavior-need frustration loop and need frustration categories, which are well-saturated. I encourage interested readers to review the coding tree in the supplementary materials for further detail.

The above limitations are both connected to the sample size of just 12 participants. With narrow research questions and a relatively homogeneous sample, I was able to achieve saturation of the core need frustration categories and process relatively quickly. However, this narrow focus came with trade-offs, namely more limited diversity of players and gaming experiences and a smaller total amount of data with which to theorize about moderators. While this sample afforded a successful investigation of the research questions and is line with existing recommendations for achieving 90%+ theoretical saturation (9–17 interviews; G. Guest et al., 2006; Hennink and Kaiser, 2022), I nonetheless hope to further develop and test the model with more diverse players and games, and encourage readers to participate in this.

6.5 Conclusion

Autonomy, competence, and relatedness need frustration are common experiences in video game play that impact play behavior and disengagement, mediated by expectations, and differ in empirical content from domain-general conceptions of frustration and need frustration. The presented model is testable and can inform more domain-appropriate measurement instruments. It provides pointers for designers wishing to avoid disengagement-inducing forms of frustration in their games. It invites self-determination theory and media researchers to direct more attention to the role of expectations for motivation and experience, and how they play out across time and generality scales. Finally, it offers starting points for describing how negatively experienced frustration differs from neutrally or positively felt frustration.

Importantly for this thesis, this study identifies several components that a larger theory of gaming and mental health should incorporate. First and foremost, it underscores the importance of including need frustration as a distinct construct, and using this as a predictor for situational mental health experiences. Second, the role of expectations as a key driver of behavior (and outcome of need-satisfying and need-frustrating experiences, via

an updating function) warrants addressing. Third, these results support that people sometimes continue to play games despite expecting to have negative experiences, due to extrinsic motivations deriving from outside the game experience itself. These components will be important considerations for the BANG model presented in Chapter 8.

7

Study 2: Do People Use Games to Compensate for Frustrated Needs During Crises?

Chapter Contents

7.1 Introduction . . . 73
7.1.1 Covid-19, Mental Health, and Gaming . . . 73
7.1.2 Present Study . . . 74
7.2 Method . . . 74
7.3 Results . . . 77
7.3.1 Autonomy . . . 77
7.3.2 Competence . . . 79
7.3.3 Relatedness . . . 81
7.4 Discussion . . . 83
7.4.1 Compensatory Gaming Selection . . . 83
7.4.2 Features and Mechanisms of Need-compensating Gaming . . . 84
7.4.3 Practical Implications . . . 85
7.4.4 Limitations . . . 86
7.4.5 Conclusion . . . 87

Publication Information and Data Availability

The following chapter is based on content published as:

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The preregistration, qualitative data, quantitative data, and analysis files in this study are available on the Open Science Framework (https://osf.io/vp7ye).

7.1 Introduction

From the previous chapter, which concerns the contextual experience of need frustration in video games, I now pivot to the other direction: how *global* experiences of need frustration affect how people engage with games. People use gaming as a coping and recovery mechanism in everyday life, be it to recover from stress, lift their mood, temporarily escape from distressing situations, or build social support (Iacovides and Mekler, 2019; Kowert, 2020; Reinecke and Eden, 2017; Reinecke and Rieger, 2021), and Basic Psychological Needs Theory has been one of the most frequently used psychological theories to explain the coping potential of gaming (Kowert, 2020). However, as noted in earlier sections, we lack a complete understanding of whether players *actively* seek out gaming experiences that correspond to the needs lacking in their daily life, and the extent to which this compensation is successful or unsuccessful.

Shedding light on this is the goal of Study 2, which consists of a mixed-methods analysis of compensatory gaming. Study 2 happened to coincide with a unique set of circumstances that likely impacted need frustration around the globe: the Covid-19 pandemic. I therefore used the opportunity presented by the Covid-19 pandemic to explore whether people's psychological state during crises led to changes in what games they play and how—that is, whether people selectively exposed themselves to gaming to cope with crises, and if so, how. I conducted a preregistered, mixed-method survey study (n = 285) using the first population-wide social isolation measures introduced during the Covid-19 pandemic in the Spring of 2020 as a backdrop against which to assess (a) whether their psychological need satisfaction/frustration levels in everyday life correlates with selecting games that provide particular kinds of need satisfaction, and (b) what game features and gaming practices are associated with particular kinds of need satisfaction. Qualitative data supported that people actively used gaming to replenish basic needs, while quantitative data showed a positive feedback loop or 'Matthew effect' (Merton, 1968), a term used to refer to situations in which wealth begets more wealth, and poverty begets more poverty. For each need, higher global need satisfaction correlated with experiencing greater satisfaction of that need in gaming. I discuss possible explanations for this data pattern and identify need-satisfying mechanisms in gameplay.

7.1.1 Covid-19, Mental Health, and Gaming

Early into the Covid-19 pandemic, public health officials, researchers, and the media voiced concern about a possible mental health epidemic following in the footsteps of the pandemic due to stress and isolation (Han et al., 2020; Rajkumar, 2020)[1]. In the case of the Covid-19 pandemic, frequently mentioned possible negative mental health effects include increased anxiety, stress, depression, and loneliness due to uncertainty, loss, increased caring responsibilities, economic hardship, and social isolation (Hossain et al., 2020). These mental health impacts can lead people to engage in coping activities (Silver and Garfin, 2016), prompting calls among the HCI community to explore how interactive technologies can be used to mitigate adverse mental health impacts and other issues of the Covid-19 pandemic (Dalsgaard, 2020).

A wide range of opinion pieces, and anecdotal news stories—and eventually, research—quickly emerged about the potential coping effects of video game play during the pandemic (Eden et al., 2020; Pigaiani et al., 2020; Siani and Marley, 2021). As a microcosm of the public and scientific debate on compensatory media use discussed earlier, this work was largely split into two groups: one concerned with potential negative mental health effects, the other with positive ones.

On the positive side, journalists and researchers explored how games like *Animal Crossing: New Horizons* (Nintendo EPD, 2020) might let players socialise with virtual and real others in-game, provide an open world to explore, and scaffold achievable tasks to master, thereby replenishing basic needs that were frustrated by social isolation measures in real life (Elphinstone and Conway, 2020; Langille et al., 2020). Marston and Kowert (2020) advocated for gaming during Covid-19 to support social connection and psychological healing, particularly for older adults and first responders who may be dealing with post-traumatic stress. The gaming industry latched onto this and similar ideas with the social media campaign #playaparttogether, which presented online gameplay as a way to promote WHO health advice and foster social connections during Covid-19 (Takahashi, 2020). Numerous studies found support for these ideas: Yuan et al. (2021) found that players used remote tabletop gaming during Covid-19 to create shared spaces, shared understanding, and shared time. Barr and Copeland-Stewart (2021) found the majority of regular video game players reported increased playtime and

[1] Oddly, the evidence since has been more nuanced: While some systematic reviews have found evidence for reduced mental health (Hossain et al., 2020), especially for healthcare professionals, the possibly most comprehensive and up-to-date meta-analysis, the 'Living Systematic Review of Mental Health in Covid-19' (https://www.depressd.ca/Covid-19-mental-health), finds no evidence for a population-wide negative effect of Covid-19 on mental health (Sun et al., 2021).

positive mental health impacts like cognitive stimulation and opportunities to socialise, connecting their findings to potential SDT explanations. A study of Danish teenagers (Bengtsson et al., 2021) paint similar pictures.

On the negative side, researchers speculated early into the pandemic that problematic game use may rise, due to fewer available activities and higher stress during lockdown (Blake and Sauermilch, 2021; King, Delfabbro, et al., 2020; Ko and Yen, 2020). Some evidence supports these concerns. Gaming does appear to have increased, with one study finding an increase of approximately 20% in daily peak players on Steam games from April–May 2020 compared to 2019, but also that the increase receded to 5–10% by June and remained roughly stable for the remainder of the year (Vuorre et al., 2021). This increased quantity of gaming may indeed have had negative effects for some: findings suggest small-to-moderate increases in dysregulated and excessive gaming (Oka et al., 2021; Xu et al., 2021). An Italian survey found that increased play of *Animal Crossing: New Horizons* was associated with higher anxiety and loneliness (Lewis et al., 2021), which the authors connected to possible negative pathways of compensatory behavior.

In summary, there has been much speculation and mixed evidence about positive and negative mental health effects of gaming under adverse circumstances and the Covid-19 pandemic in particular. Data supports that gaming use has increased during lockdown, mitigating loneliness and social disconnection. Grounded in SDT, more general research proposes that such compensatory gaming (like other compensatory behaviors) can replenish needs (and thus, improve mental health), but also lead to obsessive engagement. One recent qualitative study of gaming during the Covid-19 pandemic (Barr and Copeland-Stewart, 2021) explicitly proposed SDT as a possible explanatory framework for some of the positive mental health effects it observed. However, we do not know (a) whether people during crises actually actively select different kinds of games and gaming forms to compensate for frustrated psychological needs, and (b) what the potential mechanisms and features of gaming are by which it may compensate for thwarted needs during adverse life circumstances.

7.1.2 Present Study

This led me to pose two research questions. The first asks:

> **RQ1**: Do people actively select games and gameplay behaviors that compensate for frustrated global needs during isolation periods, as predicted by SDT?

This question speaks to the aforementioned lack of knowledge about compensatory game selection. Following previous arguments under SDT that need frustration leads to compensatory behavior, if people actively choose gaming to compensate for thwarted needs, we would expect that the less satisfied (or more frustrated) a given need is globally, the more they should select games that satisfy this given need. I preregistered this need compensation hypothesis as follows.[2]

> **H1a–c**: Satisfaction of autonomy (H1a), competence (H1b), and relatedness (H1c) at the global level will be negatively related to satisfaction of that need in gaming.
>
> **H2a–c**: Frustration of autonomy (H2a), competence (H2b), and relatedness (H2c) at the global level will be positively related to satisfaction of that need in gaming.

The second question then asks:

> **RQ2**: How do people use and adapt gaming to manage their need satisfaction?

This latter question speaks to our lack of knowledge about the mechanisms and features of gaming that support a compensatory function. This is not linked to specific hypotheses, and is instead addressed via exploratory qualitative data that may uncover both novel and previously-theorized compensation-supportive game features.

7.2 Method

To address these questions, I adopted a mixed-method approach, testing the hypotheses of RQ1 quantitatively and identifying features and mechanisms supporting compensation (RQ2) qualitatively. I recruited participants

[2]Hypotheses have been slightly reworded from the preregistration (changing 'importance placed on satisfying/frustrating that need in gaming' to 'satisfaction/frustration of that need in gaming'); this change was made to better align the hypotheses' wording with the phrasing of the measure, which assesses the *experience* of need satisfaction in games and is unchanged from the preregistration.

to fill out an online survey including both quantitative measures and open-ended questions about their daily life and gaming during the previous week. The time frame of one week appeared long enough to capture differential choices in gaming and be robust to fluctuations in affect and events, and short enough to be remembered with some accuracy. In a given day, participants may simply not have had time to play and be strongly affected by events of that day, while a month-long frame was more likely to produce generalized narratives.

The study received ethical approval from Queen Mary University of London (QMERC2020/26). The preregistration and study materials (including power analysis, questionnaire, anonymized survey responses, quantitative analysis script and qualitative coding tree and coding project file) can be found in the supplementary materials.

Recruitment and Sample

I recruited participants via social network platforms Facebook, Twitter, and Reddit to complete an online survey in Qualtrics, specifying in the advertisement that players should play one or more hours of digital/non-digital games during an average week. The survey consisted of 55 Likert scale questions and 9 open response questions, and had a median completion time of 17 minutes. Data collection began on May 4, 2020 and was scheduled to conclude either after two weeks or upon reaching the minimum adjusted sample size, whichever came later. As I achieved a sufficiently large sample within the 2-week period, data collection ended on May 18, 2020.

At the end of the survey, participants were presented with the option to leave their email address in order to either enter a raffle for one of three £20 Amazon gift cards, or opt-in to an optional second wave of the same survey in order to examine within-person effects, or both. Data from wave 2 of the study was ultimately not collected.

A total of 437 people clicked the link to begin the survey. Of these, 293 completed the entire survey; the majority of the remainder did not proceed past the consent form. Of the 293 eligible participants completing the survey, 285 correctly answered the careless response check and were therefore included in the final sample. This sample included participants from 37 unique countries, with the majority coming from the UK (58%) and the US (16%). Of the 285 included participants, 125 identified as female, 130 as male, 29 identified as non-binary or preferred to specify another gender, and 1 participant had missing data. The mean age was 31.6 years (SD = 11.6). Participants reported playing a mean of 14.2 hours of games per week (min: 1, max: 26+).

Quantitative Method

Measures

Global need satisfaction and frustration: Participants completed the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al., 2015), which contains distinct subscales for need satisfaction and frustration, and has been extensively validated across cultures (2015). The BPNSFS contains a total of 24 items, with 4-item subscales for satisfaction and frustration of each basic need (autonomy, competence and relatedness, thus 6 subscales in total), each item from 1 ('not at all true') to 5 ('completely true'). Reliability was good-to-excellent for all subscales (Table 7.1), with most participants reporting generally high need satisfaction and low need frustration.

Need satisfaction in video games: Video game need satisfaction was measured using the Ubisoft Perceived Experience Questionnaire (UPEQ; Azadvar and Canossa, 2018), which contains 21 items measuring satisfaction (but not frustration) of autonomy (6 items; e.g. 'I was free to decide how I wanted to play'), competence (6 items), and relatedness (9 items). I chose UPEQ instead of the alternative Player Experience of Need Satisfaction scale (Ryan et al., 2006) because of known psychometric flaws of PENS that UPEQ avoids (Johnson, Gardner, et al., 2018) and UPEQ's inclusion of relatedness items that refer to non-player characters (Tyack and Wyeth, 2017). To maintain consistency with the BPNSFS, items were measured on the same 5-pt Likert scale as above. Reliability was high for all three subscales. Descriptive statistics for both UPEQ and the BPNSFS can be found in Table 7.1.

Analysis

To account for the ordinal nature of the measures, all hypothesized relationships were tested using Spearman's ρ correlation tests. Exploratory analyses show that results of Spearman's ρ tests do not meaningfully differ from Pearson's r, and thus the values can be interpreted similarly. Further sensitivity checks find that results and interpretations are largely similar if using linear regression models with global needs as predictors and needs in games as outcomes, controlling for age and gender (see supplementary materials). For simplicity, I therefore report only Spearman's ρ in line with the preregistration.

Table 7.1: Descriptive statistics

	Mean	SD	Scale Reliability (ω_h [95% CI])
Demographics			
Age	31.6	11.6	N/A
Daily life			
Autonomy satisfaction	3.14	.90	.82 [.78, .85]
Autonomy frustration	2.85	.95	.78 [.74, .82]
Competence satisfaction	3.33	.96	.90 [.88, .92]
Competence frustration	2.82	1.11	.82 [.78, .86]
Relatedness satisfaction	3.91	.89	.86 [.83, .90]
Relatedness frustration	1.97	.92	.87 [.84, .89]
Games			
Autonomy satisfaction	4.21	.60	.78 [.73, .83]
Competence satisfaction	3.87	.75	.85 [.81, .89]
Relatedness satisfaction	3.61	.93	.82 [.78, .86]

Reliability is reported as McDonald's hierarchical ω_h with 1000 bootstrap samples. This value can be interpreted similarly to Cronbach's α.

For interpreting results, I specified a smallest effect size of interest of $\rho = .2$, a value that has previously been proposed as an anchor for minimally important differences in media effects research (Ferguson, 2009). In this study, I used this effect size as an estimate of the smallest relationship that would be considered 'minimally important' by players.

I generated 95% confidence intervals using 5000 bias-corrected and accelerated bootstrap samples, and based the preregistered inference strategy on upper (UB) and lower (LB) bounds of these confidence intervals. This process acts as a simplified and slightly more conservative variation of a two one-sided test (TOST) equivalence test (Lakens, 2017). The inference anchors were as follows:

LB > .2 - Evidence of a practically significant relationship
LB > 0 and UB > 0.2 - Evidence of a relationship that may be practically significant
LB > 0 and UB < 0.2 - Evidence that there is a relationship, but that it is not practically significant
LB > –0.2 and UB < 0.2 - Evidence that there is no practically significant relationship
LB < –0.2 and UB > 0.2 - Inconclusive

Sample Size Calculation Aligned with the above tests I identified a minimum unadjusted sample size of 215 by conducting a simulation study using Spearman's ρ correlation analyses with a smallest effect size of interest of ρ = .2 (see preregistration for further details), which yielded an observed power of .81. I incorporated a safety margin of 20% for participants who responded incorrectly to the careless response check or were otherwise ineligible, resulting in a final required sample of 269, which the final valid sample of 285 exceeded.

All statistical analyses were conducted in R version 4.0.3, using the packages `tidyverse` (Wickham et al., 2019), `MBESS` (Kelley, 2019), and `rcompanion` (Mangiafico, 2020). Qualitative analyses used MAXQDA version 12 (VERBI Software, 2020).

Qualitative Method

Sample Data for the qualitative analysis consisted of the answers to the nine open response questions (see supplementary materials for exact item wording). These asked participants to list up to three games they had been playing recently, and describe what made each of those games appealing. Participants were then asked (1) how (if at all) their gaming activities had changed since the introduction of social isolation measures, (2) how (if at all) gaming had affected their mood, and (3) how (if at all) their attitude toward gaming has changed. These items were designed to generate rich data on a broad set of research questions for a wider study; pilot data confirmed that they prompted useful responses for the research questions here concerning need satisfaction.

The 285 participant responses totalled 67,000 words. Qualitative analysis proceeded until 90% saturation was reached on RQ1 (i.e., for every 10 coded segments, no more than 1 would be a new code). I reached saturation and stopped further analysis at 155 participant responses (38,000 words). The subsample for analysis was generated by randomly selecting participants scoring low (≥ 1 SD below mean), medium (within 1 SD of mean), and high (≥ 1 SD above mean) on the measures in the study, in waves of 45 participants at a time (see preregistration for further details).

Analysis I used qualitative content analysis combining a deductive first cycle of coding with an inductive second cycle (Miles et al., 2014, p. 81). In the first cycle, I was interested in identifying segments reporting on instances of need satisfaction and frustration—both in-game and globally. To this end, I developed a set of 12 theory-derived protocol codes (Saldaña, 2016, p. 174–177)—satisfaction and frustration of autonomy, competence, and relatedness, both in-game and globally—with clear descriptors drawn from the most recent and comprehensive SDT handbook (Ryan and Deci, 2017) (see supplementary materials). For example, *autonomy satisfaction in games* was defined as 'experiences in games where you act with willingness, congruence and in control of yourself'. Because I did not did not prompt participants to discuss need frustration generally, references to global need frustration were closely related to compensatory gaming—people tended only to do so when their global need experiences were relevant to their gaming.

In the second, inductive coding cycle, I then openly coded for *how* gameplay satisfied or frustrated needs—these were therefore emergent, inductively developed subcodes for each high-level protocol code (e.g., *shared stimulation*, an emergent subcode within *relatedness satisfaction in games* that describes playing games as a means of providing a shared focus and joint attention with others). Emergent subcodes were not limited to solely instances of compensation, but rather any time participants discussed the satisfaction or frustration of autonomy, competence, and relatedness in connection with gaming.

In a third coding cycle, I organized the emergent subcodes into broader mid-level themes for more succinct reporting. Mid-level themes thus integrate the emergent subcodes to describe more general patterns of need-satisfying or -frustrating play (e.g., *social lubricant*, a mid-level theme of relatedness-satisfying gaming experiences which describes 'playing games to improve the quality of interactions with others', encapsulating 7 emergent subcodes). The full coding tree with protocol codes, emergent subcodes, and mid-level themes is available in the supplementary materials.

As set out in the preregistration, two researchers (myself and SD[3]) coded an initial subset of participant entries in parallel and then compared codes and discussed disagreements to arrive at a shared understanding of the deductive coding scheme. The second coder has extensive expertise in self-determination theory (both in games and other contexts) and qualitative methods. For logistical reasons, I then deviated from the preregistration as follows: the subsequent coding of all entries was conducted by myself and regularly counter-read by the other coder, resolving disagreements through discussion. Resulting emergent subcodes and mid-level themes were iteratively developed and presented to the larger study team for discussion.

7.3 Results

The following sections report the results for each basic need in turn, leading with the quantitative findings. For reasons of parsimony, I report the qualitative findings in a more narrative format corresponding to the research questions, with reference to mid-level themes. Readers interested in the specific emergent subcodes are directed to the full coding tree in the supplementary materials.

7.3.1 Autonomy

I hypothesized that autonomy satisfaction in gaming is negatively related to global autonomy satisfaction (H1a) and positively related to global autonomy frustration (H2a). Contrary to these hypotheses, I found a significant positive relationship between in-game and global autonomy satisfaction (ρ = 0.26, 95% CI [0.15, 0.37], $p < .001$) (Figure 7.1, left). Because the point estimate, but not the full confidence interval, exceeds the smallest effect size of interest, I consider this effect to be of potentially practically significant magnitude (Lakens, 2017). Similarly contrary to my hypotheses, I found a weak negative correlation between in-game autonomy satisfaction and global autonomy frustration (ρ = –0.13, 95% CI [–0.26, –0.02], $p = .023$) (Figure 7.1, right).

[3]Ballou, N., Deterding, S., Iacovides, I., & Helsby, L. (2022). Do People Use Games to Compensate for Psychological Needs During Crises? A Mixed-Methods Study of Gaming During COVID-19 Lockdowns. *CHI Conference on Human Factors in Computing Systems (CHI '22)*, 1–15. https://doi.org/10.1145/3491102.3501858

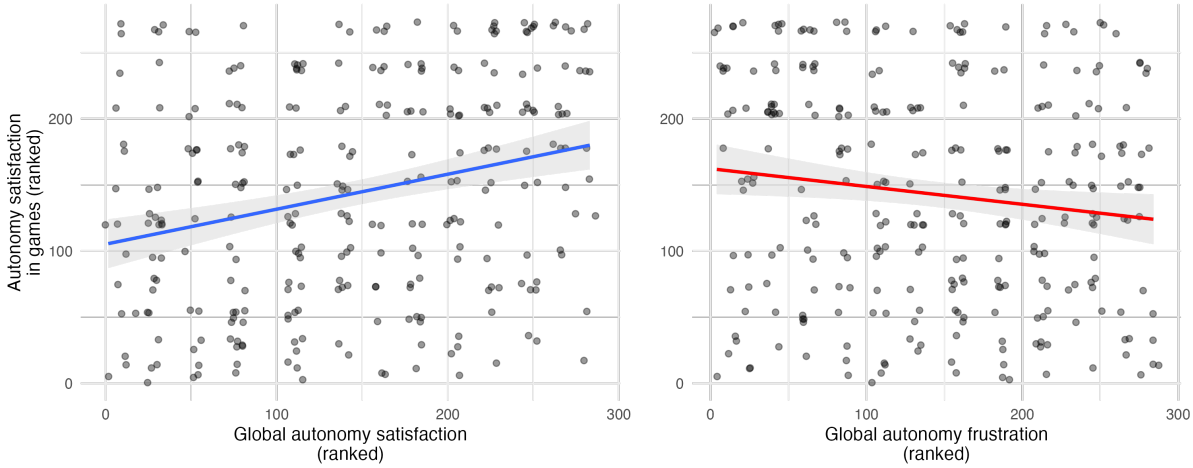

Figure 7.1: Autonomy satisfaction in games correlates positively with global autonomy satisfaction (left) and negatively with global autonomy frustration (right). Horizontal and vertical jitter are added for visibility.

Contrasting with the quantitative results, the qualitative data indicated that some players sought autonomy satisfaction in games as a compensatory strategy. I identified three themes describing types of global autonomy-frustrating experiences that people compensated for with games: *restricted movement* (3 instances), *fragmented time/space* (3 instances), and *limited activities* (7 instances).

In the case of *restricted movement*, players described how lockdown policies impinged on their ability to go places, and talked about how games offered an outlet for them to travel:

> You can explore the islands and go wherever you want. It's quite liberating when we are stuck inside. (P12955, male, 26)

For others, lockdown led to *limited activities*, or a lack of control or inability to do desired pursuits. The following participant discusses how having control over in-game characters helped to balance out the lack of self-direction afforded to them out-of-game:

> The chance to control the lives and fates of sims made up for a current lack of control of my own situation (stuck with social distancing and home office while living alone) [...] Before social isolation I would maybe play 10 hours a week at most, this time has now doubled. This change was motivated by an increased amount of time on my hands, but the effects of playing the sims (control vs. lack of control) have certainly played a part as well. (P14741, female, 26)

Another variation of autonomy compensation is referred to as *fragmented time/space*, which describes people describing a sense of having limited opportunities to get away or find personal space:

> My routine after isolation measures has actually become more chaotic and unpredictable. While I do get more time for myself overall, it's in these chunks of uncertain length that can be broken up at any moment by calls relating to family or work, a myriad of other issues, and ultimately my own inability to focus. I would have liked to dedicate more consecutive time to games that demand consistent focus and explore the ones that I consider to be interesting experiences. Unfortunately, I ended up having to settle for mainly one game that requires little attention (*Epic Seven*). (P77309, male, 32)

Although certain autonomy-frustrating situations at the global level led players to seek autonomy satisfaction in games, games did not always offer such experiences. Players also reported several examples of autonomy frustration in games, which generated three mid-level themes: *guilt/shame about time spent* (14 instances), *no perceived alternatives* (3 instances), and *cannot engage in desired way* (2 instances).

Several participants described a lack of volition or whole-hearted endorsement of their gaming, leading to feelings of *guilt/shame about time spent* when it conflicted with other social norms and demands:

> I've played more games because I've been asked to play more often by friends (since they're all free to play now). When a friend asks, I find it impossible to refuse when I'm hoping to work. As such I usually end up momentarily enjoying my games, but fall into a pit of guilt and self-flagellation afterwards. (P42517, male, 26)

Paradoxically, reflecting on and framing gaming as the only activity remaining available, as was the case for participants reporting that they had *no perceived alternatives* to gaming, could foreground the lack of willingness, volition, and control in gaming, thereby frustrating autonomy:

> Playing on my own has been frustrating and lonely. ... I'm not choosing to be alone. It's not recreation time for me. I'm playing because I can't do anything else. And that makes my mood worse. (P59433, non-binary, 31)

For the cases where gaming was successful in satisfying autonomy, it did so in two broad ways: *through one's in-game actions* (25 instances), and through the *act of playing* itself (8 instances). With regard to *in-game actions*, players discussed valuing being able to play at one's own pace, or undertake self-directed exploration. Often, this was associated with games that had few goals and no time limit, as in the following instance:

> I am also finding the type of games I'm focusing on is slightly different: I'm enjoying open-world games (*Skyrim* and *Deadfire*) where I'm not on a set linear narrative, but have the freedom to just roam around the digital landscape and accomplish tasks at my own pace. (P14316, female, 26)

For others, choosing to engage with a game, or the *act of playing*, was autonomy-satisfying in itself. This was especially salient with games that allowed them to freely (dis)engage by being playable anywhere (mobile games or portable board games) or any time, thanks to their short session length:

> [*Epic Seven* is] a mobile game that can be played anywhere with an internet connection - I could play it away from home, during breaks … [it] requires less focused attention than most games, can be interrupted at any time without penalty. (P77309, male, 32)

Taken together, the qualitative data suggests that gaming can compensate for lacking daily-life autonomy by providing players both with an in-game 'space of their own' that affords high control and self-paced exploration with little pressure, and an in-life alternative course of action that fits many situations and demands little commitment. This would manifest if participants perceived their daily life sphere as unduly restricted and controlled, and if gaming did not also elicit controlling, introjected emotions like shame or guilt, nor was discounted as 'not a real choice'.

7.3.2 Competence

Again contrary to hypothesis H1b, I found a significant positive relationship between global and in-game competence satisfaction: ρ = 0.27, 95% CI [0.15, 0.38], $p < .001$, with a potentially practically significant magnitude (Figure 7.2, left). The relationship between global competence frustration and competence satisfaction in games was negative but non-significant (ρ = –0.07, 95% CI [–0.19, 0.05], $p = .220$; Figure 7.2, right). The confidence interval suggests no practically significant relation, contradicting hypothesis H2b.

Yet as with autonomy, the qualitative data showed incidents of participants selecting gameplay to compensate for lacking or frustrated global competence experiences. Participants reported on two broad types of global competence frustration: *feeling stagnant* (6 instances) and *feeling powerless* (7 instances).

Many participants stated that games gave them a sense of accomplishment that they were not getting (sufficiently) elsewhere, leaving them *feeling stagnant*:

> Especially when work can at times feel[s] like I've not really achieved anything, the thrill of knowing that I've accomplished something each session is a huge drive. (P14316, female, 24)

For some, this compensatory effect even built momentum for seeking competence in other areas of life again, in a positive feedback loop:

> [Gaming] has been effective in making me feel like I've achieved something and so I can go back to my work and try to mirror my achievement there as well. (P73118, male, 25)

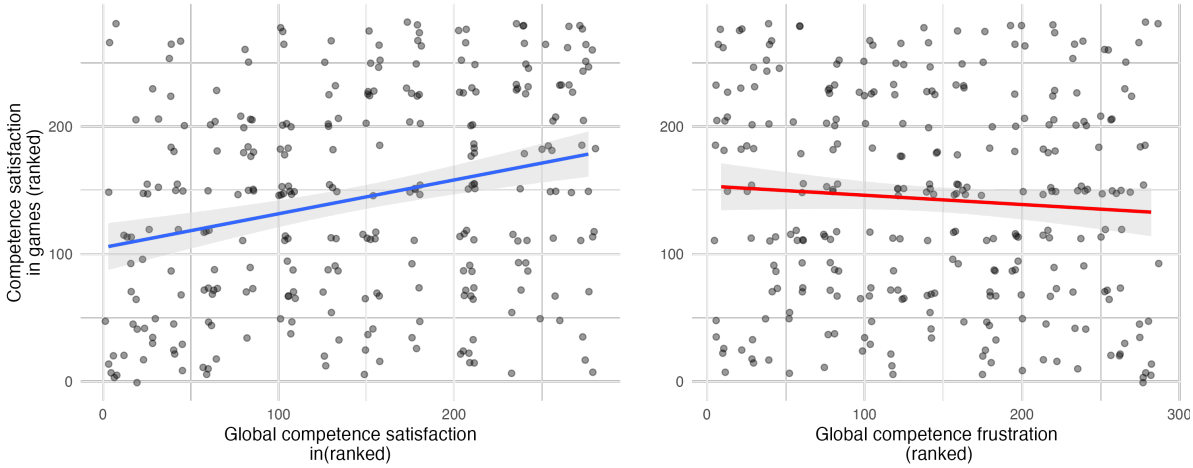

Figure 7.2: Competence satisfaction in games correlates positively with global competence satisfaction (left) and negatively but non-significantly with global competence frustration (right). Horizontal and vertical jitter are added for visibility.

This positive feedback loop notably did not manifest for all players reporting competence-compensating play. Players could frame and discount in-game competence experiences as virtual and fleeting post-game, which would undermine a possible transfer. For this player, gaming had mixed success as a means of compensating for *feeling powerless*:

> [In a game] I can escape into another world where I have the power to solve the problems there, where I can be/look/act like who I want to be but am not able to in life. Artificial feelings of achievement, collecting those cheevos [achievements] as some kind of almost tangible proof of having done something lasting. its all transient and in substantial but it lets you forget about the real life issues you have no power to solve, while in game you are successful. (P14198, non-binary, 34)

I found two high-level aspects of how games satisfy competence needs, namely by offering a *source of challenge and achievement* (12 instances) and/or a *sense of progress/momentum* (19 instances). By being a source of challenge and achievement, games provide a opportunity to test physical and/or cognitive skills:

> The specific DLC [of *Don't Starve*] I was playing, Hamlet, is essentially rebalancing the game to be more difficult, shifting it from a survival game about thriving to a survival game where there really is a genuine struggle to survive at all times. (that's the appeal to me.) I picked it up because, in quarantine, I figured I finally had enough free time to make a successful run of that game, unlike during my previous attempts. (P36744, male, 18)

The presence of challenge on its own would not afford competence, however. If and when players *overcame* these challenges, then this would create a sense of achievement and pride:

> The battle aspect makes the game challenging, so it provides both an escape from the real world and a sense of accomplishment when successfully defeating enemies (the game is difficult for my skill level). (P14741, female, 26)

Overcoming difficult challenges in games often requires prolonged effort to improve. As participants observed, one reason they were willing and able to tackle and overcome challenges was that they could (during lockdown) invest time and energy into the game such that they could improve and notice improvements in their ability:

> Being allowed to take my time with the game means I also have the mental space to delve into the rules and synergies in a new way, and so I make better decisions. At the moment I am, frankly, steamrolling it and thinking about upping the difficulty. In other words, I'm getting GOOD at this game. It's thrilling, and I am going to miss this feeling if I ever end up back in a place where I can't be motivated to play. I'll try not to go there because I'm starting to feel like I'm on some great gaming-play-medicine. (P74444, female, 33)

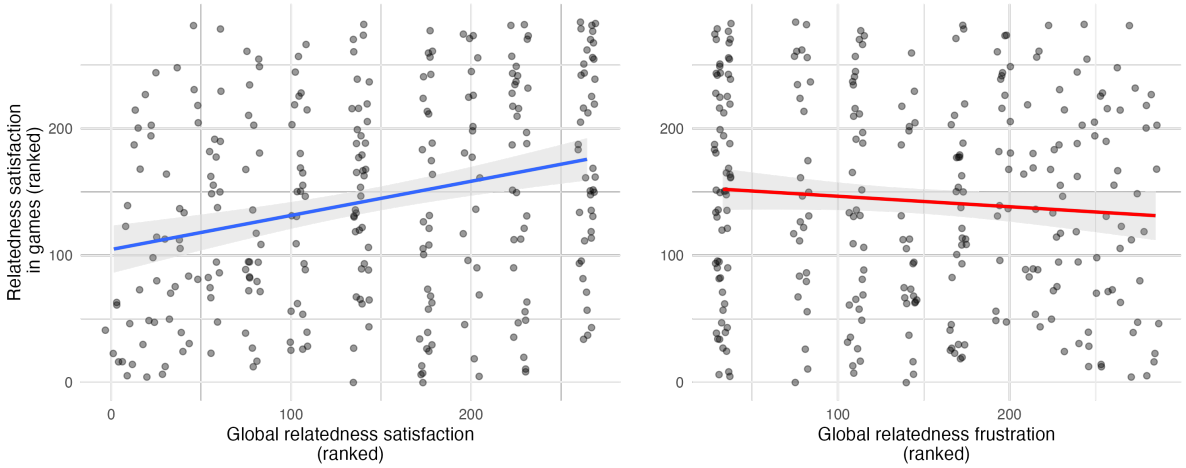

Figure 7.3: Relatedness satisfaction in games correlates positively with global relatedness satisfaction (left) and negatively with global relatedness frustration (right). Horizontal and vertical jitter are added for visibility.

However, competence did not necessarily need to derive from challenge. For some, casual games similarly afforded a *sense of progress or momentum*, helping to provide structure and forward momentum in their day:

> [*Kittens Game* is] an idle game so i decided to start playing it with the idea that it could help motivate me to do other things by forming the idea i was making progress in the game whilst going about errands. I also was drawn to it for the sense of progression. (P65511, female, 25)

In summary, gaming can compensate for lacking or frustrated global competence during lockdowns by providing players with increasing non-trivial challenges that they are nevertheless able to overcome, if players have opportunities in their daily life to invest prolonged time and effort into the game, and if they did not discount the value of in-game accomplishments.

7.3.3 Relatedness

Again, in contrast with my hypotheses (H1c and H2c), I found a significant positive relationship between global and in-game relatedness satisfaction (ρ = 0.27, 95% CI [0.16, 0.37], $p < .001$; Figure 7.3, left). The confidence interval bounds indicate that this effect may be practically significant in size. Global relatedness frustration was not significantly related to relatedness satisfaction in games, but I narrowly cannot conclude that there is no practically significant relationship (ρ = –0.08, 95% CI [–0.20, 0.04], $p = .168$; Figure 7.3, right).

The qualitative data meanwhile surfaced clear evidence that people chose games to compensate for frustrated global relatedness. I identified two mid-level themes of the kinds of relatedness-thwarting experiences people used games to help alleviate, namely *lacking opportunities to connect* (20 instances) and *connecting in unsatisfying ways* (8 instances). In the former, numerous participants echoed the usefulness of gaming to connect with others when other means of doing so were unavailable to them:

> I didn't previously play co-op games. I'm missing human contact at the moment, so playing with friends is the closest I can get. it also gives us something to do instead of talking awkwardly about how we haven't done anything. (P59433, non-binary, 31)

Other participants reported *connecting in unsatisfying ways*—despite having opportunities to connect with others, these were found to be stilted or incomplete in some way that gaming could help alleviate, as this participant illustrates:

> I'm not a great conversationalist at the best of times and I don't have anything to talk about at the moment as I'm not doing anything. I like playing games with my housemates or with friends over houseparty as it takes pressure off to constantly be thinking of things to talk about and lets me enjoy their company in person and over video. (P42020, female, 23)

For most, this compensatory selection seemed to be successful. Participants reported that gaming stabilized their relatedness satisfaction in a life situation that otherwise could have created feelings of disconnection:

> [Gaming] definitely helped. [...] it soothed the feeling of isolation, especially playing ESO [*Elder Scrolls Online*] and coming in contact with other players, although it was only online. (P16863, female, 42)

However, for others, gaming was not successful in addressing relatedness deficits. As with competence, some participants perceived or framed the social connection and relatedness experienced in-game as less 'real' or 'deep', as in the following case:

> [Gaming has] allowed me to keep in contact with friends more often, but I wonder if the connections and conversations I have with them are shallower. We don't seem to talk about how we're doing or how life's going, just about the game. Maybe that could be [because] very little is happening in our lives. I feel like I haven't really connected to anyone in a long time... (P42517, male, 26)

Relatedness was by some margin the need most often explicitly targeted for satisfaction through gameplay. The data indicated three broad ways in which gaming was used to satisfy relatedness needs: as an *excuse for interaction* (93 instances), as a *social lubricant* (43 instances), and as a *source of connection* itself (20 instances).

The first is gaming as an *excuse for interaction*. By 'excuse', I mean that games would serve as a technological mediating environment for people to interact with each other; but more importantly, also as a socially accepted occasion to socialise. In other words, gaming became a means to the end of interacting with others, with players not necessarily invested in the game itself (or in winning it).

> [During lockdown] I use games a lot more as a tool to socialise, rather than just to unwind or kill small amounts of time. (P14454, male, 21)

> The game is mainly an excuse to talk on voice chat with friends. Choice of game was fairly random, we picked it up by coincidence. (P67726, male, 32)

As part of this theme, participants reported playing games to spend time with current friends and family, reestablish relationships with older friends and family, spend quality time with a partner, or meet new people. Synchronous multiplayer games tended to be associated with gaming as an excuse for interaction.

Another way that games supported relatedness satisfaction was as a *social lubricant*: people chose gaming because it improved the quality of interactions with others, and thus, the relatedness satisfaction that it would bring. For some, games served as a source of shared stimulation and structure, something that participants felt was missing in their lockdown life, making conversations without gaming as a lubricant harder:

> Video calls to catch up with friends are all good and well but as we have little to report back on in our increasingly small lives, it can be more rewarding to actively participate in something together, and I find games are a nice way to do that - gives some structure to the virtual interaction time. (P82408, female, 34)

Finally, gaming could be selected as a direct *source of connection*. In these instances, participants derived relatedness satisfaction from gaming interactions and practices, rather than the game serving to establish or smooth non-game interactions. Participants described feeling relatedness as a member of a group or community of players with a shared interest, be it by virtue of playing a game they knew or saw others play, or by participating in online discourse about the game:

> [*The Wretched*] also encourages players to record audio/video journals during gameplay which I've been sharing with other players on Twitter, and it's helped me feel part of a community when I can't otherwise see my friends. (P68390, non-binary, 33)

This sense of resonance and connection through the appreciation of others' work extended beyond other player creations (like custom maps in *Minecraft* or music in *Second Life*) to include felt connection to the world created by game developers.

> [I] really enjoy the atmosphere of the game and its obvious the world is made with care and I love walking around in the game and seeing the incredible thought and effort gone into creating the world. (P33122, male, 29)

Nor was this sense of connection limited to other human beings; some participants reported parasocial relationships, where they felt connected to the virtual, non-player characters of the game that they were playing:

> It's doing wonders to my mental health, just having that relaxing space and nowhere else to be. I end up reading most of the lore and dialogue this way, and really lose myself in the game world, as cheesy and that sounds. I'm starting to really care about these characters and I laugh audibly at their shenanigans. It feels good and - I think - physically mitigates some of the stress I felt early on during lock-down. (P74444, female, 33)

Summarising, people compensated for thwarted relatedness by actively choosing games that offered an excuse and lubricant for non-game interactions, provided a sense of community belonging, and/or supported parasocial interactions with non-player characters. This could backfire if and when participants perceived gaming-based relatedness satisfaction as unreal and/or as foregrounding their lack of relatedness satisfaction in everyday life.

7.4 Discussion

7.4.1 Compensatory Gaming Selection

Overall, results paint a mixed picture on compensatory gaming selection (RQ1). The qualitative data contains clear incidents of people intentionally choosing gaming, particular games, and particular styles of gaming to compensate for lacking or unpleasant experiences in their day-to-day life. These lacking experiences match basic needs as framed in SDT, such as a perceived lack of control, freedom, and 'personal space', or a sense of being stuck (autonomy); a lack of achievement or accomplishment (competence); and a felt lack of human contact or sense of isolation (relatedness). Many participants who report such compensatory gaming also report it to be a valued and successful strategy to replenish their needs and support their mental health during the Covid-19 pandemic. This aligns with previous work on positive psychological effects of gaming during the pandemic (Barr and Copeland-Stewart, 2021; Kleinman et al., 2021), and prior research relating to stress and difficult life circumstances (Iacovides and Mekler, 2019; Reinecke and Rieger, 2021). In particular, the results support the existence of diverse pathways through which games can support social connection beyond simply the act of playing together. Some of these overlap with previous work; for example, Colder Carras, Kalbarczyk, et al. (2018) showed that veterans used video games as an opportunity to discuss meaningful and personal topics (aligning with my *social lubricant* theme).

However, the quantitative data showed a pattern that I did not predict for compensatory gaming. I expected a negative correlation between global need satisfaction and need satisfaction in games people chose to play, based on previous literature that suggested that deprived needs should lead to behavioral changes that may replenish those needs (Sheldon and Gunz, 2009; Vallerand, 1997; Vansteenkiste et al., 2020). Instead, I found a positive correlation for all three needs, and the effect size estimates indicate that this relationship might be practically significant in magnitude (i.e., important to players). Similarly, counter to expectation, I found negative correlations between need frustration in everyday life and need satisfaction in chosen games, though not practically significant for two out of three needs (relatedness, competence).

How do I explain this prima facie contradiction of qualitative and quantitative results? Though the cross-sectional data is severely limited in its ability to generate causal inference, I see three possible explanations worth exploring in future work. The first and perhaps most parsimonious explanation is that compensatory gaming is successful: People who experienced more need satisfaction overall in a week did so *because* they played more need-satisfying games that week. The predicted pattern (low life need satisfaction $\longrightarrow$ high in-game need satisfaction) fits the qualitative data and is occluded in the quantitative data by people reporting on their resultant need states of a given week (e.g., average, peak, or end state), not the need state at the time they were making game choices. To test this explanation, one would require study designs that capture current need states and expected in-game need satisfaction at the time of game selection, such as experience sampling or ecological momentary assessment.

A second possible explanation is that the need satisfaction derived from games follows a 'rich get richer, poor get poorer' feedback loop (Merton, 1968): people relatively high in need satisfaction in life benefit further from in-game need satisfaction, while people relatively low in need satisfaction in life (and potentially compensating for that fact) are left even more thwarted in their needs by gameplay. This explanation directly fits the pattern of the quantitative data, which also entailed some matching instances of these positive and

negative feedback loops. Across all three needs, I found reports where people discounted the value of game-generated need satisfaction, perceiving it as insubstantial. This discounting itself may have negated or reversed the need satisfaction consequences of these events (see discussion of qualitative results below); or reflecting on one's compensatory use of gaming could foreground and thereby exacerbate the lack of other, 'real' need satisfaction opportunities. Alternatively, people who believe that gameplay is a 'waste of time' may have experienced guilt and a lower-self image when thinking about the fact that they played more video games. There is some evidence that this mechanism can reduce, negate, or even reverse the overall mental health benefits of entertainment media use for recovery, moderated by self-regulation resources (Reinecke et al., 2014). For competence (but not autonomy or relatedness), I also found instances of a positive feedback loop, where in-game need satisfaction would replenish a person's psychological resources and motivation to seek out similar need satisfaction out-of-game.

This 'rich get richer, poor get poorer' pattern would fit an emerging overall picture in the literature that compensatory media use can 'work' or 'backfire' for mental health, depending on situational and especially personal moderators (Koban et al., 2021; Vansteenkiste et al., 2020). First, there is emerging evidence that higher state stress leads to more and more avoidant, escapist, procrastinating kinds of media use that do not contribute to mental health (which would include need satisfaction) (Allen and Anderson, 2018; Eden et al., 2020; Koban et al., 2021). This could be due to stress impeding self-regulation (Reinecke et al., 2014): people are momentarily less capable of exerting cognitive effort to direct their media use toward beneficial forms. Similarly, people high in resilience could bounce back from stress faster and therefore more easily regulate their media use in beneficial forms (Eden et al., 2020).

A further matching picture comes from SDT research building on Vallerand's dualistic model of passion (Vallerand, 2008). Obsessive passions have been found to arise as initially compensatory strategies in life circumstances where people's needs are thwarted (2008); in the absence of other coping strategies, people stick to the obsessive activity habitually and rigidly even where it harms mental health. A rapidly growing body of literature finds that harmonious and obsessive passion are distinct patterns in gaming experience associated with adaptive (harmonious) or maladaptive (obsessive) gaming motives, and that obsessive passion shows a negative feedback loop: global need frustration predicts obsessive passion, which in turn predicts further global need frustration (Johnson et al., 2021; Koban et al., 2021; Mills, Milyavskaya, Mettler, Heath, et al., 2018b; Orosz et al., 2018).

In short, the data pattern here would fit an emerging picture that factors like stress or obsessive versus harmonious passion moderate the mental health effects of compensatory gaming, where people with overall high momentary mental health who relate to games as a positive source of need satisfaction easily regulate their gaming use to receive such satisfaction, whereas people with poor momentary mental health engaging obsessively with games are less likely to positively regulate their gaming, and thus less likely receive need satisfaction from it. To test this properly, longitudinal study designs would be in order, including some theory-derived or mixed-method parcelling out of possible moderators. One possible, unexplored part of this overall dynamic is whether people discount or devalue gaming – see the next section.

Third and finally, the pattern in the quantitative data could be explained by people's current experience of 'global' need satisfaction at the time of reporting overshadowing remembered need satisfaction during gaming in the past week. That is, the reported positive correlation occurs because people on reporting cannot and did not differentiate experienced or remembered overall global need satisfaction from in-game need satisfaction. This would be consistent with both compensatory gaming actually existing (which would fit the qualitative data) and not existing; in the latter case, the compensatory gameplay I found in the qualitative data would be spurious in some way. For instance, it could result from impression management as a form of demand characteristics (Orne and Whitehouse, 2000): participants may have chosen to selectively report compensatory gaming instances which paint gaming in a positive light and thereby legitimise their increased gaming during lockdown to themselves and the research team. Relatedly, compensatory gaming might be an extra-ordinary player experience (Tyack and Mekler, 2021), which would be therefore easier to recall and thus, over-reported in the qualitative data relative to ordinary gaming experiences with no compensatory function. I believe this latter explanation is less likely given other evidence on compensatory media use and effects, but it remains a possibility. In either case, testing this explanation would again need methods like experience sampling that can capture need states and expected need satisfaction at the time of game selection.

7.4.2 Features and Mechanisms of Need-compensating Gaming

Moving on to need-compensating gaming mechanisms and features (RQ2), qualitative results suggest moderators for whether people succeed in obtaining compensatory need satisfaction from games which—to my

knowledge—are not accounted for in current research. As noted above, I found instances where participants' reflection on gaming as the only available option for need satisfaction and/or as less 'real' would result in an overall worse mood and lesser experience of need satisfaction. In SDT, the basic idea that an internal appraisal process determines whether an external event is perceived to be need-satisfying or -thwarting is well-established as 'functional significance' (Ryan and Deci, 2017, p. 130). But this appraisal process is commonly only used to explain the motivational consequences of especially negative performance feedback: e.g., people can perceive the same negative feedback as controlling (this tells me what to do), which thwarts autonomy; or as informational (this helps me improve), which supports competence; or as amotivating (this tells me the task is irrelevant or futile). The instances I found could be read as participants reframing the functional significance of gameplay from autonomy- or competence-supporting to autonomy- and competence-thwarting or amotivating by discounting or devaluing gaming experiences as unreal and therefore, futile or socially inappropriate. This would suggest that people's cultural beliefs and attitudes towards gaming might moderate the impacts of compensatory gaming: If people endorse gaming as a positive and 'real', worthwhile activity, negative outcomes such as guilt, poor self-image, introjected ego and social approval motives, and the discounting of experienced need satisfaction are less likely to arise. Vice versa, if they believe gaming to be an 'unreal', worthless pursuit, these negative processes are more likely to occur. Unfortunately, the qualitative data was not rich enough to establish this possible mechanism as a richly saturated theme. This is an interesting area for future research.

In terms of what gaming features and practices replenish needs, and how they do so, my findings mostly align with existing literatures—noting that the findings here vary in their saturation. Autonomy satisfaction was afforded by games offering an in-game 'space of one's own' with high player control, self-paced exploration, and low perceived pressure, while not eliciting controlling, introjected emotions like shame or guilt. This matches prior work on in-game and contextual autonomy support (Deterding, 2016). One novel observation was that games afforded contextual autonomy support when they were perceived as broadening the spectrum of available courses of action in a situation, thanks to easily 'fitting in' and demanding little commitment, as with casual mobile games that are easy to start and stop playing anywhere. This is a known appreciated quality of casual games (Juul, 2010) that may be understood through the lens of autonomy support.

Games afforded competence satisfaction with increasing non-trivial challenges that players are nevertheless able to overcome, which again matches the literature (Rigby and Ryan, 2011). Interestingly, the data contained fewer instances of participants reporting that they gravitated toward 'easy wins'. This somewhat contradicts recent work on media use for recovery which suggests that people with depleted psychological resources might gravitate to less challenging media because they do not have the energy to engage them or want to avoid the risk of being depleted even further (Helsby et al., 2023; Reinecke and Rieger, 2021). This might be explained by the sample on the whole reporting mild or even no psychological depletion during the early stages of the pandemic (the mean competence frustration was 2.82 on a 5-point scale, comparable to other non-pandemic samples; Chen et al., 2015). Another interesting and novel observation was a contextual competence support: to derive competence satisfaction from challenging games, players need opportunities in their daily life to invest prolonged time and effort into the game. This offers an intriguing sociological explanation for demographic differential preferences for different kinds of games (e.g. 'hardcore' versus 'casual').

As for relatedness support, I found games could offer (1) an excuse and lubricant for non-game interactions, (2) a sense of community belonging through sheer play and participation in meta-communication and sharing about play, and (3) parasocial interactions with non-player characters. The latter two mechanisms have been observed or speculated on in prior work (Kaye and Bryce, 2012; Rigby and Ryan, 2011; Tyack and Wyeth, 2017). Gaming as an (1) excuse and lubricant for non-game interactions has been incidentally observed before (Kaye and Bryce, 2012) and recently in the context of Covid-19 (Barr and Copeland-Stewart, 2021); the findings overlap with certain aspects of Kleinman et al.'s *using games to connect with others* theme of gaming during the pandemic (Kleinman et al., 2021). This may represent a shift in focus, as earlier work in this area often focused on offline social links and social capital afforded by online gaming communities like MMORPG guilds (Barr and Copeland-Stewart, 2021). The use of gaming to structure and afford non-game interactions with non-gamer friends and family may be a previously less noted phenomenon, or actually emerged as a novel strategy during social isolation.

7.4.3 Practical Implications

Study 2's results suggest that campaigns to promote gaming as a safe and adaptive hobby during the pandemic such as #playaparttogether (Takahashi, 2020) aligned with many players' personal perceptions of gaming as a valuable coping mechanism during the pandemic. While the sample here consists of relatively engaged

players who are likely to have played games regardless, promoting gaming to a wider audience may have led to psychological benefits for many people. As discussed, however, potential benefits were not universal, and results may help inform why certain players may be suffering negative mental health consequences in relation to their gaming.

In terms of deliberately choosing or designing games for coping benefits, these findings broadly align with prior findings on what kinds of games and game design features support the satisfaction of psychological needs (Peng et al., 2012; Tamborini et al., 2010). Counter to common devaluations of casual games as somehow less 'real' or legitimate (Consalvo and Paul, 2019), I found that their interruptibility and short required play span could actually make them more potentially beneficial for people who would not be able to fit non-casual games into their lives.

One interesting potential practical implication of these findings is the role of people's attitudes and beliefs regarding the worth, legitimacy, or 'realness' (2019) of gaming itself. People who devalue and discount gaming may experience guilt, poorer self-image, conflicted and introjected motives ('I like this but I shouldn't, that's bad') over gaming, and this in itself may partially moderate whether people benefit from gaming. If this were true, current media and public health messaging around gaming as worthless or addicting would help undermine the potential psychological benefits of gaming and feed obsessive relations with gaming by reinforcing people's conflicted, non-integrated relation to gaming, in a form of self-fulfilling prophecy. Media and public health could in turn support any potential mental health benefits of gaming by endorsing and communicating them, thereby reducing devaluing attitudes and beliefs towards gaming. For designers, this would mean that the legitimising framing messaging around a game ('this is good for you') would be an important part of the overall design. I emphasize that this is a potential mechanism that requires more research before jumping to any implementation.

7.4.4 Limitations

As with anything relating to the Covid-19 pandemic, these findings may be biased by history effects: I collected data during May 2020, early into the first lockdown measures for many countries across the globe (Hale et al., 2021). People may have experienced need satisfaction or frustration to different degrees at this stage than during later phases of the pandemic. Participants will also have experienced different kinds of social isolation measures, furlough schemes, and health challenges based on their location. The main potential history effect I can imagine is that over time, global need frustration may have become more acute and the compensatory power of gaming would 'wear thin'.

Another obvious limitation is the cross-sectional study design, which requires strong assumptions to interpret causally—based on our data, it may be that need satisfaction in games leads to global need satisfaction, the converse, or some other pattern. Notably, participants were prompted to reflect about the previous week, and therefore described 'summary' experiences rather than individual compensatorily-motivated sessions. Further work is needed on how gaming decisions are made on shorter timescales, for example using ecological momentary assessment to disentangle compensatory seeking and successful compensation (i.e., compensatory experience). Such work might also explore whether some sub-populations are more likely to experience positive or negative effects than others, for example due to differences in age, gender, or degree of involvement in gaming.

Quantitative results for relatedness should be interpreted cautiously, as a confirmatory factor analysis of the UPEQ relatedness subscale indicated that the items addressing connection with in-game characters may load onto a separate factor than items referring to other players. Future work is necessary to understand the role of parasocial interaction in relatedness satisfaction, and how to measure this appropriately.

Finally, in terms of qualitative results, I hasten to add that the themes I report have highly varying degrees of saturation: due to the one-shot survey design, I could not engage in iterative rounds of data collection, coding, and interpretation to thoroughly pursue and saturate the themes I found. As I flag in the results and discussion throughout, many of the themes I found invite multiple alternative interpretations and explanations that I could not resolve in any direction; put differently, while I did achieve code saturation, I cannot speak to the degree of meaning saturation I achieved (Hennink et al., 2017). Future qualitative work is needed here to firm up my findings–especially on how people's beliefs and attitudes toward gaming differentially shape the mental health impact of compensatory gaming.

7.4.5 Conclusion

I found qualitative evidence that during the Covid-19 pandemic, people actively sought out gaming to compensate for globally thwarted needs. This is in line with prior evidence that gameplay can replenish thwarted needs, and empirically supports prior untested predictions in SDT research about compensatory gaming selection. Games afforded need satisfaction through an in-game 'space of one's own' with high player agency, self-paced exploration, low pressure, and no triggers for controlling emotions, which fitted into people's lives (autonomy); provided non-trivial challenges to overcome with sufficient time to invest into getting better (competence); and supported parasocial interactions, belonging to a play community, and an excuse and structure for non-game social interaction (relatedness).

The quantitative results complicated this picture; counter to predictions, they showed a robust positive correlation between global need satisfaction and in games played, and no strong relations between global need frustration and need satisfaction in chosen games. I offer three possible explanations for this data pattern: (1) compensation succeeded, as people who played more need-satisfying games report higher need satisfaction in their daily life generally; (2) there is a feedback loop whereby participants with high global need satisfaction are more likely to to experience need satisfaction in gaming; or (3) global need satisfaction overshadowed remembered need satisfaction during reporting—qualitative instances of compensatory gaming may be insignificant or extraordinary gaming experiences that get over-reported, or impression management by the participants. The qualitative data offer some support for the positive feedback loop explanation, which also matches broader theory and evidence about differentiated positive and negative outcomes of compensatory gaming. One possible moderator worthy of future work is people's beliefs and attitudes toward gaming potentially undermining experienced in-game need satisfaction and inducing negative social motives and emotions like guilt or a lower self-image.

Together, these mixed-methods results show that gaming is a common and valued strategy for compensating for basic psychological needs, but that it is not universally successful, and that cross-sectional and summative quantitative assessments of compensatory gaming are limited in their ability to detect this process: summative measurements over longer timescales may be unable to detect minor, ongoing behavioral adjustments intended to balance out depleted needs. Future work would benefit from longitudinal designs with access to momentary need states and decisions, such as experience sampling or ecological momentary assessment.

For the current thesis, Study 2's results indicate that the primary hypothesized direction of the relationship between contextual and global need satisfaction is positive, but that frustrated global needs nonetheless—at least in some cases—produce motivation to seek out need-satisfying experiences in certain life domains. This will inform further pathways in the BANG model presented in the following chapter. Where this compensatory motives do occur, the results here point to a need to pay close attention to timescales—it may be that compensatory play does occur such that people in situational need-frustrated states selectively expose themselves to need-satisfying gameplay, and thereby satisfy these needs quickly before any relationships would appear in a retrospective, contextual and medium-term assessments.

8

The Basic Needs in Games (BANG) Model

Chapter Contents

8.1 Introduction . . . 88
8.2 The BANG Model . . . 89
8.2.1 Need-Related Outcome Expectations . . . 91
8.2.2 Motivation . . . 91
8.2.3 Selective Gaming Exposure . . . 92
8.2.4 Play Quality . . . 93
8.2.5 Play Quantity . . . 94
8.2.6 Problematic Displacement and Life Fit . . . 94
8.2.7 Need Satisfaction and Frustration . . . 95
8.2.8 Mental Health Experiences . . . 97
8.3 Discussion . . . 98
8.4 Conclusion . . . 99

Publication Information and Data Availability

Chapter 8 is based on content that, at the time of writing, is co-authored by Sebastian Deterding and under review at *Interacting with Computers*. There is no public version at this time.

There are no data, code, or materials associated with this project.

8.1 Introduction

Through the background section of this thesis, I motivated the need for an improved theory of video gaming and mental health. With the field reaching a greater level of maturity, I believe the time has come to work more earnestly toward theory that explains how individual differences, behavior, and player experience factors can produce *positive*, *negative*, and *null* impacts. A productive theory should give researchers and players information about both maximizing the benefits of gaming, and minimizing its downsides. In other words, the model should offer mediating or moderating factors that determine for whom and under what conditions gaming use affects mental health positively, negatively, or not at all.

With the goal of making progress on this challenge, this chapter presents the Basic Needs in Games (BANG) model of video game play and mental health. BANG has roots in self-determination theory, but also integrates

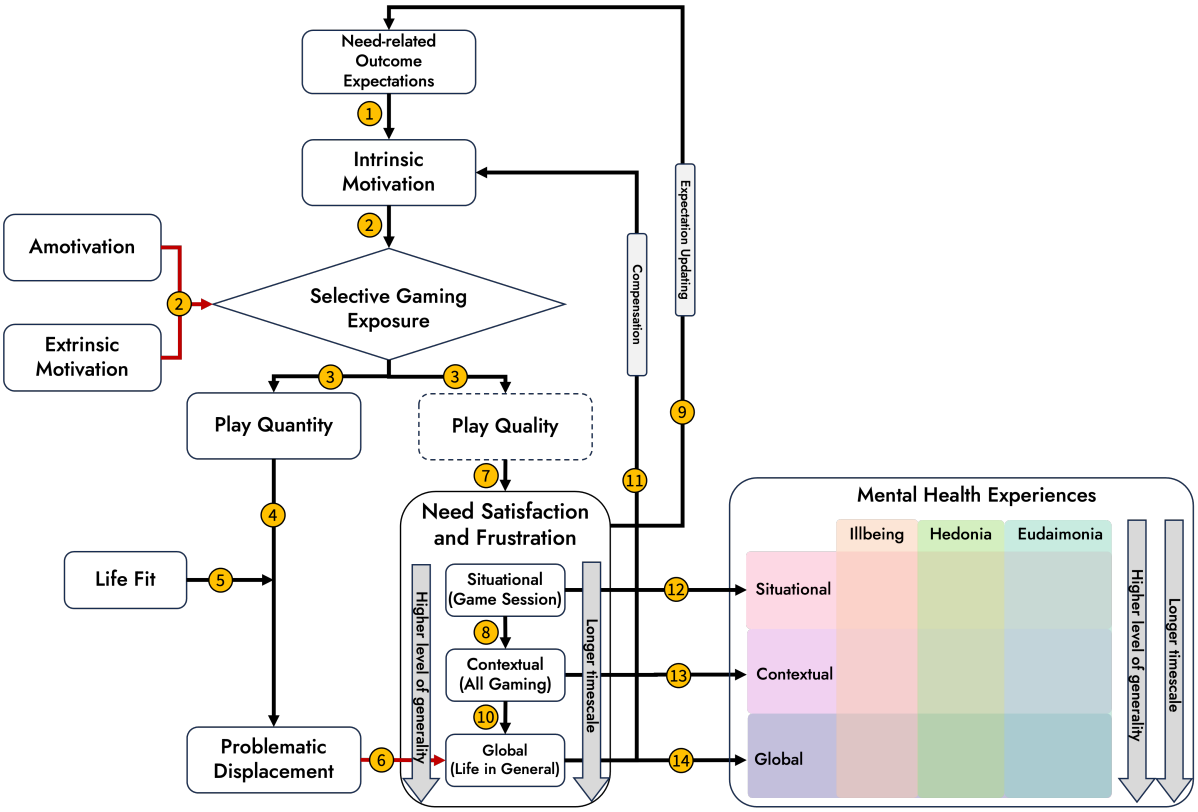

Figure 8.1: Overview of the Basic Needs in Games (BANG) model of video games and mental health. Black lines indicate positive relationships, and red lines indicate negative relationships.

aspects of other prominent theories such as uses and gratifications, mood management theory, social cognitive theory, and others. BANG includes pathways relating to both quantity of gameplay and quality of gameplay. It makes explicit causal predictions, and thereby readily lends itself to falsification.

8.2 The BANG Model

The theory is presented in Figure 8.1. True to SDT and 'active audience' paradigms like Mood Management Theory or Uses & Gratifications, BANG posits active *selective gaming exposure* at its core: players continually make active decisions about whether, what, and how to play, grounded in a motivational spectrum spanning intrinsic, extrinsic, and amotivation. Situational intrinsic motivation is determined by (a) players' state need satisfaction and frustration (inducing potential compensatory responses) as well as (b) players' learned predictions about need outcomes of available gameplay options. Gaming as compensatory coping with or recovery from frustrated needs emerges as a dynamic: where a player's global need satisfaction is depleted (e.g., due to ongoing life stressors or a recent need-frustrating event) and where players learned to expect games to be an easy and reliable source of need satisfaction, they will be intrinsically motivated to seek out gaming to compensate depleted or thwarted need satisfaction.

Different kinds of player *motivation* differentially shape both how much time they choose to play (*play quantity*) and how and what they choose to play (*play quality*)—again, given available options. All else equal, intrinsically motivated selective gaming exposure is more likely to flexibly select and adapt play of a quality that generates need satisfaction, sustain play over time, and cease play when it no longer satisfies needs. Extrinsically motivated gaming exposure, in contrast, is likely to produce less need-satisfying and more need-frustrating play experiences, and play that ceases when extrinsic motives have been served. Amotivated play would be expected to produce the least need satisfaction and most need frustration, and stop quickly unless self-regulatory processes have been disrupted.

BANG proposes a direct and indirect path from selective gaming exposure to mental health. First, play quality—what players play and how—*directly* impacts whether a given gaming session situationally satisfies or frustrates basic needs, which immediately feeds into and co-constitutes situational mental health. Longer-term,

global mental health impacts accrue and aggregate over scales of time and generality as would any other life experience—sustained need-satisfying gameplay sessions form part of players' contextual (gaming-related) and global need satisfaction, which in turn drives global mental health, while sustained need-frustrating play (e.g., driven by strong extrinsic motives) has the opposite effect. Because (a) people typically access a range of substitutable need-satisfying activities, (b) need satisfaction is impacted by a wide and varied range of events throughout everyday life, and (c) global mental health is relatively robust vis-à-vis situational fluctuations, situational need outcomes from a single gaming sessions may impact situational hedonic wellbeing (e.g., positive affect in the moment), but are unlikely to meaningfully impact global mental health. This explains why, in the main, we see null effects for relations between gaming use and mental health at population levels or for global mental health. Case reports of gaming successfully supporting global mental health identify circumstances where gaming provided reliable and sustained need satisfaction in the face of persistent, hard-to-change life stressors, such that repeated situational gaming experiences accumulate into global impacts.

In addition to this direct pathway, BANG proposes a second, indirect pathway via the impact of gaming use on other activities, following the displacement hypothesis. Large amounts of playtime can problematically displace other life activities generating need satisfaction, as well as produce social tension over failing to live up to social responsibilities. This can both reduce global need satisfaction (as other need-satisfying activities are neglected or impeded), and produce need frustration (e.g., relatedness frustration from family conflict or competence frustration over poor school or work performance). Importantly, this pathway is moderated by life fit: Problematic displacement only arises where a player cannot integrate playtime into a self-concordant and functioning life. People in the main successfully and flexibly self-regulate selective gaming exposure based on experienced and expected need satisfaction and frustration impacts, both direct and indirect. This explains why at an aggregate population level, we observe no negative mental health impacts from high amounts of playtime. Instances of disordered gaming emerge under one of at least three types of local circumstances in which either: (1) strong extrinsic motives lead players to rigidly select gaming despite in-game experiences repeated producing low need satisfaction or even high need frustration; (2) no more life-fitting, substitutable need-satisfying activities are apparent or socially available to the player; and/or (3) players' self-regulatory capacities are impeded or less developed.

Broken down piece-wise, the BANG model comprises 14 specific hypotheses:

(H1) Need-related outcome expectations shape intrinsic motivation

(H2) Selective gaming exposure is driven by intrinsic motivation, extrinsic motivation, and amotivation

(H3) Selective gaming exposure steers both play quality (what and how people play) and play quantity (how much they play), shaped by the underlying motivation: (a) Intrinsically motivated selective exposure leads to *higher and self-sustained* play quantity and play quality; (b) extrinsically motivated selective exposure leads to *higher but not self-sustained* play quantity and *lower* play quality; (c) amotivated selective exposure leads to *lower* play quantity and play quality

(H4) Greater play quantity—the amount of time spent playing—creates *the opportunity for* problematic displacement

(H5) Life fit—the player's success in integrating gaming with a functioning and self-concordant life—moderates the relation between play quantity and problematic displacement

(H6) Problematic displacement impedes other need-satisfying activities and increases interpersonal conflict, resulting in lower global need satisfaction and greater global need frustration

(H7) Play quality—the quality of emergent dynamics of player-game interaction, denoting the likelihood of play affording need satisfaction and avoiding need frustration—produces situational experiences of need satisfaction and frustration

(H8) Situational need satisfaction and frustration experiences feed into need satisfaction and frustration at the contextual level of gaming

(H9) Contextual need satisfaction and frustration (i.e., in one's experience with gaming as a life domain) feed into players' need satisfaction and frustration at the global level of life as a whole

(H10) Situational need satisfying and -frustrating gaming experiences lead players to update their expectations for future experiences with the current game, similar games, and gaming as a whole

(H11) The player's need state—their momentary level of need satisfaction and frustration—shapes their intrinsic motivation toward gaming experiences that they expect to satisfy unmet needs (i.e., compensation)

(H12) Situational need-satisfying experiences in games positively impact situational mental health (e.g., stress relief), while situational need frustration has negative impacts

(H13) Contextual need satisfaction (i.e., in games as a hobby) positively impacts contextual mental health (e.g., positive self-identity with gaming), while contextual need frustration has negative impacts

(H14) Global need satisfaction positively impacts global mental health, while need frustration or the absence of need satisfaction have negative impacts

Below, I detail each of these hypotheses in more detail, moving through the model one construct at a time.

8.2.1 Need-Related Outcome Expectations

Outcome expectations refer to the expected consequences of one's behavior (Bandura, 1978). The study of outcome expectations in media use originates in Social Cognitive Theory (1986). Early articulations of SDT similarly propose that goal or activity *selection* are (intrinsically) motivated by the 'awareness of potential satisfaction' of basic psychological needs (Deci, 1980, p. 49–56) or 'expectations about the satisfaction of those [salient] motives' (Deci and Ryan, 1985 p. 231–239). This model has interestingly not informed much subsequent empirical work; most gaming and media use-related SDT work operationally focuses on need satisfaction or frustration as the experiential consequence of media consumption. While this is able to explain why people sustain their engagement with an activity, it cannot explain initial selective exposure: why do people elect to begin playing a game before they have any experience of whether it is need-satisfying or -frustrating? This can only be answered with recourse to an internal predictive mental model about the expected outcomes or utility of an action.

In wider games research, researchers have found that outcome expectations are an important predictor of continued gaming engagement (Chang et al., 2014; Kocak Alan et al., 2022) or that adding *expected* gratifications to gratifications sought and obtained predicted substantially greater variance in selective media exposure (Larose et al., 2001). This was directly supported in Study 1, where I found that that *expected* need frustration modulated initial and continued gaming exposure as well as *felt* frustration, while felt frustration continually updated expectations.

Building on early SDT propositions and recent empirical work, I hypothesize that over the course of their (gaming) biography, players build up sets of (sub)conscious expectations of need satisfaction and frustration at different levels of generality, from a particular game at its last save state to game series, genres, and gaming more generally. Outcome expectations are informed by play experience, but also other information such as recommendations, media reviews, and the like. When presented with the opportunity to play a particular game, players draw on these priors and information accessible about the game to form an expectation about how need-satisfying (or frustrating) the play experience is likely to be, with a greater or lesser degree of certainty according to the reliability of previous information. Expectations of need satisfying outcomes are a key cognitive process underlying intrinsic motivation to initially select a certain gaming activity, but also in sustaining it. Phenomenologically, they manifest more as a spontaneously apprehended sense of interest and positive anticipation, as measured, e.g., in the 'interest' component of the interest/enjoyment subscale of the Intrinsic Motivation Inventory (McAuley et al., 1989).

Thus, BANG predicts that higher need-satisfying outcome expectations lead to greater intrinsic motivation—spanning levels of generality from a given available game session to gaming in general **(H1)**.

8.2.2 Motivation

Motivation denotes the processes that direct and energise individual behavior (Reeve, 2015). In games, the strength of each of these motivational categories is commonly assessed with measures such as the User Motivation Inventory (Brühlmann et al., 2018) or the Gaming Motivation Scale (Lafrenière et al., 2012).

Amotivation describes the feeling of lacking energy to perform a behavior, arising from the individual not perceiving value in the activity and/or not perceiving the ability to bring a desired state about (something other theories model as low self-efficacy or learned helplessness). While it seems counter-intuitive that people would engage in an activity (especially one such as gaming) when feeling amotivation, evidence shows that this is not uncommon—conditioned habit or poor self-regulatory skills can lead to gaming in the absence of conscious intention (Mills, Milyavskaya, Heath, et al., 2018). Also, parallel extrinsic motivation can lead people to engage in playing even though they feel they don't value the activity nor believe they are efficacious at it. Amotivation is associated with poor mental health outcomes in various domains (Ryan et al., 2022).

Extrinsic motivation refers to performing a behavior for some consequence perceived to be separate from the behaviour itself, such as an external reward, social approval, or avoidance of punishment (Ryan and Deci, 2017). Similarly to amotivation, despite the generally intrinsically motivating nature of games players regularly play games for reasons besides enjoyment of the game itself. Players commonly report playing games to

receive an external reward (e.g., to earn a meta-game achievement Cruz et al., 2017) or earn a reward or avoid a punish punishment given/inflicted upon oneself by oneself (e.g., to maintain a sense of contingent self-worth; Beard and Wickham, 2016). Extrinsically motivated play is consistently linked with lower wellbeing, both in games (Brühlmann et al., 2020; Johannes, Vuorre, and Przybylski, 2021) and in other domains such as work (e.g., Fernet et al., 2004) or exercise (e.g., Sebire et al., 2009). In part, the worse outcomes associated with amotivation and extrinsic motivation are explained by their less flexible nature (Ryan and Deci, 2017, Chap. 9).

Finally, intrinsic motivation describes the performance of an activity for the enjoyment and pleasure inherent to the activity itself. Intrinsic motivation is consistently linked with more sustained engagement, high enjoyment, and better mental health across domains (Ryan et al., 2022), and is the dominant motivation for playing games (an activity that, in most cases, the player is free to do or not do as they choose) (Brühlmann et al., 2020).

Together, BANG therefore predicts that selective gaming exposure is driven by intrinsic motivation, extrinsic motivation, and amotivation (**H2**).

8.2.3 Selective Gaming Exposure

In media research, *selective exposure* denotes the well-established fact that audience members are differentially exposed to a subset of a wider superset of available media stimuli, which mediates any effects arising from said stimuli (Knobloch-Westerwick, 2014). Most selective exposure work (and related models of an 'active audience', such as Uses and Gratifications research or Mood Management Theory) propose that selective exposure at least in part arises from individuals' *active choice*. Following this logic and early information-theoretical models of SDT, BANG proposes that active selective gaming exposure is a *process of choosing among salient courses of action*, where salience is determined by (a) perceived available options for satisfying needs, informed by need-related outcome expectations (see above) and (b) the player's current basic psychological need state (see below). For instance, if a day frustrated a person's competence, playing video games would become more salient, to the extent that the person has built up the learned expectation that these activities are competence-satisfying.

As noted, media exposure is far from fully determined by individual choice: there is habit and automatic behavior (Schnauber-Stockmann et al., 2018), and any exposure is constrained to perceived and actually available options (Knobloch-Westerwick et al., 2019). Similarly, people seek out media for many reasons beyond psychological need satisfaction, e.g., to produce other desirable emotional states (Ruggiero, 2000). I analytically bracket these considerations here as BANG is concerned solely with basic psychological needs as a driver and consequence of gaming.

Similar to Uses and Gratifications, BANG assumes that people choose among all perceived available courses of action promising to solve a salient problem (here: satisfy their needs), which often involves many other, substitutable media and non-media activities. For instance, when aiming to satisfy their relatedness need, a person may choose between playing a cozy game with relatable non-player characters, call a friend, or go to a café where they are friendly with the staff. Chosen courses of action will be more or less effective at satisfying underlying motives, changing a person's need state such that other needs may become more salient, leading a person to change course. Thus, *ceasing to play* (i.e., switching to another activity like going to bed, etc.) is part of selective exposure as conceived here.

At a minimum, selective gaming exposure involves actively selecting (1) *whether to play*, (2) *what to play*, and (3) *how to play*. Choosing whether and what to play may coincide or not; e.g., a player may feel and decide they 'want to play *something*' and start browsing their smartphone for the 'right' game, or feel and decide they want to play *Candy Crush Saga*, or feel they still want to play but no longer the current game and start browsing for an alternative. As for *how to play*, while all media afford degrees of agency (we can fast forward or pause a DVD), for interactive media like games, active selective exposure is arguably constitutive 'all the way down': interaction describes an ongoing loop where user action/selection determines what stimuli from a vast possibility space of stored or generateable states is actually displayed by the system in what sequence (Murray, 2012). Following Klimmt's descriptive model of video game play as a hierarchically structured activity (Klimmt, 2006, p. 70–75), I see selective exposure as operating from the 'highest' level of the activity (whether and what to play) to 'mid-level' episodes or tasks (e.g., what character to choose), potentially all the way down the 'low-level' input-output loop (e.g., which button to press to trigger which attack). Choices at each level may be conscious or part of an automated routine. 'Weighing' perceived alternative options based on one's motivational state and differential expected need outcomes might be a mostly subpersonal process that phenomenologically manifests as conscious deliberation only where no or multiple equally promising (and/or problematic) options present themselves. I do not commit (or need to commit) to a particular role or degree of

conscious deliberation here. The point is that even at the 'low' level of choosing a weapon with less damage per second but 'juicier' hit feedback mid-encounter in an action game, need-based selective gaming exposure may occur.

I conceive of selective exposure as a decision-making *process* with several inputs, marking this in Figure 8.1 with a diamond. Unlike other constructs in BANG, it therefore cannot be operationalized as a numerical variable that allows directional hypotheses. Testing specific claims (about which action from a given range is chosen) will involve model-based approaches from, e.g., computational cognitive science, such as comparing comparing simulated outputs of specified model alternatives to observed human behaviour under the same inputs.

That said, BANG does derive directional predictions from SDT about the relation between different kinds of motivation as the main selective exposure input variables (intrinsic, extrinsic, and amotivation), and differences in behavioural engagement (play quantity and quality) as its output variables. Taken together with the spectrum of motivation, BANG makes the following directional hypotheses about selective gaming exposure:

- More intrinsically motivated selective exposure will lead to higher, self-sustained play quantity and higher play quality **(H3.1)**.
- More extrinsically motivated selective exposure will lead to higher, but not self-sustaining play quantity and lower play quality **(H3.2)**.
- More amotivated selective exposure will lead to lower play quantity and lower play quality **(H3.3)**.

I explain play quality and play quantity in turn below.

8.2.4 Play Quality

The BANG proposition that the kinds of motivation underlying play shape play quality is grounded in rich evidence that the *quality* of motivation behind an activity shapes the *quality* of our engagement in it (Reeve, 2015; Ryan and Deci, 2017): Intrinsically motivated engagement tends to involve more deep, flexible, and creative problem-solving, focused attention, and exploration, as well as greater persistence over time as it generates its own motivation. Extrinsically motivated engagement tends to involve more narrowly outcome-orientated problem-solving and does not persist once the motivating extrinsic outcome is attained. Amotivated engagement tends to be rote and non-deliberate, involving little focused attention or problem-solving, and is brittle to disruption. These tendencies in behavioural engagement will impact how and how well a player plays and thus, how likely they are to generate need satisfaction and frustration in play. Second, the motives directing play are likely to produce activity satisfying these motives but not others: intrinsically motivated players are likely to select when to play, what to play, and ways of playing that actually generate the expected and desired need satisfaction, whereas extrinsically motivated players will steer toward attaining the extrinsic outcome, choosing courses of action that may not be need-satisfying or may even be need-frustrating. In addition, the very sense of extrinsic pressure in such play undermines potential autonomy satisfaction from play.

For instance, a player may shore up gold and gear for an upcoming raid in *World of Warcraft* out of a sense of social obligation to one's guild members (extrinsic motivation). Doing so leads them to choose a repetitive monster killing tactic ('grinding') that is not need-satisfying but the fastest option they see to generate the target amount of gold. This grinding play feels to them as something they 'have to do', depleting their autonomy. Furthermore, they don't see value in the grinding (they think it's just bad design) and don't perceive themselves as very capable at it (amotivation), and so engage in it rotely and inattentively. This leads to repeated errors, producing small moments of competence frustration. They will be prone to interruption and likely to cease play the moment the target amount of gold is attained. By comparison, the actual raid play may be something they are intrinsically motivated to do—they expect great amounts of relatedness and competence satisfaction from this joint challenging activity. As a result, they will choose strategies likely to generate competence and relatedness satisfaction, and play with deep focused attention and creative problem-solving, making it more likely that they successfully execute these strategies. All this will generate an ongoing experience of 'wanting to play' and enacting that desire, satisfying their autonomy.

Importantly, player action (or selective exposure) only forms one part of interaction or *gameplay* as the emergent dynamic between player input and game output (Hunicke et al., 2004). Following SDT, need satisfaction and frustration arise from how the player appraises the functional significance or 'motivational meaning' of environmental events—here, game responses to player actions (Ryan and Deci, 2017, chap. 6). Thus, game design co-shapes (but does not determine) need satisfaction and frustration from gameplay, as does *how* a

player plays—their play quality. (I recognise that the interplay of design and player action also affords other play experiences like immersion, but again bracket these here.)

I thus conceptualise play quality as *the likelihood of emergent player-game interaction affording need satisfaction and avoiding the affordance of need frustration*, arising via two mechanisms:

1. People directed by a given motive will choose whether, what, and how to play such that they are more likely to realise this motive, and more likely to not realise or actively impede the realisation of other motives;
2. The higher the relative autonomy of a person's overall motivation toward play, the more deliberately, flexibly, and creatively they tend to engage in it, increasing the likelihood of attaining its goal and underlying motives.

I therefore predict that higher play quality leads to higher need satisfaction and lower need frustration (**H7**).

8.2.5 Play Quantity

Play quantity, or playtime, refers to the amount of time players spend actively engaged in video games. BANG proposes that playtime is partly determined by selective exposure (i.e., choosing to play and keep playing), which in turn depends on a player's different motivations to play (again, acknowledging but bracketing factors like habit). As noted, the best available evidence indicates that there is no meaningful relation between how much time the average player spends playing games and their wellbeing (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022). Informed by this evidence, I diverge from previous (largely atheoretical) rhetoric that conceives of playtime as a direct predictor of negative outcomes (leading, e.g., to blanket restrictions on playtime in South Korea and China; Colder Carras et al., 2021; Király et al., 2017). Instead, I propose that play quantity impacts mental health only indirectly by displacing other activities, and only under the (rare) condition of lacking life fit.

8.2.6 Problematic Displacement and Life Fit

Playtime only becomes problematic when it displaces other activities that are essential to the maintenance of need satisfaction in life overall. From an SDT perspective, video game play is (for most players) a reliably need-satisfying and thus mental health-*promoting* leisure activity—a quality it shares with many other activities like sports or artistic pursuits. Two people may thus have highly divergent leisure time portfolios—one heavy on playtime, the other on skating—and report similar degrees of need satisfaction and mental health states. The substitutable nature of (leisure) activities with regards to needs goes a long way to explain observed population-level null effects of playtime on mental health: between-person variation in playtime simply reflects differences in preference as to *how* (i.e., with what activities) people satisfy their basic needs.

In this light, only when displacement interferes with non-substitutable activities does problematic displacement occur. Commonly proposed problematic displacements are work/school responsibilities (e.g., Drummond and Sauer, 2020), personal relationships (e.g., Domahidi et al., 2018), and physical health or sleep (e.g., Lemola et al., 2015). Notably, I do not argue normatively that people *should* put work over leisure, or that a night out is inherently 'better' than playing a video game with your partner at home. The point is that empirically, as these activities form major domains of our lives, displacing them to an extent where we can no longer effectively engage in them well will reduce overall need satisfaction. For many, this will manifest through interference with the individual's successful management of interpersonal relationships: for example, playing games such that one begins to struggle at work and school (competence frustration) can in turn creating parent-child or partner conflict (relatedness frustration). I expect particularly strong impacts when displaced activities support a person's integrated or intrinsic aspirations and life goals. Evidence suggests that acting in accordance with and attaining such autonomous, authentic, or self-concordant goals enhances need satisfaction and wellbeing (Ryan and Deci, 2017, p. 211–212, p. 272–279). Thus, a person who endorses being an attentive parent and finds their playtime interfering with the realization of that aspiration will experience particular negative impacts on their need satisfaction and wellbeing.

Now in general, people are sensitive to expected need-related outcomes of different courses of action and consciously regulate their play (and other activities) to steer clear of negative direct and indirect impacts. For instance, adult players 'make time' by shifting other responsibilities in their calendar to provide uninterrupted time to enjoy video games without neglecting their responsibilities, or limit playtime to 'free' slots on evenings, weekends, or holidays (Deterding, 2016). I refer to this successful management of gaming alongside other life activities as *life fit*. Only when life fit is not managed successfully, playtime will result in what I call *problematic*

displacement—displacement of activities in other domains that are crucial for maintaining need satisfaction, social relations, and attainment of autonomous life goals. Examples of this occurring include previous findings that gaming late in the evenings is associated with greater sleep disturbance (Lemola et al., 2015), and that playing before (but not after) school on weekdays was associated with poorer school performance (Drummond and Sauer, 2020). My conception of life fit and problematic displacement align closely with recent phenomenological studies and etiologies of disordered gaming, which posit that gaming is not itself harmful, but becomes harmful by virtue of causing impairment or distress in other life domains (e.g., Colder Carras, Porter, et al., 2018), and that 'experiences of disorder derive from gaming interfering with what one wants to be, do, and have throughout life' (Karhulahti, Siutila, et al., 2022).

The factors that make life fit more or less successful are not currently well understood—displacement has traditionally been researched as a general mechanism. One possible explanation is the absence of eudaimonic or self-regulatory life skills like mindfulness (Mills, Milyavskaya, Heath, et al., 2018; F. M. Schneider et al., 2022). Another is offered by SDT research on harmonious and obsessive passion (Lalande et al., 2017; Vallerand, 2015) and the evolution of disordered gaming (Karhulahti, Siutila, et al., 2022). These propose that obsessive or disordered gaming may arise from highly and persistently need-frustrating early life circumstances where gaming presented the only perceived available coping mechanism for satisfying psychological needs. This connects back to the *need density hypothesis*: the less need satisfaction people experience in everyday life overall, the more prone they are to 'overuse' or not successfully self-regulate gameplay dense in need satisfaction (Ryan and Deci, 2017, p. 523–525; Przybylski et al., 2009). Over time, this leads people to rigidly persist in gaming despite negative consequences in other life domains as they see no alternative, more integrated courses of action for satisfying their psychological needs—high time investment in gaming has 'thinned out' (Karhulahti et al., 2023) their abilities and opportunities to attain need satisfaction by other means. Furthermore, evidence suggests a feedback loop between self-regulation and need satisfaction: The less need satisfaction people experienced during their development or are experiencing in everyday life, the less able they are to autonomously self-regulate (Ryan and Deci, 2017, p. 524).

The need density hypothesis is an implicit dynamic of the BANG model: the lower a person's global need satisfaction and the more they learned that games provide need satisfaction, the more motivated they will be to play, resulting in higher play quantity. From there, I predict a positive but non-linear relation to problematic displacement **(H4)** that is moderated by life fit—more playtime will not lead to problematic displacement when it is managed to not interfere with other life activities that support a person's overall needs and authentic life goals (**H5**). Not playtime as such, but problematic displacement leads to less need satisfaction and more need frustration in daily life **(H6)**.

8.2.7 Need Satisfaction and Frustration

Next, I discuss the role of need satisfaction and frustration in the BANG model. As proposed by the hierarchical model of intrinsic and extrinsic motivation above (Vallerand, 2015), need satisfaction and frustration can be divided into three distinct levels of generality. Again, I wish to be clear that in my view, the situational, contextual, and global levels are useful, but ultimately arbitrary divisions—they enable standardized measurement, but are simply points on a spectrum from the most local experiences (a single button input in a game) to the most generalized ones (one's life from birth to present). In Figure 8.1, I have indicated this with an arrow depicting this increasing generality, and also include a second arrow indicating that these levels also describe progressively longer timescales (situational need satisfaction is momentary, whereas global need satisfaction is typically measured in reference to one month or more).

An important point for the predictions to come is that need satisfaction is more strongly linked with wellbeing, and need frustration is more strongly linked with illbeing (Vansteenkiste and Ryan, 2013). Thus, while I predict effects in all combinations (both need satisfaction and frustration will affect both wellbeing and illbeing) and have represented this with a single arrow in Figure 8.1, I expect stronger relationships between need satisfaction and wellbeing, and between need frustration and illbeing, than the converse.

I discuss each level, and the predictions that I derive from them, in turn.

Situational Need Satisfaction and Frustration

Situational need satisfaction and frustration—that is, the satisfaction and frustration of basic needs during brief moments in time, such as a single level or game session—is perhaps the most well-studied area of SDT in games research. As highlighted above, numerous studies demonstrate that games that satisfy players' three basic needs are most motivating, and most likely to support player wellbeing (e.g., Adinolf and Türkay, 2019; Oliver et al., 2016; Tamborini et al., 2011). Basic psychological needs formed the earliest testbed for SDT in games

research (Ryan et al., 2006), and there exist several validated questionnaires for measuring need satisfaction in games, prominently including the aforementioned PENS (2006) and UPEQ (Azadvar and Canossa, 2018).

I predict effects of situational need satisfaction and frustration on (1) contextual need satisfaction and frustration, (2) need-related outcome expectations, and (3) situational mental health outcomes, and discuss each in their respective sections below.

Contextual Need Satisfaction and Frustration

The contextual level refers to one's experience of need satisfaction and frustration throughout the entire life domain. It is implicated in topics such as *need density hypothesis*, which predicts that disordered gaming results when need frustration at the global level and need satisfaction in games (the contextual level) are both high, indicating that games are the player's primary source of need satisfaction (Rigby and Ryan, 2011). The contextual level is typically measured with variants of need satisfaction and frustration questionnaires that use phrases such as 'when I play video games' or 'in the games I play' to refer to all gaming experiences.

As the contextual level reflects an aggregation of repeated situational experiences, I predict that greater situational need satisfaction/frustration will lead to greater contextual need satisfaction/frustration (**H8**).

Together with the situational level, contextual need fulfillment affects expectations of need fulfillment in future play. Players who experience more need satisfaction (and less need frustration) throughout their gaming are more likely to be motivated to continuing playing (e.g., Adinolf and Türkay, 2019; Przybylski et al., 2010; Tamborini et al., 2011)—and in Study 1, the mechanism by which this occurred was found to be expectations: players who expect that future experiences with that game be positive will be more motivated to play, rather than a direct stimulus-response relationship.

I therefore predict that situational and contextual need satisfaction in games will positively influence expectations for future need fulfillment in games, while need frustration will negatively influence those expectations **(H9)**.

Global Need Satisfaction and Frustration

Finally, need satisfaction and frustration in games contribute to one's overall sense of need satisfaction and frustration in daily life. Several studies have found a positive association between need satisfaction and frustration at these two levels of generality (Allen and Anderson, 2018; Bender and Gentile, 2019), including Study 2. Setting aside possible compensatory behavior, this is intuitive: one's experience of needs at the global level is a function of repeated, generalized experiences in each of the various life domains (Vallerand, 1997). Thus, informed by including Study 2, I expect a positive relation between these levels—at least in people for whom gaming is a salient part of life.

Precisely how big a 'slice' of one's life gaming constitutes for different people is not well understood. One study (Allen, 2020) found that the association between global need satisfaction and wellbeing was nearly 10 times the size of the association between gaming need satisfaction and wellbeing. One interpretation of this finding is that need satisfaction in games contributed approximately 10% of the average player's global need satisfaction, with the other 90% derived from other life domains.

As the global level reflects an aggregation of many contextual experiences, I predict that contextual need satisfaction/frustration will affect global need satisfaction/frustration (**H10**).

Compensation

As described in several earlier sections, SDT predicts that (global) need frustration results in compensatory behavior—people attempt to replenish needs that are not being met by altering their behavior, and may do so by playing video games. I showed this pattern, and some limitations of it, in Chapter 7.

I operationalize this compensatory play in BANG via intrinsic motivation. The idea here is that frustrated needs in one's life in general make opportunities to fulfill those needs more salient, which—all else equal—manifests phenomenologically as an increased energy towards those activities.

Thus, BANG predicts that greater global need frustration leads to increased intrinsic motivation toward activities that satisfy the deficit needs (**H11**).

However, we also saw that playing video games as a coping mechanism can also lead to negative effects on mental health. The question, therefore, is when does compensation lead to positive effects, and when does it lead to negative effects? Under BANG, this is an implicit dynamic of the model via problematic displacement. I predict that compensation is successful (i.e., has positive consequences for the player's mental health) insofar as it is primarily intrinsically motivated (as opposed to, for example, the player feeling like they have to play because there are no other viable activities in their environment; as seen in Study 2), and is accompanied

by experiences of need satisfaction during play. If high playtime is not successfully integrated into life, and interferes with other life domains from which people normally derive need satisfaction, then global need frustration will continue to rise, despite attempts to compensate via gaming. This dynamic is effectively one potential operationalization of the need density hypothesis.

8.2.8 Mental Health Experiences

Recall that under the taxonomy of mental health presented in Figure 3.1, mental health consists of illbeing, hedonic wellbeing, and eudaimonic wellbeing components, which (like basic needs and motivation) are decomposable into situational, contextual, and global levels. At this early stage of model development, the effects I predict below are understood to encompass all of these, but it is expected that certain aspects of mental health and constructs will be more strongly affected by gaming experiences than others. As mentioned above, I expect the strongest effects to be between need satisfaction and wellbeing, and between need frustration and illbeing.

Situational Mental Health Experiences

Situational mental health experiences describe the momentary emotions, feelings, and cognitive-affective appraisals that constitute one's mental health at a particular point in time. Again, this is akin to state measures that assess a short time window.

Research has shows that need-satisfying experiences in games lead to short-term (situational) experiences of greater hedonic wellbeing (e.g., positive affect; Tyack et al., 2020), greater eudaimonic wellbeing (e.g., meaning; Oliver et al., 2016; Rigby and Ryan, 2016, and lower illbeing (e.g., reduced aggression; Przybylski et al., 2014). Effects in the opposite direction have been shown for need frustration (e.g., Kosa and Uysal, 2021; Przybylski et al., 2014).

As a result, I predict that need satisfaction in games leads to better situational mental health experiences, while need frustration in games leads to worse situational mental health experiences (**H12**).

I do not include a moderating effect of play quantity on the relationship between need satisfaction and frustration on mental health, as previous work found that need satisfaction in games did not moderate the relation between playtime and wellbeing, but rather contributed to it independently (Johannes, Vuorre, and Przybylski, 2021)—suggesting again that playtime is better understood as an outcome of other factors rather than a primary predictor of mental health.

Contextual Mental Health Experiences

Contextual mental health experiences are the feelings and emotions a person associates with a particular life domain, and their general tendency to experience those feelings when engaging with that domain. Although contextual need satisfaction and contextual motivational quality are well-developed concepts dating back to the beginning of the hierarchical model (Vallerand, 2015), contextual mental health is a relatively novel concept; indeed, even where this level of generality is proposed in Huta (2022), the study ultimately does not measure it, citing constraints on study complexity.

However, I believe contextual mental health to be a concept worth including and exploring further. Recall that digital wellbeing, as proposed by M. M. P. Vanden Abeele (2020), refers to an experiential state comprised of affective and cognitive appraisals of the integration of digital connectivity into ordinary life. Digital (gaming) wellbeing is achieved when experiencing maximal controlled pleasure and functional support from video game play, together with minimal loss of control and functional impairment. This definition identifies a clear target for healthy engagement with a life domain, and directly implicates the notion of contextual mental health.

Given the speculative nature of this concept, it is not entirely clear how it might best be measured. In the model of mental health shown in Figure 3.1, I speculated about some relevant constructs. Contextual illbeing might include withdrawal symptoms or the unpleasant subjective experience of losing control over one's play. Contextual hedonic wellbeing might refer to an aggregate of affectual experiences from that life domain (e.g., 'when I play games, I generally feel...'), or the positive preoccupation or daydreaming that comes when regularly thinking fondly of past experiences, or looking forward to future ones (see also harmonious passion). Contextual eudaimonic wellbeing might include the sense of meaning that one derives from their gaming or positive identity characteristics (e.g., 'I am proud to be part of the video gaming community').

Understanding contextual mental health experiences is therefore a promising way of operationalizing a healthy relationship with technology, and warrants further research. In the meantime, however, it follows from my earlier description of levels of generality that, within BANG, contextual need satisfaction positively affects subsequent contextual mental health, while contextual need frustration negatively affects it **(H13)**.

Global Mental Health Experiences

Global mental health experiences refer to the trait-like emotions, feelings, and cognitive-affective appraisals that constitute one's *overall* mental health. This includes measures such as depression (illbeing), trait positive affect (hedonic wellbeing), and the sense of authentic pride in oneself (eudaimonic wellbeing). A large body of evidence supports the relationship between global need satisfaction and frustration and subsequent mental health, on both the 'bright' and 'dark' sides of human functioning (Chen et al., 2015; Ryan and Deci, 2017; Van Assche et al., 2018; Vansteenkiste et al., 2020). Given the overwhelming strength of this evidence as reviewed in Chapter 4 and how fundamental it is to SDT, I do not belabor this point further.

BANG predicts that global need satisfaction positively affects subsequent global mental health, while global need frustration negatively affects it **(H14)**.

8.3 Discussion

I am hopeful that BANG can offer a useful framework for understanding when and why games both support and harm player mental health. BANG successfully explains a wide range of existing empirical evidence in the literature, namely findings related to quality of play and quantity of play, producing positive and negative effects, realized over both shot and long timescales. It also makes explicitly causal predictions, and integrates recent theory on categories of mental health (i.e., hedonic wellbeing, eudaimonic wellbeing, and illbeing). Contributions of the BANG model are discussed further in Chapter 10 and Chapter 11. Here, I want to highlight three of these strengths of the model: a differentiated notion of mental health, the formal quality and quantity distinction, and the unique role of outcome expectations.

The first contribution of BANG is a transparent specification of what is meant by mental health. At present, a large portion of the literature uses wellbeing as a 'catch-all' term, even going so far as to meta-analyze constructs that may in fact have substantially different relationships with gaming (Cheng et al., 2018). Differentiating between these aspects of mental health can allow us to better capture the nuance in effects—for example, separating out situational hedonic recovery effects of games from global eudaimonic social identity benefits—and ultimately support more targeted interventions for promoting player mental health and preventing mental illness. At present, however, BANG's mental health model is a skeleton: it is not yet clear which of the nine types of mental health will be most affected by which pattern of play. An important next step, therefore, will be to better understand when and why each type of mental health outcome arises. BANG takes an initial step in this direction by predicting that illbeing will be caused primarily by need frustration, while wellbeing outcomes will be caused primarily by need frustration, but more work will be needed. In this way, BANG is able to integrate aspects of previous theories addressing positive effects of media use, and the (often less theory-driven) research on negative effects of media use.

Another contribution of the model is the formal specification of a quantity vs quality distinction. Although the best available evidence indicates that there is no meaningful relationship between how much time the average player spends playing games and mental health (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022), there has yet to be a theoretical account that explains these results alongside the enormous body of work showing that games do, at times, have positive and negative effects on players (Kowert and Quandt, 2021b). BANG is not blind to the potential for playtime itself to cause harm to players, however; I include a moderated path from playtime to problematic displacement whereby it can still negatively affect mental health, if the player has not 'made space' for their gaming. By proposing play quantity as primarily an outcome of other processes, BANG is able to integrate disparate findings.

Finally, I believe that BANG's inclusion of an expectation-based updating function (vs in-the-moment consumption) opens up a rich vein for future research. Many theories describe an active audience that selectively makes decisions about their media consumption based on their current needs (e.g., Uses and Gratifications Sherry et al., 2006; R^2EM Reinecke and Rieger, 2021). However, rarely do such theories clearly address the process by which outcome expectations are generated and updated through experience. To better understand outcome expectations, media researchers will benefit from looking further afield, to models such as the predictive processing framework from cognitive science (Clark, 2016; discussed in further detail in Chapter 11).

In short, the detailed model put forth under BANG offers a useful theoretical tool for research on video games and mental health. Its development was enabled by the growing maturity of our field: to generate the model, I needed to lean heavily on the extensive evidence bases from SDT research, entertainment media research, and the intersection of the two. In particular, I leverage recent developments on the importance of need frustration in predicting player experience, behavior, and mental health (Kosa and Uysal, 2021; Pusey et al., 2021), including the findings from Study 1. Similarly, I use the findings from Study 2 and previous research

on adaptive vs maladaptive compensation through media use (Türkay et al., 2022; Tyack et al., 2020) to specify a potential mechanism that accounts for why compensatory play often, but not always, succeeds: as a generally need-satisfying activity, gaming can contribute to need repair similarly to other substitutable activities, but this fails if the compensatory behavior is extrinsically or amotivated (e.g., the player not feeling that there are other viable options for compensation), and/or if the player is unable to fit gaming alongside other life responsibilities.

8.4 Conclusion

The BANG model provides a set of integrated predictions that can advance understanding of when and how games do or do not affect mental health. It differentiates play quantity and play quality, recognizes that mental health is not a single construct, and builds upon a widely-used psychological theory, self-determination theory, to better account for the unique features of media use. By explicitly specifying a causal model, BANG creates fertile ground for its hypotheses to be tested and falsified.

I want to emphasize that the best theory generation is iterative, collaborative, and (of course) evidence-driven. I believe BANG is a step forward in its own right, but my larger hope is that it can provide a platform for the wider research community to build upon. I look forward to further attempts to develop, falsify, and compare the model, thereby improving upon its weak points (or discarding it completely). Rather than seeing BANG as a model to be adopted or discarded wholesale, the model is simply a ‘version 0.1’ to be regularly updated in light of new evidence, and I encourage readers to be involved in that process.

Part III: Model Validation

9

Study 3: Development of the Basic Needs in Games Scale (BANGS)

Chapter Contents

9.1 Introduction . . . 102
9.2 Development Process Overview . . . 102
9.2.1 Survey Design . . . 103
9.2.2 Scale Format . . . 103
9.2.3 Analysis . . . 103
9.2.4 Ethics . . . 103
9.3 Item Generation . . . 104
9.3.1 Method . . . 104
9.4 Study 3a: Exploratory Factor Analysis (Situational Level) . . . 105
9.4.1 Method . . . 105
9.4.2 Results . . . 105
9.4.3 Item Selection and Cognitive Pretesting . . . 106
9.4.4 Confirmatory Factor Analysis . . . 106
9.4.5 Cognitive Pretesting . . . 106
9.5 Study 3b: Confirmatory Factor Analysis (Contextual Level) . . . 106
9.5.1 Method . . . 107
9.5.2 Results . . . 107
9.6 Study 3c: Confirmatory Factor Analysis (Particular Game) . . . 107
9.6.1 Method . . . 107
9.6.2 Measures . . . 108
9.6.3 Results . . . 108
9.7 Study 3d: Measurement Invariance . . . 109
9.7.1 Method . . . 109
9.7.2 Results . . . 109
9.8 Study 3e: Discriminant/Convergent/Criterion Validity . . . 110
9.8.1 Method . . . 110
9.8.2 Results . . . 110
9.9 Discussion . . . 111
9.9.1 Comparison with Previous Measures . . . 111
9.9.2 Future Directions for BANGS . . . 112
9.9.3 Constraints on Generalizability . . . 113
9.10 Conclusion . . . 113
9.11 Acknowledgements . . . 113

Publication Information and Data Availability

At the time of writing, Study 3 is under review at the *International Journal of Human-Computer Studies*. It is available as a preprint as:

Ballou, N., Denisova, A., Ryan, R., Rigby, C. S., & Deterding, S. (2024). The basic needs in games scale (bangs): A new tool for investigating positive and negative video game experiences. *International Journal of Human-Computer Studies*, *188*, 103289. https://doi.org/10.1016/j.ijhcs.2024.103289

All data, code and materials associated with this project are available on the Open Science Framework (https://osf.io/uq8mp).

9.1 Introduction

In the previous sections, I have shown that there is both theory and evidence to suggest that need satisfaction and frustration play an important role in player experience, game engagement, and mental health outcomes of gaming. However, our understanding of basic needs in games can only progress insofar as we have valid instruments with which to measure it. In Section 4.4, I argued that the three primary measures available for assessing basic psychological needs in games (PENS Ryan et al., 2006; UPEQ Azadvar and Canossa, 2018; BPNSFS Chen et al., 2015) have important limitations. PENS and UPEQ measure need satisfaction, but do not assess need frustration. Both PENS and UPEQ have some psychometric concerns, with the intended factor structure not always replicating (Johnson, Gardner, et al., 2018). PENS and BPNSFS implicitly adopt a narrow view of relatedness, not offering easy ways for participants to respond with reference to feelings of connection with non-player characters. The BPNSFS has further items that at best are likely to miss certain types of need-related experiences (something I evidenced in in Chapter 6 by identifying several types of need-frustrating experiences that would be largely missed by existing BPNSFS items), or at worst may be invalid for use in a games context.

Given the prominence of SDT in the games literature and the potential power basic needs hold to explain engagement and the wellbeing impacts of gaming, these limitations motivate the development of an improved instrument. This was my next undertaking. Below, I present the Basic Needs in Games Scale (BANGS) and demonstrate its validity in several contexts—including both the situational and contextual level of generality—across several development stages. The measure resolves some of the limitations of previous measures, and thereby offers a useful tool for future player experience and games-related mental health research. The final item list is presented in Table 9.2.

Note: Study 3 will report on some unique data, and some data collected as part of Study 4. Chronologically, the item generation and Study 3a were conducted between August and December 2022, and demonstrated initial validity for a version of the BANGS questionnaire. This justified the inclusion of BANGS in Study 4, which began in February 2023. The additional data collected in Study 4 was then used to conduct further validation analyses (Studies 3b–e), which in turn lent greater support for BANGS.

9.2 Development Process Overview

Before beginning, I conducted a small-scale replication study (n = 168) of the modified BPNSFS used by Allen and Anderson (2018) (i.e., adding 'when I play video games' to each item). Results showed that the measure had

Table 9.1: Study details

	Design Details			Demographics			
	Context	**Population**	**n**	**Mean age (SD)**	**Men**	**Women**	**Non-binary**
Study 3a: EFA	Session	Adult video game players	383	26.0 (6.3)	288	80	15
Study 3b: CFA	Games in general	Adult US/UK Xbox users	1891[†]	32.8 (8.4)	236	50	11
Study 3c: CFA	Particular game	Adult players (50% Xbox)	449	30.4 (8.1)	297	139	13
Study 3d: Measurement Invariance	All of the above	All of the above	2723	30.2 (8.3)	821	230	79
Study 3e: Conv./Disc./Pred. Validity	All of the above	All of the above	2723	30.2 (8.3)	821	230	79

[†] Composed of the data from Study 4, constituting six waves of a longitudinal study with 414 unique participants

good construct validity, but qualitative feedback from participants indicated that they had difficulty responding to the adapted relatedness items (e.g., not knowing whether to refer to in-game characters or other human players). Quantitatively, I replicated the unexpected result from Allen and Anderson (2018) that autonomy satisfaction and frustration were not negatively correlated. Given this, alongside the rationale described above, the replication supported the need for a new questionnaire. Full results of the replication study are available on the OSF (https://osf.io/gup5f/).

To generate the new measure, I followed best practice guidelines for measure development (DeVellis and Thorpe, 2022) and adopted a multi-study, multi-sample approach to creating the scale (Table 9.1). I took particular inspiration from the development of the Player Experience Inventory (V. Vanden Abeele et al., 2020), one of the most well-validated player experience measures.

The multi-study procedure took place as follows. In Study 3a, I performed exploratory factor analysis (EFA) on 78 candidate items, which were completed with reference to a recent recalled play experience. EFA results indicated that 26 items that did not perform adequately should be discarded. Consulting with the research team, I used domain expertise to select among the remaining 52 high-performing items and reach a measure of an appropriate length (18 items). In Study 3b, I validated the 18-item measure in a different context, namely with players' experiences of gaming in general over the previous 2 weeks (the contextual level). CFA analyses demonstrated excellent construct validity, with strong model fit and high item loadings in the intended 6-factor structure. In Study 3c, I conducted CFA analysis in a third context, this time using piped text so that items referred to a player's experience with one particular game over time. I extended the CFA analysis by further assessing convergent validity with existing basic needs questionnaires, and criterion validity by correlating need satisfaction and frustration with intrinsic motivation. Finally, I combined the samples from each previous study to assess measurement invariance (Study 3d) and discriminant validity (Study 3e). Results show that the factor structure is similar for each context and subscales are sufficiently distinct, supporting the questionnaire's invariance and validity.

9.2.1 Survey Design

All surveys were built in Qualtrics. In all studies, the order of measures, and of items within each measure, were randomized.

9.2.2 Scale Format

Throughout the below studies, BANGS was administered using a 7-pt Likert scale with anchors '1 - Strongly disagree', '4 - Neither agree nor disagree', and '7 - Strongly agree.'

The instructions for the measure read 'Below, we ask you about experiences of [X]. In [X]...', where [X] could be 'the gaming session you described' (Study 3a), 'gaming in general over the past 2 weeks' (Study 3b), or the name of a game listed by a participant in a previous question (Study 3c).

9.2.3 Analysis

I performed a series of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) models to validate the questionnaire. All EFA models were fit using maximum likelihood and promax rotation, allowing for correlated factors. All CFA models used robust maximum likelihood estimation, and fit indices refer to their robust variants, which are more reliable under potential non-normality. Responses were required in most studies, so there are minimal missing data; where present, missing data are dropped pairwise.

Throughout, I do not use typical 'rules of thumb' cut-offs for model fit indices (e.g., those of Hu and Bentler, 1999), which are not universally applicable to all factor models, and instead adopt dynamic cutoffs to understand the magnitude of the misfit based on specific model and characteristics of the data (McNeish and Wolf, 2021).

9.2.4 Ethics

Ethical approval for the following studies was provided by Queen Mary University of London [QMERC20.565 DSEECS22.117]. In all studies, participants provided informed consent via Qualtrics before participating. The data originating in Study 4 (used here as part of Studies 3b–e) received separate ethics approval, described in the following chapter.

Table 9.2: Items in the final version of BANGS

Construct	Label in Candidate List	Wording	CFA Factor Loading		
			Study 3a	Study 3b	Study 3c
Autonomy Satisfaction	as06	I could make choices regarding how to play [X].	.84	.80	.76
	as01	I could play [X] in the way I wanted.	.90	.83	.73
	as05	I could direct my own play experience in [X].	.85	.84	.81
Autonomy Frustration	af01	I felt forced to take certain actions in [X].	.68	.72	.78
	af16	Many actions in [X] were boring.	.72	.62	.44
	af04	I often found myself wishing I could do something else within [X].	.72	.69	.54
Competence Satisfaction	cs13	I felt I was getting better at playing [X].	.81	.77	.73
	cs02	I felt that I made progress while playing [X].	.86	.84	.69
	cs06	I felt a sense of achievement while playing [X].	.81	.79	.72
Competence Frustration	cf01	I often felt that I lacked the skills necessary for [X].	.78	.69	.70
	cf05	I kept failing to accomplish what I wanted to while playing [X].	.61	.72	.69
	cf09	I felt disappointed with my performance in [X].	.87	.76	.85
Relatedness Satisfaction	rs05	I felt I formed relationships with other players and/or characters in [X].	.85	.81	.78
	rs13	Engaging with [X], I felt a connection to others, virtual or real.	.84	.81	.75
	rs03	I felt that other players and/or characters in [X] cared about me.	.66	.79	.70
Relatedness Frustration	rf07	Interactions with other players and/or characters in [X] felt toxic to me.	.81	.85	.82
	rf05	The community or virtual world in [X] made me feel unwelcome.	.72	.75	.75
	rf08	Others in [X] were unfriendly towards me.	.77	.83	.83

Note: X is a placeholder, which was filled in with 'the game' in Study 3a to refer to a single session; 'the games I played' in Study 3b to refer to gaming in general, and the name of a game entered by the participant using piped text in Study 3c to refer to one game over time.

9.3 Item Generation

9.3.1 Method

I adopted a mixed deductive and inductive approach to item generation, considering both top-down theory and bottom-up qualitative research describing need-related experiences to inform potential item wording. To support this, I developed a 'primer', consisting of (1) widely-cited theoretical definitions of basic psychological need satisfaction and frustration; (2) a list of items from similar gaming-specific or domain-general need satisfaction and frustration measures, and (3) brief summaries of 16 qualitative studies that describe when and how needs can be satisfied or frustrated during gaming (identified via literature review). For the latter, I particularly drew from Study 1, one aim of which was to support the development of future need frustration in games measures. The primer is available in the supplementary materials.

Four researchers, including myself[1], generated items separately, using the primer as a guide. Within the research team, we had expertise in questionnaire development, SDT (in games), and player experience research. Broadly, the intention of item generation was not to measure every possible 'subfacet' of each need experience, which are numerous, but rather to minimize the implicit exclusion of these experiences (e.g., writing about relationships with other players that are not relevant for single-player games).

After removing duplicates, the four item generators produced an initial pool of 168 items. To filter out less face valid items and minimize participant burden in Study 3b, I consulted with two team members with extensive experience in SDT and UX research (RR and CSR), who reviewed the item pool and provided feedback, edits, and comments to help select items that best aligned with theory and measurement best practices. The remaining team members reviewed all comments and feedback, and selected items for removal via discussion.

[1]Ballou, N., Denisova, A., Ryan, R., Rigby, C. S., & Deterding, S. (2024). The basic needs in games scale (bangs): A new tool for investigating positive and negative video game experiences. *International Journal of Human-Computer Studies*, *188*, 103289. https://doi.org/10.1016/j.ijhcs.2024.103289

Table 9.3: Top 15 most commonly-mentioned games in Study 3a, out of a total of 201 titles.

Game	Number of Mentions	Genre
League of Legends	46	MOBA
Counter-Strike	12	FPS
Genshin Impact	10	RPG
FIFA 23	9	Sports
Fortnite	9	Battle Royale
GTA 5	9	RPG
Minecraft	6	Sandbox
World of Warcraft	6	MMORPG
Call of Duty: Modern Warfare II	5	FPS/Battle Royal
Elden Ring	5	RPG
Overwatch 2	5	Hero Shooter
Last of Us	4	RPG
Monster Hunter World	4	Action RPG
Project Zomboid	4	Sandbox/Survival Horror
Rocket League	4	Sports

This resulted in a list of 78 items with which I proceeded to Study 3a. Stages of the pruning process and rationale for item inclusion/exclusion are available in the supplementary materials.

9.4 Study 3a: Exploratory Factor Analysis (Situational Level)

In Study 3a, my goal was to prune the large candidate item list into a scale that was manageable in length and composed of only items that meet minimum standards of performance in EFA analyses (e.g., having factor loading on the intended factor of at least .45; see below for details). For this purpose, I elected to study the session-specific (situational) context.

9.4.1 Method

I recruited 422 participants on Prolific.co, a recruitment platform tailored to social science research. Manual inspection of responses, including comparing scores of 2 repeated items, found that 39 participants were potential careless responders; these participants were dropped from further analysis, yielding a final sample of 383.[2]

In Study 3a, participants responded with reference to a recent gaming session, with placeholder [X]s replaced by the words 'the game'. To induce a degree of variation in need satisfaction and frustration in the data, participants were randomized to recall one of three different kinds of sessions: a recent session of a game they enjoyed (n = 87), didn't enjoy (n = 106), or simply their most recent experience without any specification of its valence (n = 190). All participants were asked to briefly describe the session in writing and respond to all items in the pruned item pool with reference to this experience.

In total, participants listed 201 different game titles, spanning a wide range of genres (MOBA, RPG, FPS, sports, simulator, and more). The 15 most frequently-mentioned titles are listed in Table 9.3.

Participants were paid £1.30 for the survey, which had a median completion time of 12 minutes.

9.4.2 Results

With a KMO index of 0.955 and a significant Bartlett's test of sphericity ($\chi^2(4186) = 249218.2$, $p < .001$), sampling adequacy was considered excellent and the data suitable for factor analysis. There was no evidence for meaningful floor or ceiling effects across items. I therefore proceeded to the exploratory factor analysis.

Various factor retention analyses including parallel analysis converged on an optimal number of factors to retain between 5 and 7, which I confirmed via inspection of the scree plot. Given the strong theoretical rationale for a 6-factor structure, I fixed extraction to 6 factors. The 6-factor EFA model of all 78 items fit the

[2] Participants in Study 3a were recruited in 2 waves; the first wave completed 92 candidate items, of which 14 showed clear signs of poor performance and were dropped for the second sub-sample. For clarity, I describe the Study 3a results with reference only to the 78 items shown to all participants.

Table 9.4: CFA Model Fit in Each Primary Data Study

Study	χ^2 (df)	p	CFI	RMSEA [90% CI]	SRMR
Study 3a	192.203 (120)	$< .001$	.978	.041 [.029, .052]	.050
Study 3b	946.126 (720)	$< .001$	.978	.034 [.028, .040]	.043
Study 3c	194.427 (120)	$< .001$	.947	.054 [.041, .066]	.058

data very well (see efa1_full_table.html in the supplementary materials for details).

I adopted an iterative approach to item pruning: after fitting an EFA model, I would remove any poor-performing items, then fit a new model with those items removed, and repeat this process until all remaining items met the quality criteria. Poor-performing items were defined as those that either cross-loaded strongly onto an unintended factor ($> .3$, or if their highest loading was onto an unintended factor), or loaded onto more than one factor with nearly equal strength (within .1).

After 3 rounds of iterative pruning, the final EFA model included 53 items (Appendix A3). This was longer than the intended scale length, so I then proceeded to select among the remaining moderate- to high-performing items.

9.4.3 Item Selection and Cognitive Pretesting

From the list of 53 candidate items that performed sufficiently well in Study 3a, I consulted with three domain experts on the research team to select a smaller subset for further validation. The goals were to (1) retain equal-length subscales of no more than 4 items, (2) ensure that together, the items in each subscale holistically assessed the construct, and (3) ensure that the selected items had adequate reliability and factor fit when analyzed on their own.

Ultimately, I selected 3 items per subscale for a total of 18 items.[3] All five team members reviewed the item list and the rationale for each item's selection, which are available in the supplementary materials.

9.4.4 Confirmatory Factor Analysis

A confirmatory factor analysis of the 18 selected items using the data from Study 3a indicated excellent fit (Table 9.4), with all items loading strongly onto their intended factor (all loadings $\geq .60$; Table 9.2). Dynamic fit index cut-offs showed that the degree of misfit was similar in magnitude to 2 cross-loadings of .4 each that are present in the population model but not the factor model, which would be considered minor misfit.

9.4.5 Cognitive Pretesting

To further assess whether the selected 18 items were appropriate, I conducted a cognitive pretest with 3 participants (1 native English speaker, 2 non-native speakers; all three were regular video game players). Cognitive pretesting allows researchers to establish whether (1) respondents can understand the item, (2) they do so in a consistent way, and (3) they do so in a way the researcher intended. This was conducted using a think-aloud method (Collins, 2003). On a Zoom video call, participants shared their screen while completing the questionnaire and described their decision-making process aloud. Where participants less freely voiced their thoughts, I used follow-up probes such as 'How did you go about answering that question?' and 'I noticed you hesitated before you answered, what were you thinking about?' The three cognitive pretests largely supported that the items were easily understood and understood in the intended way. Feedback from participants led to minor wording changes, such as removing the word 'tasks' from item cf05 and replacing 'actions' with 'activities' in item af16.

9.5 Study 3b: Confirmatory Factor Analysis (Contextual Level)

In Study 3b, the goal was to validate the structure of the measure using CFA, and to do so at a different level of generality—rather than players responding with reference to a recent gaming session, I was interested in players' experiences with gaming at the contextual level (i.e., across potentially many different games).

[3] In the first instance, I selected 4 items per subscale (24 total), recognizing that further data collection may identify weak items among these, and thus giving leeway to drop one item per subscale without dropping below the 3-item minimum. Subsequent data did indeed identify a low-performing item in four subscales; to keep subscale length consistent, I dropped 1 item per subscale after Study 3c (see supplementary materials for details). For clarity, I report results across all studies for the 18 items retained in the final version.

Table 9.5: Sub-scale Reliability in Each Primary Data Study

	Reliability (Omega) [95% CI][†]					
Study	Autonomy Satisfaction	Autonomy Frustration	Competence Satisfaction	Competence Frustration	Relatedness Satisfaction	Relatedness Frustration
Study 3a	.90 [.88, .92]	.75 [.70, .80]	.87 [.84, .90]	.80 [.77, .84]	.83 [.80, .87]	.81 [.78, .85]
Study 3b	.80 [.78, .82]	.68 [.65, .71]	.75 [.73, .78]	.75 [.72, .77]	.81 [.80, .83]	.82 [.80, .84]
Study 3c	.84 [.81, .87]	.69 [.63, .75]	.78 [.74, .83]	.80 [.76, .84]	.83 [.80, .86]	.86 [.83, .89]

[†] Reliability refers to coefficient omega as recommended by Kelley and Cheng (2012), which can be interpreted similarly to Cronbach's α but does not assume equal factor loadings. Confidence intervals calculated using 1000 bootstrap replicates.

9.5.1 Method

I collected 2036 responses via participants in Study 4. Full details of the design of Study 4 will follow in the next chapter.

The study had 414 eligible participants at Time 1; due to attrition, waves 2–6 contained between 308 and 355 responses each. Of these, 145 responses were flagged as potentially careless due to implausibly fast survey completion or no variance in answers, leaving a final sample of 1891.

In Study 3b, placeholder [X]s in BANGS items were replaced with 'the games I played', thus adapting items to refer to one's experiences with gaming in general (i.e., across potentially many different games).

9.5.2 Results

Model Fit

I conducted a multigroup CFA model, with each survey wave coded as a separate group.[4] Results indicated excellent construct validity with model fit indices well above traditional cut-offs (Table 9.4). Dynamic cut-offs are not currently available for multigroup CFA.

Reliability

Reliability at the contextual level was moderate (Table 9.5): three subscales had $\omega > .80$, though autonomy frustration ($\omega = .68$), competence satisfaction ($\omega = .75$) and competence frustration ($\omega = .75$), had somewhat lower reliability. As in the session-level data, autonomy frustration was the least internally consistent.

Together, results of Study 3b supported the validity of BANGS for assessing need satisfaction and frustration at the contextual level of gaming.

9.6 Study 3c: Confirmatory Factor Analysis (Particular Game)

In Study 3c, I was interested in testing BANGS at an interim level between situational and contextual, namely with one's experience in one game over time. The goal was to further confirm the factor structure, and extend Studies 3a and 3b by including comparison player experience measures.

9.6.1 Method

I recruited a total of 449 participants. 210 participants derived from Prolific.co, and 283 came from Study 4, where in the 6th and final wave only participants could optionally choose to respond to this variant of the questionnaire. 23 Prolific participants and 21 Xbox participants were flagged as potential careless responders, leaving a total of 187 + 262 = 449 responses.

Participants originating from both sources were asked to provide the name of a game they had been playing recently, and then to briefly describe their experiences playing it. I then used piped text to insert the name of the game they provided into each of the items, replacing 'the game' with, for example, 'One Step from Eden'.

Participants from Prolific completed three related measures, to allow tests of convergent and criterion validity. The specific items of all measures are available in the supplementary materials. Participants from Study 4 were paid £1.50 as above, while Prolific participants were paid £1.25 for a survey with a median completion time of 9 minutes.

[4] To avoid the potential for circularity in using the full Xbox data to justify the use of BANGS in the forthcoming Study 4, I repeated the Study 3b analysis using only the first wave of the Xbox study. Results were similarly strong and support the use of the questionnaire at the contextual level (CFI = .98, RMSEA = .028, 90% CI [.011, .041], SRMR = .046).

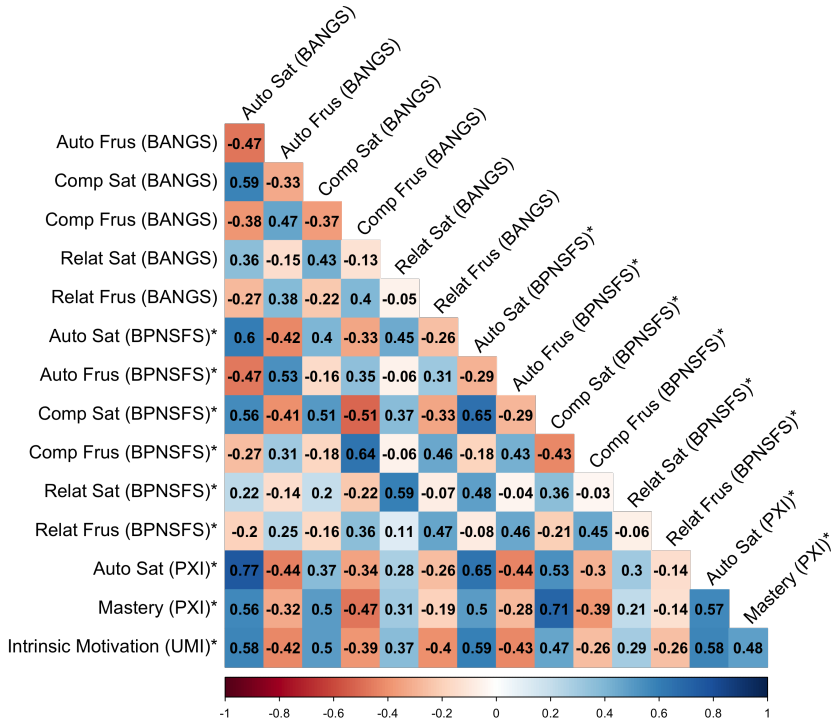

Figure 9.1: Pearson correlations between each construct in the data, using mean scores. Constructs marked with an asterisk reflect data from 178 participants (the Prolific subgroup of Study 3c), while the remainder utilize the entire dataset (n = 2723).

9.6.2 Measures

For assessment of convergent and criterion validity, Study 3c included two need satisfaction measures that partially overlap with the constructs measured by BANGS, and a third measure of motivation.

Autonomy and Mastery in Chosen Game

To measure autonomy and competence satisfaction using a measure that was developed specifically for a games context, participants completed the autonomy and mastery (akin to competence) subscales of the Player Experience Inventory (PXI; V. Vanden Abeele et al., 2020). Reliability of each subscale was high (ω_{aut} = .83, ω_{mas} = .89).

Need Satisfaction and Frustration in Chosen Game

To measure satisfaction and frustration of all three needs in the player's game of choice, participants completed the modified version of the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015), as implemented by Allen and Anderson (2018). In this version, all items are preceded by 'When I play [game]' using the same piped text format as above. The BPNSFS uses a 5-pt Likert scale from '1 - Not at all true' to '5 - Completely true'. Reliability of each subscale was high (all $\omega \geq .78$).

Intrinsic Motivation

To measure intrinsic motivation, participants completed the intrinsic motivation subscale of the User Motivation Inventory (Brühlmann et al., 2018). As above, piped text was used to insert the name of the game into each item. The UMI uses a 7-pt Likert scale from 'Strongly disagree' to 'Strongly agree'. Reliability was high ($\omega = .88$).

9.6.3 Results

Model Fit

Results showed generally good model fit (Table 9.4). Dynamic cut-offs indicated that the degree of misfit is similar in magnitude to two cross-loadings of .45 that are present in the population but absent in the model. This supported the validity of BANGS for assessing need satisfaction and frustration across one game over time.

Table 9.6: Measurement invariance across different contexts (session, one game, gaming in general) and across two different surveys waves.

	CFI	RMSEA	BIC	$\Delta\chi^2$	p	ΔCFI	ΔRMSEA	ΔBIC
Context Invariance								
Configural	.974	.040	169456					
Metric	.971	.040	169337	68	<.001	−.002	.000	−119
Scalar	.964	.044	169306	229	<.001	−.007	.003	−30
Longitudinal Invariance								
Configural	.978	.034	115583					
Metric	.977	.034	115213	73	.80	−.001	.000	−370
Scalar	.967	.039	114932	207	.98	−.010	.005	−280

In Study 3c, there was slightly higher model misfit than Studies 3a and 3b, driven primarily by the autonomy frustration subscale, where two items loaded only weakly onto their intended autonomy frustration factor (λs = .54 and .42, respectively; Table 9.2). Follow-up diagnostics using EFA indicated that two items were the main contributors of misfit, namely 'Many actions in [X] were boring', which cross-loaded negatively onto competence satisfaction, and 'I felt forced to take certain actions in [X]', which cross-loaded negatively onto autonomy satisfaction.

Reliability

Results showed good reliability (Table 9.5), with 5 of 6 subscales having a coefficient omega of .78 or higher. As in Studies 3a and 3b, reliability for autonomy frustration was lower at .69, but still within an acceptable range.

Together, therefore, Study 3c largely aligns with Studies 3a and 3b in supporting construct validity and internal consistency in BANGS, but that the autonomy frustration subscale should be used with caution at this level of generality. I return to this limitation in the discussion.

9.7 Study 3d: Measurement Invariance

9.7.1 Method

To assess whether the questionnaire functions similarly in each of the three contexts in which I tested it (one session, particular game, and games in general), I combined the data from Studies 3a, 3b, and 3c (n = 2723).

Separately, I tested longitudinal invariance by comparing the six survey waves present in Study 3b. These are only 2 weeks separated, so no major differences in factor structure are expected, but this nonetheless allowed for a basic assessment of whether participants responded to the measure consistently and with similar means across multiple measurement occasions.

9.7.2 Results

Context Invariance

Results showed that the measure is not invariant across contexts (Table 9.6). While the configural model fit well, indicating that the factor structure is invariant across contexts, constraining the factor loadings (metric invariance) led to a significant reduction in model fit. Similarly, constraining the intercepts (scalar invariance) led to a further significant worsening of model fit. However, even the scalar invariance model fit the data reasonably well (dynamic cut-off indices were not available for invariance models, but fit indices are higher than most conventional cut-offs), and the BIC selected the scalar model as the model that best balanced model fit and parsimony. This indicates that although the measure is not fully invariant, it is likely justifiable to use it in each of the above contexts and to, under certain circumstances, compare results across these. I return to the idea of invariance across gaming contexts in the discussion.

Longitudinal Invariance

Results were similar for longitudinal invariance. Although constraining the factor loadings (metric invariance) and intercepts (scalar invariance) across the 6 survey waves led to statistically significant changes in model fit, these were relatively minor (Table 9.6). The scalar invariance model continued to show strong fit, and was favored by the BIC, indicating that the slightly worse model fit is counterbalanced by the benefits of a simpler model. Broadly, I interpret this as evidence that the factor structure, loadings, and item-level intercepts were largely consistent over a period of 3 months, meaning that scores can be readily compared over time.

9.8 Study 3e: Discriminant/Convergent/Criterion Validity

In the final study, I was interested in assessing the discriminant validity (which answers the question, 'are the subscales in BANGS sufficiently distinct?'), convergent validity ('do BANGS subscales perform similarly to other scales designed to measure the same construct?'), and criterion validity ('do BANGS subscales correlate with other constructs as predicted under SDT?'). As in Study 3d, data from Studies 3a, 3b, and 3c were combined. Analyses of discriminant validity and Average Variance Extracted therefore reflect the full sample size of 2723, while analyses of how BANGS correlated with other measures reflect just the Prolific subsample of Study 3c who completed these (n = 187).

9.8.1 Method

To assess each of these forms of validity, I inspected correlations among the six BANGS subscales, as well as between BANGS subscales and the related measures included in Study 3c (mastery and autonomy from the PXI, intrinsic motivation from the UMI, and need satisfaction and frustration from the modified BPNSFS). The full correlation matrix is shown in Figure 9.1. For simplicity, I present this table with Pearson's r correlation coefficients on mean subscale scores; results, however, are highly similar when looking at latent factor correlations.

9.8.2 Results

Discriminant Validity

Satisfaction and frustration of each need in BANGS were negatively correlated (Figure 9.1). For autonomy and competence, satisfaction and frustration were moderately negatively correlated ($r = -.48$ and $r = -.33$, respectively), while relatedness satisfaction and frustration were only weakly negatively correlated ($r = -.07$, p = .02), an unexpected result. This suggests that relatedness satisfaction and frustration, as operationalized in BANGS, are largely independent, a finding that I return to in the discussion.

Across needs, I found strong relations between autonomy satisfaction and competence satisfaction ($r = .66$, 95% CI [.62, .69]), and moderate relationships for each other pair ($-.18 \leq r\text{s} \leq .48$). These correlations are in line with SDT theory, which predicts positive relations across needs, but not so high as to threaten discriminant validity: correlations were safely in line with previous recommendations that two latent factors should only be treated as distinct when factor correlations have a 95% confidence interval upper bound that does not exceed .80 (Rönkkö and Cho, 2020).

Overall, discriminant validity was supported—satisfaction and frustration of each need are distinct in measurement but co-vary in ways that align with SDT predictions.

Convergent Validity

I found moderate to strong correlations between the BANGS subscales and their BPNSFS counterparts ($.47 < rs < .64$, Figure 9.1). Correlations between BANGS and corresponding PXI subscales were similar or slightly higher ($r_{aut} = .77$, $r_{comp} = .50$). Broadly, this supported that BANGS is measuring similar, but not identical constructs as previous measures, and that there is greater correspondence among measures developed specifically for a games context. I explore possible sources of divergence in the discussion.

Some researchers (e.g., V. Vanden Abeele et al., 2020) have adopted a different definition of convergent validity based on Average Variance Extracted (AVE), or the proportion of variance in the indicators explained by the latent factor—a metric related to reliability. I tested this as well, finding that AVE was well above the conventional .5 cut-off for all subscales except for autonomy frustration, which was slightly below (.45). This is in line with its lower reliability in Studies 1–3.

Predictive Validity

To assess predictive validity, I used BANGS scores to predict both intrinsic motivation within the Prolific subsample of Study 3c. As expected, people who reported higher satisfaction also reported significantly more intrinsic motivation to play ($.37 < r\text{s} < .58$), while those who reported greater frustration also reported less intrinsic motivation ($-.39 < r\text{s} < -.42$). I fit two linear regression models where intrinsic motivation scores were predicted by the mean scores of either (1) all 6 BANGS subscales or (2) all 6 BPNSFS subscales. BANGS accounted for significantly more variance in intrinsic motivation than the BPNSFS ($R^2 = .50$ vs .42).

9.9 Discussion

Above, I described the development of BANGS and provided evidence to support many aspects of its validity. I demonstrated high construct validity across three studies and contexts (the situational level of recent recalled play session; a middle level of generality reflecting experiences with a particular game over time; and the contextual level of gaming in general over the previous 2 weeks). The measure showed good evidence of invariance across these three contexts, suggesting that the measure can be used in each, and that results can largely be compared across contexts. BANGS subscales were sufficiently distinct to be measured and understood separately, but correlated with each other in theoretically-predicted ways (e.g., satisfaction of each need is correlated with satisfaction of the others, and negatively correlated with frustration of that need). Subscales also correlated with other previous measures (the PXI and BPNSFS), indicating convergent validity. Finally, I showed that both need satisfaction and frustration were predictive of intrinsic motivation for play—even more strongly than a previous, non-gaming-specific measure in the form of the modified BPNSFS.

Together, these results demonstrate that BANGS is suitable for use in a range of games user research settings, and can thereby contribute to research rigor, theory development, and understanding of player experiences. In academic research, measures of need satisfaction and frustration are used to assess both positive and negative effects of play on wellbeing, both in commercial games for entertainment and (potentially) serious games. The results confirm and extend previous theory and empirical results showing that need satisfaction and frustration are distinct, and that both constructs are relevant for games. In particular, the dual process models proposed in self-determination theory (Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani, 2011; Vansteenkiste and Ryan, 2013) depend upon assessment of need frustration, which BANGS accomplishes. BANGS might therefore contribute to better understanding of unhealthy interactions with games (e.g., excessive gaming, spending, toxic interactions) and the identification of game features or individual differences that lead to such interactions. Need frustration in particular may have utility in investigating negative emotional or behavioral outcomes such as post-play aggression (Przybylski et al., 2014).

9.9.1 Comparison with Previous Measures

The measure improves upon competing scales such as PENS, UPEQ, and BPNSFS in several ways: by capturing need frustration in a form that is specific to gaming, by adopting broad conceptions of competence (including not just mastery, but growth as theorized under SDT) and relatedness (including both human and non-human characters), and by being validated for multiple levels of generality.

Previous prominent game-specific scales such as PENS (Ryan et al., 2006) and UPEQ (Azadvar and Canossa, 2018) only measured need satisfaction. To date, attempts to measure need frustration in games have relied on a domain-general scale, the BPNSFS, modified for a games context (Allen and Anderson, 2018; Kosa and Uysal, 2021). While these papers find good evidence for construct validity in the BPNSFS, some items stand out as not neatly applicable to games (e.g., 'I feel that people who are important to me are cold and distant towards me'), and certain results run counter to theory, such as a positive correlation between autonomy satisfaction and frustration in Allen and Anderson (2018). The results here show that addressing these concerns with a domain-appropriate need frustration measure appears to have had benefits for predictive validity: although construct validity was similar between BANGS and the BPNSFS, BANGS was more predictive of a key gaming-related outcome, intrinsic motivation, than the BPNSFS.

Looking at the items, the BANGS competence subscale captures a feeling of growth and improvement which is not explicitly included in the PXI or PENS (e.g., BANGS 'I felt I was getting better at playing this game' vs PXI 'I felt I was good at playing this game' vs PENS 'I feel competent at the game'). In line with theory suggesting that a key aspect of competence is growth (rather than simply mastery or effectance) (Deterding et al., 2022; Ryan and Deci, 2017), and with previous results showing that learning and improvement is a key predictor of video game engagement (e.g., Huang et al., 2019), I believe this the growth element is a further valuable feature of BANGS.

With regard to relatedness, the BPNSFS and PENS either explicitly or implicitly limit relatedness to only player characters, glossing over other identified sources of relatedness experiences (Tyack and Wyeth, 2017). UPEQ, on the other hand, does separate items for NPCs and listed these as part of the same construct, but results in Study 2 found them to form two distinct factors. Results here indicate that the BANGS relatedness subscales are able to capture experiences of social connectedness in both contexts, and still remain psychometrically valid. For example, previous relatedness measures have not captured the notion of toxicity, a topic that is widely discussed in the literature on video games (e.g., Depping et al., 2018) with has clear relevance for relatedness frustration.

To date, there has been no explicit comparison of validity at multiple levels of generality, for PENS, UPEQ, or BPNSFS. It is therefore unclear whether these measures can be used effectively at both situational and contextual levels, and whether scores can be compared across these. Limited previous evidence has found that the difference between a recent and a recalled experience had implications for factor structure in an effectance measure (Ballou et al., 2021), which points to a need to test this here. BANGS takes up this mantle, showing that the questionnaire can be used at three levels of generality: situational (session-level), narrow contextual (one game over time), and broad contextual (gaming in general). However, I find some evidence that reliability might be lower for several subscales at the broad contextual level.

In short, BANGS offers domain-appropriate measurement of need satisfaction and frustration with a degree of nuance and validity not available in previous measures.

9.9.2 Future Directions for BANGS

Although the validation undertaken here appears promising, there remains room for further iteration and improvement. In particular, I hope—with the help of the games research community—to refine and extend the questionnaire in four key ways: (1) advance our understanding of autonomy and relatedness frustration in games and thereby improve those subscales, (2) further assess the predictive validity of the questionnaire in conjunction with objective measures of gaming behavior, (3) investigate smallest effect sizes of interest, and (4) explore short-form or single-item variants for easier use in diverse research contexts.

At present, the weakest element of the questionnaire is the autonomy frustration subscale: two items loaded only weakly onto their intended factor in the piped text version of the questionnaire (Study 3), and reliability of that subscale was consistently lower than the other subscales across all three studies. Despite having 16 candidate autonomy frustration items in the initial pool, it was challenging to identify a subset that consistently 'hung together'. The precise reason for this difficulty is at present not fully clear. One potential explanation comes from recent proposals to differentiate not just need satisfaction and frustration, but also need dormancy (Reeve et al., 2023) or need dissatisfaction (Cheon et al., 2019), which describe related proposed states in which a need is neglected or underdeveloped, without necessarily being actively thwarted. Because gaming strongly tends towards being an activity that is undertaken voluntarily, and one in which players undertake in-game actions voluntarily, it may be the case the autonomy dissatisfaction or dormancy is more salient than active frustration, and that certain items (e.g., the one related to boredom) map better onto these than the intended frustration factor. I encourage further SDT in games research to test the relevance of these constructs. Another potential explanation is that in practice, certain situations that frustrate both autonomy and competence are common in games, and lead to cross-loadings that dilute the distinctiveness of the construct. For example, it is easy to see how players who feel forced to adopt a certain undesired playstyle to overcome a boss (a type of autonomy-frustrating experience reported in Study 1) would also feel a lack of growth competence satisfaction.

A further unexpected finding was the weak negative correlation between relatedness satisfaction and frustration, which—while in the expected direction—indicated that the two varied nearly fully independently. A likely contributor here is that the relatedness frustration items in BANGS are targeted at experiences of toxicity, as this was the category of relatedness frustration that was most salient in previous research and in the experience of our players (Türkay et al., 2020). It may be the case, therefore, that players are accustomed to persisting through occasional toxic experiences with unknown others for the greater goal of positive social experiences with known others—resulting in need experiences that are largely orthogonal. In the first instance, assessing whether this finding is sufficiently in line with theory will require replication, so as to verify whether the correlation observed here is an outlier or close to the true population value.

In understanding the unique features of these potentially problematic items and subscales, it may be useful to compare the classical test theory validation performed above with item response theory (IRT). IRT allows for estimation of item difficulty and discrimination parameters, enabling the creation of tailored tests that can efficiently measure psychological variables across multiple levels of the underlying latent trait—something classical test theory struggles to achieve with fixed-item tests (De Ayala, 2022). This is not to say that IRT is strictly preferable to the approach adopted here: classical test theory is simple and thereby easy to interpret, makes fewer assumptions about item-level processes, and often leads to very similar trait estimates (Speer et al., 2016). This suggests that a combination of the two approaches might be most effective.

Next, I would like to extend the predictive validity analyses to include more detailed analysis of logged behavioral measures. In the current study, I predicted only intrinsic motivation. Although an important construct, more nuanced behavioral outcomes such as playtime in a particular session or game over time, or in-game actions and performance, are of great interest for both industry research on engagement and for academic research on video game effects. Substantial research is needed to understand how variable playtime

is over time, and the primary factors that influence this variation—comparing both player experience measures such as need satisfaction and frustration, and real-world constraints such as family responsibilities.

Another way to extend the usefulness of BANGS is to define smallest effect sizes of interest—minimal changes in scale scores that would be considered practically significant. This idea follows long-standing warnings that statistical significance is not a good measure of practical importance (Kirk, 1996). One useful way to establish smallest effect sizes of interest is through anchor-based methods (Anvari and Lakens, 2021). This involves, for example, players filling out BANGS in reference to two games, and further completing an item about the degree to which they experienced one of those games as more enjoyable or need-satisfying than the other. The difference in mean need satisfaction and frustration associated with one game being e.g., 'a little bit more enjoyable' than the other would be a plausible smallest effect size of interest in future research.

Finally, I hope to validate single-item subscales. Single-item measures have begun to see greater use in games research for their ability to be administered quickly—potentially even interspersed throughout a play session (e.g., Vuorre et al., 2023). Single-item measures are much easier to deploy in playtesting settings where an 18-item questionnaire would otherwise be too burdensome. For non-playtesting administration, I note that BANGS is slightly shorter than existing similar questionnaires (e.g., the 24-item modified BPNSFS; Chen et al., 2015 or the 21-item UPEQ; Azadvar and Canossa, 2018), and that researchers need not use all subscales if they are not relevant to their study.

In short, I see this as the beginning, not the end of the measure development process. If researchers are interested in using BANGS but have concerns about certain items, I encourage them to include additional items alongside the ones validated here—this would allow them to 'fall back' on a well-validated questionnaire while also creating opportunities to iterate on the questionnaire. Just like BANG (the theoretical model), BANGS need not be fixed in stone—via exploratory analyses and comparison with items that others feel better capture the experience of basic needs, future versions of the questionnaire can be even more valid. Collaboratively, these efforts and others can develop BANGS as a valuable resource for the games research community.

9.9.3 Constraints on Generalizability

Participants across all studies were adult players, majority male and from Western countries, and relatively homogeneous with regard to the type of gaming they were involved in—participants were either primarily Xbox users (if deriving from the Study 4 data) or, in the case of Prolific participants, tended to play console and PC games. Although there was a wide variety of games and genres in the sample (e.g., MOBAs, sports games, puzzle games, FPSs, and more), the measure should be tested for use with more diverse types of games (e.g., mobile gacha games) and players (e.g., adolescents from non-Western countries).

9.10 Conclusion

Above, I presented the development of BANGS and show that it is a reliable and theoretically sound tool for measuring basic psychological need satisfaction and frustration. I improve upon previous similar measures by capturing need frustration in a domain-appropriate way, and adhere to high standards of measurement validity standards across 5 studies. I hope BANGS can be of use to researchers in both industry and academia who are interested in investigating player (dis)engagement, motivation, and wellbeing.

The strengths of BANGS make it more suitable for use in testing the BANG theoretical model than previous measures such as the BPNSFS. The primary contribution of Study 3 for this thesis, therefore, is to provide an instrument for measuring need satisfaction and frustration at the contextual level, for use in the next and final study of the thesis. This is presented in the following chapter.

9.11 Acknowledgements

I would like to thank Elena Gordon-Petrovskaya for her contributions to the candidate item generation and feedback on the early stages of questionnaire development. I thank the Game AI group for providing funding for the initial stages of this study.

10

Study 4: Longitudinal Relationships Between Logged Xbox Gaming and Mental Health

Chapter Contents

10.1 Introduction . . . 115
10.2 Design . . . 117
10.2.1 Sample Size . . . 117
10.2.2 Participants . . . 118
10.2.3 Measures . . . 118
10.3 Study 4a: Playtime and Mental Health . . . 120
10.3.1 Introduction . . . 120
10.3.2 Method . . . 122
10.3.3 Results . . . 123
10.3.4 Study 4a Discussion . . . 125
10.4 Study 4b: Basic Needs in Games Model . . . 126
10.4.1 Introduction . . . 126
10.4.2 Method . . . 128
10.4.3 Confirmatory Results . . . 129
10.4.4 Exploratory Results . . . 130
10.4.5 Study 4b Discussion . . . 133
10.5 General Study 4 Discussion . . . 134
10.6 Conclusion . . . 135
10.7 Acknowledgements . . . 135

Publication Information and Data Availability

Study 4a is based on content in press as a Stage 2 registered report in *Technology, Mind & Behavior*. The Stage 1 manuscript is available as:

Ballou, N., Sewall, C. J. R., Ratcliffe, J., Zendle, D., Tokarchuk, L., & Deterding, S. (2024). Registered report evidence suggests no relationship between objectively-tracked video game playtime and wellbeing over 3 months. *Technology, Mind, and Behavior*, *5*(1), 1–15. https://doi.org/10.1037/tmb0000124

All data, code and materials associated with this project are available on the Open Science Framework (Study 4a: https://osf.io/edtwn; Study 4b: https://osf.io/jw6np/).

10.1 Introduction

Let us briefly stock of what we have discovered so far. In the literature review, I showed that the current evidence base for the existence of positive and negative effects is not just mixed, but also limited and complicated by methodological issues, namely reliance on self-reported playtime, cross-sectional designs that do not allow to test causal directions of any found correlation, and a wide range of possible specifications in timescales and mental health constructs. Although research in the field is trending toward more rigorous studies using longitudinal designs and logged play data, conflicting results indicate that debates around video game effects are far from over (Kowert and Quandt, 2021a). To advance our understanding of the relations between play and mental health, therefore, we need (1) better theory that can account for this diversity of empirical evidence, and (2) better data—comprehensive objective playtime data across multiple games, and differentiated mental health data, tracked over time at a within-person level.

To date, there exist only a handful of studies that have applied methodological best practices, with a vanishingly small number having collected digital trace data, and even fewer that did so while applying a clear theoretical approach aimed at detecting the presence, and not just the absence of effects. The closest we have come to date are two recent studies that used digital trace data to provide some of the strongest evidence to date against the existence of a relationship between playtime and mental health effect (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022). But while these studies are important advancements over earlier research, even they have several limitations. First and foremost, they are focused in large part on the bivariate relationship between playtime (i.e., *quantity* of play) and wellbeing, and only superficially touch on whether the *quality* of play might or might not affect player mental health, or the mechanisms by which this might occur.

Second, they collect *game-level* data: they include playtime from just one game per player. To understand the total effect of gaming on mental health, however, we need to capture a player's full gaming diet, played across an entire *platform* (or for some players, multiple platforms) such as Xbox, Playstation, Steam, Nintendo, iOS, or similar—data from a single game may only represent a fraction of a player's total gaming, and therefore a fraction of the impact play has on their life. At present, platform-level data is close to non-existent in the scientific literature (with the partial exceptions of O'Neill et al., 2016 and Sifa et al., 2021, which include only anonymized data not linked with psychological variables): at large, we simply do not know what players' gameplay looks like across more than one game, or how that play affects them. In acquiring game-level data, Johannes et al. (2022) and Vuorre, Johannes, and Przybylski (2022) relied on exclusive data-sharing agreements with an industry partner—while their data is commendably made publicly accessible, this method cannot be easily replicated by other less well-resourced research groups (Section 2.4.5). Finally, one of the studies is cross-sectional (Johannes et al., 2022), while the other uses a 3-wave, 6-week panel design (Vuorre, Johannes, and Przybylski, 2022); they are therefore both limited in the precision with which they can investigate within-person effects at longer timescales.

This brings us back to the BANG model, developed earlier in this thesis. The BANG model makes several explicit predictions, including that there is no meaningful direct relationship between playtime and mental health, but that there *are* several alternative mediated pathways via need satisfaction and frustration, and via problematic displacement, whereby both the quantity and quality of video game play might yet still affect players.

Given that empirical evidence on both of these hypotheses is limited by both measurement and theory, my goal in Study 4 is therefore to test these propositions: that there is no meaningful direct relationship between playtime and mental health (Study 4a), and that the BANG model can instead explain through an alternative mediated pathway when and why gaming *does* relate to mental health (Study 4b). In the design of Study 4, my goal was to adhere as closely as possible to the meta-scientific practices identified in Chapter 2, and thereby attempt to improve on the quality of the evidence base.

This philosophy led to the decision to use a longitudinal panel study design with digital trace data trace collected alongside mental health measures. Specifically, I collected data from 400 adult Xbox players in the US and UK spanning 12 weeks and 6 survey waves, allowing for more precise estimation of within-person effects than previous work (Practice 3). The study collects platform-level digital trace data, with play tracked across any and all games played on a gaming platform (the Xbox Network); rather than relying on potentially limited data sharing agreements with individual industrial partners, this data is gathered using an open source method

that collects directly from players via their Xbox friends list (Practice 5). The study's psychological measures are aligned with the mental health taxonomy adopted here, using three distinct measures operating on different time scales to allow for the possibility of effects appearing for certain timescales and mental health aspects but not others: a short-term hedonic construct (positive and negative affect in the moment), a medium-term ill-being construct (depressive symptoms during the previous week), and a longer-term eudaimonic construct (general mental wellbeing during the previous 2 weeks) (Practice 4).

At the theoretical level, the derivation chain between the BANG model and hypotheses is transparent and strong, thus reducing the opportunity for failed predictions to be explained away by the study's design (Scheel, Tiokhin, et al., 2021) (Practice 1). A further theoretical strength of the study is the investigation of relationships in both directions, exploring not just effects of playtime on mental health, but also of mental health on playtime.

Analytically, I report inter-individual variation in the relationship between certain pairs of constructs, such as need satisfaction in games and subsequent playtime, to set the stage for future work on identifying individuals who exhibit more negative vs more positive effects (Practice 2). Finally, this work extends the open research philosophy on display throughout this thesis by also publishing the preregistered analyses as a registered report (in press at the time of writing) to reduce the potential for publication bias against null results (Practice 6).

Together, this study thus holds potential to make a substantial contribution to both the theory and methods landscape of work on video games and mental health. In this sense, it is the culmination not just of the empirical work I have undertaken in this thesis, but also of the methodological reforms whose value I hope to illustrate for the wider research community.

Causal Interpretation

Before proceeding, I would like to draw the reader's attention to the fact that my research interests in Study 4, and by extension my hypotheses, are causal in nature. However, people cannot be randomized into spending more or less time playing video games or experiencing greater or lesser need satisfaction. Given the observational nature of studies on this topic, interpretation of the statistical parameters I estimate below as causal relies on several assumptions: specifically, that there are no time-varying confounders, no selection bias, and the correct time lag.

First, an unknown time-varying confounder (e.g., a change in disposable income) might increase mental health now and play behavior later, creating the appearance of a positive relationship. I am unable to control for all variables that might create spurious relations or obscure true relations between playtime, play quality, and mental health, due in large part to a lack of theory identifying such confounders (see Vuorre, Johannes, Magnusson, et al., 2022). I included an exploratory open-ended question asking players to report any events they felt affected both their mental health and their play to inform future research.

Second, there is potential for self-selection bias, wherein mental health and play behavior together impact the likelihood of study participation and/or attrition. For example, if people who are feeling guilty about their high playtime are more likely to sign up for a study, this would bias results towards a negative effect of playtime on mental health. Relatedly if participants who later feel poorly and play more games than usual tend not to complete questionnaires, their attrition would mask a true negative effect. Self-selection is closely related to the potential generalizability of results, which I return to in the discussion.

Finally, building upon previous work that investigated one potential time lag (2022), I selected three potential lags of 1 day, 1 week, and 2 weeks, corresponding roughly symmetrically to the scope of each mental health variable. I expect any causal relationships between gaming and mental health to be on approximately matching timescales (e.g., mental health over the course of 2 weeks should be affected by gaming over the course of the 2 weeks' prior). In the case of positive affect, which is a state measure addressing feelings in the moment, I expect this to influence and be influenced by play over the course of the preceding or following day. However, any actual effects may be too short-lived to be detected with this design, or accumulate over longer periods of time (Dormann and Griffin, 2015). Thus, the potential causal effects discussed in this paper refer to an effect carried over the specified time scale (e.g., the previous 1 week of play on the subsequent 1 week of depressive symptoms).

Throughout the rest of this chapter, I use primarily correlational language when describing the results to reflect the likelihood that some or all of the assumptions do not hold. However, I believe these estimates nonetheless offer some information about potential causal effects, and invite readers to make their own judgements.

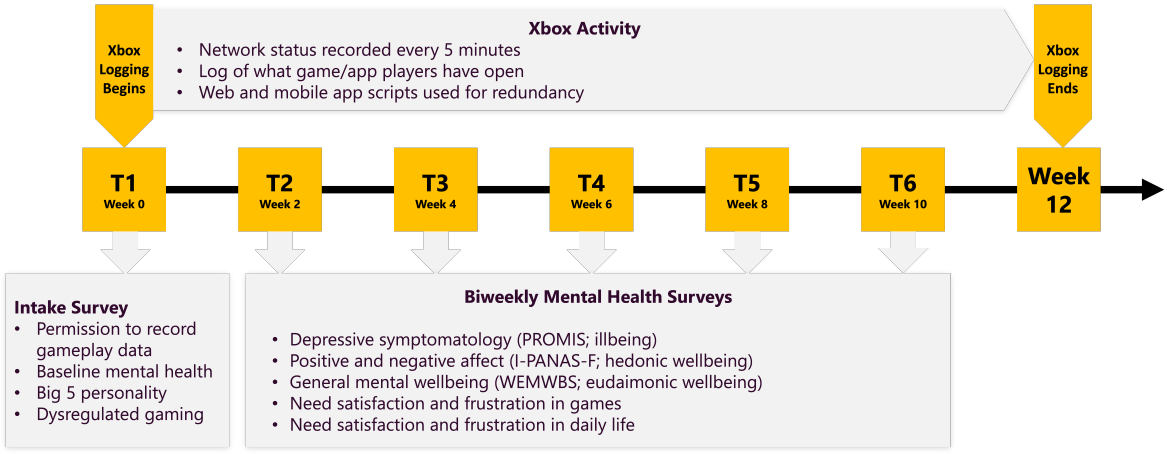

Figure 10.1: Overview of the study design

10.2 Design

I conducted a 12-week study, during which Xbox play was tracked continuously and linked with 6 bi-weekly survey waves. Participant recruitment began February 8, 2023, and data collection ended on May 23, 2023. To participate, players were required to be (1) US/UK residents; (2) at least 18 years old; and (3) active video game players playing (nearly) exclusively on Xbox, defined as playing at least 1 hour of games per week, of which at least 75% takes place on any Xbox console (Xbox 360/Xbox One/Xbox Series S|X).

To reach players, I used a combination of (1) paid advertisements on Reddit, targeting Xbox- and gaming-related subreddits (n = 260), (2) convenience and snowball sampling via the research team's[1] Twitter accounts and university mailing lists (n = 38), and (3) Prolific screening questionnaires (n = 116). I selected Reddit as the platform for advertising because Reddit is home to a large segment of the population of interest (engaged adult Xbox users), and has been found to yield comparable data quality to other commonly-used sources of participants for social science research, such as MTurk and undergraduate students (Jamnik and Lane, 2017; R. Luong and Lomanowska, 2021). I recognize that this sampling strategy is not likely to yield a sample representative of video game players in the US/UK and may specifically omit lesser-engaged players who are not forum members; instead, I target moderately- to highly-engaged Xbox players, and return to this limitation in the discussion.

The study design is summarized in Figure 10.1. At each time point, players completed a survey in Qualtrics. At Time 1, players completed baseline demographic and mental health measures and provided access to their playtime data by adding researcher accounts as friends on Xbox network. At each subsequent time point, they completed a 9-minute survey with the mental health measures specified below, with the order of both blocks and items randomized. Surveys at Times 2–6 were distributed via email in two-week intervals based on when the player joined the study. Reminders were sent after 24 and 48 hours.

The design was informed by an abbreviated 3-wave pilot (n = 37) to test the stability of the Xbox trackers, payment system, survey design, and retention rate. It was not designed to estimate power, hence I did not use any observed effect sizes to inform power analyses (Albers and Lakens, 2018). Full pilot details are available in the supplementary materials.

Ethical approval was granted by Queen Mary University of London [QMERC20.383]. All players provided informed consent prior to beginning the study. Players were paid in Amazon gift cards, £3.00 (or equivalent in USD) for the wave 1 survey, £1.50 for each subsequent wave, and a £5 bonus for completing all 6 waves, for a maximum total of £15.50.

10.2.1 Sample Size

Based on power simulations targeting the effect sizes specified in Study 4a, a sample size of 400 participants and 6 time points was determined. This justification is detailed in the method of Study 4a below.

[1] Ballou, N., Sewall, C. J. R., Ratcliffe, J., Zendle, D., Tokarchuk, L., & Deterding, S. (2024). Registered report evidence suggests no relationship between objectively-tracked video game playtime and wellbeing over 3 months. *Technology, Mind, and Behavior*, *5*(1), 1–15. https://doi.org/10.1037/tmb0000124

Table 10.1: Demographic characteristics of the participants in Study 4

Country	n	Age (SD)	Gender			Employment			
			Men	Women	Preferred to specify	Full-time	Part-time	Student	Other
US	170	33.0 (8.4)	127	35	8	81	21	12	56
UK	244	31.1 (8.2)	201	33	10	156	18	16	54

10.2.2 Participants

A total of 414 adult US/UK Xbox users completed the Time 1 survey and successfully linked their Xbox account. Demographic information is available in Table 10.1.

A total of 2,036 survey responses were collected across the 6 waves (82% response rate). Missing responses were more likely to come from younger players ($p < .001$), but did not differ across mental health, gender, or playtime ($ps > .15$). As preregistered, I excluded all survey waves from 33 players who did not log any time on Xbox for at least 4 weeks, indicating that they are not active Xbox players, and from 2 players who self-reported at Time 6 that their data should not be included (see questionnaire items). Of 1,894 remaining responses, 117 were excluded due to potential carelessness, as indicated either by implausibly fast survey completion or preregistered item-by-item variability indices (calculated using the R package *careless*; Yentes and Wilhelm, 2021). I was therefore left with 1777 eligible responses from 379 players, and 497 missing or careless responses to be imputed. Missing data were imputed using multiple imputation (Sterne et al., 2009) with the *mice* package (van Buuren and Groothuis-Oudshoorn, 2011), assuming a mechanism of missing at random (MAR).

10.2.3 Measures

Descriptive statistics and reliability for each measure are shown Table 10.2.

Need Satisfaction and Frustration in Daily Life (Global Level)

Need satisfaction and frustration at the global level was measured with the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al., 2015), which contains distinct subscales for need satisfaction and frustration, and has been extensively validated across cultures (2015). The BPNSFS contains a total of 24 items, with 4-item subscales for satisfaction and frustration of each basic need (autonomy, competence and relatedness, thus 6 subscales in total), with each item rated from 1 ('not at all true') to 5 ('completely true'). Scores were calculated by taking the mean of all items in each subscale, and therefore range from 1 to 5.

Need Satisfaction and Frustration in Games (Contextual Level)

Need satisfaction and frustration in video games at the contextual level was measured using BANGS as developed in Chapter 9. Players rated 3 items per subscale, for a total of 18 items, about their experiences playing games over the previous two weeks on a scale from 1 ('Strongly disagree') to 7 ('Strongly agree'). Example items include 'Over the past 2 weeks...I felt forced to take certain actions in the games I played' (autonomy frustration) and 'Over the past 2 weeks...I often felt that I lacked the skills necessary for the games I played' (competence frustration). Scores were calculated by taking the mean of all items in each subscale, and therefore range from 1 to 7.

The decision to collapse autonomy, competence, and relatedness into second-order satisfaction and frustration variables was taken to reduce the complexity of the analyses and visual presentation. This strategy has been successfully used in previous games research (Przybylski and Weinstein, 2019a). To verify that this was justifiable here, I fit hierarchical CFA models to the complete data from Study 3, which largely supported the use of second-order factors: a latent need satisfaction factor had strong factor loadings from autonomy satisfaction (λ = .72) and competence satisfaction (.79), and weak-to-moderate from relatedness satisfaction (.40). A latent need frustration factor similarly had strong factor loadings from autonomy frustration (λ = .86) and competence frustration (.71), and a moderate loading from relatedness frustration (.52). Reliability in the combined subscales was also high (ω_h = .85 for need satisfaction, .83 for need frustration). Together, this indicates that using combined need satisfaction and need frustration constructs is statistically justifiable, but nonetheless represents a simplification that can be improved upon in future work.

Positive Affect (Hedonia)

Positive affect in the present moment was measured with the positive affect subscale of the I-PANAS-SF scale (Thompson, 2007). Players were asked to rate the extent to which a list of 10 adjectives (e.g., 'alert' and 'determined') describe how they feel at that moment, on a 5-point Likert scale from 1 ('very slightly or not at all') to 5 ('extremely'). Scores were calculated by taking the mean of all items, and therefore range from 1 to 5.

Table 10.2: Descriptive statistics and reliability for primary measures in Study 4.

	Positive affect	Depressive symptoms	Gen. Mental WB	Need Sat (Games)	Need Frus (Games)	Need Sat (Global)	Need Frus (Global)	Prob. Displacement	Logged Daily Playtime (Hrs)	Self-reported Playtime (Hrs)
Positive affect										
Depressive symptoms	-0.41***									
Gen. Mental WB	0.6***	-0.77***								
Need Sat (Games)	0.27***	-0.21***	0.33***							
Need Frus (Games)	-0.14***	0.31***	-0.29***	-0.36***						
Need Sat (Global)	0.52***	-0.65***	0.8***	0.41***	-0.36***					
Need Frus (Global)	-0.39***	0.7***	-0.71***	-0.3***	0.48***	-0.75***				
Prob. Displacement	-0.13***	0.25***	-0.24***	-0.067**	0.37***	-0.26***	0.36***			
Logged Daily Playtime (Hrs)	-0.082**	0.077**	-0.061*	0.13***	0.0054	-0.018	-0.0054	0.089***		
Self-reported Playtime (Hrs)	-0.058*	0.093***	-0.075**	0.19***	0.005	-0.019	0.013	0.16***	0.63***	
Mean	2.83	2.68	3.25	4.92	2.89	3.60	2.43	2.27	2.79	2.55
Median	2.90	2.67	3.32	4.96	2.8	3.65	2.39	1.92	2.10	1.83
SD	0.84	0.87	0.73	0.93	1.08	0.72	0.82	1.30	2.63	2.44
Reliability	0.82	0.96	0.93	0.79†	.75†	.88†	.86†	0.83		

$^{***}p < .001, ^{**}p < .01, ^{*}p < .05$

† Average of reliability for autonomy, competence, and relatedness shown for simplicity (reliability of each subscale exceeded .7 in all cases). Reliability refers to coefficient omega as recommended by Kelley and Cheng (2012), which can be interpreted similarly to Cronbach's α but does not assume equal factor loadings. Confidence intervals calculated using 1000 bootstrap replicates.

Depression (Illbeing)

Depressive mood in the previous week was measured with the PROMIS 8-item Adult Depression scale (Cella et al., 2010; Pilkonis et al., 2011). Players rated 8 statements about how they felt in the past 7 days such as 'I felt hopeless' and 'I felt I had nothing to look forward to' on a 5-point scale from 1 ('never') to 5 ('always'). Scores were calculated using item-level calibrations through the HealthMeasures Scoring Service (https://www.assessmentcenter.net/ac_scoringservice) and are normalized to a mean of 50 and an SD of 10. To match the other mental health variables and ease interpretation in Study 4a, PROMIS depression scores were rescaled to range from 1 to 5.

General Mental Wellbeing (Eudaimonia

) General mental wellbeing during the previous 2 weeks was measured with the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS; Tennant et al., 2007), which has shown good psychometric properties and sensitivity to within-person change (Maheswaran et al., 2012). The WEMWBS covers both hedonic and eudaimonic aspects of wellbeing, and is thus treated here as a eudaimonic measure that includes items measuring the hedonic symptoms of eudaimonic wellbeing. Players rated 14 statements about how they felt during the past 2 weeks such as 'I've been dealing with problems well' on a 5-point scale from 1 ('none of the time') to 5 ('all of the time'). Scores were calculated by taking the mean of all items, and therefore range from 1 to 5.

Playtime

Playtime data was collected using two redundant Python scripts that tracked players' online status on the Xbox Network. All players were required to add three researcher accounts as friends on Xbox Network for the duration of the study, and ensure that their privacy settings allowed friends to see their play activity. Using the Xbox web interface (using Chrome 89 on Ubuntu 20.04) and the Xbox Android app (using an Android 6.0 Virtual Device on Windows Server 2019), each script independently recorded the status of each player (i.e., if they are online, and if so, what game or application they are running) at 5-minute intervals for the duration of the study.

I followed data protection and privacy by design in the setup of the tracking: identifiable playtime data was stored only on the remote, password-protected and encrypted machines where data was initially collected (hosted at the University of York and DigitalOcean's UK GDPR-compliant London servers, respectively). Identifiable information was replaced with random numeric identifiers prior to analysis and sharing. All players provided informed consent about the tracking procedure, and could opt out at any point.

Playtime variables were calculated as hours of play per day during the specified time window, a continuous variable. I took the timestamp of survey completion for each player at each wave and summed the time spent online in games during the 24-hour/7-day/14-day time windows preceding and following that survey completion timestamp, then divided by the number of days in the time window (excluding non-game activities on Xbox such as streaming TV series, shopping, or browsing the internet). Due to technical problems, there were 7.6 hours spread throughout the study where both playtime trackers were non-operational. As preregistered, I

weighted each player's playtime estimates based on the proportion of missing playtime data in that window—in virtually all cases, playtime data was missing for <1% of the window.

Final playtime values therefore correspond to the mean time (in hours) spent playing Xbox games per day during the 24 hours/7 days/14 days before or after completing that survey wave.

Self-report Playtime
Players estimated the number of hours and minutes they spent playing games on Xbox over the past 24 hours/7 days/14 days.

Displacement
Displacement was assessed using a 4-item ad hoc measure, which asks participants 'In the last 2 weeks, the time I spent playing video games interfered with my ability to manage...' followed by four domains: work/school performance, personal relationships, physical health, and other hobbies. The domains were selected to align with those referenced in the DSM-5 definition of Internet Gaming Disorder. I used an ad hoc measure because no validated measures of displacement existed to our knowledge.

Other Measures
The study also included measures of personality (BFI-2-XS; Soto and John, 2017) and dysregulated gaming (IGDS9-SF; Pontes and Griffiths, 2015) at Time 1. These constructs were included for separate confirmatory and exploratory analyses not reported here.

Data Quality
In total, approximately 100,000 hours of playtime were recorded throughout the study. Descriptive information is shown in Table 3, which lists the most played games, and Figure 2, which shows how playtime and session length were distributed. The games played in the sample broadly resembled those played by the Xbox population as a whole during the study period: 15 of the 20 top games in the sample here were present in the global top 40 (Albigés, 2023) (Table 10.3).

Data quality was high; each of the mental health measures was moderately correlated at each wave, and playtime consistently followed the expected gamma-like distribution. There was no evidence for significant floor or ceiling effects in the mental health variables. Average mental health scores of the sample closely track those of comparable general populations in reference studies: Mean positive affect is 2.82 (compared to 2.9 in a UK and cross-cultural sample; Thompson, 2007); general mental wellbeing is 3.25 (compared to 3.4 in UK adults aged 25-36; Ng Fat et al., 2017; depressive symptoms was 54 on the original scale or 2.68 when rescaled (compared to 50 in the general as the PROMIS population average, Kroenke et al., 2020), indicating slightly elevated reported depressive symptoms but below the recommended threshold for mild depression.

10.3 Study 4a: Playtime and Mental Health

10.3.1 Introduction

In Study 4a, I was interested in establishing the absence of practically significant effects of playtime on mental health, and of mental health on playtime. This is a key tenet of the BANG model and a high-impact finding from recent research that has yet to be replicated at a platform-wide level, with existing studies limited to a single game (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022). The lack of a practically significant effect is encoded in the BANG model by the absence of a direct arrow from playtime to mental health, or from mental health to playtime. I therefore have the following hypotheses:

- **H1a**$_{\text{play}\rightarrow\text{aff}}$. There will be no practically significant within-person effect of playtime during the last 24 hours on subsequent positive affect.
- **H1b**$_{\text{play}\rightarrow\text{dep}}$. There will be no practically significant within-person effect of playtime during the last 7 days on subsequent depressive symptoms.
- **H1c**$_{\text{play}\rightarrow\text{genWb}}$. There will be no practically significant within-person effect of playtime during the last 14 days on subsequent general mental wellbeing.
- **H2a**$_{\text{aff}\rightarrow\text{play}}$. There will be no practically significant within-person effect of positive affect on playtime during the following 24 hours.
- **H2b**$_{\text{dep}\rightarrow\text{play}}$. There will be no practically significant within-person effect of depressive symptoms on playtime during the following 7 days.

Table 10.3: Most popular games among Study 4 participants by total playtime

Game	Total Time (hours)	Unique Sessions	Average Session Length (hours)
Call of Duty: Modern Warfare II	6196	5773	1.07
Fortnite	5114	4361	1.17
Destiny 2	5104	3284	1.55
Hogwarts Legacy	3030	2089	1.45
Forza Horizon 5	2413	2083	1.16
Overwatch 2	2371	1856	1.28
Tom Clancy's The Division 2	1872	1572	1.19
Warframe	1640	1330	1.23
Minecraft	1476	1422	1.04
FIFA 23	1454	1502	0.97
Apex Legends	1353	1418	0.95
Grand Theft Auto V	1348	1268	1.06
Dead by Daylight: Special Edition	1328	841	1.58
Disney Dreamlight Valley	1303	1245	1.05
ROBLOX	1217	1113	1.09
MLB The Show 23	1177	889	1.32
Atomic Heart	991	835	1.19
HITMAN 3	985	907	1.09
Rocket League	960	1613	0.6
Age of Empires Definitive Edition	947	1592	0.59

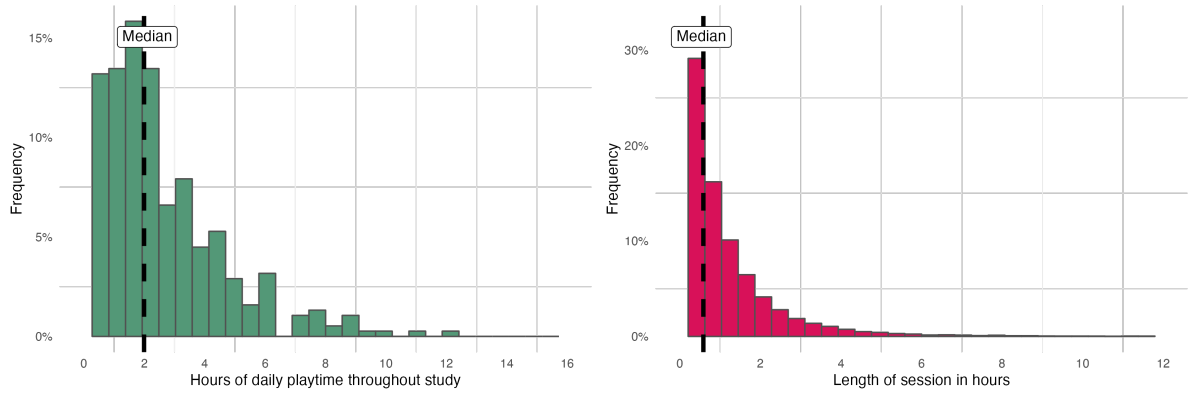

Figure 10.2: Histograms depicted the distribution of playtime and session length

- **H2c**$_{\text{genWb}\rightarrow\text{play}}$. There will be no practically significant within-person effect of general mental wellbeing on playtime during the following 14 days.

To test for the absence of such practically significant effects, I use equivalence tests with the following conservative smallest effect sizes of interest (see method for details on the derivation of these): each additional hour of daily play preceding a .06 scale point change in mental health on a 1–5 scale; each scale point change in mental health preceding to a 16% change in daily playtime. These tests were preregistered; the full preregistration for Study 4 is available in the supplementary materials.

10.3.2 Method

Analysis Strategy

I tested each hypothesis using a random effects within-between (REWB) model (Bell et al., 2019), a mixed-effects model that disaggregates within- and between-person sources of variation and that has been successfully applied in previous digital mental health research (Schemer et al., 2021). The REWB model has several benefits: it maintains high power for within-person effects, is able to handle the data structure wherein temporal precedence exists within each wave (not simply from one wave to the next), and is easily interpretable. Models were fit using the `glmmTMB` package (Brooks et al., 2017) in R version 4.3.1 (R Core Team, 2023).

With the coefficients and standard errors from the REWB models, I then used two one-sided test (TOST) equivalence tests to assess evidence for the absence of practically significant effects. In this procedure, if the 90% CI of the predictor of interest is fully within the lower and upper equivalence bounds, the data provide evidence for the absence of a practically meaningful effect. Because each model tests a different hypothesis and I interpret these separately (i.e., recognizing the timescales and mental health constructs are not interchangeable), I did not correct for multiple comparisons (Rubin, 2021). Because the theoretical focus here is on within-person effects, and because statistical power for the between-person effect is lower, I did not interpret the between-person effect—its inclusion in the models is primarily for obtaining unbiased estimates of the within-person effect (Schunck, 2013). For full details of the between-person results, please see the supplementary materials.

In total, I fit 6 REWB models. H1a–c (playtime predicting subsequent mental health) are analyzed with linear REWB models, while H2a–c (mental health predicting subsequent playtime) were analyzed with generalized linear REWB models. In the preregistration, I planned to use a zero-inflated gamma distribution with log link to account for the gamma-like distribution of playtime (see figure 2) alongside the possibility of 0s (i.e., no playtime in a given window). Due to misfit, however, I instead elected to use the closely related Tweedie distribution with log link (see Deviations from Preregistration below).

In each model, the person's grand mean-centered predictor of interest (i.e., playtime for H1a–c, one of the three mental health variables for H2a–c) was entered as a between-person predictor, while their person-centered predictor value was entered as a within-person predictor. I included correlated random intercepts and slopes for the within-person predictor, allowing them to vary by player. I included age and gender as covariates, given evidence that they are exogenously related to both playtime (Padilla-Walker et al., 2010; Ream et al., 2013) and mental health (Girgus and Yang, 2015) and are therefore potential confounds (Rohrer, 2018). I included an AR(1) autocorrelation term to avoid artificially small standard errors and wave (i.e., time point) as a categorical covariate to detrend the outcome variable, per previous recommendations (L. P. Wang and Maxwell, 2015). Full model syntax and diagnostics are available in the analysis code in the supplementary materials.

Effect Size and Sample Size Justification

The sample size for the study (400 participants, 6 time points) was determined via simulation for the aforementioned REWB equivalence tests. To test for the absence of practically significant effects in those models, it is first necessary to establish a Smallest Effect Size of Interest (SESOI).

For H1a–c, the SESOI was specified as a .06 scale point change in a mental health measure per hour of play, which I derived from previous estimates of practically significant change in the measures used. One study found that a practically significant within-person change in PROMIS depression was 3–4 points, which when rescaled to 1–5 equates to .38 scale points (Kroenke et al., 2020). This aligned with estimates for the WEMWBS (Maheswaran et al., 2012) and PANAS positive affect subscale (Anvari and Lakens, 2021), both approximately .3 scale points. Next, I needed to determine how large a change in playtime should predict a change in mental health of that magnitude to be practically significant. Here, I based my estimate on the average amount of daily leisure time available to US and UK adults, approximately 5 hours (Office for National Statistics, 2017; Sturm and Cohen, 2019). As a highly conservative threshold for practical significance, I set that a 5-hour change in playtime should predict at least a .3 scale point difference in mental health; effects smaller than this indicate that the average person does not have enough time in the day to modulate their play to an extent that it would meaningfully affect their mental health. The final equivalence bounds for H1a–c are therefore .3 scale points / 5 hours = a .06 scale point change per additional hour of daily playtime.

For H2a–c, I specified a practically significant effect as a change in playtime of 20 minutes. This corresponds to the shortest amount of time UK adults report devoting to one continuous activity (for example, cooking, online shopping, or socializing with household members; Payne, 2018). Changes in playtime therefore need to be at least this large to potentially displace or make space for another activity. For the median player in the

sample with a playtime of 2.1 hours per day, 20 minutes equates to a 16% change. I anchored this to a 1-point mental health change for interpretability and to roughly align with the mental health measures in terms of standardized effect sizes (and thereby statistical power). Specifying this as the SESOI, I thus aimed to establish the absence of effects equal to or larger than a 1 scale point change in mental health leading to a 16% change in playtime.

I determined the intended sample size and time points via simulation based on the above SESOIs. Assuming a true null effect (Lakens, 2017), simulation results showed that with 400 subjects and 5 time points (H1a–c) or 6 time points (H2a–c), there is >95% power to declare equivalence within the specified SESOIs: a 1-hour change in daily playtime leading to a .06 scale point change in mental health on a 1–5 scale (H1a–c); and a 1 scale point change in mental health leading to a 16% change in playtime (H2a–c). Power simulation details are available in the supplementary materials.

Deviations from Preregistration

I originally planned to recruit players using Reddit advertisements only. The advertising costs per recruited player were higher than anticipated, however, and I therefore transitioned to using Prolific screening questionnaires partway through the study, which proved a lower cost option.

Although the models for H1a–c fit well, when fitting models for H2a–c, I experienced three problems: first, `glmmTMB` produced false convergence warnings when including the auto-correlation term. This is likely the result of the high number of parameters estimated in a zero-inflated mixed effects model, combined with the relatively short number of time points over which autocorrelation might occur. To address this, I dropped the auto-correlation term from these models. Second, I experienced singular fit warnings when including the random slopes term, indicating that the data did not support the inclusion of varying relationships between mental health and subsequent playtime across players. I therefore dropped the random slope term, retaining the random intercept. The simplified models converged without issue, and differed only minimally in terms of estimates and standard errors from the models with convergence warnings, suggesting that these changes did not meaningfully affect the inferences drawn here.

Finally, diagnostics for these simplified models (particularly H2c) indicated a substantial degree of left-skew in the residuals, and thus, poor model fit. To address this, I fit alternative models in `glmmTMB` using the Tweedie distribution, a family of exponential dispersion models of which the gamma distribution is a special case (Bonat and Kokonendji, 2017). The Tweedie distribution estimates an additional parameter p, or power, which allows it to handle zero-inflated data in a unified way, and by virtue of using a log link function yields regression coefficients that can be interpreted in the same way as those from the gamma regression (J. P. Andersen et al., 2019). Diagnostics of the Tweedie models showed substantially improved fit with regard to dispersion and residual quantiles, and unlike the preregistered models, converged while retaining the autocorrelation term.

I therefore report the results of the Tweedie models below, as these have the least degree of bias stemming from model misfit. Results from the originally preregistered zero-inflated gamma models are available in the supplementary materials. The precise estimates between the Tweedie and zero-inflated gamma regression models diverged little, with only one impacting on inference: the preregistered model for H2c was inconclusive, with the confidence interval overlapping both 0 and the upper SESOI, whereas the Tweedie estimate for H2c was within the equivalence bounds. I discuss this divergence in the results below. For both H2a and H2b, the preregistered and modified models equally supported the absence of practically significant within-person effects of mental health on subsequent playtime.

10.3.3 Results

After adopting the Tweedie regression (as specified in Deviations from Preregistration above), diagnostics for each multilevel model indicated either no or only minor violations of assumptions of heteroskedasticity, linearity, and distribution of residuals. Sensitivity analyses indicated that results using imputed data differed slightly from complete-case analysis of players who completed all waves, but led to the same inferences in the equivalence testing. I therefore report only the results with imputation below due to their additional precision, and refer readers to the supplementary materials for the complete case analysis.

I therefore proceeded with the planned analysis strategy.

H1a–c. Relationship between Playtime and Subsequent Mental Health

Results showed support for hypotheses H1a–c (Figure 10.3): there is strong evidence to reject a practically significant relationship between playtime and subsequent mental health. This held true at all 3 investigated timescales. There were no meaningful relationships between playtime in the last day and current positive

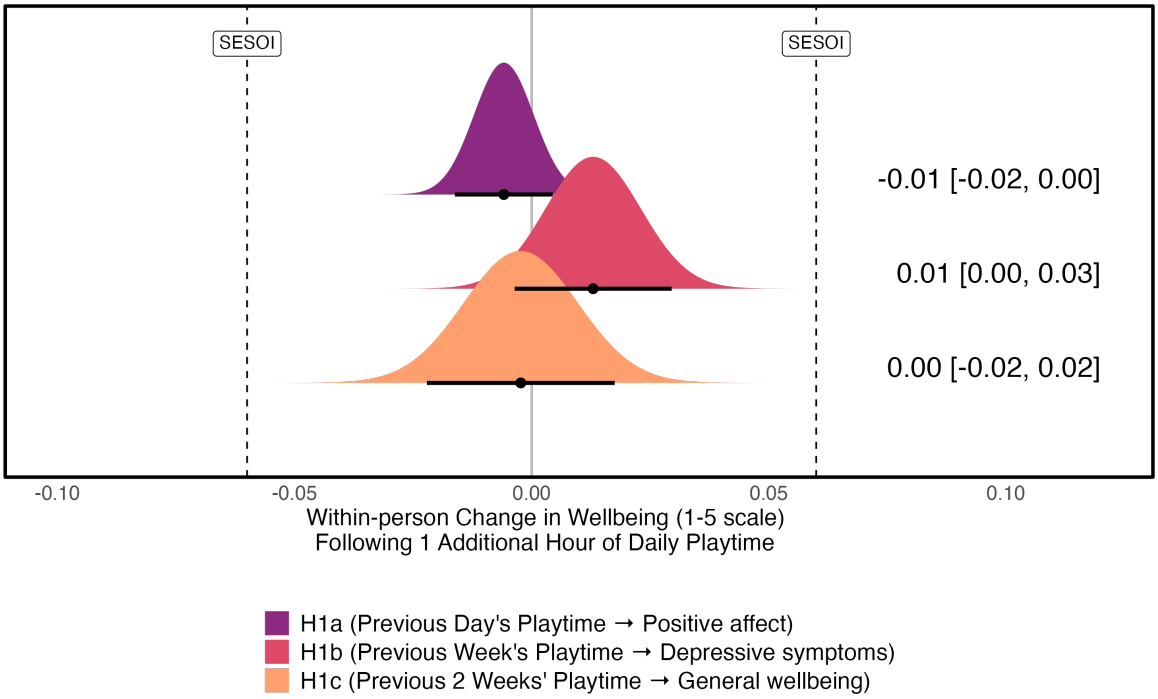

Figure 10.3: Relationship between playtime and subsequent mental health. Dashed lines represent the prespecified smallest effect size of interest (SESOI), a .06 scale point change in mental health following a 1-hour change in daily playtime. Bell curves represent the sampling distributions of the effect size estimated, based on the point estimate for the effect size and standard error. Black lines represent 90% CIs used for hypothesis testing (shown numerically on the right side).

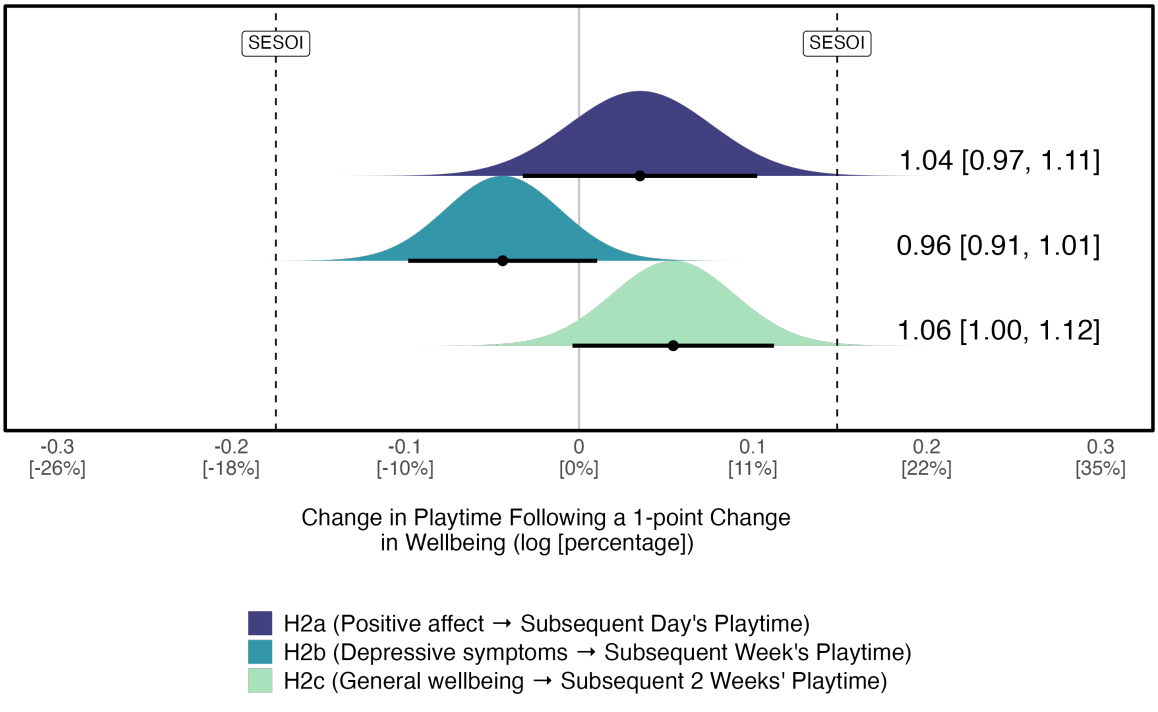

Figure 10.4: Relationship between mental health and subsequent playtime. Dashed lines represent the prespecified smallest effect size of interest (SESOI): a 16% change in playtime following a 1-point change in mental health. Bell curves represent the sampling distributions of the effect size estimated, based on the point estimate for the effect size and standard error. Black lines represent 90% CIs used for hypothesis testing (shown numerically on the right side). Percent change shown for reference on X axis, but note that this is not perfectly linear.

affect (H1a), playtime in the last week and current depressive symptoms (H1b), or playtime in the last two weeks and current general mental wellbeing (H1c). Estimated relationships were all within the equivalence bounds, and all three overlapped 0 (ps > .24). Based on the estimates in which 1 hour of additional playtime was associated with a less than .02 change in all three of the mental health variables, players who increased their playtime by 5 hours—the average total leisure time available to US/UK adults—would be predicted to show a less than .10 scale point change in mental health, or just a third of the estimate for a practically significant, noticeable effect of .3.

Comparison with Self-Reports As preregistered, I ran identical models for H1a–c using self-report playtime instead of logged playtime to explore whether findings differ. Though not the focus of the current paper, self-report data was moderately correlated with logged playtime, with shorter time periods showing slightly greater concordance (r = .64 over the previous day, r = .60 over the previous 2 weeks). Results aligned with those of logged playtime: no estimates of self-report play were significantly related to subsequent mental health (ps > .18) and all 90% CIs were within the equivalence bounds. Complete findings are available in the supplementary materials.

H2a–c. Relationship Between Mental health and Subsequent Playtime

Results similarly supported H2a–c (Figure 10.4): there is evidence to reject any practically significant within-person relations between positive affect (H2a), depressive symptoms (H2b), or general wellbeing (H2c) and subsequent playtime. Tweedie estimates indicate that a 1 scale point increase in depression would predict a 4.3% decrease in playtime during the following 24 hours, or 5 minutes for the average player. This means that a player who reported a change from mild depression to severe depression—a 20-point change on the original PROMIS scale, or a 1.8 point change when rescaled to 1–5 (Kroenke et al., 2020)—would be predicted to play just 10 minutes less per day, half the size of the specified SESOI. Effect estimates were only marginally larger for general wellbeing, and even smaller for positive affect.

As noted above, results from the preregistered H2c model differed somewhat: though there was no statistically significant relationship between general mental wellbeing and subsequent playtime, the 90% CI of general wellbeing overlapped with the smallest effect size of interest and the results were therefore inconclusive (see Plots/H2_ZeroInflatedGamma in the supplementary materials). While the point estimates between the two models differed only marginally, the Tweedie regression had slightly smaller errors—this improved precision resulted in an estimate that was within the equivalence bounds. Given the degree of model misfit in the preregistered model, I believe the Tweedie estimate to be the more trustworthy one.

10.3.4 Study 4a Discussion

In line with previous research (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022), results strongly indicate that there is no practically significant direct, within-person relationship between playtime and mental health in the general population. This finding improves on prior evidence in several ways: First, by logging Xbox playtime of Xbox-predominant players, I closely approximate players' actual total playtime, as opposed to prior studies that tracked time spent playing just one particular game, or used self-report measure of play with known validity issues. Second, I track data over a longer time scale (12 weeks) to assess within-person relationships with greater precision, and compare multiple timescales. Third, the study design allowed me to investigate relationships in both directions. Fourth, to my knowledge, I offer the first study on the topic using a registered report methodology that minimizes potential for publication bias and questionable research practices.

Finally, I extend previous studies (which showed an absence of evidence) by providing evidence of absence for effects of playtime on mental health or vice versa: the relationships I find are too small to be practically significant, based on easily interpretable smallest effect sizes of interest. For depressive symptoms, the mental health measure with the 'strongest' correlations, a player who increased their playtime by the total average daily leisure time of 5 hours would be predicted to show only a .06 point change—well short of the .3 point change interpreted here as practically significant. Such extreme modulation of playtime occasionally occurs, but is exceedingly rare even in the sample here skewing toward more involved gamers, which we might expect to be more sensitive to, e.g., increased leisure time from holiday periods: just 14 players in the sample of 414 recorded a change in daily playtime of 4 hours or more between successive waves; just 3 did so more than once. The relationship in the opposite direction was similarly weak if not weaker: the average player's depression score would need to change from the minimum score (1, no depression symptoms) to the maximum (5, clinically severe depression) to predict a 20-minute decrease in subsequent daily playtime. For positive

affect and general mental wellbeing, the equivalent maximum possible change would be associated with a 19-minute and a 30-minute increase, respectively—amounts of time that are meaningful on the surface, but unlikely to ever occur given the implausibility of such extreme variation in mental health.

Public debate has often framed the relation between gaming and mental health as a simple universal and monotonic effect: the more time individuals tend to spend playing video games, the worse their mental health tends to be (Feiner and Kharpal, 2021; Twenge and Campbell, 2018). The results here contradict this narrative: for a general adult gaming population, and at time scales of up to two weeks, even variations of 4–5 additional hours of daily video game play are unlikely to have a practically significant impact on mental health. This leads me to conclude that at a population level, the typical range of observed playtime and playtime variation for adult gamers—ignoring content, context, and player specifics moving us outside 'ordinary' player experience—has no practically significant mental health impact, positive or negative. By conducting the first registered report on the topic, and the first approximating a player's actual total objective playtime (tracking all Xbox play from Xbox-predominant players), this study significantly strengthens the evidence base on this topic.

Given these findings, research (or interventions) targeting raw, decontextualised playtime alone as a cause of mental health are bound to miss the mark (Colder Carras et al., 2021)—the evidence is clear that mental health impacts arise from the interaction of specific player, content, and context circumstances. Unpacking these impacts will involve descriptively tracing and theoretically specifying temporal scales and dynamics far more carefully. In other words: to understand how games affect us, we should pay more attention to time—just not playtime.

10.4 Study 4b: Basic Needs in Games Model

10.4.1 Introduction

Having robustly established the absence of a direct playtime↔mental health correlation in Study 4a, the final element of this thesis was to attempt to validate certain paths in the BANG model put forth in Chapter 8.

As hinted at earlier, the BANG model is prohibitively complex to assess as a whole entity, at least at this stage in its validation. Some constructs are not easily measurable at present (need-related outcome expectations and selective gaming exposure in particular). Even if measures of all constructs were included, including all pathways would introduce substantial complexity into the statistical modelling that would both reduce its interpretability, and its trustworthiness. Further, the iterative development of the BANG model occurred in stages, of which only some were complete prior to beginning Study 4—as a result, not all constructs in the model were measured (and even if I had finalized the constructs at the time of survey design, the sheer number of constructs in the model might have resulted in a prohibitively long survey).

To address these issues and maximize the hypothesis-testing value of the data I collected, I elected to break the BANG model into two smaller, more easily testable chunks. The logic and hypotheses associated with these respective models are described below, and they are represented visually in Figure 10.5 and Figure 10.6.

Model 1

In Model 1, I concern myself with the *quality* of play. Model 1 looks at the path from the BANG model whereby *contextual* need satisfaction and frustration in games contributes to players' *global* need satisfaction and frustration, and thereby mental health. Model 1 therefore encompasses hypotheses **H10** and **H13** of the BANG model as a whole, which are specified here as:

H10. Need satisfaction (frustration) in games at Time T will be positively associated with need satisfaction (frustration) in daily life at Time T+1.

H13. Need satisfaction (frustration) in daily life at Time T will be associated with higher (lower) general well-being and lower (higher) depressive symptoms at Time T+1.

Model 2

In Model 2, I am interested in *quantity of play*. Model 2 tests three hypotheses from the BANG model.

First, I tested whether need satisfaction and frustration in games is associated with subsequent changes in playtime. The mechanism posited for this effect is via players' updating need-related outcome expectations, which in turn generate higher intrinsic motivation. However, as described above and in Chapter 8, there currently exists no measurement of need-related outcome expectations, and the development of the model partially overlapped with data collection for the study, and I therefore do not have a measure of motivation.

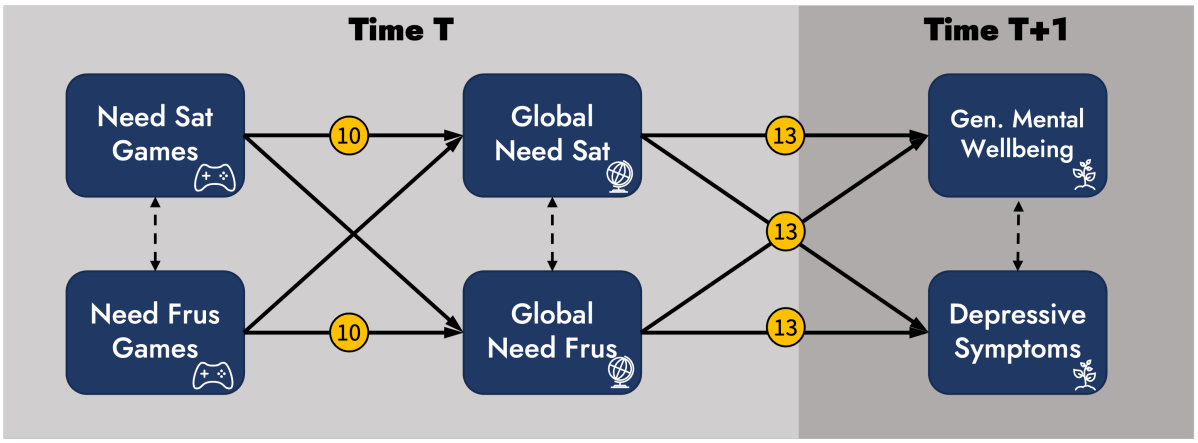

Figure 10.5: Structure of Model 1

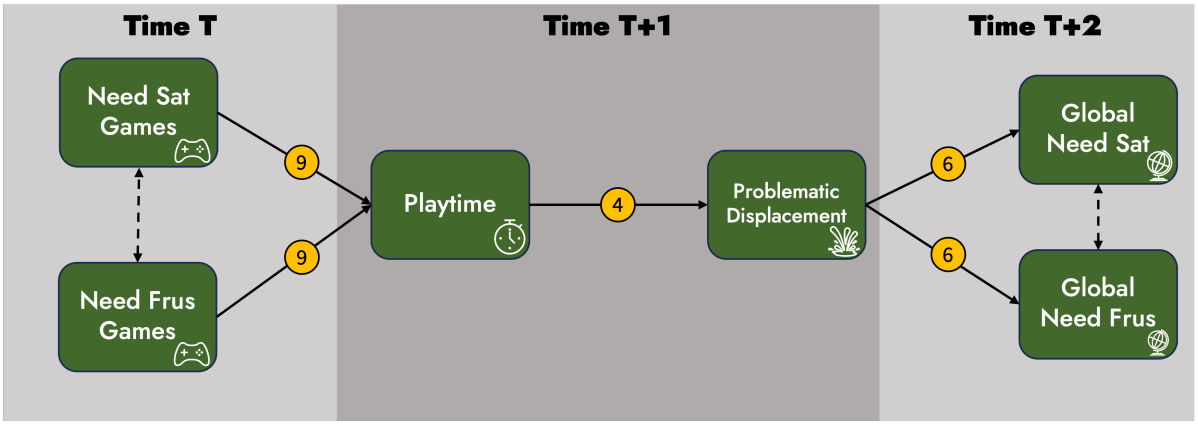

Figure 10.6: Structure of Model 2

Thus, this is a partial test of **H9** of the BANG model, with the recognition that by testing a direct effect instead of the hypothesized indirect one, there is greater potential for false negatives: an observed weak direct relationship between X and Y may suffer from low power, but be fully mediated by moderately-strong relationships between X and M, and between M and Y, for which statistical power would be higher. Nonetheless, that in-game experiences should have an impact on subsequent behavior is logical, and warrants testing as best as possible within the constraints of the current study.

H9. Need satisfaction (frustration) in games at Time T will be positively (negatively) associated with playtime at Time T+1.

Second, I investigated whether playtime is linked with greater problematic displacement. As the study design predates the life fit construct of the BANG model, I here assess only the direct relationship, and am unable to test whether this is moderated.

H4. Playtime at Time T will be positively, but weakly, associated with displacement at Time T.

Finally, I then tested whether problematic displacement is indeed linked to lower global need satisfaction, and higher global need frustration. Recall that the proposed mechanism here is that problematic displacement reduces opportunities for players to derive need satisfaction from other life domains.

H6. Displacement at Time T will be associated with lower global need satisfaction and higher global need frustration at Time T+1.

Across both Model 1 and Model 2, the final element of Study 4b was a first attempt at investigating the *variance* in the relationship between need satisfaction, playtime, and mental health. This speaks to a topic I

addressed in Chapter 2 about person-specific effects. Psychological effects necessarily vary from person to person, and an important finding to establish is precisely how much. From here, researchers can begin to make judgements about whether observed variation suggests meaningful moderating factors, or whether this degree of variation is simply noise that cannot be accounted for given the inherent measurement error and inter-individual differences that influence a person's experienced effect (Johannes, Masur, et al., 2021). This in turn can inform theory development.

10.4.2 Method

Statistical Modelling

In the preregistered analyses, I applied multilevel structural equation modelling (SEM) using `lavaan` (Rosseel, 2012) in R. Multilevel SEM has previously been used effectively in the field to separate within- and between-person relationships with hypothesized causal directions (Mills, Milyavskaya, Mettler, Heath, et al., 2018a). I used robust maximum likelihood estimation, and report robust variants of all fit statistics. Models were fit with random intercepts only, as `lavaan` does not currently support random slopes models.

However, given the limitations of multilevel SEM as a relatively recent and less established statistical technique, and the fact that `lavaan` is not yet capable of estimating random slopes, I also conducted an exploratory secondary analysis using multilevel regression models. This allowed for both a sensitivity check on the results of the multilevel SEM, as well as the aforementioned investigation into effect size variation (which is predicated on the inclusion of a random slopes). To fit the multilevel regression analyses, I mirrored the approach taken in Study 4a, and use random effects within-between models fit with `glmmTMB`. I fit one model per outcome in Models 1 and 2, predicting each outcome with the relevant within- and between-centered predictors, and a random intercept and slope for each participant. For example, the model for H10, which concerns a predicted effect of contextual need satisfaction and frustration on global need satisfaction is specified in `glmmTMB` as:

$$\begin{aligned} nsGlob \sim\ & nsGames_{cw} + nsGames_{cb} + nfGames_{cw} + nfGames_{cb} + \\ & (1 + nsGames_{cw} + nsGames_{cw} | ID) \end{aligned} \tag{10.1}$$

where ns refers to need satisfaction, nf refers to need frustration, $_{cw}$ indicates a within-person centered predictor, $_{cb}$ indicates a between-person centered predictor, and ID refers to a participant identifier. This formulation is a close analogue to the Study 4a modelling approach.

All multilevel regressions models are linear with the exception of the paths where playtime is the outcome. Here, I follow the analysis approach from Study 4a, which used Tweedie regressions to account for the highly right-skewed distribution of playtime.

Results of the piecewise multilevel regression models largely converged with those of the multilevel SEM. For this reason, I focus reporting of the results on the preregistered models (shown in Figure 10.7 and Figure 10.8), but include the results of the multilevel regression models in Table 10.4 for comparison, and use these for the basis of the exploratory effect size variability analysis.

Deviations from Preregistration

I initially preregistered a multilevel structural equation modelling approach with latent variables (https://osf.io/jw6np/). However, I experienced convergence issues when including the measurement model of psychometric variables (need satisfaction/frustration in games, global need satisfaction/frustration, and general mental wellbeing). This is likely related to the relatively small sample, and the large number of parameters that need to be estimated in multilevel measurement models. As a result, I omitted the measurement model and used mean scores instead, which implicitly assumes that variables are measured with no error. Models are therefore path models. Given that latent variable scores typically correlate $r > .9$ with mean scores, this is likely to have had a small, but not entirely negligible influence on parameter estimates (Widaman and Revelle, 2022).

The initial Model 2 showed poor fit to the data. Modification indices indicated that the primary factors influencing this poor fit were the lack of paths from need satisfaction and frustration in games at Time T to (a) displacement at Time T+1 and (b) need satisfaction and frustration in daily life at Time T+2. Given that the inclusion of these direct paths (in addition to the indirect ones connecting these constructs) does not violate the theory, I added these and found that this improved model fit to acceptable levels.

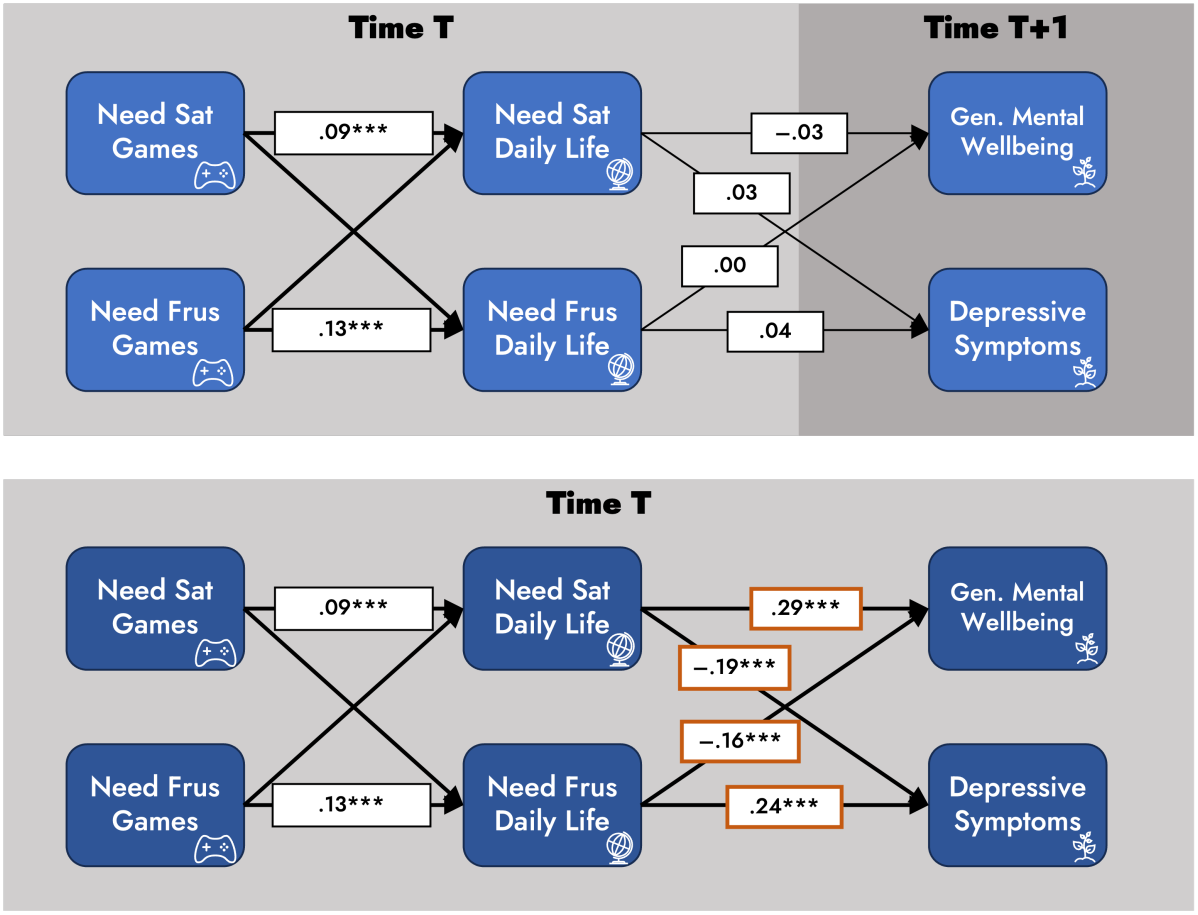

Figure 10.7: Multilevel path model results for Model 1. On top, results of the preregistered analysis with a within-person lagged effect of global need satisfaction and frustration on mental health. On bottom, the exploratory alternative analysis with no such time lag, showing substantially larger effects in the predicted direction. *p < .05, **p < .01, ***p < .001

10.4.3 Confirmatory Results

Model 1

Model 1 showed excellent fit to the data (TLI = .982, RMSEA = .024 [.002, .042], $SRMR_{within}$ = .017, $SRMR_{between}$ = .023). I therefore proceeded to interpretation as planned.

I found support for H10 at the within-person level (Figure 10.7): people who experienced greater need satisfaction in games than they normally do tended to also feel more global need satisfaction (and less global need frustration) than they normally do. This was equally the case for need frustration in games and global need frustration.

Surprisingly, I found no support for H13: those who reported greater need satisfaction at Time T than usual for them did not report better than usual general mental wellbeing, or lower than usual depressive symptomatology at Time T+1. This is contrary to substantial prior literature, and suggests that previously-identified effects may be sensitive to timescales—a topic I return to in the exploratory results below.

Model 2

Model 2, after adding the additional direct paths specified above, fit the data well (TLI = .982, RMSEA = .030 [.000, .058], $SRMR_{within}$ = .022, $SRMR_{between}$ = .010). I therefore proceeded to interpretation as planned. Results are summarized in Figure 10.6.

Within-person results showed partial support for H9: those who experienced 1 scale point greater need satisfaction in games than usual for them at Time T tended to play games for approximately 16 more minutes per day in the two weeks following than usual for them. Contradicting H9, however, there was no significant relationship between need frustration and subsequent playtime.

I found good support for H4, as playtime was weakly but significantly associated with greater displacement at the same time point.

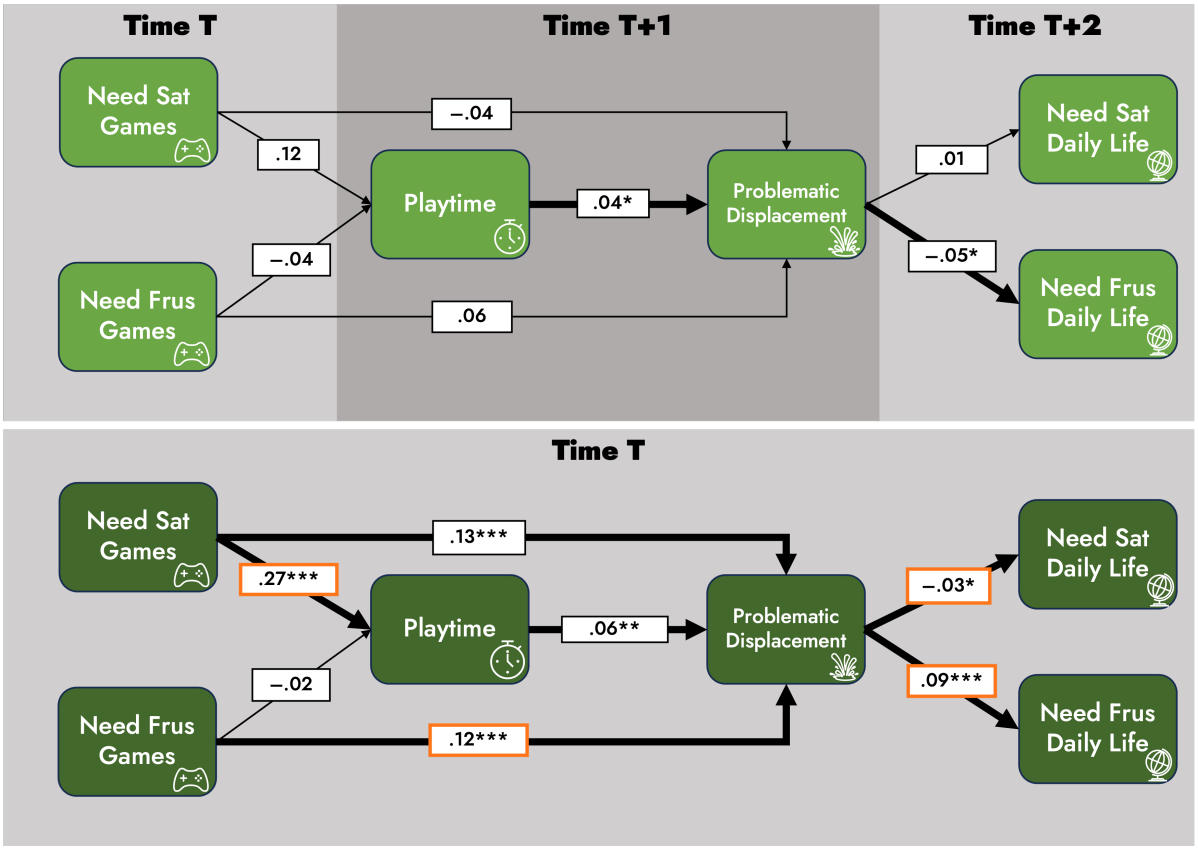

Figure 10.8: Multilevel path model results for Model 2. In the top panel, results of the preregistered analysis with within-person lagged effects of contextual need satisfaction and frustration on playtime, and of displacement on global need satisfaction and frustration. In the bottom panel, the exploratory alternative analysis with no time lag, again showing larger effects in the expected direction. *p < .05, **p < .01, ***p < .001

Table 10.4: Results of the Multilevel Structural Equation Models (ML-SEM) and Multilevel Models (MLM) for each hypothesized relationship. NS = need satisfaction; NF = need frustration.

			Within-person				Between-person		
			ML-SEM		Piecewise MLM		ML-SEM		Piecewise MLM
Model	Hypothesis	Path	B [95% CI]	β	B [95% CI]	Random Slope SD	B [95% CI]	β	B [95% CI]
1	H10a	NS Games → NS Life	.09 [.04, .13]	0.13	.08 [.05, .11]	0.20	.37 [.25, .49]	0.40	.32 [.24, .40]
	H10b	NF Games → NF Life	.13 [.08, .17]	0.19	.13 [.10, .16]	0.19	.44 [.32, .55]	0.50	.35 [.28, .43]
	H13a	Global NS → Gen WB	−.03 [−.10, .04]	−.03	−.03 [−.09, .03]	0.27	.74 [.56, .93]	0.76	.61 [.51, .71]
	H13b	Global NF → Gen WB	.00 [−.06, .06]	0	.01 [−.04, .06]	0.23	−.16 [−.31, −.01]	−.19	−.21 [−.30, −.13]
	H13c	Global NS → Dep	.03 [−.06, .11]	0.02	.03 [−.04, .09]	0.27	−.44 [−.66, −.23]	−.37	−.41 [−.55, −.27]
	H13d	Global NF → Dep	.04 [−.03, .12]	0.04	.04 [−.02, .09]	0.27	.49 [.30, .68]	0.47	.46 [.36, .44]
2	H9a	NS Games → Playtime	.12 [−.05, .28]	0.05	.09 [.03, .15]†	0.24	.83 [.37, 1.28]	0.25	.21 [.09, .35]†
	H9b	NF Games → Playtime	−.04 [−.20, .10]	−.02	−.01 [−.07, .04]†	0.20	.41 [.04, .77]	0.14	.11 [.00, .22]†
	H4	Playtime → Displacement	.04 [.00, .08]	0.08	.02 [−.02, .05]	0.02	.02 [−.04, .07]	0.04	.05 [−.01, .10]
	H6a	Displacement → Global NS	.01 [−.03, .05]	0.02	.01 [−.02, .04]	0.07	−.12 [−.21, −.03]	−.22	−.17 [−.23, −.12]
	H6b	Displacement → Global NF	−.05 [−.09, −.00]	−.08	−.03 [−.07, −.00]	0.09	.09 [−.00, .19]	0.14	.21 [.15, .28]

† Log scale coefficient from a Tweedie regression, and thus not directly comparable to its analogous coefficient from the ML-SEM

Finally, I found no within-person support for H5: there was no significant relationship between reporting greater displacement than usual at Time T and subsequent need satisfaction or frustration at Time T+1.

10.4.4 Exploratory Results

In addition to the confirmatory, preregistered analyses, I conducted several exploratory analyses to understand timescales, effect size variability, and the difference between within- and between-person results.

Concurrent Relationships

As highlighted above, there was minimal evidence to support any of the lagged within-person relationships I predicted (i.e., of global need satisfaction and frustration on subsequent mental health; of need satisfaction and frustration in games on subsequent playtime; or of problematic displacement on subsequent global need satisfaction and frustration). Particularly surprising from these results was the null result between global need satisfaction and frustration on mental health 1 time point later, given that previous longitudinal evidence had strongly supported such effects. This led me to question whether I had selected the right timescale, and whether it might instead be the case that effects of need satisfaction and frustration on mental health manifest immediately, rather than in a delayed fashion.

To explore this possibility, I fit alternative models for both Model 1 and Model 2 in which the time lag was removed. These models therefore test for the presence of concurrent within-person relationships among the constructs.

Results of this analysis (for the multilevel SEM) are summarized in the bottom panels of Figure 10.7 and Figure 10.8, and shown in detail in Appendix A4. For several hypotheses, estimates changed from non-significant in the lagged models to significant in the concurrent models. In all cases, these shifts to significance matched the direction of the hypotheses. Changes from non-significant to significant findings are highlighted in orange in the figures.

To summarize, I found significant effects in the expected direction for all concurrent relationships with the exception of one: need frustration in games is not associated with playtime over the same time period.

Effect Size Variability

While the originally hypothesized lagged relations were largely null *on average*, following the principles laid out in Chapter 2, it is valuable to examine the extent to which relationships varied across individuals.

It is vital to note that this analysis is presented only as an illustration, and basic description of the data. Given that the interpretation of effect size variance is novel in both games and SDT research, it is unclear how much variance around the point estimate should be considered meaningful (as opposed to variation that is constrained enough to be practically equivalent; Johannes, Masur, et al., 2021). The data is further limited by the low number of time points, meaning that each within-person effect is estimated with a high degree of uncertainty, introducing the possibility of bias in the model-implied distribution.

To assess effect size variation, I plotted the model-implied random effect distribution, seen in Figure 10.9. This consists of a normal distribution centered at the point estimate (i.e., the average relationship in the sample), with variance defined by estimated SD of the random slope (recall that random effects models nearly always assume normality of random effects).

Results included several surprising findings. First, the relationship between global need satisfaction and frustration and subsequent mental health (H13) was centered around zero, but varied substantially, with their respective 95% density regions ranging from approximately $-.2$ to $.2$. This means that some participants exhibited relationships that were directly counter to theory and previous findings: e.g., the model estimates that approximately 16% of participants would show a strong *negative* relationship between global need satisfaction and subsequent general mental wellbeing. Findings were similar, though somewhat less stark in the magnitude of variation, for the strongly directional hypotheses about displacement and need satisfaction/frustration (H6): model estimates predict a substantial portion of participants to show a *positive* relationship between displacement and subsequent global need satisfaction.

There was marginally less variability in the relationship between contextual need satisfaction/frustration and global need satisfaction/frustration (H10), with the majority of participants expected to show the hypothesized positive relationship between need experiences at each of these levels.

Finally, there was almost no variability around the relationship between daily playtime and displacement (H4). Manual inspection of these estimated (rather than model-implied) random effects indicated that this was in part driven by non-normally distributed random effects: whereas many participants' estimates were close to zero, almost none were negative, and many were positive (ranging up to approximately .06, indicating a .06 scale point change in displacement per hour of additional daily playtime), producing a heavily right-skewed distribution.

Between-person Effects

Interestingly, while support for the preregistered within-person hypotheses was contingent upon a concurrent, rather than lagged relationship, there was support for all but 2 of the original lagged hypotheses at the between-person level, with moderate to large effect sizes (Table 10.4). To succinctly summarize the results for which between-person relationships supported BANG hypotheses:

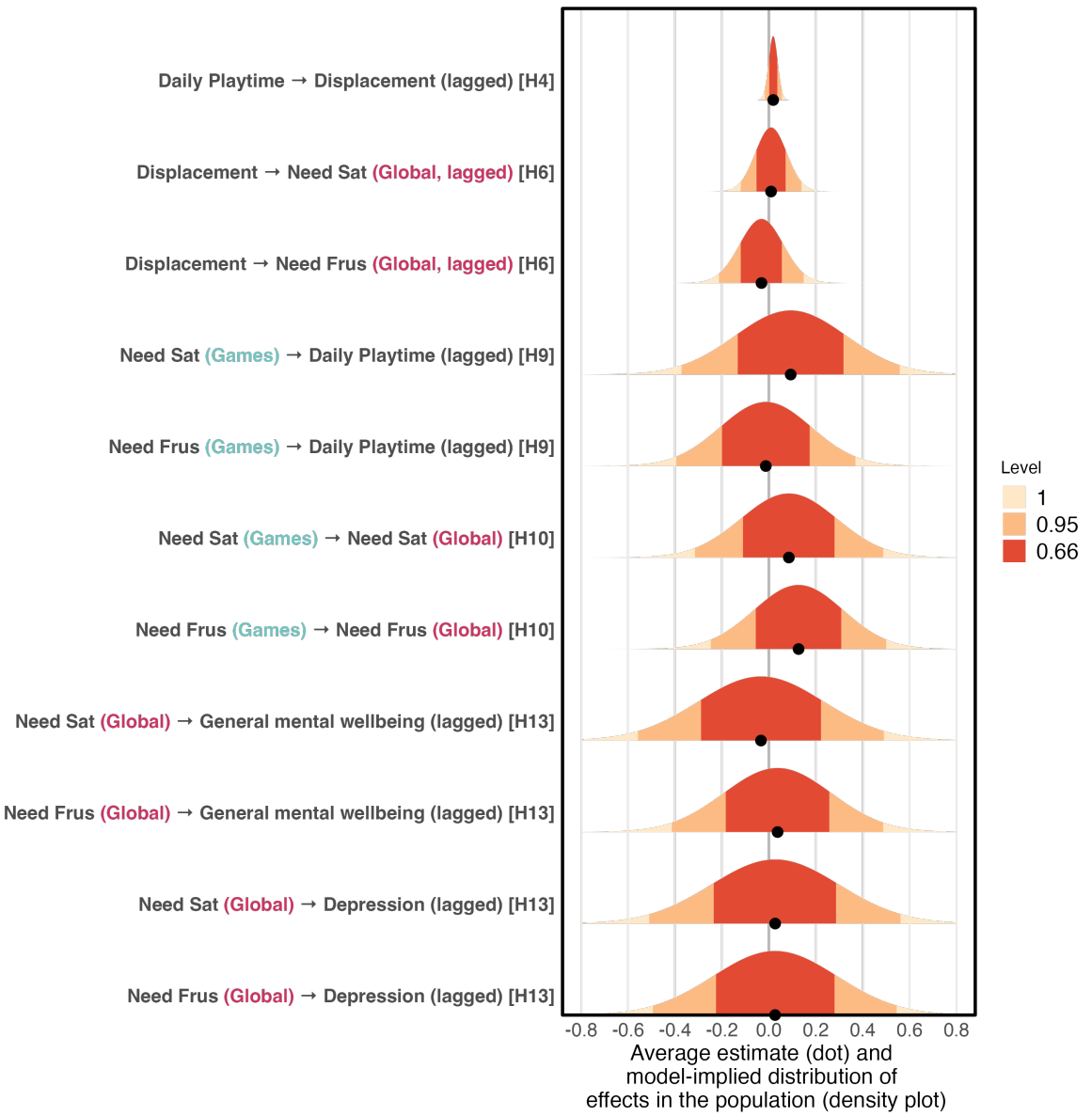

Figure 10.9: Between-person variability in each relationship investigated across Models 1 and 2. Plots are visual representations of the point estimate and random effect SD as show in Table 10.4. Each distribution indicates the model-implied proportion of respondents who would be expected to have a within-person relationship of the indicated magnitude. For example, the bottom-most plot indicates that the average within-person relationship between global need frustration and subsequent depressive symptoms is near 0, but that 66% of people will have an effect ranging from approximately −.02 to .025, with 33% of people exhibiting relationships smaller than −.02 or larger than .025.

H10. People who reported more need satisfaction in games also reported higher global need satisfaction than their peers; people who reported more need frustration in games also reported higher global need frustration than their peers

H13. People who reported more global need satisfaction and less global need frustration than their peers reported substantially higher mental health than their peers 2 weeks later

H9a. People who experienced higher need satisfaction in games than their peers also tended to spend more time playing video games in the following 2 weeks

H6. People who reported a higher degree of problematic displacement than their peers also reported less global need satisfaction, and more global need frustration 1 time point later

For two relationships, however, results were null or in the opposite direction as expected:

H4. People who spent more time playing games than their peers did not report greater problematic displacement than their peers

H9b. People who experienced more need frustration in games than their peers tended to spend more (rather than less) time playing video games than their peers

In short, between-person results were more in line with predictions than the within-person effects, insofar as lagged relationships still held, whereas many lagged within-person relationships were weak or null, and only became significant when concurrent.

10.4.5 Study 4b Discussion

The findings in Study 4b are a tale of two halves: I find limited or no support for the hypotheses of the BANG model when looking at lagged relationships, in some cases running counter to highly-established prior literature (specifically, the relationship between global need satisfaction and mental health; Olafsen et al., 2018; Ryan and Deci, 2017; Tian et al., 2014). However, when I remove the time lag (relying purely on theory, rather than temporal precedence, to support causal inferences), nearly all hypotheses were supported. This can be framed as evidence in favor of falsifying BANG model for one timescale (2 week lags), but the model having survived a falsification attempt for concurrent relationships (or very short time lags). That there is some relationship between these constructs—albeit potentially a confounded one—is further supported by the between-person results, which were significant and in the expected direction for all but two relationships (need frustration in games → playtime, and playtime → displacement; see below).

This, while data do not themselves support causal inference, I learn on theory to interpret these results as initial support for the tenets of the BANG model. It appears, based on the results of Study 4b, that experiences of need satisfaction and frustration in games contribute to one's experience of global need satisfaction and frustration, and that experiences of global need satisfaction are linked with improved mental health (here, lower depressive symptoms and higher general mental wellbeing).

Notably, however, one relationship was not supported by any of the models: need frustration in games was not linked to lower playtime, at any of the lagged within-person, concurrent within-person, or between-person levels. To some degree, this aligns with intuitions: to experience need frustration with any frequency, players need to engage with games regularly. However, this still runs counter to previous research showing that need frustration diminishes intrinsic motivation (Vansteenkiste et al., 2020). One potential explanation is that players' reports reflect salient need-frustrating experiences in games during the previous two weeks (i.e., a peak-end effect in reporting; Kahneman et al., 1993), but players have already adapted their behavior by playing differently, or playing different games. Thus, while need frustration remains higher than usual for them, their playtime remains largely unchanged (or perhaps even slightly increased upon discovering a new, particularly-motivating game). This could potentially be investigated in the data here by analyzing how need frustration relates to the frequency of switching games. Given the contrast in findings between Study 1 and Study 4b regarding the behavioral effects of need frustration in games, this is an important topic for further research.

A second unexpected set of findings are the positive direct relationships between problematic displacement and both need satisfaction and frustration in games, in addition to the mediated path from need satisfaction through playtime to problematic displacement. For need frustration, a possible explanation is that—by virtue of appraising the time spent playing more negatively—players are more likely to believe that the time was 'wasted' and detracted from other life domains, regardless of the actual amount of play. For need satisfaction, this result is somewhat more puzzling. A speculative explanation might be that highly need-satisfying play leads to greater preoccupation, and thus occupies mental resources even after play has ceased (Billieux et al., 2019). That need satisfaction in games would have a mediated, negative relationship with global need satisfaction and subsequent mental health via displacement is a puzzling result running counter to theory, however, and will need further investigation.

One other finding worth briefly highlighting, in part to showcase the methodological and theoretical challenges associated with within- vs between-person processes, is that of playtime on problematic displacement. As expected, there was a positive within-person relationship between playtime and displacement, albeit a very small one: people who played more than they usually do also tended to report higher problematic displacement. Interestingly, however, in contrast to the majority of the other findings, this relationship did not appear in the between-person results; people who spent more time playing video games than their peers did not report higher problematic displacement. This aligns with the tenets of BANG, which argue that people are generally adept at 'making time' for games by shifting other responsibilities, or limiting playtime to 'free' slots

on evenings, weekends, and holidays. People who have higher stable playtime than others are usually people who have simply intentionally dedicated a larger portion of their leisure time to gaming, without it coming at the expense of other critical responsibilities. At the within-person level, however, people's playtime tends to be in harmony with the arrangement of their life as a whole, and increases in that playtime are more likely to problematically displace other activities. This highlights the importance of being clear whether theoretical processes are predicted at the within-person level, the between-person level, or both, as these can differ (e.g., Mills, Milyavskaya, Mettler, Heath, et al., 2018a).

10.5 General Study 4 Discussion

In Study 4, I found support for several predictions of the BANG model: there is no direct within-person relationship between platform-wide playtime and mental health, but games do appear to contribute in a small way to mental health via their need-satisfying and -frustrating qualities, or by displacing other need-satisfying activities. These findings are discussed at length in the respective Study 4a and Study 4b discussions, and will be returned to in the main discussion (Chapter 11), so I will not belabor them here. However, I want to briefly draw attention to a meta-methodological contribution of Study 4, and to some of the study's limitations.

The Value of Platform-wide Digital Trace Data

A strength of the method used here is the ability to capture play data across an entire platform, the Xbox network, rather than a single game. This was a key limitation of recent prominent studies, which were limited to objectively logged playtime for one game per player, not reliably capturing total objective playtime (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022). The data demonstrate that highly-engaged players tend to play many games over the course of a week or month; capturing playtime in a single game therefore severely limits our understanding of how gaming relates to mental health.

I hope that this chapter can serve as an example of creative digital trace data collection. Games researchers have made regular calls for higher-quality behavioral data, often emphasizing collaboration with industry (e.g., Griffiths and Pontes, 2019). However, this chapter helps demonstrate that this is by no means the only method of accessing such data (see also Section 2.4.5). While the method here has important limitations (e.g., a laborious setup process and reliance on user interfaces that are subject to change), I hope to see others improve upon it or develop alternatives. Together, this can help generate data infrastructure that is accessible to the whole research community, rather than simply the subset with resources and technical expertise to develop these from scratch.

The data presented here are rich, and ripe with opportunities for further investigation. Future research could classify the games based on genre, certain features of interest, social modes, and more, to understand if and how these affect players differently. Other researchers might also be able to take advantage of the data relating to Big 5 personality (e.g., Johnson and Gardner, 2010), internet gaming disorder (e.g., Jin et al., 2022), time of day (e.g., Drummond and Sauer, 2020), and more. All data, materials, and tracking software are available in the supplementary materials under a permissive license, and I encourage readers to explore whether their own research questions might be addressable with these.

Limitations

The largest limitation is the inability to account for potential time-varying confounders. Various other factors may have impacted both gaming and mental health (e.g., demanding care responsibilities that cause a player to play less and feel worse), and these have the potential to suppress effects that may otherwise have surfaced. While this remains a key limitation here, the data include 1221 responses to an open-ended question about what events might have affected both their mental health and their gaming. These offer a valuable opportunity for research identifying prevalent or impactful confounds to be accounted for in future research.

Other limitations include coarse a relatively coarse timescales (with two weeks separating each wave, in contrast to intensive longitudinal designs, e.g., Aalbers et al., 2021) and possible non-linear relationships. While I extend previous research by comparing three different timescales of playtime and mental health, this is by no means exhaustive: games may affect various aspects of mental health over shorter or longer time periods than were investigated here. Similarly, as I suggested, such effects may not be linear, an assumption of the analysis approach used in this study—for example, players may experience a meaningful increase in mental health only after an initial small amount of playtime, after which no further benefits occur, or there may be a different relationship for extreme high engagement. I hope these results can catalyze the generation of better-specified theory that can predict such non-linear relationships and the timescales during which effects may occur.

Constraints on Generality

These results have potential to generalize in some regards, but not others. On mental health measures, the sample mirrors adult UK/US populations. In demographics and play behavior, the sample is fairly representative of adult US/UK highly-engaged console players, who tend to be majority male, between 25–34 years old, and play approximately 1.5 hours per day (Newzoo, 2023b), characteristics that are broadly reflected in this sample. Similarly, the most popular games here overlapped considerably with the most popular games across the Xbox platform during the same period (Albigés, 2023), suggesting that these findings may generalize to other Western adult Xbox players outside the sample. I believe this population to be an important one to study: given existing evidence that effects of games, where present, are small and contextual, highly engaged players may be most likely to experience accumulative effects over long periods of sustained high engagement.

However, the sample is *not* representative of many other populations of people who play games. I did not look at younger players (especially minors), countries besides two culturally similar Western ones, and or other gaming platforms besides Xbox. While the sample included a range of players from casual to extreme high engagement, the findings are primarily reflective of the moderately- to highly-engaged group. I look forward to assessing the generalizability of these findings in future research on children and adolescents, from a wider range of countries, platforms, and level of gaming engagement.

10.6 Conclusion

In conclusion, Study 4's use of logged Xbox data over several months has yielded valuable insights into the complex dynamics of gaming and mental health. Contrary to popular rhetoric, the findings reveal that the amount of time spent gaming does not have a direct or linear relationship with mental health. This finding, which extends previous results by showing evidence of absence and by logging play across multiple games, challenges the simplistic narrative that gaming is inherently detrimental to mental health and underscores the importance of focusing on quality of play.

Instead, the study supports an alternative framework in the form of BANG model. Results provide initial evidence that BANG is a valuable predictive and explanatory model for understanding how both quality and *quantity* of play—in mediated and/or moderated fashion—affect mental health, based on multiple pathways related to players' basic psychological needs. As we move further into a digital age where gaming is an increasingly dominant form of entertainment, Study 4 provides a valuable foundation for informed discussions about mental health in people who play video games, while dispelling unwarranted stigmas related to the idea that play is an inherently detrimental use of time.

10.7 Acknowledgements

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Part IV: Sense-making

11

Discussion

Chapter Contents

11.1 A Summary of Findings . . . 137
11.2 Implications . . . 138
11.2.1 For Games and Mental Health Theory . . . 138
11.2.2 For Measurement of Player Experience with BANGS . . . 140
11.2.3 For Self-determination Theory and Games . . . 141
11.2.4 For High Quality Evidence Generation . . . 144
11.2.5 For Practice . . . 146
11.3 Limitations and Next Steps . . . 148
11.4 Conclusion . . . 150

11.1 A Summary of Findings

Throughout the past 10 chapters, I have covered substantial ground. We saw an overview of the wide variety of effects gaming can have on mental health, and the dearth of theory that accounts for more than small pockets of these (Chapter 3). I discussed some of the methodological and meta-scientific reasons that solid and generalizable answers have been elusive (Chapter 2). And we saw how self-determination theory offers a promising starting point, with opportunities for even more precise and useful predictions in the domain of games (Chapter 4).

We then saw that need frustration is common in games, and that people reflect on need-frustrating experiences to update their expectations for future experiences in that game or similar ones, and that this then drives behavior (Chapter 6). We saw evidence that many people use games to compensate for frustrated global needs, but that this mechanism is not common or strong enough to produce a positive relationship between global need frustration and in-game need satisfaction (Chapter 7).

We used these findings to generate the Basic Needs in Games (BANG) model (Chapter 8), which argues that games are positive for mental health insofar as they satisfy players' basic needs and thereby contribute to their overall experience of need fulfillment. It argues that games are negative for mental health insofar as they either (1) regularly frustrate the basic needs of players who continue to play anyway, and thereby contribute to an overall sense of need frustration, and/or (2) displace players' ability or opportunity to derive need satisfaction from other life domains, causing them to be increasingly reliant on games. To afford empirical investigations of the BANG model, I developed a new measurement instrument, the Basic Needs in Games Scale (BANGS), showing that need satisfaction and frustration can validly be measured at situational and contextual levels of generality, and that together they strongly predict intrinsic motivation (Chapter 9).

BANG and BANGS then came together in a longitudinal study of Xbox behavior and mental health, in which I used platform-level data to bolster previous findings that there is no meaningful direct relationship between

playtime and mental health at the population level (Chapter 10)—supporting a hypothesized absent direct link in the BANG model. Instead, the BANG model predictions of mediated relationships between both play quality and mental health (via need satisfaction and frustration) and play quantity and mental health (via problematic displacement) were largely supported—though relationships appeared only concurrently, not at 2-week lags, raising questions about causality and temporal precedence.

11.2 Implications

Putting this all together, how does this thesis contribute to our understanding of gaming and mental health? I see five areas in which this work might have important implications: (1) for academic research and theory on the topic, (2) for measurement of basic needs in player experience research, (3) for self-determination theory, (4) for methodological rigor and the quality of evidence, and (5) for practitioners such as designers, players, and clinicians. I discuss these in turn.

11.2.1 For Games and Mental Health Theory

Integrative Theory Development

The primary contribution of this thesis is the presentation of an empirically grounded, integrated, and partially validated theory of how games affect mental health positively and negatively via basic needs. This enables future systematic theory-testing research, which ultimately stands to improve our understanding of the intricate dynamics of video game play and mental health. It provides a integrated model of the circumstances and underlying mechanisms that determine whether gaming serves as a support or detriment to mental health. This framework offers several advantages that make it a valuable platform for researchers.

First and foremost, BANG has potential to explain a diverse array of existing empirical evidence about gaming effects. It explains previous findings that the outcomes of compensating for life difficulties through gaming can be either positive (Helsby et al., 2023; Iacovides and Mekler, 2019) or negative (Allen and Anderson, 2018; Di Blasi et al., 2019). BANG provides a mechanism to explain both the well-documented short-term impact of gaming on positive affect, stress, or vitality (Russoniello et al., 2009; Tyack et al., 2020), as well as the more enduring influence of gaming as a prominent hobby in one's life (Allen and Anderson, 2018; Beard and Wickham, 2016; Kaye, 2019). It explains population-level null results (Vuorre, Johannes, and Przybylski, 2022) alongside evidence of negative outcomes associated with too much play leading to displacement (Guo et al., 2022) Together, this adaptability makes for a model that is applicable across different contexts and timescales.

BANG's coverage of many existing effects provides a potential framework for coordinating research effort, helping us get more value from testing individual and isolated hypotheses. Without a means of organizing research on a topic, we risk talking past each other or unnecessarily duplicating efforts due to differences in how constructs are labeled and defined (see jingle/jangle fallacy; Section 2.4.4), weak connections between research groups even within small subfields, and the astonishing amount of literature produced each year (B. Anderson, 2023). This can result in key findings that go unnoticed and fail to influence the theories for which they have implications. Similarly, if we treat theories as isolated creations that compete wholesale with one another, we risk ending up with a towering array of 'fossilized' explanations—for example, there are at least 83 competing theories of behavior change (Zhang et al., 2021). While a certain amount of theoretical diversity is desirable, too much can be overwhelming for intervention designers who want to selectively apply theories to their designs, for a research community trying to make collective progress, and for individual researchers trying to get to grips with the literature. In my opinion, a long-term goal for the field is to generate a small and empirically well-supported set of theories for a given topic, standing on the shoulders of the theories that preceded them whose successes they have integrated.

This was my goal with the BANG model, which attempted to integrate some of the well-supported insights and aspects of other theories. For example, BANG includes the notion of an active audience, who selectively expose themselves to media in part because they have fundamental psychological needs, with Uses and Gratifications (Ruggiero, 2000), R^2EM, and Mood Management Theory (Zillmann, 1988), among others. BANG shares the notion of outcome expectations with Uses and Gratifications, Social Cognitive Theory (Bandura, 1986), and the Theory of Planned Behavior.

BANG is most closely related to with the R^2EM (Reinecke and Rieger, 2021) and IM^{3}UNE (F. M. Schneider et al., 2022) models, with which it shares the notion of need satisfaction and frustration as a critical mediator between media use and mental health. With IM^{3}UNE in particular, BANG shares the distinction drawn between need-satisfying and -frustrating media use leading to wellbeing and illbeing, respectively; with R^2EM it shares the

notion of compensatory media use, with a player's mental state informing their selective exposure decisions.

BANG also complements and adds to these two models in a few ways. R^2EM specifies only positive potential effects, so both BANG and IM^{3}UNE each account for a wider variety of outcomes. Whereas IM^{3}UNE is limited to mobile media demands, BANG speaks video game play. In principle, there is little reason to believe that either model would not be equally applicable to other types of media—IM^{3}UNE's tenets are a priori compatible with gaming, VR, or any other kind of interactive use where there is the potential for ambivalent effects of use on need experiences. Thus, this divide in media types may be temporary, with potential for future unification. One key element of BANG that is not present in IM^{3}UNE is the focus on motivation and selective exposure. Whereas IM^{3}UNE focuses on the experiential consequences of use, BANG also specifies mechanisms governing the decision to engage or disengage. BANG explores effects at various levels of generality, while IM^{3}UNE focuses on situational experiences, with some implicit reference to contextual experiences of mobile media use in general. In comparison to both R^2EM and IM^{3}UNE, BANG specifies a role of quantity of media use, addressing how media affect mental health not just through one's engagement, but the knock-on effects that use has for other life domains.

In the other direction, IM^{3}UNE specifies one key component that is not present in BANG, namely *sense of coherence*: a trait-like, global orientation to embrace life as comprehensible, manageable, and meaningful. Interestingly, sense of coherence fits well within the *orientations* category of wellbeing (Huta and Waterman, 2014)—personal priorities, reasons, motives, values, and goals behind a person's chosen behaviors. In line with SDT's recognition that the functional significance of an event and the environment are moderated by individual characteristics and BANG's interest in expanding to not just wellbeing outcomes but ways of living, sense of coherence represents a promising candidate for introduction into the model. This integration would be a straightforward one, with the only necessary addition being a moderation effect of sense of coherence on BANG's H7 (play quality to situational need satisfaction and frustration) and H12–14 (need satisfaction and frustration to mental health).

Sense of coherence is just one opportunity to continue integrating the empirical successes of other theories into BANG. I see particular potential to draw from other models in understanding selective gaming exposure, which as I note in Chapter 8, is influenced by many more components than simply motivation. Factors such as habit (Schnauber-Stockmann et al., 2018) and the perceived availability of options (Knobloch-Westerwick et al., 2019) also crucially affect the decision-making process. These are omitted from BANG with a view to keeping the model targeted and manageable in size, but warrant careful consideration for future research into the non-motivational factors that most strongly impact selective exposure decisions.

One further promising candidate for introduction into model as a determinant of selective gaming exposure, and one that may lead to maladaptive media use, is self-regulatory capacity, defined as 'the dynamic process of determining a desired end state (i.e., a goal) and then taking action to move toward it while monitoring progress along the way' (Inzlicht et al., 2021, p. 3). Reinecke et al. (2022) propose self-regulation as a key boundary condition in the relationship between media use and mental health—social media use will only support mental health if users are able to monitor their use in relation to some goal they have. A review paper details substantial evidence in favor of such a moderating effect of self-control on the relationship between our daily activities and their mental health outcomes, both with regard to media use and in various other life domains (Hofmann et al., 2017). While less developed, some evidence supports this claim for video games: Mills and Allen (2020), for example, find that feeling need-frustrated inhibits self-control, resulting in less integrated motivation to play games and higher rates of disordered play (i.e., play that negatively affects mental health).

Here, some careful disentangling of terminology will be necessary, as SDT also regularly refers to 'self-regulation', using it to refer to relative autonomy of an action—'autonomy is another term for self-regulation' (Ryan and Deci, 2017, p. 167). Self-regulation in the broader psychological context, by contrast, extends beyond motivation and internalization to include all processes of controlling one's thoughts, emotions, and behaviors to achieve a desired goal or outcome.

Given this, self-regulation in the broader sense might can complement the role of motivation in determining selective exposure—when users either lack the awareness to monitor their own goals, or lack the self-control to override undesirable behavior, this would be characterized by less autonomous motivation and ultimately less need-satisfying media use. In part, this would be driven by controlled vs autonomous motivation (e.g., users with deficient self-regulation reporting lower scores on identified motivation items such as 'Using [X] is a good way to achieve what I need right now', and higher scores on amotivation items such as 'I use [X], but I question why I continue to use it'; items taken from the User Motivation Inventory; Brühlmann et al., 2018). However, the motivational determinants of self-regulation stand to be supplemented by the various other influencing factors identified by Reinecke et al. (2022), including media affordances (e.g., notifications that

demand attention), social dynamics (e.g., Fear of Missing Out), cue triggers, or trait user characteristics such as online vigilance.

Putting an End To a Tired Debate

On the empirical side, I offer some of the strongest evidence to date that there is no direct link between playtime and mental health. It is my hope that this finding helps puts an end to debates that continue to place play quantity, rather than quality, at the fore (Boxer et al., 2015; Burke and Lucier-Greer, 2021; Wenzel et al., 2009). Alongside other recent high-quality evidence, my findings call for a shift in the popular conversation, moving away from time as the important factor, and redirecting attention toward the qualitative aspects of gaming experiences.

This shift is formalized in the BANG model, which argues for a transition away from discussion of 'raw' gaming quantity toward how gaming interacts with and fulfills an individual's basic psychological needs, and how gaming fits alongside other responsibilities in their life. This shift in focus is supported by the results of Study 4b, which bolsters previous evidence (Allen and Anderson, 2018; Bender and Gentile, 2019) supporting relationships between need satisfaction/frustration in games and global need satisfaction/frustration; and between global need satisfaction/frustration and global mental health. Here, I take those previous investigations a step further by examining relationships at the within-person level, offering evidence that requires fewer (though nonetheless difficult-to-meet) assumptions to interpret as causal (Rohrer and Murayama, 2021).

This playtime-related finding was enabled by the application of an underappreciated statistical technique in the form of equivalence testing, which I have yet to see previously applied in games research. In many cases, establishing the absence of a (practically meaningful) effect is of utmost importance; however, a non-significant or null result does not accomplish this (Lakens et al., 2018). Equivalence testing provides an intuitive, relatively simple statistical procedure that satisfies this analytical need without requiring significant additional training for researchers already familiar with frequentist statistics.

In sum, this research encourages a more nuanced research approach to gaming and its impact on mental health. It underscores the importance of considering the quality of playtime and its alignment with an individual's psychological needs, rather than solely focusing on the quantity of time spent gaming. This shift in focus promises more efficient allocation of research resources and has the potential to address and redirect parental concerns, ultimately contributing to a more comprehensive understanding of the complex relationship between gaming and mental health.

11.2.2 For Measurement of Player Experience with BANGS

In such investigations of the quality of gameplay, BANGS (the questionnaire, that is) can enable more valid empirical work into the effects of need frustration in games—a topic where work has recently begun with many signs of promise (Allen and Anderson, 2018; Kosa and Uysal, 2021; Pusey et al., 2021). However, this emerging literature has been hindered by a lack of appropriate scales, something specifically called for in previous research (Tyack, 2019). BANGS thus potential benefits for both academic and industrial player experience research.

Opportunities here are myriad: they might include investigations into specific game features, for example whether elements of competition or social aspects of games can satisfy or frustrate specific needs; whether situational need frustration impacts the likelihood of quitting a game (exit intentions, retention rates); or what the behavioral patterns of play look like for people with high contextual need frustration. This is in part enabled by the fact that BANGS is validated for multiple levels of generality, which make it usable for both situational-level questions (e.g., how individual experiences aggregate up to form holistic impressions of games) and contextual-level questions (e.g., how experiences of gaming in general relate to dysregulation).

In industry research, assessing need frustration might help developers better understand where negative experiences arise, identify the driving factors of disengagement and churn, and monitor community health. This could have applications both for understanding the success or failure of released games (e.g., comparing need satisfaction and frustration to similar titles in the genre), and for informing design decisions during development (e.g., running comparisons between different prototypes/variations to identify how design features affect the prevalence of need frustration). This potential to impact industrial player research is supported by the relatively extensive use of SDT in the games industry, including among major publishers such as Ubisoft (Schreiber, 2017)—in contrast to the majority of psychological games research, which has struggled to firmly embed itself in the day-to-day operations of developers (Drachen et al., 2018). Though regularly used, industry practitioners of SDT may not be fully up-to-date with the latest developments, and

therefore may not be aware of need frustration's potential for predicting disengagement, churn, or negative emotional experiences, something that BANGS can help enable.

I see particular potential for BANGS to be useful for designers seeking to create more complex experiences of meaning and appreciation (eudaimonic gaming; Daneels et al., 2023) that are not always inherently positive—for instance, in games that intentionally create uncomfortable or negative experiences for players (Bopp et al., 2016; Denisova et al., 2021). Evidence shows that need satisfaction and frustration are closely connected with emotionally challenging game experiences (Rigby and Ryan, 2016), and might play a role in differentiating those that are eventually appraised as meaningful vs those that are appraised as adverse—and how both of these differ from experiences that are perceived as simply lighthearted fun.

Similarly, need frustration might offer an explanatory mechanism for understanding what makes certain experiences of frustration—that is, the emotional experience of having one's goal impeded—negative for players, and others motivating and ultimately positive. Positive experiences of frustration are frequently reported in video game play (Frommel, Klarkowski, et al., 2021; Petralito et al., 2017), and are in fact a common design goal. Perceiving one's goal-directed action to be impeded *without* feeling controlled, ineffective, or excluded (i.e., *need*-frustrated) may set apart the positive, motivating experiences of wanting to get past a difficult obstacle from negatively-valenced instances where goal attainment *and* needs are frustrated.

As a second contribution, BANGS may offer slightly improved measurement of need satisfaction in comparison to existing measures (PENS, UPEQ, and BPNSFS), which have received criticism. Specifically, I want to highlight BANGS' formulation of relatedness items that are able to capture feelings of social connectedness with both other human players and non-player-controlled characters or virtual settings. That these experiences could contribute to the overall sense of relatedness that players derive from games has been theorized for several years (Rigby and Ryan, 2011; Tyack and Wyeth, 2017), but existing relatedness measures either are not clear about whether non-player characters are included, or assess non-player character relatedness with separate items that later create challenges for correctly scoring the experiences of players who may experience *either* multiplayer *or* NPC-based relatedness, but not both. In BANGS, by contrast, this is operationalized as a single factor that can be broadly applied.

While I am hopeful that BANGS can be useful for both academic and industrial player experience research and testing, further research will be needed to realize this potential. There is an inherent trade-off between measuring a construct across all possible gaming contexts, genres, and players, and zooming in on specific features or experiences of one game. For example, the BANGS' overall assessment of whether players felt their actions were forced does not specifically capture how they might experience the monetization structures of free-to-play games as pressuring vs. offering purely optional opportunities (Petrovskaya and Zendle, 2021). I hope to see further qualitative research that bears out context-specific need-frustrating mechanics and experiences in more depth. This would create opportunities for potential BANGS variants that are tailored to specific game genres and help explain why certain games, despite being superficially similar, may have vastly different effects on players.

11.2.3 For Self-determination Theory and Games

Specifying Need-Supportive and -Thwarting Conditions for the Games Domain

Another contribution of the thesis research is in fleshing out the specific features of games and gaming experiences that result in need satisfaction and frustration. Core SDT describes many features of a person's social environment that tend to support or thwart needs: for example, autonomy is supported by the provision of choice and giving a person a meaningful rationale for actions that they are pressured to take; competence is supported by structured learning and positive informational feedback (Ryan and Deci, 2017). But while basic needs and need supports are theorized to be universal, this does not rule out opportunities to form more empirically grounded and content-rich descriptions of need-supportive and -thwarting environments within a particular domain. SDT research continues to actively investigate such environmental characteristics in several specific contexts, for example in education (Aelterman et al., 2013) and sports coaching (Benish et al., 2023).

Similar work is well underway in the games domain, with early research finding, for example, that found that avatar customization, skill upgrades, and dialogue options support autonomy (Peng et al., 2012), and that intuitive control schemes support competence (Przybylski et al., 2014). Indeed, the primer developed to inform the item generation in Study 3 included a mini-review of previous studies that identified particular need-satisfying and -frustrating features and experiences (see supplementary materials), to ensure that the questionnaire wording aligned with naturalistic player experience.

The qualitative work presented in Study 1 helps continue this line of research, particularly for need frustration, whose relevance and prevalence for gaming had largely been theoretical, and not grounded in players'

lived experience. The identified categories of need-frustrating gaming experiences (e.g., having one's desired playstyle constrained by needing to fill a particular role, thwarting autonomy), bolster our understanding of these experiences. I make minor contributions to the more well-established research into need-satisfying experiences as well via the categories of need-satisfying gaming experiences described in Study 2 (e.g., gaming as a social lubricant and object of shared attention to support relatedness).

Given that identifying need supports is a peripheral focus of this research, I mention it only briefly here. Future work may consider synthesizing comprehensive lists of the types of (1) game features and (2) in-game situations that players perceive as particularly need-satisfying or need-frustrating, giving developers experiential targets for their games.

Expectations

One general upshot of the findings here is that *expectations* modulate both need frustration experiences and behavioral consequences. To my knowledge, mainstream and game-specific self-determination theory work to date has not explicitly identified expectations to play a role here (although see Hagger and Chatzisarantis, 2009 for a counter-example combining self-determination theory with the theory of planned behavior, showing that expected consequences about a behavior shape engagement intention). SDT-informed researchers may therefore be missing a crucial component of motivational processes. Cognitive evaluation theory, a main sub-theory of SDT, specifies that people appraise the functional significance of an event as informational, controlling, or amotivating, which will shape need satisfaction (Ryan and Deci, 2017, p. 130). Need satisfaction in an activity will lead to enjoyment, which will then increase intrinsic motivation to continue the activity (2017, p. 117; cf. Ryan et al., 2006 for games). In this model, appraisal occurs but primarily impacts experienced need satisfaction, which then energises continued 'consummatory' behavior. In contrast, the findings in Study 1 and in the BANG model suggest that (a) appraisal includes comparing actual with expected need frustration, (b) salience of experienced need frustration arises from the delta between the two, and (c) observable motivation in the form of behavioral persistence and intensity is not directly driven by felt frustration (as the inverse of enjoyment), but by *expected future frustration*, which (d) also shapes 'appetitive' or satisfaction-seeking behavior (such as choosing a particular game and start playing it).

In wider media research, expectations have been chiefly theorised in Burgoon's expectancy violation theory (Burgoon, 2015). Originally developed for proxemics (people's preferred interpersonal spatial distance), the theory predicts among other things that positive and negative violations of expectations disproportionally affect our evaluations of other social agents. It has seen some prior use in HCI (Bonito et al., 1999) and more recent applications in the study of artificial agents (Burgoon et al., 2016; Lew and Walther, 2023). Yet in HCI more generally, the potential importance of expectations for user frustration and other factors has been largely neglected (Noyes, 2006).

The role expectations play in BANG aligns not just with expectancy violation theory (negative violations produce salient negative evaluations), but also with the predictive processing model of cognition (Clark, 2016). This account asserts that human perception and action consist of generating (subconscious) predictions about the world and comparing these to actual observations, where mismatches produce prediction error. Motivation is a function of expected error reduction, and positive and negative affect emerge from the delta between expected and *actual* error reduction: we continue to engage in an activity as long as we expect it to progress us toward desired states, and feel good (or bad) when we actually progress better (or worse) than expected (Van De Cruys, 2017). A budding strand of mostly theoretical research has applied this model to play (M. M. Andersen et al., 2022) and video games (Deterding et al., 2022). These findings suggest that at least for negative, need-frustrating experiences, predictive processing tracks players' self-reported experiences and behavior well: frustration arises from the delta of expectations and observed events; things going 'worse than expected' are felt negatively; and motivation to continue playing is tied to expectations, not immediate positive or negative experience.

Taken together, my findings invite future empirical research into the role of (conscious and unconscious) expectations in gaming and human-computer interaction, and self-determination theory research more broadly. This is likely to be relevant both for need frustration as well as need satisfaction: under the BANG model, need satisfaction should arise and be (most) salient if events positively exceed expectations, and *expected* need satisfaction should fuel game selection as well as continued play. This would also align with predictive processing and partially, expectancy violation theory predictions.

Timescales

The results of both Study 1 and Study 4 draw attention to questions of the timescales at which need frustration, motivation, and gaming operate.

This issue first arose in Study 1, where players discussed shifts in motivation and need satisfaction at the momentary level, varying throughout the course of a gaming session. This points to a need for either a further level of generality beyond situational, contextual, and global, or a more flexible operationalization of these concepts. If for no other reason than methodological necessity, research on basic needs in games has investigated experiences ranging from a single gaming session up to experiences with games in general. However, the grounded theory model in Study 1 follows existing theory in implicating what I tentatively refer to here as the *momentary level* (analogous to the 'gameplay scenario' level proposed by Melhárt, 2018, as distinguished from a 'gameplay session'). Melhárt observes that players are usually intrinsically motivated to play on the overall *situational* level of a gaming session. *Momentary* need frustration might then occur during a game segment (such as a level), leading players to temporarily shift orientation toward extrinsic motivations, which would 'bridge the gap' to the next need-satisfying gameplay segment.

In Study 1, I similarly observed extrinsic motivators sustaining play in need-frustrating moments at various 'in-game' time scales. However, I found that changes in expectations or behavior are more likely to happen at longer, session-to-session time scales. This makes sense; at shorter, moment-to-moment time scales, players expect occasional (need) frustration, but expect overall enjoyable gameplay at session and session-to-session timescales. Thus, while occasional momentary or even segment-level need frustrations are unpleasant, they do not violate expectations and hence, do not impact situational or contextual motivation to continue playing. Instead, *repeated or sustained* segment- or session-length need frustration experiences violate and update expectations. Experiences over time update and generalize into ever-more global expectations (about a game, game series, game genre, or gaming overall), which then top-down modulate players' gaming selection, persistence, and incoming expectations for a particular game or session. This, continuing on from the predictive processing approach described above, is well-suited to Bayesian modelling; people have minimal data and thus very diffuse priors regarding moment-to-moment experiences, but an abundance of data and highly informative priors for their overall experience of life.

Given that the BANG model is but an initial attempt at understanding these dynamics, the momentary level was not explicitly integrated. However, I believe that the model is well-positioned to accommodate this extension—as defined in Chapter 8, selective exposure decisions and need satisfaction and frustration can be understood as something as instantaneous as the competence-satisfying experience of a single button input, a 5-minute strategic approach to boss fight, or a 45-minute session of *The Legend of Zelda: Tears of the Kingdom*. The BANG model points to a 'sliding time and generality scale' of bottom-up learning informing ever more global expectations and back, ranging from moment-to-moment play to the whole domain of gaming.

To operationalize player experience and selective exposure decisions at the the momentary level is challenging, but an enticing body of work points to several ways of collecting data throughout a gaming session, including video-aided recall (e.g., Kumari et al., 2017), collaborating with developers to embedded survey items into the flow of a commercial game (e.g., as done with *PowerWash Simulator*; Vuorre et al., 2023), or creating custom games with in-game NPCs asking questions diegetically (Bowey et al., 2021; Frommel, Phillips, et al., 2021). The momentary level may be especially important for designers, for whom a holistic evaluation of a gameplay session is important, but perhaps less useful than identifying moments or dynamics that cause brief negative emotions or increase the likelihood of disengagement.

A different question of timescale arose in Study 4, whereby initially-hypothesized lagged effects of gaming quality and quantity on mental health did not appear, but concurrent relationships (and between-person relationships) did. This raises the question whether there is simply no temporal precedence among these pairs of constructs (increasing the plausibility of reverse causality or some other causal mechanism), or whether they unfold at a timescale different than the 2-week one investigated. Although the research presented here is unable to offer a convincing answer to this question, it helps clearly define aspects of the theory that warrant specification in further research. Different methodological paradigms can trace effects at very different time scales, yet theory (where it exists) too seldomly specifies claimed scopes of generality for time scales. This lacking specificity also holds for potential temporal dynamics, e.g., whether we predict 'lossless' or 'decaying' accrual of (good or bad) playtime toward wellbeing, or expect fixed thresholds or dynamic tipping points. Here, again, careful qualitative and descriptive work seems in order to construct (better) theory.

As and when such work becomes available, BANG should seek to specify the shape of an expected effect over time for each hypothesis. Figure 11.1 shows examples of how the shape of effects might vary: Whereas some effects might arise immediately and then taper off over time (e.g., the effect of a need-frustrating experience on outcome expectations), others may appear slowly (e.g., the moderated effect of playtime on problematic displacement). This is a major challenge not just for games research, but for causal modelling more broadly (see e.g., Arnold et al., 2019). Uncovering the timescales under which effects are most salient will form an important

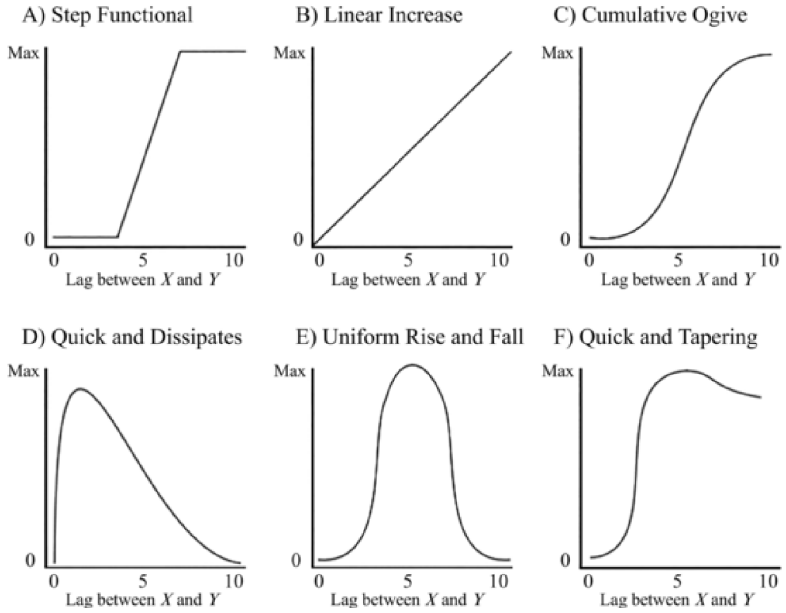

Figure 11.1: Some possible types of effects and their lag relations. The time scale for the lag between X and Y can be on any scale, from milliseconds to years. The size of the effect can also vary from small to medium to large. Reproduced with permission from Meter and Ehrenreich (2022).

organizing force for further research on this topic: where null results are found, it may be because there is no such effect, or because the effect exists on either a shorter or longer timescale than the one investigated.

11.2.4 For High Quality Evidence Generation

Digital Trace Data

This work contributes to our knowledge of how researchers can best access digital trace data, whose value for in advancing our insights into gaming behavior and mental health is well-established (Griffiths and Pontes, 2019; Seif El-Nasr et al., 2013). At present, collecting digital trace data often necessitates collaboration with the games industry. This makes sense; games industry bodies hold the key to data generated by people playing commercial games in their natural context. While having people play custom or commercial games in a lab setting is highly valuable (e.g., Tyack et al., 2020), games' most societally important effects are likely to be accumulate over long-term exposure to games as one naturally chooses to engage with them, and this warrants the collection of data that reflects that sustained engagement. Collaborations with industry have been the source of several highly-publicized studies in recent years (Johannes, Vuorre, and Przybylski, 2021; Vuorre, Johannes, Magnusson, et al., 2022; Zendle, Flick, Gordon-Petrovskaya, et al., 2023).

However, such privileged industry collaborations have notable downsides. They are rare, slow to get off the ground, and largely limited to high-resource, high-prestige universities and lab groups. The career benefits they bring also create opportunities for conflicts of interest (Zendle and Wardle, 2022). This presents ethical challenges for the field. To ensure equitable access to digital trace data data, the academic community needs to work towards infrastructure that affords trace data access in ways that do not necessitate going through industry.

In this study, I applied a novel web scraping technique. This had some important benefits, such as capturing rich data at the platform level, thus producing a much closer approximation of true total playtime than a single game. This type of platform data is virtually nonexistent in the literature (cf. O'Neill et al., 2016; Sifa et al., 2021), meaning that we lack even basic descriptive knowledge of how people engage with multiple games over time—and are even more lacking in knowledge about how this relates to mental health. While less sophisticated than some state of the art computational social science scraping methods (Luscombe et al., 2022), this technique was novel in scraping data from consenting individuals, and thereby combining it with psychological self-reports—in contrast to most scraping studies, which collect publicly available data from largely anonymous users (Speckmann, 2021). The method used here maintains strong support for user privacy and research ethics, by virtue of the fact that participants opt in with full awareness and consent, and can opt out at any time.

While this scraping and self-report approach was ultimately successful and may be viable for certain future research projects, the method used here has limitations that make it unlikely to be the optimal solution for digital trace data collection. First, each of the two scraping methods had approximately 5% loss, necessitating redundancy for full data coverage. Second, the scripts are both brittle: even minor changes to the user interface in Xbox's mobile or web app could change the structure of the data being sent or displayed and cause data collection to stop—indeed, this is precisely what happened early in the project, when I had considered collecting data from Playstation instead before Sony removed the friends interface from their website. Finally, scraping—while not directly prohibited in my reading of the Xbox terms of service—is also in a policy grey area, meaning that accounts could be banned or shut down at any time. While ethical from a user perspective and permissible by research ethics boards (at least at my institution) their legal status as far as the platform owner is concerned is somewhat murkier.

Open Research

The incorporation of open research practices throughout this work undoubtedly made the resulting output stronger and more informative. My adoption of open research is by no means innovative—many researchers before me have implemented all of these practices in their work. However, it remains the case that most research in our field does not adopt these practices, and it is therefore worth highlighting the value they added here.

First, the use of preregistration helped improve the precision of my predictions, and did so in quite varied ways across the three studies in which it was applied (Study 2, Study 4a, and Study 4b). In Study 2, I preregistered both qualitative and simple quantitative analyses using a specified smallest effect size of interest. Preregistration of qualitative research remains relatively uncommon, and its merits are still being debated (Haven and Van Grootel, 2019), but I found it a valuable tool for clarifying my theoretical perspective entering the research, and transparently communicating where a researcher's personal biases may affect how qualitative data is analyzed. This was very different for the preregistration in Study 4a, wherein the registered report methodology allowed us to catch numerous potential issues before they arose (for example, the spacing of survey waves, and the switch from a gamma regression to a zero-inflated gamma regression to deal with players who recorded 0 hours in a given day or week). Once the study was then conducted, analysis proceeded quickly, and there was no incentive to fish for particular results, since the study's publication was already guaranteed. This process was not entirely smooth, with Study 4a (and 4b) also forcing me to deviate from the preregistration. This highlights a crucial, yet sometimes misunderstood necessity of preregistration: Preregistration is a plan, not a prison (Henderson, 2022)—and sometimes plans quite rightly need to change.

Part of the preregistration process involved thinking through sample sizes. Statistical power has long been an afterthought in social science research—in no small part due to its difficulty for any analysis more complicated than standard models such as t-tests and OLS regressions. However, it is a pivotal aspect of a study's ability to yield informative results. When a study with poor statistical power fails to find a significant result, it is ambiguous whether that is because there is no true effect to be found, or because the study simply did not have enough observations to detect an effect of that magnitude. Researchers should do their utmost to ensure their sample is large enough to be informative, and when that is not possible, that they articulate their justification for nonetheless carrying out the research (and perhaps adjust their statistical methods to maximize the study's value despite low power) (Lakens, 2021). I found simulation-based power analysis to be an invaluable tool for Study 4 in particular, and encourage quantitative researchers to explore resources for performing power simulations (e.g., Buchberger et al., 2022).

These study planning materials, alongside the resulting data and analysis code, were then shared openly—a practice that according to recent estimates, takes place for as low as 2–5% of games HCI papers and psychology papers more broadly (Hardwicke et al., 2022; Vornhagen et al., 2020). All projects were hosted on the Open Science Framework, the de facto standard for psychology research, but the data and materials for Study 3 were also stored on GitHub for the purposes of version control—another practice that is invaluable for identifying and preventing mistakes in the analysis process, as well as in preventing fraud (Simonsohn et al., 2023). As data-sharing becomes increasingly expected by funders and publishers, postgraduate courses might consider providing additional training on how to make data open (including e.g., issues of documentation, repositories, and version control).

Research with aspirations to be impactful outside academia must, first and foremost, be read by people outside the academia. Most people without an affiliation with a wealthy (often western) institution will not have easy access to subscription journals, and therefore rely on papers to be made available open access. This was achieved here through a combination of gold open access (papers freely from the publisher themselves),

green open access (papers whose published versions can be self-archived in institutional repositories such as Whiterose), and preprints (papers whose submitted version is posted on open access repositories such as PsyArXiv many months before potential publication). Preprints have the further advantage of accelerating the speed of knowledge dissemination, a noted benefit during the Covid-19 pandemic (Fraser et al., 2021). Researchers can further improve the accessibility of their work with layperson-friendly summaries. This is something I attempted with Twitter threads[1] and blog posts[2]. While I by no means claim to be an adept science communicator, I hope that my stumbling attempts can encourage others to take steps towards making their work available to others in both formal and informal forms.

During the time this thesis has written, open research has taken important steps from being *possible* and *easy*, to being *normative*, *incentivized*, and in some cases *required* (Nosek, 2019). I hope that my use of these methods, and the visible positive impact they had on my work, can contribute to making open research the de facto standard for the games domain.

Inter-individual Effect Size Variation

As discussed, a null effect on average can obscure tremendous variability in that relationship—it may still be the case that there are large portions of the population who are experiencing meaningful positive and negative effects, and that these simply balance out on average (Valkenburg et al., 2021b). To resolve this, we need to more carefully investigate effect size variation, and begin establishing benchmarks for what degree of variation is expected. Given that human psychology, and the measures we use to access it, are far too complex for a deterministic, zero-variance relationship to ever exist, effect size variation is inescapable, but excessive variation can act as a signal that there are important moderating factors at play. Ultimately, this can help improve theory and make more precise predictions about who, for example, is more likely to have their playtime lead to problematic displacement (Johannes, Masur, et al., 2021).

My findings contribute initial evidence about the magnitude of variation in BANG model relationships—for example, I showed that despite precision for the average relationship between need satisfaction and playtime was high, this obscured substantial variability from person to person. Perhaps more importantly, I also point to challenges for future investigations. One important area of concern relates to normally-distributed random effects. In previous research applying person-specific methodologies, it has generally been plausible to observe both positive and negative relationships for the given effect: e.g., the effect of using Instagram on wellbeing almost certainly is positive for some users and negative for others, depending on qualities of their usage (Beyens et al., 2020). In my case, however, certain predictions were strongly directional and based on substantial previous evidence. There is no logical or theoretical reason to expect that some people who experienced greater need satisfaction would also experience more depression (indeed, this would directly challenge SDT's universality claims; Vansteenkiste et al., 2020). However, under the assumption of normally-distributed random effects, a model with a small *average* effect and a moderate model-implied random slopes SD will predict substantial portions of the population to exhibit positive and negative effects, respectively.

However, the effect size variation findings in Study 4b are highly limited by the short timescale, and should not be considered definitive. The goal of including these findings was primarily to illustrate how this can be done (and potentially also highlight what approaches do *not* work), to provide a baseline for comparison in future investigations, and to offer a starting point for thinking about possible mechanisms that would drive the observed variation. I echo the calls by Johannes, Masur, et al. (2021) and Vuorre, Johannes, and Przybylski (2022) for media effects researchers to learn from other domains where this type of conceptual and statistical approach is more well-developed, such as personalized medicine (e.g., Senn, 2018), and hope that this will lead to important insights in the upcoming years of work in our own domain.

11.2.5 For Practice

There is frequently pressure on researchers to sell the wider implications, or impact, of their work. In games research, this often takes the form of informing game design practice, identifying targets for clinical or non-clinical interventions, or by providing an explanatory framework that can inform policy or public debates on a topic (cf. moral panics; Bowman, 2016). Done prudently, articulating the implications of one's work should indeed be at the forefront of researchers' minds when they proceed with a program of research. At the same time, however, it is equally important to acknowledge that research is slow, methodical, and may not have immediate impact—something that many previous researchers have pointed out (e.g., criticisms by Dourish,

[1] e.g., twitter.com/nbballou/status/1471132948183326727
[2] e.g., nickballou.com/blog/need-frustration-grounded-theory/

2006 about the overemphasis of design implications in HCI; or general criticisms about the pressure to find 'impactful' results leading to questionable research practices Munafò et al., 2017).

Instead, research may simply serve to improve our basic understanding of a phenomenon, so that others in the future can build upon it or adapt it to applied contexts. This thesis is primarily an example of this kind of research, and its path to applied impact is therefore longer and less obvious. Nonetheless, it is important to have a map and compass to see where my work might eventually fit in. With that caveat, I describe the potential implications of my research—and the larger body of literature into which it fits—for three stakeholder groups.

Clinicians

While my work does not directly focus on psychopathology or gaming disorder, it does interface with these topics at a few points that might be of use in clinical settings. One especially relevant one concerns the pathways toward negative impacts of gaming. The BANG model currently implicates two distinct etiologies of problematic gaming. In the first, games are so need-satisfying that they eventually cause players to exceed their available leisure time, and begin displacing other important activities if other factors undermine the players' ability to successfully manage life fit. As discussed, this creates a feedback loop: as gaming reduces opportunities to derive need satisfaction in other life domains, players become increasingly reliant on games to satisfy needs (i.e., their need-related outcome expectations for games far exceed their outcome expectations for other activities), thereby further displacing other activities and further reducing need satisfaction. This etiology closely tracks the need density hypothesis (Rigby and Ryan, 2011), adding some specificity with regard to mechanisms.

In the second etiology, the model predicts a proportion of players who experience high need frustration in games, but have high extrinsic motivation or deficient self-regulation and continue to play anyway. Under normal conditions, players experiencing high need frustration in games would reduce play, or change games/gameplay style such that gaming becomes need-satisfying again. However, extrinsic motivations such as needing to maintain a sense of self-worth ('if I don't play and my ranking goes down, I'll be a failure') or a disrupted system of generating outcome expectations (e.g., evidence showing that people with depression have distorted predictions about future experiences; Kube et al., 2020) may cause players to remain 'stuck in a loop' and continue playing anyway. Persisting through repeated situational experiences of need frustration would be expected to cause both immediate post-play negative mental health experiences (e.g., greater negative affect), and through repeated experiences contribute to one's global need frustration—ultimately leading to poorer global mental health.

These etiologies would likely require different treatment plans. In the first, focus might be on helping the player develop new avenues for need satisfaction—helping them engage in a wider variety of hobbies, attend to interpersonal relationships, and ultimately slowly reduce their dependency on gaming as the only satisfying activity available to them. In the second, focus might be on meta-cognitions surrounding gaming (Spada and Caselli, 2017), and helping the player to be more aware of their gaming, and the emotional effects it has on them, hopefully bringing their outcome expectations more in line with reality and allowing the self-regulatory system to work more effectively.

Ultimately, clinicians and health professionals bear the brunt of dysregulated gaming—they are the ones who are face-to-face with patients who either believe themselves that they need help, or who may need help but are not yet aware of it. Our job as non-clinical researchers is to educate clinicians—who may not be experienced with games—about the nuances of quality and quantity of play, risk factors for and behavioral signs of dysregulation, and the mechanisms that connect gaming to mental health. This will help ensure that gaming is neither demonized nor ignored when it is a legitimate causal factor in an individual's illbeing.

Players and Parents

Parents and children are tasked with negotiating video game use in the face of highly imperfect information. They need to differentiate valid concerns from potential moral panics, educate themselves about warning signs for potential unhealthy play and monitor for these, and form judgements about what kinds of gaming will have the largest cognitive and social benefits (Kowert, 2016). As pointed out above, one valuable output from this thesis is helping demonstrate that focusing on playtime is unlikely to be an effective strategy for guiding healthy gaming behavior. Instead, understanding the relationship between players' motivation and basic psychological needs (both in games and at the global level) may yield more helpful insights.

While concrete interventions from this alternative need-related focus remain distant, I want to take this opportunity to distill some core concepts from BANG into a list of questions that players and parents can ask

themselves. I view these as conversation starters, to have with a friend, a parent or child, or in solo reflection. By drawing conscious awareness to one's motivations for play and the need-satisfying or -frustrating quality of that play, players might become better able to steer themselves towards gaming habits that maximize the benefits for them.

- Do you sometimes find yourself playing games despite not really wanting to?
- How do you feel about the people or characters you interact with in games? Do you feel connected to others and part of a community?
- To what extent is gaming helpful in providing a way to distract yourself or recover from a bad mood or stressful day? If gaming provides this, what other activities have similar effects on your mood?
- What kinds of gaming experiences make you feel like you're learning and getting better? What kinds make you feel like you're a failure or no good?
- What kinds of gaming experiences leave you feeling bored, frustrated, angry, irritated, or otherwise negative?
- Think back to the times you played games during the past week. If you hadn't played games during those times, what might you have done instead?

This list is a first, small attempt to distill BANG concepts into language that the general population can access. As I (and hopefully others) continue this line of work, I hope to see further attempts to create 'self-check-in' questionnaires of this nature, rather than solely psychometric scales. Similar content might include what types of discussions to have with one's children to understand not just *what* they are playing, but *how* and *why*; or signs to look out for that might indicate some degree of dysregulation. This can be combined with specific guidance for players who are unhappy with some aspect of their relationship to gaming, whether that be easy-to-digest descriptions of why games are so motivating or strategies for managing game use in a healthy way, such as keeping gaming diaries.

Game Design and Industrial Player Research

In addition to the potential value of BANGS for the games industry (discussed above), one other finding with potential implications for design relates again to outcome expectations. The results from Study 1, and the model itself, suggest that (positive and negative) expectation violation may deserve particular design attention. Rather than aiming for a blanket 'good' or 'need-satisfying' experience, these findings invite designers to ask what (biographical, genre-specific, series-specific) expectations their audiences are likely to bring, and to focus ideation and formative evaluation around positively, not negatively violating these expectations. The nine specific need-frustrating situations my model identifies can here serve as heuristics or 'strong concepts'. The findings here also suggest that *expectation-setting* could be an important design consideration. For instance, by introducing explicit, up-front labels of its levels, *Candy Crush Saga* may have helped set player expectations and thereby reduce felt frustration despite repeated failings at hard levels.

More broadly, the concepts discussed in this thesis can support ongoing efforts to use SDT as a lens for understanding guidelines around ethical technology design. The current most well-developed framework from this comes from Peters (2023), who builds a domain-agnostic approach with support from previous SDT-based design heuristics for gamification in digital education (Van Roy and Zaman, 2017)), conversational agents (Yang and Aurisicchio, 2021), or motivational app design (Villalobos-Zúñiga and Cherubini, 2020). The heuristics proposed by Peters (2023) can be mapped onto game features to generate hypotheses about which features might cause need frustration and potentially harm players vs support need satisfaction and benefit players. For example, the heuristic of 'Use language and communication styles that support volitional action rather than coercion or control' identifies possible autonomy-related harms coming from intrusive and aggressive notifications (Fitz et al., 2019), or daily login rewards that players feel they cannot miss (Frommel and Mandryk, 2022). Such autonomy-frustrating design features might in turn be linked with greater rates of dysregulated play. In short, need support is an important consideration for designers trying to protect user wellbeing and maximize sustained engagement, and this thesis adds to our understanding of how need-frustrating situations arise.

11.3 Limitations and Next Steps

Limitations of each individual study are detailed in their respective discussion sections. Here, I revisit some of these that are substantial enough to affect the thesis as a whole, and point out how future work might begin to address them.

First and foremost, the BANG model has only undergone very basic empirical validation. I have attempted to justify each of the paths in the model with existing findings and/or theory, but not all have been robustly studied, and few have been studied in conjunction. Thus, the obvious next step will be to test the largely untested tenets of the BANG model—for example, need experiences in games updating outcome expectations (H9), the relationship between motivation and play quantity and play quality (H2), or the role of life fit in moderating the relationship between play quantity and problematic displacement (H5). Studies that combine measures of logged play quantity, player experience in the form of situational need satisfaction and frustration, motivation, and mental health experiences at both the situational and global levels will be especially valuable here.

To zoom in on one example, although motivation was an important theme running through this thesis, it formed a peripheral part of each study: participants in Study 1 were not directly prompted to talk about their motivations for play; participants in Study 2 reported on the perceived effects of their gaming, which I coded in an attempt to derive their motivation; BANGS scores from Study 3 were validated only against intrinsic motivation, and not other types of regulation; and motivational quality was not included among the measures in Study 4. As the BANG model directly implicates motivation in the selective exposure process, this will be a crucial component of future testing of the model.

Validation of the model as a larger entity creates challenges for the statistical analysis—the model is not a Directed Acyclic Graph (DAG); several paths are feedback loops that return to the same node. This places limitations on how the model can be used to dictate which variables should or not be included as covariates, based on whether they are a potential confound or collider (Rohrer, 2018). As a result, cross-sectional work can offer relatively low burden ways to falsify the model (or certain components thereof), but validation work is likely to require longitudinal evidence. For example, to test the feedback loop between need satisfaction and frustration, need-related outcome expectations, and selective gaming exposure, researchers will likely need at least three time points to establish both temporal precedence between each component and within-person effects.

The studies conducted in this thesis have limitations regarding the generalizability of findings. Across all studies, players were adults, and the vast majority hailed from Western countries (particularly the US/UK in Study 4). The thesis focuses primarily on console and PC gaming and may not capture the diversity of gaming experiences across various platforms, genres, and player demographics. As a result, the findings may not be fully applicable to the broader gaming community. While I do not expect substantial divergence in BANG's core hypotheses among, for example, players in the Global South or mobile game players—indeed, one of SDT's core claims is universality—at minimum I would expect a broader range of situational need-satisfying and need-frustrating experiences to emerge. In a further limitation on generalizability, the data collected during the Covid-19 pandemic in Study 2 may not accurately reflect normal gaming behaviors, given the unique circumstances of the pandemic. My findings also pertain primarily to moderately-to-highly engaged players; while this group is important in that their sustained engagement creates more opportunities for gaming to accumulate into meaningful impacts on their lives, this should be complemented with research into how more casual players experience games, and whether constructs such as life fit are relevant for them. Future research would benefit from exploring the full range of gaming populations, including younger players, players from non-Western countries, and players of other platforms—mobile games in particular are almost entirely omitted from the empirical result presented here.

The 12-week longitudinal study in Study 4 provides valuable insights, but is still relatively short in duration in comparison to (some) potential long-term effects of gaming, which may instead accrue over years (Buckley and Anderson, 2006). Longer-term studies could offer a more comprehensive perspective. Conversely, research could equally benefit from shorter, but more intensive longitudinal designs. As social media research moves forward into an era dominated by highly-impactful daily diary studies and experience sampling methods (Aalbers et al., 2021; Gilbert et al., 2021; Valkenburg et al., 2021b; Verbeij et al., 2022), I see enormous potential for games research to follow their lead. This data, with dozens or hundreds of data points per person, can be invaluable for unpacking the dynamic, often non-linear processes that occur within individuals, and how these processes differ between individuals.

Again, the digital trace data method here is brittle against potential UI or terms of service changes by providers. Thus, future work would benefit from more thoroughly interrogating the various trace data methods (Section 2.4.5) that may offer greater stability. First, access can be achieved with one or more forms of automated API access. Though relatively common in social media research, there are somewhat fewer publicly available API services for games research, and those that are available (e.g., the Steam API) are not currently widely used. Where APIs exist, however, researchers have the potential to access industry behavioral

data without needing to reach a special agreement with the company. One promising instantiation of this is https://gameplay.science, a website under development that provides a user-friendly way for players to authorize API access to their Steam and Discord accounts.

Another option is through GDPR requests (Zendle, Ballou, et al., 2023). Since the introduction of updated data protection regulations (DPA in the UK, GDPR in the EU, APPI in Japan, etc), many users have a legal right to obtain a copy of the data that companies hold about them. Upon requesting and receiving that data, they then have the freedom to share it with academic researchers (Araujo et al., 2022; Breuer et al., 2022). This option has the benefit of being flexible; researchers can collect relatively detailed data from a single game, or platform level data from companies such as Nintendo, Xbox, or Playstation. Data requests can be further streamlined in the form of a data download package—a user option to directly download a copy of their data. As above, this is relatively common in social media, with platforms like Facebook, Instagram, and TikTok all offering some kind of data download option. Providing this is intuitive; in many jurisdictions, the companies are already mandated to provide this information to users (for example, via GDPR), and would otherwise need to do so through a more laborious individual request. However, data download options are rare for games companies, and I want to encourage both game and platform developers to implement this feature more widely, and academics and players to push for this to happen.

In short, I believe the field should strive for standardized access to digital trace data with methods that improve upon the limitations of the web scraping technique used in this thesis. As such data becomes more widely used, this will contribute to more equitably produced and higher quality research on how players are affected by games.

11.4 Conclusion

In the BANG model, this thesis presents a new lens through which to understand the relationship between gaming and mental health, moving us beyond tired debates focused on raw quantity and towards a more nuanced and comprehensive understanding of how games affect people, both for better and for worse. This consists of contributions to our understanding of (1) need frustration in games; (2) compensation for need frustration using games; (3) valid measurement of need satisfaction and frustration in games; (4) integrative theoretical accounts of games and mental health; and (5) the *absence* of direct playtime–mental health links and *presence* of need outcome–mental health links.

Though just one small brick on the path to a more constructive future for psychological games research, this work is part of a larger tide of work that recognizes the importance of strong theory, digital trace data, careful measurement, and open research. With each generation of researchers emerging with more tools in their toolkit, and more awareness of what makes research trustworthy, I am confident that the upcoming decade of research on games can be the most productive yet.

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12

Appendix

A1 Supplementary Materials For All Thesis Studies

Table A1. Location of each study's supplementary materials as referred to throughout the thesis.

Study	Keyword	Supplementary Materials Link
Study 1	Need Frustration Interview	https://osf.io/mwpqc
Study 2	Compensatory Gaming	https://osf.io/vp7ye
Study 3	BANGS Questionnaire	https://osf.io/uq8mp
Study 4a	Xbox Playtime	https://osf.io/edtwn
Study 4b	BANG Model Validation	https://osf.io/jw6np/

A2 A2. Interview Study Script

Table A2. Interview questions and prompts used in Study S1 to elicit responses about various types of need-frustrating experiences, and the antecedents/outcomes of those experiences.

Theme	Questions
Background/ Warm up	**What's a game you've been playing recently? Can you describe it for me?**
Antecedents, processes, and outcomes of colloquial frustration	**Can you remember a recent situation when you felt frustrated by a game?** Please describe. What happened? How did that feel – in your body? What went through your head? What happened before that led to the frustration? **Do you remember a similar moment in this or another game when you didn't feel frustration?** Describe. Why was that different? **Have you experienced other similar frustrations during games?** **Have you experienced frustration that felt different?** **Can you think of a recent experience of frustration in games that you would describe as positive [or; that you felt was engaging]?** What did you think, feel, do afterward? **Can you think of a recent experience of frustration in games that you would describe as negative?** When did you stop or pause playing after that moment? Why?
Autonomy frustration	**Can you remember a time when gaming that you felt you were being 'forced' to do something?** Describe. What caused this? What did it feel like? What did you do when it happened? **Has there been a time when you felt a game restricted your sense of choice or freedom?** What about the game? What did you do when it happened? Have you had another experience of being restricted that you felt had the opposite impact [i.e., was engaging/disengaging]? **Can you think of a time when you played a game despite not really wanting to do so?** Why? When? **Can you remember a time that you really wanted to play a game, but couldn't?**
Competence Frustration	**Can you think of a time when gaming that you felt ineffective or incapable as a player?** Describe. What caused this? What did it feel like? What did you do when it happened? **Can you remember a time when you felt like a failure because of something that happened in a game?** Describe. What caused this? What did it feel like? What did you do when it happened? Did this change your approach to the game, and if so, how?
Relatedness Frustration	**Can you think of a time when playing a game that you feel socially excluded or disconnected?** Describe. What caused this? What did it feel like? What did you do when it happened? **Have you experienced a time when something outside of a game made feel excluded from a game's community or from the gaming community at large?** Describe. What happened? How did this affect your relationship with the game? Have you had the same experience during play itself? **Can you think of a time that you felt disconnected or "put off" by game's character or world?** What caused this? What did it feel like? What did you do when it happened? Is this important to you, and if so, why?

A3 Basic Needs in Games Scale - Full Item Pool Exploratory Factor Analysis

Table A3. EFA Results from Study M1a, used to select the subset of high-performing items from the larger candidate item pool. Bolded items are those retained in the final version of the measure. Comm = communality; Uniq = uniqueness; Comp = complexity.

Item	F1	F2	F3	F4	F5	F6	Comm	Uniq	Comp
rs05: I felt I formed relationships with other players and/or characters.	0.89	-0.01	-0.07	0.06	-0.02	0.04	0.77	0.23	1.02
rs09: I consider the relationships I formed in the game fulfilling.	0.89	-0.02	0.01	-0.05	0.04	-0.02	0.77	0.23	1.01
rs08: I consider the relationships I developed in the game meaningful.	0.87	-0.01	-0.06	0.01	-0.01	0.01	0.71	0.29	1.01
rs10: I consider the relationships I developed in the game valuable.	0.87	-0.05	-0.06	0.02	0.01	0.00	0.73	0.27	1.02
rs15: I felt satisfying relationships in engaging with this game.	0.82	-0.01	0.03	0.00	-0.05	-0.03	0.73	0.27	1.01
rs14: Engaging with the game, I felt I was bonding with others.	0.78	0.06	0.00	0.01	0.07	-0.03	0.61	0.39	1.03
rs13: Engaging with the game, I felt a connection to others, virtual or real.	0.75	-0.06	0.07	0.03	0.06	0.01	0.66	0.34	1.05
rs02: I felt a sense of connection with other players and/or characters.	0.75	-0.01	0.11	-0.04	-0.01	0.01	0.63	0.37	1.05
rs03: I felt that other players and/or characters in the game cared about me.	0.63	0.06	0.16	-0.09	-0.18	0.05	0.47	0.53	1.39
rs04: I cared about what happened to other players and/or characters.	0.60	0.01	-0.01	0.08	-0.04	-0.06	0.42	0.58	1.07
rs01: I could put myself in other characters' shoes.	0.56	-0.09	0.04	0.02	-0.04	0.04	0.36	0.64	1.09
rs12: I felt like part of a community.	0.50	0.12	0.26	0.10	0.11	-0.07	0.52	0.48	1.89
cf12: I felt like the game was too difficult for me.	-0.04	0.84	-0.04	0.02	-0.08	-0.05	0.66	0.34	1.03
cf01: I often felt that I lacked the skills necessary for the game.	0.04	0.81	0.05	-0.06	0.06	-0.04	0.66	0.34	1.04
cf08: I had doubts about being able to do things well in the game.	-0.07	0.69	0.10	-0.02	0.04	0.06	0.52	0.48	1.08
cf09: I felt disappointed with my performance in the game.	0.00	0.68	-0.13	0.02	0.08	0.06	0.63	0.37	1.12
cf05: I kept failing to accomplish what I wanted to while playing.	0.03	0.65	-0.03	-0.05	0.05	-0.04	0.46	0.54	1.04
cf14: I felt its too difficult to make progress in the game.	-0.13	0.61	-0.08	0.03	-0.03	0.17	0.54	0.46	1.30
cf03: I felt incompetent while playing the game.	0.03	0.57	-0.15	-0.07	0.09	0.06	0.55	0.45	1.26
cf07: I felt helpless when playing the game.	0.02	0.50	-0.25	-0.01	0.11	0.06	0.52	0.48	1.63
cf13: Playing this game, I often felt stuck.	-0.11	0.48	-0.06	-0.06	0.07	0.23	0.52	0.48	1.68
cf02: I felt that the game put me in impossible situations.	0.04	0.43	-0.05	0.02	0.13	0.12	0.33	0.67	1.41
cs13: I felt I was getting better at playing the game.	0.00	-0.12	0.78	0.04	0.01	0.01	0.73	0.27	1.05
cs14: I was improving at the game.	-0.05	-0.16	0.76	0.02	0.04	0.03	0.65	0.35	1.10
cs12: I felt my ability to play this game was growing.	0.05	0.01	0.74	0.09	0.03	-0.02	0.68	0.32	1.04
cs02: I felt that I made progress while playing.	0.04	-0.01	0.73	0.04	-0.07	-0.08	0.69	0.31	1.05
cs06: I felt a sense of achievement while playing.	0.11	0.09	0.72	0.05	-0.06	-0.06	0.67	0.33	1.12
cs03: I felt a sense of mastery while playing.	0.05	-0.06	0.65	0.09	0.00	0.07	0.55	0.45	1.09
cs01: I felt a sense of growth when playing the game.	0.25	-0.01	0.48	0.17	0.01	-0.03	0.59	0.41	1.79
cs11: I was able to fully use my abilities.	0.02	-0.12	0.45	0.15	-0.03	-0.08	0.46	0.54	1.46
cs04: I felt I could exercise my capabilities while playing.	0.15	0.09	0.43	0.21	0.02	-0.08	0.47	0.53	1.93
as06: I could make choices regarding how to play the game.	0.06	-0.07	-0.09	0.90	0.00	0.02	0.78	0.22	1.04
as08: I could choose different strategies or actions to use in the game.	-0.04	0.11	0.09	0.74	0.05	-0.01	0.57	0.43	1.09
as01: I could play [X] in the way I wanted.	0.00	-0.09	0.10	0.71	-0.01	-0.12	0.76	0.24	1.13
as05: I could direct my own play experience.	0.05	-0.04	0.10	0.71	-0.08	-0.03	0.71	0.29	1.08
as04: I had the agency to decide how I wanted to play.	0.00	-0.01	-0.01	0.64	-0.06	0.13	0.38	0.62	1.10
as07: I could develop or apply different strategies when I wanted.	-0.03	0.09	0.24	0.64	0.01	-0.04	0.63	0.37	1.34
as09: I was able to choose how I explored the game environment.	0.03	-0.03	0.10	0.49	-0.11	-0.08	0.43	0.57	1.24
rf07: Interactions with other players and/or characters felt toxic to me.	-0.01	0.03	-0.01	-0.01	0.78	0.05	0.68	0.32	1.01
rf08: Others in the game were unfriendly towards me.	0.02	0.07	0.02	-0.03	0.78	-0.09	0.60	0.40	1.05
rf09: I disliked some of the other players.	0.00	-0.05	0.06	-0.01	0.77	-0.01	0.56	0.44	1.02
rf05: The community or virtual world in the game made me feel unwelcome.	-0.10	0.03	-0.11	0.00	0.60	0.13	0.54	0.46	1.23
rf02: I found the community in and around the game off-putting.	0.10	0.02	0.02	-0.06	0.56	0.09	0.38	0.62	1.14
rf01: I felt distance between myself and other players in the game.	-0.09	0.12	-0.03	0.03	0.40	0.16	0.32	0.68	1.64
rf04: I felt alienated from others.	0.09	0.21	-0.07	-0.07	0.38	0.14	0.38	0.62	2.21
af10: I felt like I had to keep playing the game even though I did not want to.	-0.05	-0.03	-0.05	0.05	0.20	0.67	0.60	0.40	1.22
af02: At times, I found myself playing the game despite not really wanting to.	0.03	-0.03	-0.10	0.00	0.23	0.61	0.58	0.42	1.33
af16: Many actions in the game were boring.	-0.12	-0.01	-0.09	-0.14	-0.07	0.57	0.48	0.52	1.29
af04: I often found myself wishing I could do something else within the game.	0.10	0.19	-0.06	-0.13	-0.06	0.57	0.51	0.49	1.44
af05: A lot of my in-game activities felt like things I had to do.	0.04	0.13	0.17	0.02	-0.10	0.53	0.27	0.73	1.42
af01: I felt forced to take certain actions in the game.	-0.08	0.04	0.08	-0.29	0.06	0.48	0.44	0.56	1.81
af09: I felt pressured to progress through the game at a certain speed.	0.03	0.29	0.06	-0.02	-0.02	0.45	0.35	0.65	1.77
af15: It feels like the things I did in the game, I did out of external pressure.	0.12	0.22	-0.10	0.08	0.12	0.33	0.29	0.71	2.76

A4 Concurrent Relationships in the BANG Model

Table A4. Results from the Multilevel Structural Equation Models (ML-SEM) and Multilevel Models (MLM) for each hypothesized relationship, with no time lag.

			Within				Between		
			ML-SEM		MLM		ML-SEM		MLM
Model	Hypothesis	Path	B [95% CI]	β	B [95% CI]	Random Slope SD	B [95% CI]	β	B [95% CI]
1	H14	Global NS → Gen WB	.29 [.22, .37]	.28	.33 [.27, .39]	.32	.76 [.61, .91]	.76	.63 [.53, .72]
	H14	Global NF → Gen WB	−.16 [−.22, −.11]	−.18	−.15 [−.19, −.11]	.28	−.12 [−.25, .01]	−.14	−.20 [−.28, −.12]
	H14	Global NS → Dep	−.19 [−.27, −.11]	−.16	−.20 [−.28, −.13]	.43	−.39 [−.61, −.17]	−.32	−.41 [−.54, −.27]
	H14	Global NF → Dep	.24 [.17, .30]	.23	.22 [.17, .27]	.31	.54 [.35, .72]	.50	.48 [.36, .59]
2	H9	NS Games → Playtime	.27 [.14, .40]	.13	.12 [.06, .19]†	.27	.66 [.19, 1.12]	.20	.23 [.11, .35]†
	H9	NF Games → Playtime	−.02 [−.16, .12]	−.01	−.03 [−.10, .03]†	.32	.30 [−.06, .66]	.11	.10 [−.00, .21]†
	H4	Playtime → Displacement	.06 [.02, .09]	.09	.07 [.03, .10]	.02	.04 [−.02, .09]	.07	.04 [−.02, .09]
	H6	Displacement → NS Life	−.03 [−.06, −.00]	−.08	−.03 [−.05, −.00]	.09	−.14 [−.23, −.05]	−.22	−.20 [−.26, −.14]
	H6	Displacement → NF Life	.09 [.06, .12]	.19	.10 [.07, .13]	.11	.14 [.04, .23]	.20	.28 [.22, .35]