"The Small Decisions Are What Makes it Interesting": Autonomy, Control, and Restoration in Player Experience

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Games and play research at CHI employs psychological theory to investigate the ways that varied qualities of people, videogames, and play contexts contribute to nuances in player experience (PX). Play is often characterised as self-endorsed and freely chosen behaviour, and self-determination theory (SDT) proposes that this *autonomous* quality contributes to wellbeing restoration. However, prior research has produced only inconsistent support for this claim.

In this study, 148 participants experienced an autonomy-satisfying or -frustrating puzzle before playing *Spore* [60], a videogame likely to satisfy autonomy. Need-frustrated participants showed comparatively greater improvement in autonomy, vitality, and intrinsic motivation when playing *Spore*, and in-game autonomy satisfaction was shown to index post-play wellbeing outcomes. However, further results were mixed, and only competence frustration was found to predict ill-being outcomes. These findings are contextualised by post-study interviews that investigate the ways that autonomy, wellbeing, and motivation emerge in and through play in daily life.

CCS Concepts: • **Applied computing** → **Computer games**; • **Human-centered computing** → *Empirical studies in HCI*.

Additional Key Words and Phrases: video games; wellbeing; self-determination theory; need frustration; player experience; restoration

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1 INTRODUCTION

Among the myriad reasons that people play videogames is *to feel better* – as a means to recover from the strain of day-to-day life [77], or for refuge in times of crisis [41]. For many, videogames offer experiences without equivalent in everyday life [32]; virtual worlds in which players can satisfy their psychological needs for competence, relatedness, and autonomy [93]. The popularity of videogame play as a pastime raises questions around whether and how effectively the medium can provoke restorative processes, and indeed support human flourishing.

The present work approaches this topic by examining the potential benefits of videogame play after a controlling or pressuring experience. Self-determination theory (SDT) posits that the satisfaction of basic psychological needs – autonomy, competence, and relatedness – can improve wellbeing outcomes [87]. However, empirical investigation of autonomy-wellbeing relations in PX

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research [e.g., 11, 93, 104] has yielded inconsistent or inconclusive results. The circumstances in which autonomy-satisfying PX can result in improved wellbeing outcomes are not well-understood – yet an understanding of these factors is needed to confidently design autonomy-supportive games that promote flourishing.

This paper investigates the restorative potential of videogame play through an SDT lens, examining relationships between need satisfaction and positive psychological states – wellbeing outcomes and intrinsic motivation – as well as relations between need frustration and negative states, discussed in terms of "ill-being outcomes" [e.g., as in 112]. To this end, we designed two versions of a tangram game that respectively support or thwart autonomy needs; in our subsequent experiment, participants played either version before playing *Spore* [60], whose procedural qualities have been characterised by SDT scholars as particularly supportive of autonomy [93]. Interviews were conducted after the experiment to further develop our understanding of the ways that restorative play occurs in day-to-day life.

Results indicate that videogame play can support restorative experiences; in our case, participants whose autonomy needs were thwarted by the puzzle game experienced comparatively greater improvement in autonomy satisfaction, intrinsic motivation, and vitality when playing *Spore*, relative to autonomy-supported participants, and a greater decline in autonomy frustration. These findings are complicated, however, by analyses indicating that competence frustration bears a stronger influence on ill-being outcomes. Finally, interview findings suggest that the quality of players' motivation to initiate play, perceived threats to the desired play situation, and their relationship with the videogame may each influence the medium's restorative potentialities. The present work contributes to HCI games scholarship by demonstrating autonomy's contribution to the restorative processes that manifest in need-satisfying play; problematising relations between game design, player experience, and wellbeing; and identifying ways that single-player games in particular can support or thwart autonomy in daily life.

2 RELATED WORK

2.1 Self-Determination Theory

> Rather than defining happiness as simply having good feelings, the eudaimonist conception of well-being or flourishing rests on the proposition that what is most subjectively satisfying over the course of a life is activity that develops and expresses one's most reflectively valued and well integrated human potentialities [86, p. 58].

Self-determination theory (SDT) – a widely-used theory of human motivation, growth, and wellbeing – formed the theoretical basis for this study, offering a robust framework of empirically-testable propositions regarding autonomy and positive functioning. In SDT, autonomy pertains to activities perceived as "volitional, congruent, and integrated" [90, p. 10] within the self. Autonomy satisfaction is often operationalised in terms of feeling free, experiencing actions as self-endorsed, and a sense of choice in directing behaviour. Conversely, autonomy frustration relates to feeling controlled or pressured, experiencing actions as inconsistent with the authentic self, and a sense that external impositions direct behaviour. Alongside competence (feelings of effectance in action) and relatedness (a sense of warm, reciprocal connection with others), SDT posits that autonomy satisfaction is essential to human thriving, or flourishing [87] – a *eudaimonic* view of wellbeing (as defined in the quote above) that connects autonomy with flourishing through their mutual grounding in behaviour that is wholeheartedly and reflectively self-endorsed.

In SDT, wellbeing is largely conceptualised within the Basic Psychological Needs (mini-)Theory (BPNT), which posits that flourishing individuals exhibit reflective self-awareness towards their behaviour [20], and feelings of internal energy or vitality [91]. Vitality in particular is considered

to reflect feelings of positive energy or aliveness that result from autonomous behaviour [67]. In contrast, emotions are described as *symptomatic*, but not constitutive, of well- or ill-being [87]. Central to BPNT is that need satisfaction is essential for human flourishing, and conversely, that need frustration causes ill-being [87, p. 242]. Need satisfaction has been observed to predict wellbeing outcomes across social contexts such as work [109], education [66], and sport [5]. Importantly, need-satisfying experiences have been shown to exhibit "bottom-up" effects on wellbeing, in that experienced need satisfaction within individual *episodes* of activity can independently affect general wellbeing [i.e., considering life as a whole; 64], over and above the effects of general need satisfaction. Similar findings that the effects of individual events "cumulate to produce meaningful outcomes" [1, p. 129] have also been observed in other wellbeing research [37].

Although autonomy is rarely of primary concern in HCI games research, and is typically assessed as part of a battery of PX measures [e.g., 11, 13, 31, 104], some HCI games scholarship has investigated autonomy in detail. For example, Deterding [32] interviewed a variety of people who engage with videogames (e.g., game developers, critics, regular social players) to identify social-contextual factors that influence autonomy. Study findings indicated that autonomy is supported when play occurs in a conflict- and distraction-free environment, with choice over when, how, and what to play. In contrast, autonomy-thwarting play may be engaged in somewhat unwillingly (e.g., to meet review deadlines), or subject to interruption.

Other games research has examined choice as it relates to games, primarily in terms of dialogue options. Qualitative work [43], for example, has observed that players particularly appreciate choice as a means to influence in-game events. In contrast, Nay & Zagal [65] analysed the design of consequential choices in *The Walking Dead: Season Two* [100], *Life is Strange* [34], and *Mass Effect 2* [7] from a virtue ethics perspective, concluding that in-game consequences may unduly influence player decisions by gating particular game content. In this way, the rewards attached to ostensibly meaningful choices may instead be perceived as controlling feedback [88].

2.2 Need Frustration and Wellbeing Restoration in Play

SDT has seen widespread use in research on games and play, particularly in HCI, where its concepts have often been applied in studies that evaluate the player experience (PX) of novel artefacts [e.g., 56, 72, 102]. These studies resemble, to some extent, the earliest empirical SDT-PX research [93], which identified in-game need satisfaction as an effective predictor of intrinsic motivation and post-play wellbeing outcomes across three experimental studies. Importantly, whereas robust links were observed between competence and wellbeing [operationalised in the study as emotion, self-esteem, and vitality; 93], in-game autonomy satisfaction was less consistently predictive of these key outcomes.

In the substantial literature on restorative play that has since emerged [e.g., 26, 79, 85], competence has seen further investigation as an explanatory mechanism [51, 78, 104], while the restorative effects of autonomy and relatedness are yet to see dedicated study. Similarly, the extent to which videogame play can reduce feelings of need frustration – and consequently attenuate ill-being outcomes – largely remains to be seen. While need satisfaction and wellbeing remain highly relevant for games research, a recent CHI PLAY masterclass on SDT [101] highlighted the importance of studying need frustration for understanding experiences of disengagement, stress, and burnout [also see 112], which have implications for player enjoyment and retention [47, 96].

Survey research [2] has provided initial evidence for a negative relationship between game-related autonomy frustration and wellbeing in day-to-day life. More recently, experimental work [104] showed that changes in competence satisfaction and frustration could explain wellbeing restoration during play. While autonomy needs were less consistent predictors of well- and ill-being outcomes, the authors observed that "measures of autonomy satisfaction and frustration demonstrated low

reliability [and] results involving these measures should be interpreted with some caution" [104, p. 9]. The present study extends the nascent body of research at the intersection of SDT, PX, and wellbeing, investigating the extent to which improvements in autonomy satisfaction and frustration during videogame play can predict positive and negative psychological outcomes.

3 METHOD

3.1 Hypotheses and Research Question

This study used quantitative methods to test three hypotheses about the relationships between autonomy, motivation, and wellbeing in a specific context. First, prior work has shown that videogames can generally satisfy basic needs [e.g., 93], are intrinsically motivating [46, 93], and can essentially neutralise the effects of a negative [i.e., competence-thwarting; 104] event. As such, we propose that:

> Relative to participants in the supported condition, controlled participants will experience greater improvement in need satisfaction (H1a), and a greater decline in need frustration (H1b) when playing *Spore*.
>
> Relative to participants in the supported condition, controlled participants will experience greater improvement in wellbeing and intrinsic motivation (H2a), and a greater decline in ill-being (H2b) when playing *Spore*.

Basic Psychological Needs Theory proposes that need satisfaction and frustration respectively predict well- and ill-being outcomes [87]. Although cross-sectional games research has identified positive correlations between need frustration and negative psychosocial outcomes [e.g., obsessive passion; 106], and inverse relations with wellbeing [2], these results are yet to be verified in the experimental context. Therefore, we expect that:

> In-game experiences of need satisfaction will predict post-play wellbeing and intrinsic motivation (H3a), and in-game experiences of need frustration will predict post-play ill-being (H3b).

Broadening the scope of this work beyond the laboratory, we also conducted post-study interviews to consider the ways that people typically play in daily life. Research has shown that people deliberately *use* games as a means to feel better [16, 70] and relieve stress [45, 52]. Other research has shown that episodic improvements in need satisfaction can uniquely contribute to wellbeing at a general level [64], suggesting that individual play sessions influence psychosocial outcomes beyond their immediate context. From an SDT-based perspective, we are primarily interested in exploring the ways that self-endorsed behaviour, eudaimonic wellbeing, and PX more broadly intersect in everyday encounters with videogames. Accordingly, we ask:

> How do experiences of autonomy, motivation, and wellbeing relate during videogame play in day-to-day life (RQ1)?

3.2 Participants

A total of 151 participants[1] (120 men, 30 women, and 1 person of undisclosed gender, aged between 17 and 51) were recruited from a local tertiary institution between August and October 2018[2]. Of these, 11 participants also contributed to the post-study interviews. All participants were given the option to receive a random PC game code as compensation; students in a first-year game design course could alternatively elect to receive up to 5% course credit. In sum, 62 participants chose

[1] A power analysis was not conducted for this study, as no comparable work (i.e., pre-post studies of need frustration in games) had yet been published.

[2] This study was conducted in Australia, where 17-year olds can give informed consent to participate in research.

the PC game code, 44 received course credit, and 45 preferred to volunteer without compensation. Most participants were undergraduate students, recruited via in-class announcements or directly approached on campus; additionally, some members of the general public were recruited via word of mouth.

Three participants were removed from the final sample, due to an error with the online survey (n=1), an unreplicated bug in the tangram game (n=1), and admitting their prior participation in a similar study (n=1). The final sample therefore consisted of 148 participants, with 74 in each condition. Participants in the supported condition were aged from 17 to 45 (M = 23.22, SD = 5.60; 14 women, 60 men), and played videogames between 0 and 54 hours per week in the previous month (M = 16.31, SD = 12.73). Participants in the controlled condition were aged from 17 and 51 (M = 22.49, SD = 5.37; 16 women, 57 men, 1 undisclosed), and played videogames between 0 and 96 hours per week in the previous month (M = 18.53, SD = 17.01).

3.3 Measures

Intrinsic motivation was measured with the full 7-item interest/enjoyment subscale of the Intrinsic Motivation Inventory [IMI; 92]. The scale has been successfully used in prior research, including studies of videogame play [46, 114], and independently validated [61]. Items were rated on a 7-point scale between "Not at all true" and "Very true", and modified to refer to prior activity (e.g., "I enjoyed playing the Tangram game very much").

The 3-item Mastery, Autonomy, and Immersion subscales of the Player Experience Inventory [PXI; 110, 111] were used to assess competence and autonomy satisfaction[3], as well as immersion. The PXI was selected over more established measures because it is freely available, and has demonstrated high subscale reliability. Items were assessed on a 7-point scale between "Not at all true" and "Very true". Sample items include "I felt capable while playing the game" (competence), "I felt free to play the game in my own way" (autonomy), and "I was immersed in the game" (immersion)[4]. Scale reliability values were computed as categorical omega [a measure of composite reliability best suited for ordinal data; 50] using the MBESS package [49]. Reliability was consistently high across scales and measurement occasions (all $\omega \geq 0.756$; Table 1).

Competence and autonomy frustration were measured with 5-item subscales adapted from existing instruments [5, 24, 53, 57, 83], as suitable play-specific measures of need frustration were not available. Items were introduced with the following text: "Please read each of the following statements carefully, thinking about how true it was for you while playing [the Tangram game / *Spore*]". Items were rated on a 7-point scale between "Not at all true" and "Very true". Sample items include "I felt disappointed with my performance in the game" (competence frustration) and "My actions in the game felt like obligations" (autonomy frustration). These scales are listed in full in the supplementary materials.

Vitality was measured with a 5-item version of the Subjective Vitality Scale [VS; 91]. A negatively-worded item was removed on the basis of an independent validation study [15]. Another item ("I am looking forward to each new day") was also excluded, following issues identified in prior PX research [104]. A more recent validation study [48] has also recommended excluding this item. Items were rated on a 7-point scale between "Not at all true" and "Very true". An example item from the scale is "At this moment, I feel alive and vital". The scale has been successfully used alongside measures of emotion to assess positive functioning in PX research [93, 104].

[3]Relatedness was not assessed in this study, owing to the absence of an applicable instrument for single-player videogames at the time [but see 3], and the difficulty of constructing *ad-hoc* items relevant to both the tangram game and *Spore*.
[4]Immersion was used only to test a separate hypothesis, the results of which are not reported here.

A selection of 4-item subscales from the 32-item Brunel Mood Scale [BRUMS-32; 54] – happiness, calmness, depression, anger, and tension – were used to measure emotion. Although these subscales are not commonly used in PX research, they are relatively brief and reliable measures whose granularity extends beyond generalised positive and negative affect. The scale was introduced with the text: "How did you feel while playing [the Tangram game / *Spore*]?", with items rated on a 5-point scale between "Not at all" and "Extremely". Sample subscale items include "Happy", "Calm", "Depressed", "Angry", and "Anxious", respectively.

3.4 Stimulus Games

This section first describes the tangram game, which served as the experimental manipulation, then *Spore*, the chosen autonomy-supportive videogame.

3.4.1 Tangram Game. Inspired by a previous study of autonomy frustration [75], the experimental manipulation took the form of a digital tangram game (with minor variations between conditions), in which players could manipulate seven standard shapes into representations of ordinary objects. The game was designed by the first author, and developed in the Unity Game Engine [107, version 2017.3] between December 2017 and July 2018. Three iterations of the game were designed and playtested during this time to ensure between-condition differences in autonomy satisfaction and frustration would reliably emerge.

Both versions of the game began with a short tutorial, followed by a series of puzzles displayed in a pre-determined sequence. After completing the tutorial, participants in the controlled condition were directed to "follow the hints provided to complete the puzzles" (Figure 1). The hint system took the form of a large animated arrow, which pointed at a blinking region inside the tangram set to correspond with the size and colour of an unused shape. Unauthorised moves were rejected: in such an event, the game simply returned the offending shape to its original position outside the tangram. The tangram game played in the supported condition did not feature the hint system, but they were otherwise identical.

	Pre-play						Post-play					
			Supported		Controlled				Supported		Controlled	
Measure	ω	95% CI	*M*	*SD*	*M*	*SD*	ω	95% CI	*M*	*SD*	*M*	*SD*
CS	0.756	0.657, 0.828	4.820	1.252	5.144	1.262	0.843	0.790, 0.880	4.752	1.358	4.869	1.141
AS	0.929	0.900, 0.950	3.932	1.620	2.284	1.145	0.905	0.852, 0.937	5.869	1.318	5.869	1.085
CF	0.864	0.807, 0.901	2.530	1.294	1.416	0.627	0.846	0.781, 0.889	2.024	1.172	1.832	0.926
AF	0.901	0.860, 0.924	2.543	1.273	4.546	1.417	0.852	0.782, 0.897	2.232	1.239	2.119	0.935
Happiness	0.761	0.679, 0.822	3.314	0.867	3.287	0.641	0.800	0.726, 0.855	3.378	0.904	3.652	0.697
Calmness	0.817	0.755, 0.861	3.449	0.912	3.730	0.765	0.833	0.764, 0.878	3.345	0.875	3.338	0.887
Anger	0.818	0.720, 0.898	1.453	0.489	1.260	0.513	0.773	0.601, 0.891	1.351	0.490	1.304	0.586
Depression	0.775	0.606, 0.896	1.169	0.290	1.169	0.452	0.816	0.613, 0.934	1.189	0.434	1.084	0.204
Tension	0.854	0.785, 0.898	1.676	0.748	1.331	0.611	0.858	0.795, 0.897	1.598	0.752	1.530	0.713
IM	0.931	0.905, 0.947	5.542	0.954	4.342	1.166	0.927	0.890, 0.947	5.600	1.110	5.826	0.983
Vitality	0.916	0.888, 0.934	3.924	1.298	3.538	1.194	0.916	0.878, 0.939	4.016	1.410	4.305	1.198
Immersion	0.796	0.726, 0.848	5.545	1.125	4.734	1.359	0.847	0.779, 0.886	5.820	1.030	5.856	1.050

Table 1. Scale characteristics when measured before and after playing *Spore*. Composite reliability estimates and 95% confidence intervals are represented by categorical omega (ω) bootstrapped with 5000 replications. C/AS: competence/autonomy satisfaction; C/AF: competence/autonomy frustration; IM: intrinsic motivation.

Fig. 1. Left: the controlling version of the tangram game (cropped), where participants were forced to follow step-by-step instructions. Right: The primordial soup of *Spore*'s cell stage, where food and predators are always pressing concerns.

As SDT indicates that "control ... can be done to people by contextual events and is therefore more easily evidenced [than autonomy support]" [28, p. 1027], the design process largely focused on the controlling version of the game. The manipulation operates via the presence or absence of pressuring directives (e.g., those in the controlled condition "must" follow the hints), pre-determined puzzle solutions, and elements that limit choice over in-game behaviour, each of which have seen successful use in prior research [e.g., 75, 76].

3.4.2 Spore. *Spore* was selected as the target autonomy-supportive game following a lengthy selection process [see 105]. First, conceptual definitions of autonomy from the SDT literature were collated [e.g., 28, 29], alongside literature describing autonomous experience during play [80, 81, 93]. Unfortunately, this summary proved largely unhelpful for creating a shortlist of suitable videogames – for example, an endless number of videogames "provide considerable flexibility over movement and strategies, choice over tasks and goals", and design rewards "to provide feedback rather than to control the player's behaviour" [93, p. 349]. The game selection process remained inconclusive after specifying other relevant criteria (e.g., frequent checkpoints, simple controls) aimed at limiting confounds and maximising sample size. The final game selection was made on the basis that SDT scholars' original conceptualisation of autonomy in PX [i.e., 93] appeared to refer largely to *Spore*, which was demonstrated [122] in 2005 by its lead designer, Will Wright — who was subsequently described by SDT scholars as "a leading game developer" whose design approach "reflected ... a 'procedural' structure ... [that responds] dynamically to an individual's choices without constraining or anticipating them" [93, p. 349]. This praise made *Spore* a particularly salient choice as the autonomy-supportive game.

Spore is a simulation game whereby players guide an organism's evolutionary process – from the beginning of its life as an amoeba, through to its (land-dwelling) descendents' colonisation of outer space. The game's core feature is an adaptive character creation system, which uses procedural generation techniques to support a range of cosmetic and functional customisation options. In this mode, players use a drag-and-drop interface to change their evolving avatar (and in later stages, their society's architecture and spaceship design), and immediately see the effects. Game controls are relatively straightforward – much of *Spore* can be easily navigated with just a mouse – and avatar death results in only minor penalties. *Spore*'s design privileges player creativity, and de-emphasises skills more traditionally associated with videogame play.

3.5 Procedure

Participants were welcomed and thanked for their attendance upon arrival, then introduced to the tangram game that served as the experimental manipulation. All participants were informed that the game contained all necessary information to play, and their performance was unimportant. Participants in the supported condition heard an additional phrase emphasising autonomy ("feel free to play in whatever way makes sense to you") during this scripted introduction.

Afterwards, participants played the tangram game variant specific to their condition, which was expected to produce between-condition differences in autonomy satisfaction and frustration. After 10 minutes in the tangram game, participants completed the first survey, which contained demographic questions and PX measures. Upon completion, participants played *Spore* for 30 minutes, then completed the post-play PX survey. We decided on a 30-minute play session primarily to avoid potential confounds associated with shorter periods [95], while trying to limit participant fatigue. The first author remained in the room, behind a partition, for the study's full duration.

After completing the post-play survey, participants were debriefed, allowed to select their preferred form of compensation, and given the option to participate in the post-experiment interview, where possible (i.e., when the first author was free of successive commitments). Semi-structured interview questions[5] focused on in-game experiences of autonomy satisfaction and frustration (e.g., feeling forced to perform in-game actions), and relations between play and wellbeing (e.g., whether play was a reflectively valued activity). These questions aimed to investigate the ways that autonomy manifests in PX, and how videogames affect human flourishing in daily life. Overall, participants took between 60 to 90 minutes to complete the study, depending on interview involvement.

3.6 Preliminary Analyses

Correlations between variables of interest were calculated; these correlation tables are listed in full in the supplementary materials. Normality assumptions were assessed using Shapiro-Wilk tests, and satisfied for pre- and post-play vitality. Levene's test was also conducted on sample medians to assess homoscedasticity, which was satisfied for all measures except pre-play autonomy satisfaction, competence frustration, happiness, and tension. As attempts to satisfy the assumptions of common parametric tests largely failed, all between-condition analyses were conducted using tests that are robust to departures from normality and homoscedasticity [21, 120]. The WRS2 package [58] in R [74, v3.5.1] was used to conduct t-tests, 2×2 (between-within) ANOVAs on 20% trimmed means, and post-hoc tests, with effect size ξ, for which $\xi = 0.1$, 0.3, and 0.5 may be respectively considered small, moderate, and large effects [59].

Interview data were examined via theoretical thematic analysis based in SDT, focusing on game-related experiences of autonomy, wellbeing, and motivation in daily life. Braun & Clarke describe theoretical thematic analysis as "tend[ing] to be driven by the researcher's theoretical or analytic interest in the area, and ... thus more explicitly analyst-driven" [19, p. 84], as opposed to an inductive approach "of coding the data *without* trying to fit it into a pre-existing coding frame" [19, p. 83; emphasis in original]. In this way, the theoretical thematic analysis suited our particular interest in understanding day-to-day play experiences in terms of existing SDT concepts. The first author wrote the interview script, conducted all interviews, transcribed and coded the data, developed the themes, and wrote up the final analysis. The second author contributed to theme development and the write-up. The first and second authors developed four themes from a total of 55 codes. Disagreements between the first and second authors during theme generation were minor; all were resolved in agreement. One theme, concerning participants' personal definitions of wellbeing

[5]The full list of interview questions can be found in the supplementary materials.

(independent of play), was discarded due to limited relevance to the research question. Three final themes remained – Autonomy Support in the Player-Game Relation, Threats to the Desired Play Situation, and Play as Maintenance.

4 RESULTS

First, we verified the effect of our experimental manipulation (Table 2). As expected, participants in the controlled condition experienced comparatively lower autonomy satisfaction and higher autonomy frustration after playing the tangram game, relative to supported participants. We also found that controlled participants experienced greater competence frustration than supported participants (Table 2). These differences likely resulted from the absence of challenge inherent to following directions in their version of the tangram game. This unintended finding was consequently explored further in the following sections where appropriate.

4.1 H1: Relative Change in Need Satisfaction and Frustration

We predicted that participants in the controlled condition would experience a greater improvement in autonomy satisfaction (H1a) and a greater decline in autonomy frustration (H1b) during play, relative to supported participants. Two between-within ANOVAs were conducted to test this claim: significant interaction terms were observed for both autonomy satisfaction and frustration (Table 3). Follow-up tests for each condition suggest significant improvements in autonomy satisfaction for participants in both conditions; however, as predicted, this increase was greater for controlled participants. In contrast, significant reductions in autonomy frustration were only observed for controlled participants. H1 was therefore supported.

Measure	t	df	p	ξ	95% CI
Autonomy Satisfaction (AS)	6.642	81.70	< 0.001	0.697	0.553, 0.824
Autonomy Frustration (AF)	9.007	88.63	< 0.001	0.815	0.689, 0.911
Competence Satisfaction (CS)	1.598	88.66	0.114	0.202	0.000, 0.447
Competence Frustration (CF)	6.037	55.59	< 0.001	0.663	0.469, 0.773

Table 2. Two sided t-tests (20% trimmed means) on pre-play need satisfaction and frustration measures. Note: ξ is bounded at zero, as its equation is enclosed by a square root.

	Interactions			Post-Hoc Tests			
Measure	Effect	Q	p	Condition	W	p	ξ
AS	Group × Time	25.582	< 0.001	Supported	9.721	< 0.001	0.748
				Controlled	17.988	< 0.001	0.866
AF	Group × Time	62.554	< 0.001	Supported	-1.927	0.060	0.211
				Controlled	-13.124	< 0.001	0.901
CF	Group × Time	24.622	< 0.001	Supported	-3.432	0.001	0.329
				Controlled	4.064	< 0.001	0.453

Table 3. 2-way between-within ANOVAs on manipulated need satisfaction and frustration variables. See [119] for further information on test statistics Q and W. Significant interactions were followed by pairwise comparisons (post- minus pre-play) on 20% trimmed means. AS: autonomy satisfaction; C/AF: competence/autonomy frustration.

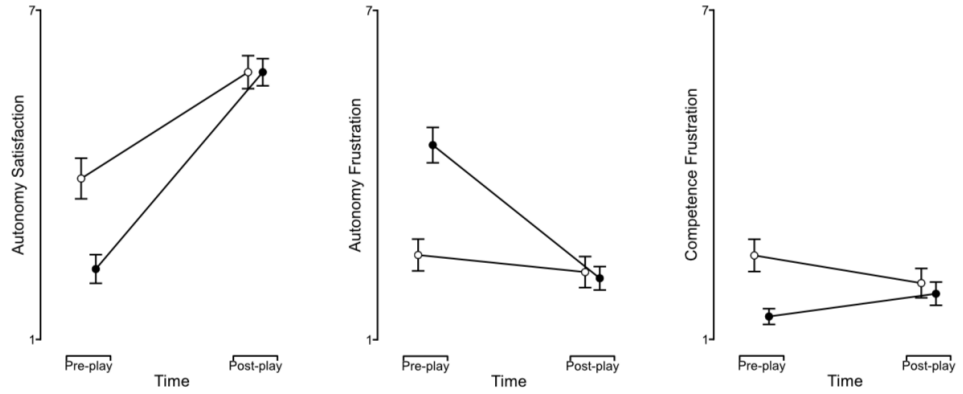

Fig. 2. Pre- to post-play autonomy satisfaction, autonomy frustration, and competence frustration for participants in the supported (○) and controlled (●) conditions. Error bars represent 95% confidence intervals.

An exploratory 2-way ANOVA on competence frustration was also conducted (Figure 2), owing to its unintended manipulation. Results (Table 3) indicated that when playing *Spore*, competence frustration declined for supported participants, but increased for controlled participants instead.

4.2 H2: Relative Change in Wellbeing, Intrinsic Motivation, and Ill-being

We predicted that controlled participants would experience a greater increase in wellbeing and intrinsic motivation (H2a), and a greater reduction in ill-being (H2b) when playing *Spore*, relative to supported participants. Between-within ANOVAs were conducted on each measure, and significant interactions were observed for vitality, intrinsic motivation, anger, and tension (Table 4). On inspection of the interaction plots (Figure 3), H2a was only partially supported: controlled participants experienced comparatively greater vitality and intrinsic motivation when playing *Spore*, and follow-up analyses (Table 4) indicated that these improvements were significant. In contrast, participants in the supported condition did not experience significant improvement in either outcome ($p \geq 0.216$). Significant interactions were not observed for happiness or calmness, and therefore H2a was only partially supported.

	Interactions			Post-Hoc Tests			
Measure	Effect	Q	p	Condition	W	p	ξ
Vitality	Group × Time	7.278	0.008	Supported	0.987	0.329	0.085
				Controlled	4.991	< 0.001	0.414
IM	Group × Time	39.637	< 0.001	Supported	1.255	0.216	0.127
				Controlled	9.198	< 0.001	0.744
Anger	Group × Time	6.762	0.011	Supported	-2.167	0.036	0.209
				Controlled	1.439	0.157	0.142
Tension	Group × Time	6.053	0.016	Supported	-1.231	0.225	0.100
				Controlled	2.409	0.020	0.245

Table 4. 2-way between-within ANOVAs on wellbeing, intrinsic motivation, and ill-being measures where significant interactions were observed. See [119] for further information on test statistics Q and W. Pairwise comparisons (post- minus pre-play) were conducted on 20% trimmed means. IM: intrinsic motivation.

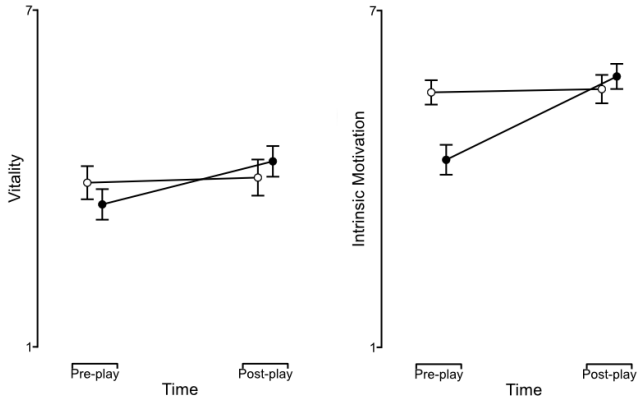

Fig. 3. Pre- to post-play vitality and intrinsic motivation for participants in the supported (○) and controlled (●) conditions. Error bars represent 95% confidence intervals.

However, inspection of plots of ill-being outcomes (H2b) suggested a less consistent pattern of results (Figure 4): participants in the supported condition appeared to experience declining anger when playing *Spore*, and controlled participants seemingly experienced increased tension during play. Pairwise comparisons (Table 4) showed that only the controlled participants' increase in tension was significant when correcting for multiple comparisons (significant $\alpha < 0.025$). Support for H2b was not observed in light of these adverse results.

4.3 H3: Predictive Value of Need Satisfaction and Frustration

We expected that in-game experiences of need satisfaction would predict post-play wellbeing and intrinsic motivation (H3a), and that experiences of need frustration during play would predict ill-being outcomes (H3b). These hypotheses were examined through a series of multiple regression analyses, all of which were conducted in JASP [44, v0.9]. Full regression tables are reported in the supplementary materials. Assumptions of linearity, normally distributed and independent errors,

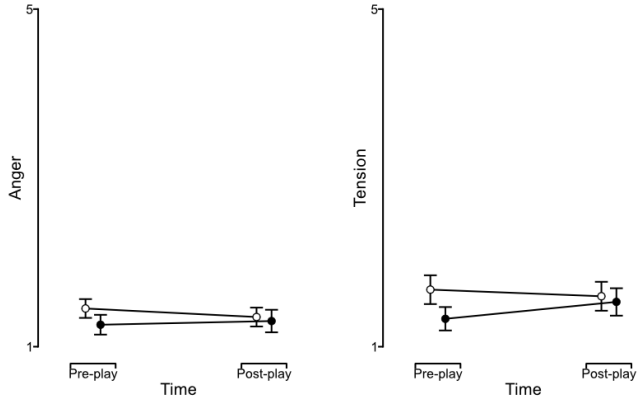

Fig. 4. Pre- to post-play anger and tension for participants in the supported (○) and controlled (●) conditions. Error bars represent 95% confidence intervals.

Dependent measure	Predictors	sr^2	p
Happiness	Happiness (pre-play)	0.058	< 0.001
R^2(adj.) = 0.390	Competence	0.085	< 0.001
$F(3, 144) = 32.33$	Autonomy	0.030	0.008
Calmness	Calmness (pre-play)	0.147	< 0.001
R^2(adj.) = 0.271	Competence	0.050	0.002
$F(3, 144) = 19.17$	Autonomy	0.003	0.455
Vitality	Vitality (pre-play)	0.147	< 0.001
R^2(adj.) = 0.429	Competence	0.048	< 0.001
$F(3, 144) = 37.77$	Autonomy	0.032	0.005
Intrinsic motivation	Intrinsic motivation (pre-play)	0.012	0.097
R^2(adj.) = 0.390	Competence	0.053	< 0.001
$F(3, 144) = 32.33$	Autonomy	0.096	< 0.001

Table 5. Multiple regression models of wellbeing measures and intrinsic motivation, as predicted by need satisfaction (H3a), and controlling for their pre-play values.

multicollinearity, and homoscedasticity were satisfied in tests of H3a; however, homoscedasticity was not satisfied in tests of H3b. These issues were mitigated in tests using log-transformed dependent variables, which did not substantially change our interpretation of the results[6]. Results from untransformed models are reported here for clarity [as recommended in 36].

4.3.1 H3a: Competence and Autonomy Satisfaction as Predictors. Both competence and autonomy satisfaction were observed to predict happiness, vitality, and intrinsic motivation (Table 5), and the total variance explained in each of these models is relatively large (R^2(adj.) $\geq$ 0.390). However, only competence emerged as a relevant predictor of calmness, and less variance is explained by the model (R^2(adj.) = 0.271). These results represent partial support for H3a.

4.3.2 H3b: Competence and Autonomy Frustration as Predictors. In contrast with models of positive outcome measures, only competence frustration emerged as a significant predictor of post-play anger, depressed emotion, and tension (Table 6). Explained variance in each model (0.223 $\leq$ R^2(adj.)

[6]More specifically, the (non-)significance of need frustration variables did not change, and differences in R^2(adj.) and sr^2 were small.

Dependent measure	Predictors	sr^2	p
Anger	Anger (pre-play)	0.054	0.001
R^2(adj.) = 0.245	Competence	0.105	< 0.001
$F(3, 144) = 16.89$	Autonomy	0.009	0.191
Depressed emotion	Depressed emotion (pre-play)	0.010	0.174
R^2(adj.) = 0.223	Competence	0.141	< 0.001
$F(3, 144) = 15.03$	Autonomy	0.014	0.106
Tension	Tension (pre-play)	0.126	< 0.001
R^2(adj.) = 0.262	Competence	0.060	< 0.001
$F(3, 144) = 18.42$	Autonomy	< 0.001	0.970

Table 6. Multiple regression models of ill-being measures, as predicted by need frustration (H3b), and controlling for their pre-play values.

≤ 0.262) was closer to typical values in PX research [9]. Autonomy frustration was not seen to reach significance as a predictor for any ill-being outcomes. We therefore observe only partial support for H3b.

4.4 RQ1: Autonomy, Motivation, and Wellbeing in Regular Play Experiences

Interview questions focused on experiences of videogame play in day-to-day life, and participants' relationship with videogames in general. In particular, these interviews aimed to investigate past experiences of play as a means to develop more robust links between eudaimonic wellbeing, self-endorsed behaviour, and player experience. Here, we elaborate the three final themes, which concerned autonomy supportive videogames, pressuring play experiences, and experiences of motivation and wellbeing with respect to play in daily life (RQ1).

4.4.1 Theme 1: Autonomy support in the player-game relation. This theme considers the ways that participants identify opportunities for autonomous behaviour in videogame play. Central to this theme is an understanding of videogames, alongside their human player(s), as active contributors in the production of play. Participant responses therefore reflect the facilitating and controlling potentials of the player-videogame dialogue.

Most frequently, participants (P2, P4, P9) discussed autonomy in the context of making choices with clear effects on the game state; decisions "that really affect the story later on, like especially *Mass Effect* [6] is a big one for that, like things you do in the first game will affect what happens in the third one and stuff" (P9). For these participants, choice is primarily a means to influence their own experience with a game (or series), with less consideration towards how their decisions affect the virtual world. Virtual worlds and characters are regarded as objects to be acted on: in the *Mass Effect* series, for example, the player is faced with recurring opportunities to commit genocide on alien and machinic species (or not). P2 similarly valued the presentation of life-or-death choices in *Until Dawn* [99] for their narrative influence:

> P2: I like games like *Until Dawn*, where every choice you make changes the final ending of the game. Even like, in the start with the two sisters, whether you ... take the stranger's hand, or you just ... die with your sister or whatever [laughs].

In *Until Dawn*, the outcomes of this decision are almost identical: by intention or chance, the player-character and her sister fall to their gruesome deaths, and the game continues thereafter. In this way, P2 also illustrates a second position common to participant responses (P2, P5, P10), whereby opportunities for choice are seemingly valued for their own sake, regardless of their in-game outcomes. For P5, this involved a rejection of worldly influence in favour of the (ostensibly) trivial:

> P5: Dialogue trees ... might change the story of the game and stuff like that, but for me, the small decisions are what makes it interesting. Like in *Deus Ex* [42], you can choose ... a pistol or like a tranquiliser rifle. [But] an enemy that's dead or stunned in the game is in the exact same state. ... It's those small decisions.

Although it is possible (albeit cynical) that these participants are merely repeating the language of triple-A videogame advertising, which privileges (among other things) freedom and choice [69], it seems more likely that choice serves a functional purpose in player experience design. Indeed, the presence of choice in design may represent an attempt to convey the videogame's "willingness" to cooperate in the active reciprocity of play [103]. From this perspective, opportunities for choice support autonomy by reframing play as a *negotiation* with the videogame, rather than a product of computational control.

Finally, some participants (P1, P3) discussed play with an awareness of its conceptual and social intersections with material reality. For P1, this emerged through self-reflection:

> P1: I find a lot of the time when it comes to choice in a linear game, it's more about the choice itself than the impact it's going to have [in the game] – like if it's done well, the choice isn't like, "what's the impact going to be down the line", it's like "what does this mean for me right now, why am I making that decision".

Here, P1 deliberately rejects in-game outcomes as inherently valuable, and instead emphasises the potential meaning to be derived from awareness and interrogation of the self in conversation with the (virtual) environment. Conversely, P1 considers choices least interesting "when they're extremely obvious, like 'are you going to support the freedom fighters or the nazis', I'm obviously not supporting the nazis". The videogame choice supports autonomy only to the extent that it (re)produces a scene of conflict in the self, and provides the means to resolve it. In contrast, P3 describes an approach to play that centres awareness of the social context:

> P3: [An in-game decision becomes interesting] when it specifically affects other real players directly. ... The decisions that you make there extend beyond the confines of the game world. ... So with boardgames specifically, ... those interactions and consequences directly affect people that you know, and potentially care about, as opposed to online people which you have no ties to, no responsibilities for.

P3 considers any game played with friends as primarily cooperative, using an awareness of the play situation to maximise mutual benefit rather than individual advantage. Autonomy support emerges as the willingness to work with other (known) players towards a positive experience.

4.4.2 Theme 2: Threats to the desired play situation. Autonomy frustration occurs in response to internal pressures or external influences alike [87] – in this study, internal pressure appeared to reflect qualities of the player-game relation, whereas externally-pressuring events implicated individual social actors.

A number of participants (P1, P4, P6, P8, P11) described internally pressuring play experiences when confronted with risk in ambiguous circumstances. For example, P8 described feeling overcome by the sheer range of activities available in *Stardew Valley* [4], saying "it *[Stardew Valley]* doesn't give you enough, sort of, push towards certain directions, so you're left standing there being like 'ah, I don't know if what I'm doing is correct'. You're not doing the secret sequence". For P8, the personal stakes of playing "incorrectly" – or rather, being unable to see the correct approach to the game – produced feelings of concern: "Every day you waste is like going into like a death spiral within the game, right? ... You tank your save, because you're just losing more days, and then you're wasting more money, and then you just can't stay alive" (P8). While Stardew Valley does not contain a fail state, the risk of poverty and death became salient for P8 in response to the game's ambiguous direction.

Moral dilemmas in which the stakes themselves are obfuscated can become overwhelming, as P1 observed:

> P1: I stopped halfway through *The Witcher 2[: Assassins of Kings]* [23], because I can't make the decision between the human guys, and the rebellious elves. ... The complexity of the two factions ..., where there's extreme moral ambiguity, ... you haven't been given all the information up until that point, it's too hard to make a decision.

The threat produced in this scenario is personal: for P1, who becomes "invested in the.. story, and characters, and wanting to see where it goes" (P1), taking the wrong side may represent a moral failure. Internal pressure emerges with self-doubt – and like P8, P1 would rather quit, without resolving the situation, than play "incorrectly".

External pressures toward videogame play were also prevalent (P2, P3, P5, P6, P10), largely implicating friends (P3, P5, P6) or family members (P2, P6). Socially pressuring play experiences seemed relatively mild, characterised by feelings of boredom (P2, P5), annoyance (P2), and futility (P3, P10). Despite the unpleasant quality of these experiences, participants often continued to play, motivated by a sense of social obligation. For example, P5 recalled playing *Delta Force: Land Warrior* [68] on a friend's suggestion, even though "the game itself wasn't interesting. But a friend recommended it to me, and so I thought 'ok, I'll play it through to the end, just to see what it's about"' (P5).

However, more substantial issues may arise when the controlling figure holds a position of authority. P6, for example, described how being prevented from playing videogames at home contributed to feelings of incompetence and ostracism among peers:

> P6: [As a child] my mum was pretty strict on if I spent time on PC. Before junior school, I only had fifteen minutes on PC every week. ... So the time I'm playing *Dota [2]* [108], everybody in my class can wreck me, ... they can't play solo [queue] with me, I always lose.

In P6's case, experiencing autonomy frustration at home coincided with frustration of all three needs in play – being rejected by friends (relatedness) due to lack of skill (competence) prevented P6 from the desired play experience (autonomy). However, the extent to which each form of need frustration influences the others is less clear.

4.4.3 Theme 3: Play as maintenance. The third theme relates to perceptions of wellbeing as it relates to videogame play in day-to-day life, the potential for game overuse, and the motivational qualities associated with the decision to initiate play. Some participants described wellbeing largely in terms of maintaining a basic level of functioning. Here, wellbeing was considered a largely personal responsibility; an internal practice to mitigate the effects of work (and other obligations) on organismic functioning. Participants (P1, P2, P5, P7, P8, P11) discussed using videogames for this purpose:

> P8: I think you can manufacture them [positive experiences], and yeah, I think that's games. ... So for example, today, when I was in the dentist, I got so sick ... and it was the most awkward experience of my life. But then I'm here, and even playing *Spore*, and even in a study for thirty minutes, it makes me feel better, right? So it's manufactured good experiences.

Videogames are seen as utilities for "maintenance" (P1), and play is "a good way to take a break from everything else that's going on" (P2). For these participants, videogame play contributes to the perpetuation of life *as it is*, without necessarily supporting further improvement. Some participants also discussed past or present challenges around moderating the amount of time spent playing videogames (P1, P6, P8, P9). One participant (P7) distanced themselves from game overuse by posing it as a hypothetical situation:

> P7: I feel like if you're sitting down and playing videogames, and you know you shouldn't be doing it, you should be doing study, [it's] detrimental to your happiness and wellbeing, because ... you can't really sit down and fully enjoy the videogame, because your mind's like, torn.

For P1, past engagement in game overuse was contextualised as compensatory behaviour that created further obstacles in daily life:

> P1: When I was a teenager, I would play videogames instead of doing anything else. And they would be things like RPGs, that give you choices, and ... like I played *Dragon*

> *Age II* [8] ... obsessively, instead of doing schoolwork and stuff, and I failed classes, it was really fun.

The relatively clear account provided by P1 above contrasts with P8's ambiguous account of online game play, which was (somewhat paradoxically) characterised by both sustained engagement and feeling distanced from game content:

> P8: Playing *World of Warcraft* [12] ... that gameplay is like licking an ashtray ... especially when you play it, and then you think about it later on, and you're just like 'I accomplished nothing', you know? Like ... the things that it was putting forward, I didn't value, but ... I thought that I could have valued them.

Each participant (P1, P7, P8) described these experiences as negative through a lens of abstraction (P7), sarcasm (P1), or hindsight (P1, P8). In contrast, P9 was more conflicted towards their recent play behaviour, seemingly unable to reconcile their preference for boundless game content (to relieve boredom) with post-play feelings of meaninglessness:

> P9: It's like I didn't really get much done in the game, but I still felt it [completing sidequests] was necessary though. ... I don't know. Now that I say it, I'm really on both sides. ... At the time, I feel like I'm really spending my time well, but then after, I'm like 'I don't know, that was kind of a waste'.

P9's inner conflict towards their play behaviour provides the context for P7's abstracted definition of compartmentalisation ("you can't really sit down and fully enjoy the videogame, because your mind's like, torn"). When considering these inner conflicts, participants describe their play behaviours as "obsessive" (P1), "like licking an ashtray" (P8), or "necessary" (P9), suggesting a form of controlled motivation. Playing videogames for escapism appears to involve (and may indeed require) some degree of compartmentalisation. Selecting game content with poorly-conveyed (P8) or absent (P9) narrative qualities may prevent the intrusion of aspects of the self that would prompt conflict.

5 DISCUSSION

5.1 Summary of Findings

The present study investigated the extent to which autonomy in play contributes to wellbeing restoration. In particular, we examined whether experiences of autonomy satisfaction and frustration while playing *Spore* predicted positive and negative psychological outcomes. Participants in the controlled condition experienced improvements in autonomy satisfaction (ξ = 0.748) and frustration (ξ = 0.901), vitality (ξ = 0.414), and intrinsic motivation (ξ = 0.744) during play, as expected, but also experienced increased tension (ξ = 0.245). Participants in the autonomy-supported condition initially reported greater competence frustration, which declined while playing *Spore* (ξ = 0.329); however, as post-play competence frustration was comparable across conditions, it is less clear how this manipulation influenced ill-being outcomes. In-game competence and autonomy satisfaction emerged as consistent predictors of post-play intrinsic motivation and wellbeing, but only competence frustration was observed to predict ill-being outcomes.

Interview findings suggest that while players largely consider the provision of in-game choices an essential quality of autonomy-supportive design, for some, play reflects a means to engage with concepts and alternative perspectives towards reality. Game-related autonomy frustration appears to emerge in internally-pressuring situations characterised by (perceived) ambiguity and risk, and externally-pressuring circumstances whereby others are seen to encroach on the scene of play. In day-to-day life, videogames were considered useful tools for wellbeing maintenance, but also appear to represent an ever-present threat of overuse, associated with ill-being.

5.2 Autonomy Frustration

Our qualitative findings indicate that autonomy frustration occurs when the desired play situation is threatened – by an influential social actor, or the videogame itself (RQ1). Externally-controlling experiences seem to occur when social actors are seen to impose on the desired play situation: the degree to which social actors frustrate autonomy primarily reflects their relative authority over the player, and the scope of their encroachment on play behaviour – from playing an uninteresting game at a friend's insistence, to having limits placed on screen time.

These results align with prior work, which showed that play can become controlling when attached to social or work-related obligations, indicating that "*solitary* leisurely play is the most autonomy-supporting context" [32, p. 3939; emphasis in original]. The present study extends this perspective, locating the potential for controlling player experiences in aspects of the solitary leisure context. In particular, internal pressure was seen to arise when ambiguous circumstances were perceived to have meaningful stakes. Videogames generally reward players for working to "optimise" their play behaviour within the rules and systems provided [39, 69], and players may feel pressured when optimal play behaviour is indeterminately specified in the game design, or eschewed altogether. Single-player games such as *Stardew Valley* and *The Witcher 2*, then, may frustrate autonomy when players can neither read the optimal play – for efficient accumulation, or moral truth – nor consider, even momentarily, taking action with potentially sub-optimal consequences. This controlling effect may be greater for games such as *The Witcher* that present all options undesirably [121]. In many cases, selecting between similarly-valued options can improve intrinsic motivation [71] – here, however, internal pressure emerges from players' rigid conformity to self-imposed standards of successful, productive play, and the threat to contingent self-esteem that failure represents. While "unsubtle and strict" [65, p. 6] consequential choices are indeed transactional, their ambiguous counterparts seem to elicit more detrimental effects on player engagement and wellbeing.

In contrast to research indicating that "deliberately restricting player autonomy can make for an intensely emotional experience" [13, p. 3003], autonomy frustration did not emerge as a significant predictor of ill-being outcomes (H3b) – despite indications in our qualitative findings that threats to autonomy can be sufficiently unpleasant so as to cause disengagement from play. These acute experiences of autonomy frustration were associated with pressuring events that obstructed the ongoing situation of play, producing reactive behaviour (i.e., ending play) and likely high-arousal emotions such as tension. In other words, the *intensity*, or salience, of autonomy frustration appears to modify the form of negative emotional response. One explanation for why autonomy frustration failed to predict ill-being outcomes, then, may be that the quantitative effects of competence frustration, relative to autonomy, were felt more intensely. In the first stage of *Spore*, the game's simulation of basic evolutionary logics foregrounds the basic conditions for success and failure: surviving predation, consuming food before any nearby competitors, and (optionally) preying on other amoeba. In comparison, the controlling or limiting influence of the game's rule system is less salient – in part because playing as an amoeba presents a justifiable *rationale* for any limits placed on player behaviour [e.g., see 76].

5.3 Restoration

Pre-play differences in autonomy satisfaction and frustration were substantially reduced after the 30-minute play session (H1), demonstrating that videogames can effectively neutralise an autonomy-frustrating event. Controlled participants also experienced significant increases in vitality and intrinsic motivation (H2a). That these participants also experienced a somewhat smaller increase in tension during play suggests that playing *Spore* elicited greater arousal than following directions in

the tangram game. A discussion of the practical relevance of these changes must go beyond effect size categorisations [e.g., 25, 59], and consider the actual contexts in which these effects typically occur. It is well-known that even "small" effects that occur regularly accrue more substantial *cumulative* value [1, 84], and videogame play is a daily activity for many people [17, 18]. SDT research has also shown that individual episodes of need-satisfying activity contribute to overall wellbeing [64]. The "large" and "medium" effect sizes observed in this study may not be quite as substantive outside a controlled environment – however, our findings agree with prior studies [16, 41, 45, 52, 70] whose qualitative findings demonstrate that the restorative effects of videogame play are large enough to be noticed by players in regular use contexts. Our own qualitative findings also suggest that players tend to understand *when* play will be helpful, and when it will not (e.g., in the presence of other pressing commitments).

In SDT, vitality is conceptualised as "the positive feeling of having energy available to the self" [67], and considered to directly index wellbeing [91]. Although prior work [67] has found that vitality, but not happiness, is linked to autonomous behaviour, it is surprising that the substantial changes observed in autonomy satisfaction did not predict changes in happiness or calmness. The theory itself is somewhat unclear on this point: in SDT, positive emotions are considered merely "symptomatic" of wellbeing, and hence may not always reflect need satisfaction. Indeed, if happiness only "*typically* accompanies or follows from eudaimonic living and is associated with basic need satisfaction" [87, p. 240, emphasis added], identifying the circumstances that produce these "typical" cases (as well as those for which need satisfaction should not affect happiness) seems essential to formulate adequate hypotheses. On this point, a recent meta-analysis [98] indicates that the PANAS [116] is the most frequently used emotion measure in SDT research. The scale's bias towards high-arousal states [33] may, to some extent, inflate relations with need satisfaction. In this sense, it may be more correct that need satisfaction predicts energetic arousal (i.e., vitality) rather than positive emotion in general.

Whereas the observed variation in emotional trajectories (H2) speaks to the difficulty of characterising these experiences as unequivocally positive or negative in the context of PX [10, 13, 63], this interpretation is complicated by their respective associations with need satisfaction and frustration (H3) – which *are* identified as unequivocally positive and negative in SDT [87]. Competence frustration in PX is characterised by feeling inadequate when faced with challenging obstacles [104], and autonomy frustration in PX likewise reflects feeling restricted by the game environment. Neither experience immediately appears to lend itself to producing beneficial outcomes; however, a potential resolution rests with the concept of emotional challenge – the struggle to integrate internal conflicts associated with an event, and regulate their coincident emotions.

Interpreting the results of a recent study [14] through SDT suggests that need frustration accompanies a range of emotionally challenging experiences. Autonomy frustration in particular may occur when faced with difficult or morally ambiguous choices, or unethical plot-critical tasks. Emotionally challenging videogame experiences create opportunities for growth: players' successful resolution of inner conflict promotes movement toward more complex forms of self-organisation. Crucially, emotionally challenging events are associated with feelings of appreciation and meaning [14], both of which are long-term wellbeing outcomes that derive from the integrative process [87]. The possibility of meaning in play emerges from the dynamics of need frustration – real or threatened – in a social context of support.

5.3.1 Play in the well-lived life. SDT posits that eudaimonic wellbeing emerges from "activity that develops and expresses one's most reflectively valued and well integrated human potentialities" [86]. Fully functioning individuals experience an open awareness towards the self in relation to its social context; they enact the "good life" through the extension and practice of their capabilities

[87, 94]. In our qualitative work, we identified practices of game engagement in which play served as a means to support players' continued functioning (RQ1). Participants described wellbeing as a practice of balancing time spent fulfilling commitments against pursuing their own interests. Videogame play was seen both as an activity that could encroach on this balance, and one where positive experiences could be "manufactured", or wellbeing "maintained".

Whether play for wellbeing maintenance can be considered part of a "well-lived life" for SDT is not straightforward. Considered alongside other work on videogame play and wellbeing [e.g., 16, 41, 70], play for maintenance may reflect – to varying degrees – an awareness of (and engagement with) the self, or a means of distraction from daily life. To the extent that either motive operates, however, well-integrated extrinsic motivation appears most salient in these participants' initiation of play, rather than an intrinsically motivated desire to play for its own sake. The continuation of play, however, may become more intrinsically motivated as restoration becomes less pertinent, as indicated by its increase for controlled participants. When autonomously motivated, then, using videogames to restore or maintain wellbeing does not seem to *conflict* with eudaimonic living.

However, Rigby and Ryan [82, p. 46] locate the potential for eudaimonic play in "mindful ... aware[ness] of how one's feelings are being activated by media content and ... reflecting on and integrating the potential relevance of those experiences to one's real life". Only two interview participants described their approach to games in similar terms, which aligns with prior research on reflection [62], and suggests that (from SDT's perspective) eudaimonic play is rare. Yet such a view seems to disregard the varied circumstances of daily life: in times of crisis, for example, using games to cope is often adaptive in ways that awareness and reflection on the outside world are not [41]. Ultimately, SDT's view of the "well-lived life" as one of striving for improvement dovetails with wider (and less savoury) trends that "move away from any consideration of 'public health' as a legitimate concern and toward health as a fully privatised good" [40, p. 197], enrolling play into practices of responsible self-governance[7] [35, 39, 117, 118].

5.4 Player Experience

> Given that the arena of electronic entertainment is a creative, quickly evolving, and widely variable area, we believe that the most practical motivational models ... will be those that address fundamental psychological and motivational dynamics rather than deconstructing specific instances of games or genres [93, p. 360].
>
> In-game need satisfactions are a function of identifiable game elements, such as the availability of choices of goals and avatar features, multiple types of competence feedback, and opportunities to cooperate with other players [89, p. 508].

These quotes, taken from SDT publications a decade apart, document a substantive change in approach – one that forms increasingly prescriptive links between need satisfaction and specific game elements. This work instead speaks to the *complexity* of player experience – in particular, autonomy, motivation, and wellbeing – and in doing so, highlights the potential consequences of unqualified, generalising claims that connect game design to player experience. In the earliest empirical SDT games research, these claims' speculative nature is more clearly evident, even while gesturing at the procedural design of (yet unreleased) games like *Spore* as the apparent apogee of autonomy-supportive design practice [93]. Instructively, however, *Spore* was a critical and commercial disappointment, and failed to afford the high degree of autonomy its developers had promised [122] – in part because procedurality's apparent responsiveness to player behaviour is ultimately circumscribed by inflexible coded rules. In the years since, the limits and situational utility of procedural design have become more readily apparent [97]. The wider point is that

[7] Trends that are, admittedly, also furthered by this research.

procedurality, open-world environments, opportunities for choice, and customisation are not *in themselves* guarantors of autonomy-supportive game design [cf. 81], and cannot be treated as such. Indeed, P8's discomfort with *Stardew Valley*'s open structure illustrates that these seemingly established autonomy-supportive design patterns can themselves *cause* autonomy frustration. The varied motives associated with in-game autonomy satisfaction observed in our qualitative findings reinforce this point: opportunities for choice were alternatively viewed as a means to influence the virtual world, a source of inherent satisfaction [i.e., acting as the 'origin' of behaviour; 27], and a resource for understanding the outside world. This multiplicity of player perspectives fundamentally resists attempts to cast 'in-game choices' – or, indeed, other game elements – as singular, static design features with generalisable links to PX [also see 22]. Beyond the study of individual differences [which can require prohibitively large samples; 38], identifying new ways to account for these variations remains a substantial problem for player experience research.

5.5 Limitations and Future Work

While the tangram games successfully manipulated autonomy satisfaction and frustration, the unintended manipulation of competence frustration demonstrates the difficulty of influencing a single basic need. The development of suitable artefacts for use in manipulation represents an area of largely untapped potential for PX research. We note that our ad-hoc need frustration scales, and some other measures used in this study [e.g., the Player Experience Inventory; 111] are yet to see independent validation. Although recent efforts have seen increased development of PX scales [e.g., 3, 30, 73], there remains an ongoing need to independently validate these novel measures [55].

Although the aims of the present study do not directly pertain to gender, we acknowledge that our convenience sample consisted primarily of male university students. Future work in this area, particularly involving relatedness frustration [113], would benefit from a more varied demographic sample. More generally, although we have noted that our findings are in broad agreement with prior work indicating that players themselves recognise videogame play as a vehicle for coping or wellbeing improvement [e.g., 16, 41, 52], the extent to which this study's results generalise across people, games, and other circumstantial factors is yet to be seen. Ultimately, generalisation is the product of a *trajectory* of research – one to which the present work contributes.

It remains unclear why autonomy frustration exhibited consistently smaller correlations with ill-being outcomes, relative to competence frustration. However, tests involving ill-being measures (particularly depressed emotion) were likely influenced by floor effects; these analyses should therefore be interpreted with caution. Future research could examine when and why game-related autonomy frustration and ill-being are more strongly related. Exploration of ill-being outcomes with greater relevance in PX research may also prove fruitful.

While some lines of inquiry remain, our examination of the ways that in-game need frustration can influence well- and ill-being outcomes further explains when and how videogame play can support human flourishing. As an example of confirmatory research [115] driven by theory [102], these quantitative findings lend themselves to further investigation. Moreover, the present work's investigation of autonomy-supporting and controlling game designs has elaborated our knowledge of autonomy as applied to PX. These expanded conceptualisations are increasingly relevant against a growing trend of videogames that attend to difficult topics and themes – games designed to support an unpleasant, nuanced, or emotionally challenging experience.

6 CONCLUSIONS

The present work began by asking how videogames satisfy autonomy, and under what circumstances in-game autonomy could improve wellbeing outcomes. It should be clear, given our qualitative findings in particular, that these questions place too much emphasis on videogames in isolation [cf.

105]. In general, our participants found their 30-minute play session relatively enjoyable, autonomy-satisfying, and restorative. Our findings show that games may indeed support or obstruct player autonomy – however, this appears to have just as much to do with players' *appropriation* of games for their own purposes. As P8 put it, "even playing *Spore*" can help manufacture a positive experience.

But is game design really so unimportant? A stronger test of 'autonomy-supportive' game design principles would involve a videogame that does *not* offer meaningful choices, open environments, and so on. Our findings are important as evidence that games influence well- and ill-being outcomes via need satisfaction and frustration – ultimately, however, we are yet to determine to what extent these changes are driven by players, rather than latent qualities of game design. Just as games are designed to accommodate a wide audience, players themselves find ways to adapt to games. What is needed are ways to account for the complexities of both.

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