Why is This Happening to Me? How Player Attribution can Broaden our Understanding of Player Experience

Ansgar E. Depping and Regan L. Mandryk
Department of Computer Science, University of Saskatchewan
Saskatoon, SK, S7N 5C9, Canada
{firstname.lastname}@usask.ca

ABSTRACT
Games user research (GUR) measures the performance and preference of digital game players, and interprets these measurements in the context of theories that explain human behavior. There are many validated approaches for measuring player experience that are grounded in psychological theories on motivation and emotion. Attribution theory explains how people assign causes to events and how these attributions affect peoples' emotional reactions and motivations. In this paper we argue that attribution theory can provide additional value to the existing suite of GUR tools; however, there are currently no validated tools to assess player attribution in the context of games. This paper describes the conceptualization of player attribution based on literature, presents the development and validation of a scale to assess player attribution in games, and discusses the implications of adding player attribution to the toolbox of methods for the design and evaluation of digital games.

Author Keywords
Attribution theory; Game user research; Scale development.

ACM Classification Keywords
K.8.0 [Personal Computing]: General - Games.

INTRODUCTION
The digital games industry continues to grow worldwide – with estimates suggesting that it will surpass $100b in the next few years [38]. As such, researchers and practitioners are invested in improving game design and development [46], understanding the implications of gameplay on well-being (e.g., [41]), and developing new methods to understand and model players and their game experiences (e.g., [5,9]). Games user research (GUR) focuses on understanding, measuring, analyzing, and designing novel game experiences. Drawing from foundations in human-computer interaction (HCI) and psychology, GUR provides researchers and practitioners with a range of tools to answer questions about why players behave in the ways that they do. Many of the salient constructs used to describe gamer behaviors and preferences are grounded in psychological constructs that help researchers understand, describe, and predict human behavior, thoughts, and beliefs. For example, the concept of flow [8] has long been included in how games user researchers talk about game design. As such, game-specific tools to measure flow have been created [49]. Similarly, Ryan et al. introduced the Player Experience of Need Satisfaction (PENS) scale [45] based on Self-Determination Theory (SDT) [44] to explain and measure how our basic psychological needs of competence, autonomy, and relatedness can be satisfied through games. The same group also applied the Intrinsic Motivation Inventory [35] to games to describe and measure how good games foster enjoyment and invested effort [45]. And in terms of describing player motivations, De Grove et al. [9] use social cognitive theory to create a framework and scale to describe the individual motives for playing digital games.

These contributions are not just about creating game-specific scales, but rather in furthering our theoretical understanding of player experience. While the scores on these scales can help researchers predict in-game behavior, the theoretical constructs measured provide deep insights into how a player experiences a game and how they feel about themselves while playing it. The concepts of flow, psychological need satisfaction, and intrinsic motivation are deeply grounded in decades of research on the psychology of motivation in many different life situations. It is therefore not surprising that psychological constructs have been shown to be very relevant in understanding why and how players enjoy games (e.g., [4,49,45]).

Even with the application of several foundational psychological theories to GUR, there are still many aspects of player experience that we don't understand. Consider a player who gives up after the first experience of failure versus one who keeps trying in the face of frustration. Or consider a player who feels pride after beating one game, but apathy after beating another. A lot of the variance in player experiences is still a mystery to game user researchers. In this paper, we argue that causal beliefs about achievements

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strongly shape emotional and motivational reactions to digital games. Enduring failure could be linked to beliefs about how much control the player has over their performance. Emotional reactions to achievements such as pride or apathy could be linked to beliefs about the internal or external nature of the cause that lead to success (skill or luck). The process by which players ascribe causes to events is called attribution [52]; as demonstrated in these examples, understanding player attribution in games can provide value for games user research. Although attribution theories could provide additional value to the suite of tools already available to games user researchers, there are no validated tools to assess player attribution in the context of games. This paper describes the process of conceptualizing the construct of player attribution based on previous literature, and developing and validating a scale to assess player attribution along its four dimensions (internality, stability, controllability, globality) in games user research. We make the following three contributions:

Our first contribution is theoretical. We introduce attribution theory and argue its relevance in the context of understanding player experience.

Our second contribution is methodological. We iteratively develop and validate a scale to measure player attribution in games (the Game-Specific Attribution Questionnaire, GSAQ) through several steps.

1. We created and refined a pool of items in collaboration with expert gamers and games user researchers.
2. Using factor analyses, we refined the included items to create the GSAQ that separately assesses the four dimensions of attribution theory.
3. We validated the GSAQ, testing for invariance, reliability, discriminant validity, and convergent validity.

Our third contribution is applied. We interpret the results of a study using the GSAQ and situate them within theories of player experience, demonstrating the added value that player attribution provides. Finally, we discuss the implications for game design and evaluation.

Causal attributions answer questions of "why" [19]. When we succeed or fail in a task, when we are welcomed or excluded in a group, or when our ideas are valued or rejected by our peers, these events cause us to ask ourselves a simple question: why is this happening to me? In this paper, we argue that this question is just as important to ask in the context of digital game play. Including player attributions in the digital games research toolbox can broaden our understanding of players and their experiences.

ATTRIBUTION THEORY

Having ideas about causality helps people understand and predict events in their lives. Psychologists call this process *attribution*. In this section we introduce attribution, discuss it in the context of emotions and game play, and present ways in which it has been measured.

Introducing Attribution

Attribution theories try to explain how people assign causes to events and how these attributions affect emotional reactions and motivations (e.g., [52,22,1]). For example, when a student fails an exam, they can choose from a range of causes that might be responsible for this event. They could attribute this failure to causes such as not being smart enough, not having studied hard enough, unfair questions, a bad teacher, the flu they had the week before, test anxiety, or bad luck. Most of these causes are specific to the situation of a failed exam, e.g., a bad teacher or unfair questions. A lost basketball match offers a different list of possible causes than the failed exam, and yet the emotional and motivational responses to these different causal attributions can be the same. Research on attribution theory attempts to identify the basic properties, characteristics, or dimensions of causes. Describing causal beliefs on abstract dimensions allows us to classify and quantify otherwise qualitative descriptions. Attribution research has identified four abstract characteristics that describe causes [52,22,1]: *internality* (generally called locus of control) – i.e., whether the cause is internal to the agent or due to outside forces; *stability* – i.e., how stable or present the cause is over time; *controllability* – i.e., how much the cause can be volitionally altered; and *globality* – i.e., whether the cause applies across multiple situations or circumstances.

Internal vs. External

Internality has been the most embraced characteristic of causes in literature (e.g., [55,22,19]). This dimension – often called locus of control – [52] describes whether the achievement is caused by the agent (internal) or outside forces, such as the situation or another person (external). Success at a sports game because of height, success on an exam because of intelligence, and securing a date because of personality are similar attributions in that the causes lie within the person. On the other hand, success at sports because of a weak opponent, success at an exam because of a good teacher, or being accepted for a date because the other person feels lonely are similar attributions because the causes lie outside of the person [52,22,19].

Stability

The second fundamental property of causal attributions is the causal stability or causal permanence. This dimension describes causes based on how stable or present they are over time [52]. Failure or success in sports and academics due to bad luck or not enough effort are similar attributions given the unstable nature of these causes. Luck and effort are both causes that can change over time. Therefore, the next sporting event, exam, or social interaction could go differently. On the other hand, if achievements in sport are attributed to general aptitude or academic success attributed to intelligence, future events will be expected to have the same outcome due to the stable nature of these causes (e.g., [52,53,54,55]). The causal characteristic of stability is closely related to expectancies of future experiences, and is therefore linked to motivation as well as emotional responses such as confidence, hope or helplessness [19,54,55]. The

dimension of stability is conceptualized as being orthogonal to the dimension of internality. Achievement attributions can be internal and stable (e.g., aptitude), internal and unstable (e.g., effort), external and stable (e.g., a teacher) or external and unstable (e.g., luck) [52,53,19].

Controllability

The dimension of controllability describes the extent that a cause can be altered or controlled. It expresses the capability of the agent to volitionally alter the cause [52]. For example, if failure has been attributed to a lack of effort, the agent can invest more effort in the future. An athlete can try harder at the next match and a student can study more for the next exam. On the other hand, if failure has been attributed to an uncontrollable cause like aptitude, the agent has no reason to believe that they can change the outcome for future events. The dimension of control is closely related to the concept of responsibility [19,54,55]. If an agent is believed to have control over what caused their achievement, they are more likely to be held accountable for it because they could have volitionally altered the outcome of the event. Thus, emotional responses to questions of responsibility such as guilt, shame, remorse, or sympathy are presumed to be closely linked to beliefs about causal controllability [19,54,55]. While internality and stability are assumed to be conceptually orthogonal, causal controllability is confounded with internality and stability. Internal causes can either be controllable (e.g., effort) or uncontrollable (e.g., aptitude). However, it is reasonable to assume that all external causes are also uncontrollable for the agent [55]. Therefore, the dimensions of internality and controllability are closely connected. Similarly, a controllable cause seems inherently unstable because the agent can alter it. Despite being conceptually distinct, causal control is assumed to overlap with both internality and stability and is not empirically orthogonal to these dimensions [55].

Globality

The final dimension, proposed by Abramson et al. [1], pertains to the global vs. specific nature of causes. Causal globality describes whether the cause for an achievement is important in all aspects of the agent's life or is specific to a situation or circumstance. If an occurrence of failure or success is attributed to a global cause, such as general intelligence or likability, the agent has reason to believe that similar outcomes can be expected in other life situations. On the other hand, given a specific cause, such as having a good day, a talent for math, or a coincidence, the agent is less likely to assume their achievement is predictive for other life situations. However, while Abramson and Seligman found support for globality, Weiner [52] questions the relevance of describing the globality of causal beliefs. As a result, globality has not always been included in attribution measurements [22].

Attribution theory has already been applied in non-game contexts to understand how people react to failure and success. Achievement attribution has been linked to emotional reactions and motivational consequences. In the next section, we present some of these findings and apply these findings to game user research.

Attribution, Emotion, Motivation, and Games

Throughout the past decades, multiple studies have tied attribution to emotional and motivational responses. The link between attribution and emotional response is based on the assumption that feelings are determined by thoughts, and specifically by beliefs about causality [19,55]. This connection between cognition and emotion has long been acknowledged by theories regarding the genesis of emotions. It is well established that an emotional response to a stimulus is highly dependent on how that stimulus is appraised by the subject [17]. Similarly, it can be assumed that the emotional reaction of a player to a game event is dependent on that player's appraisal, i.e., attribution, of the event. A player who experiences success in a game can attribute this success to various causes (e.g., aptitude, effort, luck, strong team members), which in turn affects how the players feels about their success (e.g., confidence, pride, surprise, gratitude). In turn, motivational consequences of achievement attribution are closely linked to how someone feels about an event. For example, confidence and pride would impact future behavior differently than apprehension and surprise [54,21,55]. We next describe some achievement-linked emotions that have been empirically linked to attribution. We will also demonstrate how these findings relate to the experience of playing digital games.

Pride and Admiration

Pride for one's own success seems to build on the belief that the cause for the achievement lies within oneself (internal). Similarly, admiration for someone else's success seems to depend on an internal causal belief for that person's achievement. Attribution literature suggests internal attribution to be an antecedent of pride and admiration [19,21,55]. This relationship appears to be independent of perceived controllability of a cause. One can feel pride or admiration for both controllable (effort) and uncontrollable (aptitude) causes [55]. In games, pride in personal triumph is one of the feelings that game designers try to elicit when they think about designing challenges like boss fights or puzzles [31]. Attribution can explain why players experience more pride when they believe their success to be due to skill and good decision making rather than an easy level.

Admiration is an emotion that game designers try to elicit when it comes to status symbols within a multiplayer game [11]. Rankings or badges or skins are status symbols that are more rewarding for the receiving player when others respond to these symbols with admiration. A high ranking in a game that requires skill and dedication (internal) might elicit more admiration among other players than a high ranking in a game in which rank is less indicative of skill and dedication (e.g., pay-to-win or luck-based games).

Confidence and Apprehension

Confidence and apprehension are two emotions connected to uncertainty about future events. Research on attributional styles suggests that confidence and apprehension are con-

nected to causal stability [52,55]. Agents may be more inclined to assume the event will repeat itself if the cause is believed to be stable than if the cause is believed to be unstable. Success that has been attributed to a stable cause (e.g., intelligence, work ethic) can lead to an expectation of future success, and thus evoke confidence. On the other hand, a success that is attributed to an unstable cause (e.g., luck) would more likely lead to uncertainty about future outcomes, thus evoking apprehension [55,19].

In games, uncertainty in the outcome is an essential tool to keep a game interesting [46]. While many games aim to make players feel competent and in control, most games also include mechanics that ensure a degree of uncertainty in the outcome. These uncertainty mechanics often include elements of chance (unstable), while confidence-evoking mechanics emphasize skill (stable). Game designers could use the concept of perceived causal stability as a framework for game mechanics when designing the balance between confidence and apprehension.

Sympathy and Contempt

Sympathy and contempt are two emotional reactions that are closely connected to pro- and antisocial behaviors [21,54,55]. Sympathy is experienced when the misfortune of another is ascribed to an uncontrollable cause. Contempt is assumed to be generated by the belief that another agent is responsible for a transgression and that they could have done otherwise [21]. Research on attribution has indicated that if someone is in need (e.g., poverty) and the need is attributed to a controllable cause (e.g., lack of effort), agents are inclined to react with anger towards them and withhold help. When the cause for the need is believed to be uncontrollable (e.g., disability), agents are more inclined to react with sympathy and offer help [21,55].

In games, attribution could be helpful in understanding antisocial behavior in multiplayer games. While most multiplayer games try to inspire prosocial (e.g., helpful) behavior, antisocial (e.g., toxic) behavior is still a big problem in online communities. In multiplayer team games, toxic behavior can be easily triggered when another team member performs poorly [15]. According to attribution theory, the causal beliefs of other team members regarding that poor performance will influence their reaction. If the underperforming player is believed to have no control over the failure (e.g., due to an unfairly matched opponent or high network latency), teammates should be more likely to react with sympathy and offer help. If the cause for failure is believed to be controllable, team members might be more likely to react with anger and thus engage in toxic behavior.

Attribution can contribute insight into when players behave antisocially and when they behave pro-socially. Based on attribution research, game designers could aim to inspire sympathy rather than anger by addressing the players' beliefs about causal control when a teammate underperforms.

Shame and Guilt

While sympathy and anger are emotions directed at another person, shame and guilt are assumed to arise from self-blame (internal attributions) [21,55]. The two emotions can be difficult to distinguish. However the underlying difference between them can be described by causal controllability [21,55]. Shame is triggered by failure that is attributed to an uncontrollable characteristic (e.g., low height, low intelligence). Guilt is triggered by failure that is attributed to a controllable characteristic (e.g., not having tried hard enough). After a failure, the agent's belief about how much volitional control they had can explain their emotional reaction. Building on this idea, Weiner [55] further contends that shame leads to inhibition of achievement striving and social withdrawal. Guilt on the other hand, is assumed to enable change and progression.

Game designers could examine failure in games from the perspective of controllability to further their understanding of what makes players give up versus endure when faced with failure. Successful games already suggest high controllability of the player to motivate progress and strengthen player resilience to failure [46].

Previous Attribution Measures

As research on attribution theory became more prominent, measurements of attributional styles were developed. The Attributional Style Questionnaire (ASQ) [39], the Children's Attributional Style Questionnaire (CASQ) [48] and the Causal Dimension Scale (CDS) [26] are trait measures of attribution, measuring an agent's general attributional style across life situations. There are also more domain-specific questionnaires like the Academic Attributional Style Questionnaire (AASQ) [40], Organizational Attributional Style Questionnaire (OASQ) [27], or the Relationship Attribution Measure (RAM) [7]. All of these questionnaires measure attribution by presenting a number of hypothetical positive and negative scenarios. Participants were asked to name a cause they think would be responsible had that event happened to them. The participant then rated the cause on the four attributional dimensions.

Attributional measurements contribute valuable insight to many domains. People who make internal, stable and global attributions of negative events tend to exhibit more signs of depression [1,48]. Similarly, students who attribute academic failure to internal, stable and global causes tend to do more poorly in classes [40]. And in romantic partnerships, attributing negative partner behavior to internal, stable, and global causes decreased relationship satisfaction [7]. Furthermore, attributional styles in the workplace are able to predict work-related motivation and performance [27].

Despite their predictive qualities, these questionnaires have been criticized for their low reliability, and factor analyses indicated that there was little consistency between the hypothetical situations [22]. They measure attribution as a stable personality trait, assuming that within a domain (e.g., relationships, academia), attribution is cross-situationally consistent. Current literature has proposed that attributional

styles may in fact not be consistent over domains or even situations[22]. The trend has therefore been to measure domain specific attributional styles (e.g. relationships, work) as the concept of the general, trait like attribution style (e.g. ASQ) does not seem to be the best empirical model. Based on these findings, a game-specific attribution questionnaire is necessary to understand player attribution, and it should measure attribution in a given situation– not as a general personality trait. Another problem is the role of controllability. While the construct of causal control is conceptually distinct from internality, they are not orthogonal, which often leads to correlations between these two dimensions.

MEASURING GAME-SPECIFIC ATTRIBUTION

Our goal was to create and validate a game-specific attribution questionnaire (GSAQ) that measures how players attribute their in-game achievements. The following section describes the process of creating and validating our scale. We describe the process of creating the GSAQ in four steps: first, the creation and refinement of the item pool; second, the studies conducted to gather data; third, the creation of an adequate measurement model; and fourth, the quantitative assessment of the GSAQ.

1. Creating and Refining the Item Pool

The first step was to create a large pool of items. The four-person team that created the item pool consisted of experienced games user researchers as well as experienced gamers. The item creation was informed by the literature review on previous attributional measures in other fields. We also conducted unstructured interviews with 8 participants who considered themselves gamers to help us generate further items. Respondents were asked to remember instances of success and failure in different games and describe what they thought was responsible for those instances. The result was an item pool of 43 items, the majority of which (30 items) were designed to measure internality and controllability because these two constructs were expected to be the most difficult to empirically distinguish. We then qualitatively tested the items on a sample of 8 participants to specifically identify phrasing issues, ambiguities and difficult-to-understand items. We also asked our test subjects to cluster the items into groups they thought belonged together. This process allowed us to identify items that might not be eligible to distinguish between internality and controllability. Based on our findings, we rephrased 7 items resulting in the final refined item pool of 43 items (complete item pool of 43 items can be seen in Table 6 in the appendix).

2. Gathering Data

Our next goal was to gather response data we could use to create and validate a measurement model. To achieve this goal, we conducted two studies in which the only difference was the game played. Testing our items on two games allowed us to test for invariance over different games.

Measures

We included all 43 items in a randomized sequence in one questionnaire. First, we collected the GSAQ. Second, we collected player experience of need satisfaction (PENS scale) [45], which measures how much an activity satisfied a user's need for competence, autonomy and relatedness. Because we were looking at single player experience (as opposed to multiplayer), we excluded the relatedness subscale. The PENS scale also includes two constructs specific to interacting with virtual environments – intuitive control and immersion. Third, we collected intrinsic motivation using the Intrinsic Motivation Inventory (IMI), which assesses participants' interest/enjoyment, perceived competence, effort/ importance, and tension/pressure while performing a given activity [14]. In order to avoid overlap, we did not measure the competence subscale because competence is also measured by PENS. Fourth, we gathered the positive affect/ negative affect scale (PANAS), which measures positive and negative affect by asking participants to rate their agreement with a series of adjectives describing their present emotional state [50]. As we wanted to investigate how player attribution is linked to player characteristics, we also used two personality trait scales: The Big Five Inventory (BFI) [24,25], which measures personality on five dimensions (extraversion, agreeableness, conscientiousness, neuroticism and openness), and has been shown to moderate play experience [5]; and the Rosenberg self-esteem scale (RSS) [43], which measures self-esteem and which has been shown to predict game experience [4]. All items were rated on a 7-point Likert scale.

Participants

We conducted the study on the crowdsourcing platform Mechanical Turk. Mechanical Turk has been shown to be robust for conducting user studies [29,34]. The first study was conducted with 120 participants. Sixteen participants were eliminated from further analyses due to lack of compliance [34], which was indicated by failed control items in the questionnaires (e.g., "please select "agree" if you are reading this question"), as well as unrealistically quick responses to items in our attribution scale (i.e., average response time per item below 2 seconds). After this elimination process, 104 viable participants (female = 38 (36.5%), male = 66 (63.5%); Age: m= 33.00, SD = 9.81) remained. The second study was also conducted with 120 participants, of which 13 were eliminated due to lack of compliance [15], leaving 107 viable participants (female = 46 (41.5%), male = 61 (57.5%); Age: m= 32.86, SD =10.08). How frequently participants played games was measured with a descriptive 8-point scale ranging from 'every day' (8) to 'Not at all' (1). On average they played 'A few times per week' (M= 6.9, SD= 1.3).

Procedure

In both studies, participants were first asked to provide informed consent, fill out the personality questionnaires (BFI, RSS), and then play a game for 5 minutes. In the first study, participants played the match-3 type game. In the second study, they played a whack-a-mole game for 5 minutes. We chose an alignment-puzzle game and a reaction time game because we wanted two different primary mechanics that represented popular game genres. After the game, the participants were asked to fill out our Game-Specific Attribu-

Sub-scale	Item	Factor 1	Factor 2	Factor 3	Factor 4
I	The reasons underlying my performance in this game lie within me.	**0.74**	-0.01	0.13	0.03
	How well I did in this game was completely due to me.	**0.88**	0.00	-0.06	-0.12
	My effort determined how well I did in this this game.	**0.68**	0.03	0.02	0.13
	In this game, my performance was determined by my abilities.	**0.74**	-0.02	0.08	0.03
S	The reasons for my performance in this game will stay the same in future games.	0.01	**0.78**	-0.01	-0.10
	Whatever affected my performance will continue to affect me in future games.	-0.14	**0.77**	0.08	0.12
	The cause for my performance in this game will always be present.	0.12	**0.63**	-0.05	-0.01
G	The reason for my performance is something that affects other areas of my life.	-0.01	-0.02	**0.88**	0.03
	My performance in this game is typical for my general abilities in other areas of life.	0.24	0.25	**0.51**	-0.04
	Whatever caused my score in this game is only important in the context of games. (R)	0.01	-0.16	**-0.61**	0.05
C	Players have very little influence over their score in this game. (R)	-0.29	-0.04	0.15	**-0.53**
	It is in a player's power to become better at this game.	0.38	-0.01	0.04	**0.81**
	Players are responsible for their performance in this game.	0.23	0.11	0.03	**0.63**

Table 1: EFA performed with principal axis factoring. Direct Oblimin rotation. Fixed to 4 factors. Factor loadings > .5 are printed in bold. Reverse-coded items marked with "(R)". (I = Internality, S = Stability, G = Globality, C = controllability)

tion Questionnaire along with the other player experience measures and a final demographic survey. In total, participants filled out 115 items. On average they took 16 min to complete the study for which they received 2$ as compensation.

3. Creating the Measurement Model

Our next goal was to pick the best possible items out of our item pool to create a measurement model that reliably measured the four attributional dimensions We describe this process in three steps: First, we performed a preliminary analysis of the individual items to assess the item quality and remove items that performed poorly. Second, we performed exploratory and confirmatory factor analyses to assess the quality of our measurement model and to further refine it. Third, we tested if our measurement model is invariant over different games.

Preliminary Assessment of Item Quality

Before assessing the four dimensions of attribution using factor analyses, we inspected individual items to identify poorly-performing items. This process acted as a preliminary filter to make subsequent steps easier. As recommended [9], items were removed when a combination of several factors was present: extreme means (below 2 or above 6), limited variance (below 0.9), low squared multiple correlation (below 0.4), a low item whole correlation (below 0.4), and significant improvement of Cronbachs's alpha when removed. After this process, 28 of 43 items remained.

Creating a Good Measurement Model

Our scale items were designed based on a theoretical model. We therefore already had expectations about the latent factors the items were loading on. To confirm these assumptions, we performed an exploratory factor analysis (EFA) and a subsequent confirmatory factor analysis (CFS). The EFA with all 28 remaining items was performed using principal axis factoring (PAF) with Oblimin rotation. Based on our conceptual framework, factor extraction was fixed to 4 factors. With a Kaiser-Meyer-Olkin (KMO) index of .89 and a significant Bartlett's test of sphericity (χ^2= 2680, $p < .001$), sampling adequacy was considered good. The total variance explained amounted to 45.6%. To further increase the quality of our measurement model, items were removed based on two criteria. First, on psychometric grounds: items with low factor loadings and low squared multiple correlations were candidates for removal to improve the model fit [9,32]. Second, on theoretical grounds: items that were similar in phrasing to better-performing items were removed. In an attempt to conceptually distinguish the four constructs, we removed items that were, on a content level, too similar to other constructs. Items were also removed despite performing well in an effort to increase parsimony of the model. This trade-off between goodness-of-fit and parsimony was accepted to avoid an unnecessarily long questionnaire [9,12]. Through this process, 15 items were removed. The final model included a total of 13 items measuring internality (4 items), controllability (3 items), stability (3 items), and globality (3 items). A final EFA with the remaining 13 items was run (PAF, Oblimin rotation). The sampling adequacy was good (KMO = .86, χ^2= 1059, $p < .001$) and 59.6% of the variance was explained. All items loaded highly (> .5) and uniquely on their intended factors (see Table 1 for the final item set and the factor loadings). To test the quality of our measurement model, we conducted a CFA using AMOS. There are multiple measures that can be used to assess the goodness-of-fit for a specific model. The model fit indices for this measurement model can be seen in Table 2 along with the thresholds as recommended by Hu and Bentler [23]. The model for our Game-Specific Attribution Questionnaire shows a good fit with our data. χ^2/df is good, and the significant p-value was expected due to sample size [23,9]. The CFI, TLI, RMSEA and PCLOSE values all indicate a good to great model fit.

	Overall Model	Game 1 Model	Game 2 Model	Thresholds
χ^2/df	1.69	1.72	1.42	< 3 good
p-value	0.01	0.01	0.03	< .05
CFI	0.96	0.95	0.96	>.95 great; >.90 traditional
TLI	0.96	0.92	0.94	>.95 great; >.90 traditional
RMSEA	0.06	0.08	0.06	<.05 great <.10 acceptable
PCLOSE	0.26	0.06	0.25	>.05

Table 2: Model Fit for Overall Model and Invariance Tests

Testing for Invariance

Because we want our scale to measure player attribution in many different games, the CFA has to validate that the factor structure and loadings are sufficiently equivalent across games. We tested our model comparing data from the match-3 game with data from whack-a-mole. For both games, the measurement model is still sufficient, as can be seen in Table 2. The slight decrease in model fit is mainly due to the sample size that is low for a CFA once the data set is split by game [56]. Because both models still show a sufficient fit, we can assume configural invariance of our Game-Specific Attribution Questionnaire [9,32]. In addition to configural invariance, the model also has to be metrically invariant. In order to test differences in the model between games, we used a multi-group moderation test using the critical ratio differences in AMOS [32]. For all subscales, the differences in critical ratios were *not* significant indicating that our scale is also metrically invariant over different games. Stability across games for both the model fit and factor-loading suggests psychometric and theoretical soundness of the instrument [9].

4. Quantitative Assessment of the GSAQ

With the final items selected, we have a good measurement model for the GSAQ. We tested the scale for reliability, convergent validity, discriminant validity, and criterion-related validity.

Reliability

Composite reliability (CR) and Cronbach's alpha values were good for internality, controllability and stability (CR > .70, α > .75). The globality scale's CR value marginally misses the threshold of >.7 (CR = .69) and its Chronbach's α is low but still acceptable (α = .70) [9,12] (see Table 3).

Convergent Validity

The Average Variance Extracted (AVE) for each of the subscales is above 0.50, suggesting a good convergent validity (see Table 3). Good convergent validity indicates that the items measuring one factor are strongly related to one another, supporting the idea that they are conceptually measuring the same latent construct [9,12].

	CR	Cronbach's α	AVE	MSV
Internality	0.87	0.86	0.62	0.86
Controllability	0.75	0.75	0.51	0.86
Stability	0.77	0.77	0.53	0.34
Globality	0.69	0.70	0.53	0.34

Table 3: Composite reliability, Cronbach's α, Average Variance Extracted and Maximum Shared Variance for the GSAQ

Discriminant Validity

The Maximum Shared Variance (MSV) scores for internality and controllability are higher than their AVE scores, which is an indicator for low discriminant validity [32] (see Table 3). As already discussed, conceptually it is to be expected that the sense of control is strongly confounded with the locus of that control – i.e., internality. The two constructs can therefore be statistically similar due to high correlation (Table 5), but still be theoretically distinct. Nevertheless, the relationship between these constructs must be acknowledged when interpreting player attribution results.

Criterion-Related Validity

Until now we have only demonstrated the quality of the measurement for player attribution. The more interesting questions are if attribution can help us understand how players experience a game and how attribution is linked to player personality.

The GSAQ shows a few interesting relationships with both player characteristics and player experience. Table 4 shows a correlation matrix between attribution and player personality and experience. The player's self-esteem correlates significantly with both controllability and internality but not with stability and globality. Of the personality constructs, extraversion and agreeableness reveal no significant correlations. Conscientiousness is the tendency towards self-discipline and to control and regulate impulses [24,25]. The subscale is correlated with internality and controllability. Neuroticism is the tendency towards experiencing negative emotions, such as anxiety or depression [24,25]. The subscale is negatively correlated with internality. Openness to experience describes a willingness to engage in new experiences or imaginative activities [24,25]. The subscale is positively correlated with controllability.

While player attribution is partially linked to player personality, the attribution scales have an even stronger link to player experience measurements (i.e., PENS, IMI). This is not surprising as attribution and experience were both measured as states. Competence measures players' perceptions that "the game provided a challenging but not overwhelmingly difficult experience and enhanced efficacy" [44,45]. Internality, controllability, stability, and globality all correlated with competence. Autonomy measures "the degree to which participants felt free, and perceived opportunities to do activities that interested them" [44,45]. Autonomy significantly correlates with internality, controllability, and globality. Immersion measures how physically

	Internality	Controllability	Stability	Globality
Self-esteem	**.212****	**.156***	.033	.052
Extraversion	.062	.019	.027	.032
Agreeableness	.019	.03	-.077	-.125
Conscientiousness	**.231****	**.243****	.096	.018
Neuroticism	**-.149***	-.093	.003	-.038
Openness	.066	**.142***	.053	.085
Competence	**.564****	**.430****	**.285****	**.383****
Autonomy	**.380****	**.242****	.056	**.271****
Immersion	**.214****	.006	-0.03	**.282****
Intuitive Controls	**.315****	**.305****	**.289****	**.167****
Interest	**.272****	**.231****	.059	**.213****
Effort	**.280****	**.277****	**.240****	**.146***
Pressure	**-.215****	-.135	-.041	-.053
Positive affect change	**.189****	**.194****	.028	.119
Negative affect change	**-.177***	**-.201****	-.052	-.045
Performance	**.233****	**.185****	**.206****	**.170***

Table 4: Attribution scales correlation with player personality and player experience (*p <= .05, **p <= .01)

and emotionally present the player felt in the game environment [45], and is significantly correlated with internality and globality. Intuitive controls indicates how easily the players were able to control movement or action in the game [45], which is significantly correlated with internality, controllability, stability, and globality.

Interest/enjoyment measures how much a player enjoyed playing a game and is often interpreted as a self-report measure for intrinsic motivation [35,45]. Interest is significantly correlated with internality, controllability, and globality. Effort/importance measures how much work a player invested in the game [35,45], and significantly correlates with internality, controllability, stability, and globality. Pressure/tension measures the amount of tension and duress the player felt while playing [35,45], and as one would expect, it is negatively correlated with internality. Positive affect change [50] is significantly correlated with internality and controllability. Negative affect change [50] is negatively correlated with internality, and controllability. Finally, performance is the standardized value of in-game performance based on the game score. Game performance is significantly correlated with internality, controllability, stability, and globality. We interpret the correlations between player attribution and player experience in the next section.

DISCUSSION

The goal of this paper was to demonstrate the value of Attribution Theory in games user research and to introduce a scale to measure player attribution in games. We have demonstrated in theory how player attribution as a construct could contribute to our understanding of player experience. We have also introduced the Game-Specific Attribution Questionnaire as a reliable and valid measurement tool. In the following section, we will interpret our findings, propose possible applications in games user research, and discuss the limitations of our study and how future research can address them.

	Internality	Controllability	Stability	Globality
Internality	-			
Controllability	.720**	-		
Stability	.323**	.251**	-	
Globality	.303**	.154**	.362**	-

Table 5: GSAQ correlation matrix (*p <= .05, **p <= .01)

Interpretation of Results

Through the process of careful item creation, selection and scale validation, we have come up with a reliable and valid scale to measure player attribution. Our analysis indicates a good model fit, reliability and convergent validity [9]. As expected, internality and controllability are strongly correlated. These issues replicate previous findings [22]. In line with previous literature, we acknowledge the statistical connection between the two constructs while still viewing them as conceptually distinct.

The correlations between player attribution and other personality and experience measures revealed several interesting results. First, the positive connection between self-esteem and internality and controllability as well as the negative connection between neuroticism and internality replicate established connections between attributional styles and self-esteem and a tendency toward negative emotions [16,39,48]. Second, the positive relationship between game performance and all player attribution measures can be explained by well-established patterns of self-enhancing biases. Research on attribution has repeatedly shown a tendency towards attributing success as more internal, controllable, stable and global, and failure as more external, uncontrollable, unstable, and specific [6].

Third, the initial results show a strong link connecting player attribution to need satisfaction of autonomy and especially competence. We can't draw conclusions about causality based on these correlations, but a reasonable hypothesis is that a player's causal beliefs are antecedents of feelings of competence and autonomy (e.g., internal and controllable causes for success are more likely to evoke feelings of competence). Fourth, high internality, controllability and globality beliefs appear to be connected with higher interest and enjoyment of a game. How much effort the player is willing to invest is linked to all four attribution dimensions. Similar to need satisfaction, one explanation for these relationships is that a player's causal beliefs (e.g., high controllability or globality) might lead to higher interest and effort.

Finally, internality as well as controllability are positively associated with positive affect change and negatively associated with negative affect change. These findings support

the ideas stated above, that causal beliefs of players can impact their emotional reaction to a gaming experience.

Application in Digital Games Research

Our results demonstrate how attribution can be relevant in the context of player experience – providing additional explanatory value to existing measures of player experience common in games user research. We describe two ways in which the GSAQ can provide value to academic researchers and industry practitioners: by providing explanatory power and by guiding design.

Improving Understanding using the GSAQ

The GSAQ gives researchers a tool to explain differences observed in other measures of player experience. For example, Gerling et al. [18] created a system that allowed players to use a wheelchair as input to a Dance Dance Revolution clone, and a difficulty balancing technique that allowed people in wheelchairs to compete against able-bodied players. The authors suggested that if players in wheelchairs think they are only winning because of the system's aid, competence would not be fostered and self-esteem could be harmed. Assessing internality using the GSAQ for different multiplayer balancing schemes would provide value in addition to measuring the standard constructs, such as competence and self-esteem.

Recently, researchers have started using broad concepts of causal beliefs to better understand player experience. Work on dynamic difficulty adjustment has investigated the effect of overt or covert assistance in multiplayer games [10]. Overt assistance did not seem to detract from the players' perceived competence and the authors use the well-established concept of self-serving attribution biases to explain that players attribute their performance internally despite knowing they were being assisted. In another example, attribution theory was used to explain the difference between players being frustrated as an intended experience "in" the game or as a negative reaction "at" the game [36]; the authors argue that causal beliefs about internality and controllability are constructs that help us understand the nature of frustration during game play that results in a motivating or disheartening experience.

In another example, the GSAQ gives researchers a tool to further investigate aggressive (toxic) behavior in multiplayer online games. One of the most successful online multiplayer games (League of Legends, Riot) is struggling to prevent players from verbally abusing each other [15,28]. Research has shown that 48% of these toxic team conflicts arise after one team member makes a mistake that results in the death of another [15]. Escalating conflicts often contain comments like "report noob" or "stop feeding" [28]. Players can "report" other players after a game and the average number of reports per match is highest for "intentional feeding" (intentionally dying) and "assisting the enemy" [28]. Toxic behavior in these cases seems to partially stem from the belief that an underperforming team member *should* and (more importantly) *could* have done better. As such, the toxic player might be characterized by the assumption that team members control their own performance, whether or not it is appropriate or true. The GSAQ could provide insight into the idea that toxic players suffer from an attributional fallacy of overestimating causal controllability in other players. The scale could also investigate the assumption that lower controllability in other players will lead to sympathy and a willingness to help.

These examples are not an exhaustive list of all application possibilities of attribution theory, but merely serve as illustrations of how attribution theory and the GSAQ can be used to further understand player experience.

Guiding Game Design

In addition to promoting understanding, the GSAQ can also help guide designer decisions.

For example, consider a designer of an educational game who wishes to evaluate two different methods of providing feedback in their game. Attribution theory suggests that internal attribution of performance translates into pride [55]. Using the GSAQ to evaluate how different achievement badge implementations affect internality should help designers create badges that foster a sense of pride and inspire further progress in the game.

Or consider the designer of a persuasive game intended to help players learn a language. Feelings of stability resulting from the game would differentiate between a player experiencing confidence (the improvements will last) and apprehension (the improvements will go away) in using the skills learned in the game [55]. Evaluating the stability of different designs in an iterative process could help to improve the efficacy of the game during development.

Finally, consider a game intended to help players overcome a fear of public speaking by helping the player practice and apply techniques in private. Evaluating how globally players attribute progress over various designs may help determine whether players will feel that they can apply the learned in-game skills to the public speaking context.

Limitations and Future Work

On a theoretical level, we have shown the value that attribution theory can contribute to research in digital games. Our results indicate strong links of player attribution to player personality as well as player experience. However, these initial results only hint at the insights our scale can contribute to digital games research. Further studies now have to investigate the specifics of how player attribution affects player experience. Another limitation is the relatively small sample size we used. For a CFA, a larger sample size would have been valuable [9]. Given the parameters of our model (four factors, factor loadings greater than .65, 211 participants) and no missing values in our data, we can still be confident in our interpretation of our results [56].

Our study was conducted on Amazon's Mechanical Turk, which is a crowdsourcing platform for people who want to earn money doing online work. This means that our participants were engaging with the games in a professional ca-

pacity with the extrinsic motivation of getting paid. It could be argued that the professional, experimental setting of the game experience contradicts the usual volitional, hedonistic and playful characteristic of gaming [46]. Applying our scale to volitional and playful gaming in the future will ensure that it is valid across contexts.

Both the match-3 game, and the whack-a-mole game were casual games, and these games were played for a short duration, limiting the generalizability of our results. In order to truly understand player attribution, the scale should be tested in different game genres, different levels of engagement, and in longer game sessions.

Although we show interesting correlations with player experience measures, the causal paths and relationships between attribution and need satisfaction or intrinsic motivation should be further explored to better define the role of player attribution in player experience. Is internality an antecedent of competence? Does controllability mediate the known relationship between autonomy and effort [5]? Future research should strive to further our understanding of how player attribution explains player experience. The specific relationships of causal beliefs determining emotional reactions (e.g., pride, confidence, shame, sympathy) of game users should also be explored.

CONCLUSIONS

Research in player experience of digital games has long been using methods that are grounded in motivational psychology to further understand how a player experiences a game and how they feel about themselves while playing it. We believe that attribution theory is a valuable addition to the box of tools game researchers and designers have at their disposal. In this paper we have applied findings in attributional research from other fields to games to argue its potential value in understanding emotional and motivation reactions to games. We have also introduced the GSAQ as a tool for game research and design. A vast amount of empirical research on causal beliefs has demonstrated the effects of attribution on emotion, motivation, and behavior. We are confident that causal beliefs will provide valuable insights into game user experience. "Why is this happening to me?" is an important question in many life situations – we argue that this question is just as relevant in our understanding of how, when, and why people play digital games.

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APPENDIX

My performance in this game was completely due to other people or circumstances. (R)(I)
The reasons underlying my performance in this game lie within me. (I)
The reasons underlying my performance in this game lie outside of me. (R) (I)
The score of the game was caused mostly by things other than myself. (R)(I)
How well I did in this game was completely due to me. (I)
How well I did in this game reflects on me. (I)
I currently have the capacity to do well in this game. (I)
My performance in this game can be used to make assessments about me. (I)
Performance in this game is indicative of a player's attributes. (I)
Something other than me influenced my performance. (R)(I)
I controlled my performance in this game. (I)
My effort determined how well I did in this this game. (I)
My performance in this game reflects directly on my skill. (I)
In this game, my performance was determined by my abilities. (I)
The score of the game would have been the same no matter how hard I tried. (R)(I)
My aptitude affects how well I do in this game. (I)
The cause for performance in this game can be controlled. (C)
Players can affect the cause of their performance in this game. (C)
Whatever influenced performance in this game is out of the player's hands. (C)
It is up to the player how well they do in this game. (C)
Players have very little influence over their score in this game. (R)(C)
Performance in this game is completely under the player's control. (C)
Players have control over their success in future rounds of this game. (C)
It is in a player's power to become better at this game. (C)
If a player wanted to, they could perform poorly in this game. (C)
Players can allow others to perform better than themselves in this game. (C)
Through practice, players can become better at this game. (C)
Players cannot change anything to be become better at this game. (R)(C)
Players are responsible for their performance in this game. (C)
Poor performance in this game can be blamed on the player. (C)
The causes for my performance in this game are stable. (S)
The reasons for my performance in this game will stay the same in future games. (S)
Whatever affected my performance will not change in future games. (S)
Whatever affected my performance will continue to affect me in future games. (S)
My performance in the game could be completely different the next time I play. (R)(S)
The cause for my performance in this game will always be present. (S)
The cause for my performance in this game will never be present again. (R)(S)
Whatever affected my performance is variable over time. (R)(S)
It is easy to predict how well I will perform in future rounds of the game. (S)
The reason for my performance is something that affects other areas of my life. (G)
Whatever caused my score in this game is only important in the context of games. (R)(G)
My performance in this game is typical for my general abilities in other areas of life. (G)
My performance in this game is only representative of my game-related abilities. (R)(G)

Table 6 (continued): Initial item pool of 43 items. Reversed items marked with "(R)". Final items in bold. (I = Internality, S= Stability, G = Globality, C = controllability)

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