This is the author's version of a work that was submitted/accepted for publication in the following source:


This file was downloaded from: http://eprints.qut.edu.au/63692/

© Copyright 2013 ACM

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

Notice: Changes introduced as a result of publishing processes such as copy-editing and formatting may not be reflected in this document. For a definitive version of this work, please refer to the published source:

http://dx.doi.org/10.1145/2513002.2513010
Motivation during Videogame Play: Analysing Player Experience in terms of Cognitive Action

Wilawan Inchamnan
QLD University of Technology Brisbane, Australia
w.inchamnan@student.qut.edu.au

Peta Wyeth
QLD University of Technology Brisbane, Australia
peta.wyeth@qut.edu.au

ABSTRACT
This paper describes a method for analysing videogames based on game activities. It examines the impact of these activities on the player experience. The research approach applies heuristic checklists that deconstruct games in terms of cognitive processes that players engage in during gameplay (e.g., addressing goals, interpreting feedback). For this study we examined three puzzle games, Portal 2, I-Fluid and Braid. The Player Experience of Need Satisfaction (PENS) survey is used to measure player experience following gameplay. Cognitive action provided within games is examined in light of reported player experiences to determine the extent to which these activities influence players’ feelings of competence, autonomy, intuitive control and presence. Findings indicate that the positive experiences are directly influenced by game activity design. Our study also demonstrates the value of expert review in deconstructing gameplay activity as a means of providing direction for game design that enhances the player experience.

Categories and Subject Descriptors
K.8.0 [Personal Computing]: General – Games.

General Terms
Experimentation, Human Factors; Design; Measurement

Keywords
Videogame Play, Player Experience, Expert Review, Puzzle Games, PENS

1. INTRODUCTION
Increasingly, videogame play is an important leisure activity for many people. The dramatic growth of gaming as entertainment and the pervasive quality of the game play experiences, has led to a need to better understand the phenomena. Much of the research in this area has focused on the negative (e.g., game addiction), and only recently have researchers begun to examine the positive consequences of game play experiences. The positive benefits of commercial games primarily designed for entertainment purposes, have only recently become a focus within the games research community (e.g. well-being [47], mood [35] and cognitive reasoning [43]).

The question of how, and in what contexts, interactions with games promote lasting engagement and immersion is an ongoing one. The aim of our research is to understand the relationship between demonstrated in-game gameplay activity and a player’s experience of, and engagement with, the game. Specifically, the research reported in this paper examines how gameplay activities impact on player experience as measured by the Player Experience of Need Satisfaction (PENS) survey. Videogame experiences are examined in terms of action execution and evaluation. Norman’s theory of action [28] is adapted to analyse how cognitive action impacts on the gameplay experience. Measuring the extent to which games support players in achieving goals, performing actions, and interpreting the state of the game world is a key aspect of the research. Enjoyment is a complex construct and this study is particularly focused how cognitive dimensions of interaction influence experience.

The paper reports on a study of twenty-seven game players involved in playing three puzzle games. In the study game play activity has been examined to better understand how working towards achieving goals, controlling actions, analysing cause and effect, and evaluating outcomes impacts on a player’s motivation. As cognitive action is the focus of this research, puzzle games with their focus on logical and/or conceptual problem solving, were selected as a practical starting point. Future studies will examine the applicability of our method to different game genres.

2. BACKGROUND
The growth of research into the player experience in the past five years is evident with research covering player motivation and engagement, and the influence that game design has on player enjoyment [32][48].

2.1 Player Motivation
Recent research has identified motivation, in terms of cognitive processes, as playing a central role in the game play experience. Videogames are largely autonomous pursuits that create their own internal motivations for playing [15]. Intrinsic motivation can be characterised by free choice, interest, optimal challenge, and psychological needs, such as effectance, personal causation, competence, autonomy, and social needs [12]. Motivation theories focus on people as problem solvers; notions such as curiosity, incongruity, and complexity; and concepts of perceived control and self-determination [21].

In the early 1980’s, Malone [25] identified three categories of individual motivations during gameplay: challenge, fantasy, and curiosity. This original theory was later expanded to add control as an individual motivation, as well as cooperation, competition, and recognition as interpersonal motivations [26]. Increasingly,
the social components of gameplay are being explored as motivations for gameplay (e.g., [51][11]). While intrinsic motivation is central to videogame play, research has also examined the influence of extrinsic motivation on the gameplay experience. The Work Preference Inventory developed by Amabile et al. has been used to measure both intrinsic and extrinsic motivation orientations of game players [2].

Ryan, Rigby and Przybylski [32][37] have applied an established psychological theory – Self-Determination Theory (SDT) – to videogame player motivations. In this research project measurement of player experience is based on this theory. SDT is primarily concerned with the potential of social contexts to provide experiences that satisfy universal needs in people. As an approach to motivation, it defines three key needs associated with positive processes of self-motivation and personal integration [36]. These needs are competence (sense of efficacy), autonomy (volition and personal agency) and relatedness (social connectedness).

SDT has been successfully applied in research on sports, education and leisure domains. In applying SDT to videogame player motivations, Przybylski et al. [33] examine how video games fulfill or thwart psychological needs and thus promote or discourage sustained engagement and either positive or negative outcomes for players [32]. Based on SDT and other relevant theories (e.g., presence), Przybylski et al. developed the Player Experience of Need Satisfaction (PENS) measure, which assesses the play experience in terms of competence, autonomy, relatedness, intuitive controls and presence/immersion [37]. To assess game experience we used the 21-item PENS survey that consists of five dimensions: competency, autonomy, relatedness, presence, and intuitive controls. For this study we focused on competency, autonomy, presence and intuitive controls sub-scales.

2.2 Game Design and Player Experience

Games significantly extend the range of experiences available to a person. Enjoyable game experiences result from players being able to work through the game interface to become immersed in playful activity. The game environment is the medium that allows the player to achieve such an experience. The characteristics of the game form and content, in combination with characteristics of players, influence a player’s feeling of presence [23] According to Scoresby and Shelton [41], a computer game environment creates motivation through emotionally linking the player to the content. It is the interaction between sensory stimulation, environmental factors, and a player’s internal tendencies that encourage involvement and enable immersion [49].

Achieving a state of enjoyment or flow is dependent on activities that have clearly achievable goals and where the person understands the rules of interaction and feels in control [9]. It relies on a dynamic interaction between the skill and challenge levels offered by an activity [9][10]. Expectations of personal efficacy determine our ability to perform effectively [5]. Manipulating the difficulty levels of simple videogames has been demonstrated to influence task fluency and absorption in a game [25]. Immersive flow experiences emerge when an ideal balance between level of ability and challenge is achieved.

Malone and Lepper [26] identified heuristics for creating engaging experiences. These heuristics are based on features that make games fun and have been designed to motivate and engage. Habgood [15] has used these heuristics as the foundation for designing engaging educational games. Similarly GameFlow [46] is designed to identify elements of game environments that influence the player experience. Research has also explored how different people are motivated by different psycho-structural elements of games [48]. It builds on the structural features of games that might influence the play experience [50] and a taxonomy created by King et al. [19] that offers a psychological understanding of these structural features.

Motivation can be defined as the set of game characteristics that prompt a player to realize specific actions and continue the game task until goal achievement [14]. The game defines the interplay between a player’s actions, choices, and feedback, and creates a series of internal sensations [20]. Player experiences are influenced by game playability in terms of effectiveness, efficiency and satisfaction [39] and are affected by the quality of the storyline, game responsiveness, usability, control, strategy and intensity of interaction [14]. Game mechanics provide the game players with the goals of the game, the rules and rewards of action, and in-game choices.

2.3 Game play and Theory of Action

As people play games, patterns of behavior emerge. Player actions, their conduct in game play scenarios, as well as the consequences and relationships to other actions can be identified [6]. Identification of action and event patterns in puzzle games will allow us to better understand and articulate in-game player behavior. Norman’s Seven Stages of Action [28] has been used to model human interactions with both physical and computational objects. This interaction driven model details the process of executing and evaluating actions enacted by a person to achieve a particular goal. The execution of actions involves the intention to act, the sequence of actions to be performed and the physical execution of that action sequence. The evaluation process, which can change the current goal, involves a person’s perception of the world, the interpretation of that perception and an eventual evaluation of those perceptions [28].

Gameplay consists of the challenges and actions that a game offers the player how to solve those problems. Central to the player experience are the challenges that a player must face to achieve game objectives and the actions the player is permitted to address those challenges [1]. The core mechanic of a game contains the set of essential interactions which a player repeats during play [7]. It is these core mechanics that are translated into game challenges [1]. Game interactions are formalized through the rules of a game and players experience this system through play activity [38]. They translate goals embedded through rules and mechanics to actions suitable for the system. Feedback from the game system allows players to assess the effectiveness of their actions.

Our study focuses on deconstructing player activity from a cognitive perspective based on three key components – goals and challenges, action and interaction, and interpretation – that can be mapped to Norman’s seven stages of action. We consider game goals and challenges in the way that Norman describes activity goals. Action and interaction embody the ideas of developing an intention to act, action specification and execution. Interpretation includes players perceiving and interpreting feedback, as well as their evaluation of that feedback. This study focuses on puzzle-based games that emphasize problem solving through logical thinking, strategy formulation and pattern recognition [17].
3. GAMEPLAY ACTIVITY CHECKLIST

Based on the current literature we developed a checklist designed to be used by experts to deconstruct games based on the activities performed. These activities were categorized in terms of goals and challenges, action and interaction, and interpretation and were considered in relation to motivation theory and player experience. The checklist was refined using a two stage process.

Firstly, the six participants, who were either PhD students or researchers in game design, were involved in brainstorming ideas related to items that could be considered in each category. They worked with an initial set of items and were involved in categorizing them, assessing their appropriateness, and including new items.

The second stage of the process involved three game design experts analyzing the three puzzle-based used throughout our study using the resultant checklist. The experts played each game for 30 minutes and then assessed each item in the checklist on a 7-point Likert scale. The scale indicates their level of agreement from strongly disagree to strongly agree relating to each statement provided within the gameplay activity checklist. Discrepancies were addressed through a group meeting where items were discussed and refined in order to ensure the experts had a complete understanding of the checklist items and that they were clear and readily interpretable. The checklist categories and resultant items are outlined in the following sub-sections.

3.1.1 Goals and Challenges

Goal achievement is the vehicle for actions in the game [31]. These goals can be simple or complex and they may consist of sub-goals. Goals help maintain engagement and this engagement provides motivation for the player to gradually progress through a game [27]. The goals presented should consider the skill of a player. Skills refer to how players address game challenges to reach the different objectives and are enhanced as a player learns to play the game [14].

Goals and challenges within games are closely connected; striving to achieve a goal often embodies a level of challenge. Engagement during gameplay is delivered by achievable challenges and experiences within the game world [27]. Challenges must support player skill development and mastery. According to Loveless [24], engagement relies on players having the ability to acknowledge risk and uncertainty within challenges. Games should be sufficiently challenging and match the player’s perceived skill level [8][41].

3.1.2 Action and Interaction

The rules of a game specify what actions the players may take to overcome the challenges and achieve the goals of the game [1]. Actions are meaningful in the larger picture of the game that the player must understand in order to answer the question “What can the players do” [40]. Gameplay emerges from elements that allow player action and interaction [44].

Action underpins a player’s capacity to understand and master the game’s system and mechanics. Enabling players to learn the rules of the game allows them to interact with game objects and avoid frustration and confusion. A sense of competence emerges when players are successfully able to reach goals after overcoming obstacles [47]. Game difficulty is an important characteristic to manage and directly impacts these feelings of competence. However, games with simple actions mapping to goals may result in boredom as players progress through the game (Bjork & Holopainen in [27]). Difficulty may be perceived by a player as high or low depending on the steepness of a game’s learning curve [14]. One of the goals of game design is to make the game interface easy to learn, use and master [30]. The game interface is the mechanism through which the player interacts with a game; it is the mechanism of enabling player control.

The choices available in a game can generate a number of paths for the player to follow. Choice promotes the experience of autonomy that enhances intrinsic motivation [34] and therefore game activity should provide meaningful choices to players.

Control is achieved through game mechanics that allow players to act freely based on their own aspirations [42]. Feeling in control facilitates the fluency phenomena: an ability to achieve goals generating positive feelings and a sense of competence [46]. Although, the immersive game experience should reduce concern for self and sense of time, players should feel a sense of control over the tasks they complete [46]. The freedom and control to practice within a game environment provides players with the opportunity to play and solve problems in their own way and with a variety of choices [45]. The interface should make game control intuitive for the player [30], allowing them to readily recover from problems and errors.

Importantly, the game needs to unfold for players in a way that they understand well enough to continue to play the game and game designers should balance difficulty through including a tutorial level within the game [13]. Good game design will result in the player needing successively less time to improve their abilities to achieve the game’s objectives [14].

3.1.3 Interpretation

Gameplay involves players performing actions and assessing the outcomes. It is through interpreting and reflecting upon feedback within a game that players refine their behaviours. In order to evaluate whether a game goal or subgoal has been achieved, some kind of cognitive processing needs to occur [29]. The first step requires perceptual processing of game information. Both visual and auditory output is important as a mechanism to make players aware of changes that have occurred within the game environment.

When the system responds as a gameplay, the player must interpret the output, translating the physical display of the game interface [28]. This process is facilitated through high quality feedback. According to McGinnis et al. [27] player engagement is supported by the interactive feedback loop. The feedback helps players balance challenges through supporting a process of trial and error. Feedback allows players to interact without significant fear of repercussions, effectively providing learning without consequence (Gee in [27]). Players may therefore be comfortable exploring response possibilities and generating ideas to solve the problems. Safe environments provide positive feedback and frequent diagnostic assessment [3]. Within game environments feedback allows patterns of errors to emerge. Rapidity of feedback and continual representation of progress allows player to make use of perceptual facilitates in evaluating the outcome of actions [16].

The reflection enabled through feedback supports the construction of schemata that help players work towards their goals [18]. Through observing the interplay between actions and outcomes in games players may develop an understanding which is of relevance to within the game’s problem solving context [22].
4. ANALYSING PLAYER EXPERIENCE

We report on a study designed to examine player experience during gameplay in terms of the cognitive activity provided by the game. In exploring the relationship between the gameplay activities during game play and player experience, we decided to focus our study on three puzzle-based games – Portal 2, I-Fluid and Braid.

The study involves two parts. First, we designed the gameplay activity checklist using the method described in Section 3. The three expert reviewers analysed the games chosen for the study using the refined Gameplay Activity Checklist which deconstructs games in terms of goals and challenges, action and interaction and that they played games once a week, once a month and less than once a month respectively; 7.4% indicated they do not play videogames.

4.2 Method

Participants played approximately 45 minutes in total and completed a Player Experience Needs Satisfaction (PENS) questionnaire [33] after of each game. They played each game for 15 minutes. The order in which players were presented with the games was varied to avoid order effects.

4.2.1 PENS Measures

To assess game experience we used the 21-item PENS survey that consists of five dimensions: competency, autonomy, relatedness, presence, and intuitive controls. The PENS survey is designed to explain the game play factors that lead to enjoyable and meaningful player experiences [37]. Player experience as measured by PENS was our dependent variable.

For this study we focused on competence, autonomy, presence and intuitive controls sub-scales. We did not examine the PENS relatedness sub-scale, as all games were played individually. Each item consists of a statement on a seven-point scale ranging from 1 to 7. Specific subscales are described below [32].

PENS: In game Competence. This scale measures participants’ perception of competence during game play. Competence describes a player’s need for challenge and feelings of effectance [37].

PENS: In game Autonomy. This scale assesses the degree to which participants feel freedom of choice and perceive opportunities to do activities that interest them.

PENS: In game Presence. This scale measure a sense of immersion in the gaming environment and covers physical presence, emotional presence and narrative presence.

PENS: In game Intuitive Control (IC). This scale assesses the degree to which participants feel they are able to control actions in the game environment.

4.2.2 Gameplay Activity Measures

4.2.2.1 Goals and Challenges

The six items that are included that relate to achieving game goals are:

- G1: Primary goals have multiple components, are open-ended and/or are emergent, e.g. I can choose which non-playing characters I can help.
- G2: Primary goals encourage the player to create their own combination of sub-goals, e.g. I need to set my own practice schedule so I will be ready to battle the boss.
- G3: Goals orient the player towards developing new skills, understanding, improving the level of competence, or achieving a level of mastery based on self-referenced standards, e.g. I am going to improve on my last lap time.
- G4: The game provides a series of short-term goals with complexities built in.
- G5: Primary goal of game should be clear and presented at appropriate times.
- G6: Narrative mechanisms such as events, travel and/or time allow players to understand their progress towards achieving primary goal.

The ten items that are included that relate to game challenges are:

- G7: Cognitive, logical thinking or strategic planning is the focus of the main challenges in the game.
- G8: There are multiple types of scenarios/challenges made available in the game.
- G9: The game provides new scenarios/challenges at an appropriate pace.
- G10: The game allows the player to feel like they can perceive problems in their own way.
- G11: Challenge difficulty is adjusted by the player to match his/her level of competence.
- G12: Challenges in games match a player’s skill levels.
- G13: The game provides different levels of difficulty for different players.
- G14: The level of difficulty increases as the player progresses through the game and increases his/her skill level.
- G15: The game allows the player to solve problems through a variety of choices.
- G16: The scenarios and choices in the game are clearly related to the game narrative.

4.2.2.2 Action and Interaction

The eleven items that are included that relate game performing actions are:

- A1: The game provides easily understood rules.
- A2: Players develop an understanding of the rules using reasoning, observation, hypothesis testing and/or mental reflection.
- A3: The rules allow the player to perform more than three different interactive actions at any one time to address a scenario.
- A4: The rules allow the player to perform different methods or solutions to complete/solve a problem.
• A5: The game provides the player with interesting options and choices.
• A6: The game allows the player to experience a lot of freedom in the game.
• A7: The game allows for player actions that impact on and shape the immediate game world.
• A8: The game’s interface is easy to learn, use and master.
• A9: Game actions provide a sense of control over characters, units, movements and/or interactions in the game world [46].
• A10: Players discover the story of a game as part of gameplay.
• A11: The actions available to the player work well with the context of the game.

The seven items that are included that relate to having physical control are:
• A12: The game has good input control.
• A13: The game allows a sense of intuitive to use the game interface.
• A14: The game minimizes errors that are detrimental to the gameplay.
• A15: The game supports players in recovering from errors.
• A16: Players should feel a sense of control over the actions that they take and the strategies that they use.
• A17: Players feel free to play the game the way that they want.
• A18: The game increases the players’ skills at an appropriate pace as they progress through the game.

4.2.3 Interpretation
The five items that are included that relate to perceiving outcomes are:
• I1: The game provides visual and/or audio output that allows the player to assess the state of play at any given time.
• I2: The game provides mechanisms for players to receive immediate feedback on their actions.
• I3: The game allows the player to readily recognize the effect that his/her actions have had during gameplay.
• I4: The game provides players with a sense that the system responds to their actions.
• I5: Dramatic effects in the game are supported by game events.

The seven items that are included that relate to interpreting feedbacks are:
• I6: Feedback on goal progression provides positive reinforcement or information which enhances free choice and self-awareness, e.g. Progression bar used to show goal progress.
• I7: The game provides outcomes based on chance and randomness.
• I8: Feedback of goal progression is continuous, e.g. progression bar, constantly updating to reflect the players performance.
• I9: The game rewards players for their effort and skill development.
• I10: The game provides players with feedback on progress toward their goals.
• I11: The game’s visual and/or audio output is consistent with game elements and the overarching setting and story.
• I12: The game allows players to always know their status or score.

The two items that are included that relate to evaluating goals are:
• I13: The game allows players to evaluate the success of their actions based on outcomes of these actions.
• I14: The game requires players to experiment with ideas and evaluate their effectiveness.

5. RESULTS
Our results are based on the data gathered from the 27 participants who completed a PENS questionnaire for each game. The expert analyses of gameplay activity across the three games are also reported upon.

5.1 PENS Evaluation
The comparison of average player experience scores for each game is shown in Figure 1. The significant p-value \((F(df,8)=2.545, p<.05)\) shows an effect of each game on the dependent variables. Portal 2 received the highest average scores from players across all four sub-scales. I-Fluid received the lowest average scores for competence, intuitive control and presence. Both Braid and I-Fluid performed worst than Portal 2 in the autonomy sub-scale, with Braid performing slightly worse than I-Fluid. While averages were relatively close for all three games in the competence sub-scale (between 5.4 and 5.7), there were larger differences between Portal 2 and the other two games across autonomy, intuitive control and presence. Our results suggest that the Portal 2 player experience was better than either the Braid or I-Fluid experience. Player responses also appear to indicate that they generally had more positive experiences during Braid gameplay over I-Fluid.

![Figure 1: PENS (competence, autonomy, intuitive control and presence) for each game.](image)

5.2 Gameplay Activity Evaluation
Based on estimated marginal means using One-Way-ANOVA, the results show between three games there is significant difference in terms of goals and action \((F(df,2)=15.573, p=.004,F(df,2)=14.402, p=.005)\). In terms of goal-challenge and action/interaction assessment, Portal 2 received the highest scores, and Braid received the highest score in terms of interpretation assessment (Figure 2).

5.2.1 Goal and Challenge Activity Evaluation
The results in Figure 3 show the mean differences in expert assessment in terms of how players achieve goals and how the game allows players succeed at particular challenges. Portal 2 has the highest average scores for providing mechanisms that allow the player to succeed at particular challenges, while Braid performed the best in terms of allowing players to achieve their goals.
Through examining the items within these categories in more detail, the game variations that produce these results become clearer. When considering achieving goals, the experts indicated through their scores that primary goals in Braid gameplay were more likely to encourage the player to create his or her own combination of sub-goals (G2). Conversely, I-Fluid did not perform well in providing players with narrative mechanisms such as events, travel and/or time to allow players to understand their progress towards achieving their primary goal (G6). Table 2 provides a comparison of the average scores for these two items across the three games.

Table 3 shows the items that were noticeably different across the three games within the category of succeeding challenges. The expert reviewers assessed Portal 2 gameplay as providing greater opportunities for cognitive, logical thinking or strategic planning (G7) than Braid, which in turn performed better than I-Fluid on this item. Similarly, Portal 2 performed better on providing players with multiple types challenges (G8), introduces challenges at a more appropriate pace, and allows players to perceive problems in their own way (G10) than either Braid or I-Fluid. Portal 2 also received higher scores for providing choice based on game narrative (G16).

In comparison to Portal 2 and Braid, I-Fluid received the best average scores for game design related to managing difficulty, by allowing better options for players to adjust the difficulty level (G11) and including different levels of difficulty for different players (G13). I-Fluid and Portal 2 offered gameplay that allowed players to solve problems through a variety of choices at a greater level than Braid (G15).

5.2.2 Action and Interaction Evaluation

The results in Figure 4 show the mean difference of expert scores with respect to how they felt the games allowed to perform actions and the level of physical control enabled. In both areas Portal 2 performed better than the other two games, with I-Fluid not performing as well in comparison.
as effective as the other two games in connecting gameplay action to an emerging story (A10 and A11).

<table>
<thead>
<tr>
<th>Perform more than three different interactive actions (A3)</th>
<th>Braid</th>
<th>I-Fluid</th>
<th>Portal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td>2.67 (0.58)</td>
<td>2.67 (0.58)</td>
<td>6.00 (1.00)</td>
</tr>
<tr>
<td>Perform different methods/solutions (A4)</td>
<td>3.67 (0.58)</td>
<td>2.67 (0.58)</td>
<td>4.67 (0.58)</td>
</tr>
<tr>
<td>Actions impact on and shape the game world (A7)</td>
<td>1.67 (0.58)</td>
<td>3.33 (1.15)</td>
<td>4.00 (1.00)</td>
</tr>
<tr>
<td>Discover the story (A10)</td>
<td>4.33 (1.15)</td>
<td>1.67 (0.58)</td>
<td>5.67 (0.58)</td>
</tr>
<tr>
<td>Actions available with the story (A11)</td>
<td>4.33 (1.15)</td>
<td>2.67 (0.58)</td>
<td>5.67 (0.58)</td>
</tr>
</tbody>
</table>

**Table 4: Performing actions across the three games.**

Table 5 outlines the physical control items that had notably different mean reviewer scores. Portal 2 received scores that indicated it performed better than the other two games with respect to having good input control (A12). With respect to minimizing and recovering from errors (A14 and A15), I-Fluid received scores that were low in comparison to Braid and Portal 2.

<table>
<thead>
<tr>
<th>Good input control (A12)</th>
<th>Braid</th>
<th>I-Fluid</th>
<th>Portal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td>4.67 (0.58)</td>
<td>5.00 (0.00)</td>
<td>6.33 (0.58)</td>
</tr>
<tr>
<td>Minimises errors (A14)</td>
<td>4.67 (1.15)</td>
<td>1.67 (0.58)</td>
<td>5.33 (0.58)</td>
</tr>
<tr>
<td>Support recovering from errors (A15)</td>
<td>6.67 (0.58)</td>
<td>3.67 (0.58)</td>
<td>6.00 (1.00)</td>
</tr>
</tbody>
</table>

**Table 5: Physical control across the three games.**

### 5.2.3 Interpretation Activity Evaluation

The results in Figure 5 show the mean differences between how experts judged each game’s ability to provide mechanisms which allow players to perceive outcomes, interpret feedback, and evaluate goals. Portal 2 and I-Fluid received lower scores than Braid for providing ways for players to interpret feedback, yet received higher scores than Braid for allowing players to evaluate goals. Portal 2 performed better than the other two games on providing means by which players can perceive the outcome of an action.

Across all categories within the interpretation domain there was only one item that had a clear variation across games. Analysis shows Portal 2 and Braid provided better feedback on goal progression which resulted in positive reinforcement (see Table 6).

<table>
<thead>
<tr>
<th>Provides positive reinforcement / information (I6)</th>
<th>Braid</th>
<th>I-Fluid</th>
<th>Portal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (SD)</td>
<td>3.67 (0.58)</td>
<td>2.33 (0.58)</td>
<td>4.00 (1.00)</td>
</tr>
</tbody>
</table>

**Table 6: Interpreting feedback across the three games.**

Average reviewer scores for perceived outcome items appeared quite consistent, ranging between 5 and 6 for three of the items (12, 13 and 14). I-Fluid’s performance was rated a little lower for 11 – the game providing appropriate audio/visual output. Braid scored an average below four on item 15 which related to dramatic effects tying to game events. In terms of evaluating outcomes results were relatively even, with Portal 2 and I-Fluid outperforming Braid slightly on both items.

While other differences weren’t large, it is interesting to note that Braid performed best on four of the seven interpretation items (17, 18, 110 and 111) and received an equal average score with I-Fluid on another item (110). The only item that Portal 2 received the best average score is reported in Table 6 (16). I-Fluid outscored the other two games it providing the best rewards for player effort and skill development (19).

### 6. DISCUSSION

Our analysis of the three games, Portal 2, Braid and I-Fluid, demonstrates that Portal 2 engenders feelings of competence, autonomy, intuitive control and presence/immersion at greater levels than either Braid or I-Fluid. Portal 2 also performed best on expert assessment on providing appropriate goal and challenge activity and allowing players to effectively act and interact. There was not a lot of difference across the three games in terms of interpretation activities, and Portal 2 once again performed best in allowing players to perceive outcomes and evaluate goals (equal with I-Fluid).

Braid was the middle performer with respect to engendering feelings of competence, intuitive control and presence/immersion. Expert assessment of Braid is mixed. While it fell between Portal 2 and I-Fluid in terms of action and interaction, it performed best in across interpretation activities, largely due to scores in the feedback category, and performed worst in the goals and challenge domain. The breakdown indicates that while experts felt that Braid performed best with respect to goal design, the challenges players faced were not necessarily appropriate. Difficulty and pace of challenges isn’t managed in a flexible way. Despite good feedback, these limitations in challenges may account for the PENS results for Braid. The lack of choice and the limitations with respect to difficulty adjustment may have resulted in Braid being judged by players as providing the least amount of autonomy.

PENS results for I-Fluid indicate that players felt the least amount of competence, intuitive control and presence. It was the middle performer for providing feelings of autonomy. Well designed goals, and the ability to effectively act and interact within the game world appear to directly impact on player motivation. Here again the autonomy result is might be an indication of the
importance that choice in challenge and difficulty has on perceived autonomy.

Results indicate that there may be a relationship between feelings of intuitive control, and the action and interaction dimension of videogame activity. Players felt in more control while playing Portal 2 and felt the least amount of control in I-Fluid. Similarly, Portal 2 performed best in expert assessment of allowing players to perform actions and being in physical control of the experience, and I-Fluid performed the worst of the three games. While intuitively this makes sense, it is useful to have data that points to this relationship. It might be assumed that the lack of error support in I-Fluid might account for players’ perceived lack of control. It also appears that the choice of actions to achieve goals in Portal 2 and its ability to connect to story elements to gameplay may improve player feelings of control. It is perhaps this linking to story elements to gameplay that also influences player feelings of presence.

Results indicate that there was a close relationship between action and physical control from a design perspective. The game that had better clarity and choice around actions also provided better physical control. However similar patterns weren’t seen in the other two activity domains. For example, it appears that games can be design to have strength in one category relating to interpretation and be weak in another. Where the experts felt that Braid did the best job of providing feedback, they also felt it provided the worst at allowing players to evaluate their performance. While it may have been assumed there would be a close link from a design perspective between quality goals and quality challenges, our results demonstrate that goals can be clearly designed in a context where challenges are limited or lack flexibility.

The problems that the game presents underpin the potential for the game to support engagement of creative processes [3]. While the games selected for the studies – Portal 2, I-Fluid and Braid – are all puzzle-based, they have different game mechanics, goals and settings and may therefore provide different opportunities with respect to engagement in decision making processes.

7. CONCLUSION
The findings reported in this paper show that the expert review method is able to identify game play activities and therefore offers opportunities to examine games in detail. We have used activity data to better understand how in-game activities influence player motivation. Findings indicate that the positive experiences, particularly with respect to competence, autonomy, intuitive control and presence are directly influenced by game activity design. It appears that good player action and interaction design, particularly with respect to error management, has an impact on feelings of intuitive control. The impact that challenge design has on autonomy is particularly noteworthy. While it may be assumed that categories within activity domains might be closely associated from a design perspective our research demonstrates that this is not necessarily the case. Designers need to carefully consider all aspects of activity and not value one over another (e.g. clear goals over appropriate challenges, good immediate feedback over mechanisms for players to assess progress towards goals) in order to produce games that are highly motivating.

8. ACKNOWLEDGMENTS
The authors would like to thank Games Research and Interaction Design Lab team, Queensland University of Technology for their support and cooperation during this study.

9. REFERENCES