Finding Flow with Games: Does Immediate Progress Feedback Cause Flow?

Emergent Research Forum Paper

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Abstract

Nakamura & Csikszentmihalyi (2002) proposed that three flow conditions lead to flow: clear proximal goals, immediate progress feedback, and challenges that stretch skills. So far, only the link between optimal challenges and flow has been validated by controlled experiments (Keller & Bless, 2008). This paper presents a between-subjects controlled experiment to investigate if one of these flow conditions, immediate progress feedback, leads to flow using a computer game. The treatment version of the game is designed to give more immediate progress feedback than the control version. This feedback shows both how well they are playing and how they can improve their performance. Flow conditions and flow indicators will be measured with questionnaires adapted primarily from Fang et al. (2013). The Flow Indicator Questionnaire will measure how much participants experience flow and the Flow Condition Questionnaire will serve as a manipulation check.

Keywords

Introduction

The computer and video game industry sold over $21.5 billion in the US and over $93 billion worldwide in 2013 (TheESA.com, 2014; Gartner.com, 2013). What are people buying when they buy games? We argue they are buying enjoyable experiences. So, understanding what makes games enjoyable is important, and one main source of game enjoyment is flow (Fang et al., 2013).

Flow is the experience of overcoming optimal challenges for the enjoyment they provide while continuously adjusting performance based on feedback. Much of research on flow has focused on measuring how much people are in flow. For example, several flow measures consist of 9 dimensions from Csikszentmihalyi's (1990, 1993) popular books on flow (e.g. Fang et al., 2013; Jackson & Marsh, 1996; Jackson & Eklund, 2004).

Nakamura and Csikszentmihalyi (2002) separated flow into two sets of factors: conditions leading to flow and indicators showing how much a person is in flow. Most research on flow failed to separate flow conditions from indicators (Fang et al. 2013; Jackson & Eklund, 2004; Sweetser & Wyeth, 2005). If practitioners know what conditions lead to flow, designs can be engineered to meet the flow conditions. While controlled experiments have shown that optimal challenges lead to flow (Keller & Bless, 2008), the causal link between immediate progress feedback and flow has not been tested. This paper aims to fill this research gap.

Our research objective is to investigate if immediate progress feedback causes flow. This kind of feedback communicates how well they are performing and how they can improve their performance. This study's findings aim to shed light on how to design systems that facilitate flow. This paper is organized as follows: 1) flow theory, 2) flow conditions and indicators, 3) hypothesis, 4) method, and 5) current progress and next steps.
Flow Theory

Flow is the empirical phenomenology of intrinsically motivated activities, of activities done for their own sake. Flow theory focuses on motivation that comes from enjoyment of the activity itself (Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005).

Much of the popular focus on flow has been on the balance between skills and challenges. The original model showed three channels resulting from different skills and challenges: anxiety, boredom, and flow (Csikszentmihalyi, 1975). Massimini and Carli (1988) expanded this into an 8-channel model separating a Cartesian plane of high and low skills and challenges into a circle with the following 45 degree segments: arousal, flow, control, boredom, relaxation, apathy, worry, and anxiety.

Csikszentmihalyi and Larson (1987) developed the Experience Sampling Method (ESM) to investigate experience fluctuations in daily life. DeVries (1992) applied ESM to the study of mental illness. Hektner et al. (2007) created a practical guide for ESM research. Using ESM, Csikszentmihalyi and LeFevre, (1989) found that people were over three times more likely to experience flow while working than while in leisure.

Finneran and Zhang (2003) suggested that flow conditions could be met by the states and traits of the person, the design of the system being used, the task or activity, or interactions between these three sources. Their Person-Artifact-Task (PAT) model emphasized separating the task from the artifact when investigating flow in computer-mediated environments. While the PAT model describes sources of influence on flow conditions, our research focuses on the causal relationship between flow conditions and flow indicators. Cowley, Charles, and Black (2008) extended the PAT model to games with their User-System-Experience (USE) model. However, they did not present research to validate this model.

Agarwal and Karahanna (2000) argued that cognitive absorption, which is what they call flow, leads to perceived usefulness and perceived ease of use, which in turn lead to an intention to use. They also suggested that individual traits of playfulness and personal innovativeness lead to cognitive absorption, similar to the Person component of the PAT model.

Numerous researchers have attempted to apply flow theory and measure flow in computer games (Cowley et al., 2008; Fang et al., 2013; Fu et al., 2009; Sherry, 2004; Sweetser & Wyeth, 2005; Sweetser et al., 2012).

Flow Conditions and Indicators

Nakamura and Csikszentmihalyi (2002) proposed three flow conditions are required to get into flow: challenges that stretch skills, clear proximal goals, and immediate progress feedback. They wrote flow is "the subjective experience of engaging just-manageable challenges by tackling a series of goals, continuously processing feedback about progress, and adjusting action based on this feedback" (p. 90). This is how the flow conditions come together to create the flow experience.

Schaffer (2013) proposed seven flow conditions in a company whitepaper, adding clear methods for action, freedom from distractions, and clear navigation if navigation is involved, and splitting challenges and skills. However, these flow conditions have yet to be validated by controlled experiments, so we began with the three conditions from Nakamura & Csikszentmihalyi (2002).

The following subsections describe previous research on the three flow conditions and their relationships with flow.

Optimal Challenges that Stretch Skills

To get into flow, user perception of challenges and skills must be balanced and high (Csikszentmihalyi et al., 2005). Pagulayan et al. (2012) distinguished between challenges created intentionally by designers for players to overcome, and frustrating usability problems.

The correlation between optimal challenges and flow has been well established in the literature. For example, Moneta & Csikszentmihalyi (1996) showed the mean of challenge, skill, and the balance between the two was positively related to flow. Shernoff et al. (2003) found that experiences of high challenge and
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skill were related to flow using longitudinal ESM data from 526 US high school students in the Sloan Study of Youth and Social Development (Schneider, 2013). Abuhamdeh & Csikszentmihalyi (2012) studied internet chess players with post-game surveys and found that perceived challenge and perceived skill were both correlated with enjoyment.

Few studies have tested if optimal challenges cause flow (Keller & Bless, 2008; Moller et al., 2010). Keller & Bless (2008) tested if optimal challenges lead to flow by varying the speed of a Tetris game. Participants in the adaptive difficulty condition reported higher enjoyment and involvement than in the fast or slow conditions.

Clear Proximal Goals

Clear proximal goals are often misinterpreted as the overall goal of an activity. For example, the measure of flow developed by Jackson and Eklund (2004) has items such as "I knew what I wanted to achieve" and "My goals were clearly defined" that seem to focus more on the overall goal. As Csikszentmihalyi and Nakamura (2010) explained, "What counts is not that the overall goal of the activity be clear but rather that the activity present a clear goal for the next step in the action sequence, and then the next, on and on, until the final goal is reached" (p. 187). In contrast, an item from the flow measure developed by Rheinberg et al. (2002) and Engeser (2012) says, "I know what I have to do each step of the way". This item seems closer to the intended meaning of clear proximal goals.

Several researchers have pointed to Mannell and Bradley's (1986) controlled experiments as evidence that clear goals cause flow (e.g. Keller & Bless, 2008; Moller et al., 2010). However, all participants across their experimental conditions were given the same clear instructions about how to play the game. Their manipulation had more to do with perceived choice and having clear criteria for evaluation than clear proximal goals.

Immediate Progress Feedback

Immediate progress feedback tells players how well they are progressing at an activity, whether to adjust or maintain performance, and how players can adjust their performance if needed (Csikszentmihalyi et al., 2005).

Butler & Nisan (1986) conducted a study on the effects of different kinds of feedback on the performance and intrinsic motivation of sixth-grade students. Students who received written comments rated the activity as more interesting and were more willing to do more of the activity than students who received grades. However, the feedback was given after each session, not continuously as the students were performing each task of the activity.

Norman (2013) defined feedback as continuous information about the results of actions. Immediate progress feedback needs to convey more information than just the results of actions. It needs to communicate how well the user is doing the task and how they can improve their performance.

Flow Indicators

The flow indicators indicate how much a person is in flow. Hektner, Schmidt, & Csikszentmihalyi (2007) wrote that flow could be measured as a continuum based on the sum of three variables: "Concentration", "Enjoyment", and either "Interest", "Wish to be doing the activity", or "Excitement", depending on whether one is interested more in the cognitive, motivational, or emotional aspects of the flow experience. Similarly, Shernoff et al. (2003) measured flow by averaging ratings of concentration, enjoyment, and interest. Analysis of ESM data suggests ease of concentration is another important flow indicator (Csikszentmihalyi & Nakamura, 2010).

Fang et al. (2013) and Jackson & Marsh (1996) instead started with the 9 elements or dimensions of flow laid out by Csikszentmihalyi (1990, 1993). These factors became the subscales for their measures of flow. Not including the three flow conditions, the flow indicators from the measure of flow developed by Fang et al. were: concentration on the task at hand, sense of control, immersion, and autotelic experience. Rheinberg et al. (2002) and Engeser (2012) created another flow measure, the Short Flow Scale. These measures did not differentiate between flow indicators and conditions.
Hypothesis

If the flow conditions Nakamura and Csikszentmihalyi (2002) proposed cause flow, designs that fulfill these flow conditions will lead users to experience more flow, and they will rate their experience higher on a measure of flow indicators (Figure 1).

Figure 1. A model of flow conditions and indicators

Keller and Bless (2008) showed that challenges that stretch skills cause flow. The association between clear proximal goals and flow may be self-evident. If users do not know what to do next, they will be less likely to get into flow. Clear proximal goals are also very similar to affordances or signifiers, which are already established as important usability factors in the HCI literature (Norman, 2013). Only the effect of immediate progress feedback on flow remains to be validated in this model.

Hypothesis: participants in the flow condition of immediate progress feedback will rate their flow experience significantly higher on the Flow Indicator Questionnaire than participants who do not receive such feedback.

Method

Participants

Sixty undergraduate and graduate students will be recruited at DePaul University as participants. This university has a very diverse population.

Independent and Dependent Variables

The independent variable is immediate progress feedback and the dependent variable is flow.
Figures 2 & 3 illustrate differences between the two experiment conditions. Both versions provide audio and visual feedback about success or failure. This is to ensure that all participants play a functioning game. However, only the treatment version of the game provides immediate progress feedback, showing participants how far they were from their target and whether they pressed the spacebar too soon or too late.
The dependent variable is measured by the 22-item Flow Indicator Questionnaire (FIQ). Flow conditions are measured as a manipulation check with the 13-item Flow Condition Questionnaire (FCQ). These questionnaires were adapted primarily from Fang et al. (2013). Appendices A and B present item sources.

**Experimental System**

The experiment will be conducted on a single laptop computer, a Lenovo Thinkpad E531. Participants will play a simple timing game developed using GameMaker: Studio.

When the game starts, a short message appears on screen with instructions explaining the controls and objective of the game. Players press the spacebar to begin each round. Two objects move across the screen, one horizontally and the other vertically, and intersect in the middle of the screen. Players attempt to press the spacebar when the objects intersect. Successful timing results in a positive sound and an explosion animation, while pressing the spacebar too early or too late results in a negative sound and the visual feedback shown in Figures 2 and 3 above.

The initial object speed is 480 pixels per second. Each successful round increases object speed by 15 pixels per second. However, each unsuccessful round decreases the speed by 30 pixels per second. This is similar to the adaptive difficulty condition used by Keller and Bless (2008), also known as dynamic difficulty adjustment (Hunicke, 2005).

Player performance and object speed will be logged with timestamps. The game will automatically end after a fixed amount of time, which will be determined in pilot testing with the aim of giving players enough time to play without getting fatigued.

The simple timing game design was chosen to isolate and manipulate immediate progress feedback. The same instructions and dynamic difficulty adjustment are used in both conditions to hold clear proximal goals and optimal challenges constant. Manipulation checks will verify that, out of the three flow conditions, only immediate progress feedback is significantly different between the two groups.

**Procedure**

Participants will be recruited with flyers and emails. Each participant will volunteer to participate and be given an information sheet about informed consent before the experiment begins. Then they will be randomly assigned to one of the two experimental conditions. Participants will read on-screen instructions and play the game.

When the game ends, participants will fill out the Flow Indicator Questionnaire (FIQ) and then the Flow Condition Questionnaire (FCQ). This order ensures that the manipulation check, the FCQ, will not bias their responses on the measure of the dependent variable, the FIQ.

Next, participants will fill out a questionnaire to collect demographics and gameplay experience. A debriefing will follow to gather additional insights about their experience playing the game. Participants will receive a $20 gift card as an incentive to participate.

**Next Steps**

We plan to conduct the experiment during summer and report our preliminary findings at the conference.
References


### Appendix A. Flow Condition Questionnaire

<table>
<thead>
<tr>
<th>Flow Conditions</th>
<th>Number of Items</th>
<th>Example Items</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges that Stretch Skills</td>
<td>5</td>
<td>I was challenged by this game, but I believed I was able to overcome those challenges. I felt just the right amount of challenge.</td>
<td>Fang et al. (2013); Hektner et al. (2007); Rheinberg et al. (2002); Engeser (2012)</td>
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<tr>
<td>Clear Proximal Goals</td>
<td>4</td>
<td>My next steps were clearly defined. I knew what I had to do each step of the way.</td>
<td>Fang et al. (2013); Csikszentmihalyi &amp; Nakamura (2010); Rheinberg et al. (2002) and Engeser (2012);</td>
</tr>
<tr>
<td>Immediate Progress Feedback</td>
<td>4</td>
<td>I was aware of how well I was playing this game. It was really clear to me how I was doing in the game.</td>
<td>Fang et al. (2013); Jackson &amp; Eklund (2004)</td>
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### Appendix B. Flow Indicator Questionnaire

<table>
<thead>
<tr>
<th>Flow Indicators</th>
<th>Number of Items</th>
<th>Example Items</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration on the task at hand</td>
<td>2</td>
<td>My attention was focused entirely on the game that I was playing. When playing this game, I was totally concentrated on what I was doing.</td>
<td>Fang et al. (2013)</td>
</tr>
<tr>
<td>Ease of Concentration</td>
<td>2</td>
<td>It was hard to concentrate. I had no difficulty concentrating.</td>
<td>Csikszentmihalyi &amp; Nakamura (2010); Schneider (2013); Rheinberg et al. (2002); Engeser (2012)</td>
</tr>
<tr>
<td>Sense of Control</td>
<td>3</td>
<td>While playing this game, I felt in control over what I was doing in the game. I felt that I had everything under control.</td>
<td>Fang et al. (2013); Rheinberg et al. (2002); Engeser (2012)</td>
</tr>
<tr>
<td>Immersion</td>
<td>9</td>
<td>I often found myself playing the game spontaneously and automatically without having to think. I was not concerned with what others may have been thinking of me. I did not notice time passing.</td>
<td>Fang et al. (2013); Jackson &amp; Eklund (2004); Rheinberg et al. (2002); Engeser (2012)</td>
</tr>
<tr>
<td>Autotelic experience</td>
<td>6</td>
<td>I enjoyed the experience. Playing this game was rewarding in itself. I wished I was doing something else.</td>
<td>Fang et al. (2013); Shernoff et al. (2003); Hektner et al. (2007)</td>
</tr>
</tbody>
</table>