ABSTRACT
Because of the immersive user experience (UX), digital games are the most popular form of entertainment today. Game designers have found Csikszentmihalyi’s flow model useful in order to optimize UX. Although the flow model is widely used in both the game design and research, it tends to narrow UX down to an optimal flow channel. Based on the analysis of self-report data of 2,436 gamers, we studied psychological dimensions of UX within all four channels of the original flow model, namely, flow, boredom, apathy, and anxiety. Our analysis suggests renaming boredom, apathy, and anxiety channels respectively as relaxation, impassiveness, and overwhelm, at least in the context of digital games. Our results also point out the relevance of a multidimensional UX evaluation in future projects, which aim at enhancing UX outside the flow channel or assessing outcomes related to digital games.

Author Keywords
Digital games; user experience; flow; emotions

ACM Classification Keywords
K.8.0 Personal Computing; General: Games; I.6.8 Gaming

INTRODUCTION
Digital games (e.g., PC, console, and mobile) are the most popular form of entertainment due to experiences they provide for gamers [8, 11]. Gamers often describe user experience (UX) in games as immersive and fun [8, 15]. These descriptions are similar to those people report when having an “optimal experience”, that is, flow [3]. Consequently, many researchers use Csikszentmihalyi’s flow model to describe UX in games [8] and the “flow-zone” is proposed one of the major game design goals [1].

Flow is a sum of many subcomponents. The most commonly referred flow subcomponents in game design heuristics are challenges and positive emotions [11]. More subcomponents are included in the theoretical set of GameFlow criteria [15], namely, concentration, challenge, skills, control, clear goals, feedback, immersion, and social interaction. An empirical gamer interview data reveals similar concentration, challenge, competence, enjoyment, and control subcomponents [14]. Nevertheless, the right amount and relevance of the subcomponents to evaluate flow is not clear [7]. Many of the above subcomponents contribute to UX, in addition to the optimal flow. Unfortunately, the field of game research still lacks an empirical study that reveals how UX evolves within Csikszentmihalyi’s original flow model [2]. Such inspection would show why flow is achieved and what happens outside the flow channel.

Flow
Csikszentmihalyi [3] defines flow as a positive and enjoyable experience stemming from an interesting activity that is considered worth doing for its own sake. In the core of the theory are the cognitively evaluated challenges provided by the activity and the skills possessed by the respondents. Flow evolves when a person evaluates both the challenges and the skills as being high and in balance. More specifically, this state is referred to as the “flow channel” [3]. Later, the flow channel model was expanded to a four channel flow model, which integrates flow and three different emotional states to cognitive challenge-skill evaluations (Figure 1).

In addition to cognitions and emotions, Csikszentmihalyi [3] included motivation and attention, such as deep involvement and concentration as part of the flow theory.

Figure 1. The four channel flow model.
Csikszentmihalyi introduced Experience Sampling Method (ESM), which includes subcomponents to evaluate challenge-skill channels. Thus, the theory provides psychologically relevant dimensionality and subcomponents to study UX in general [17].

Previously, ESM has been used to study experiences in daily activities [5]. In an ESM, a beeper randomly alerts participants during the course of the day to fill in a self-report form questioning participant’s immediate experience. ESM studies in schools [6, 12] and work places [10] have revealed that characteristics for flow channel are increased motivation, heightened arousal, concentration, creativity, sense of control, positive affect, satisfaction, and enjoyment. The boredom channel is characterized by the high sense of control, satisfaction, positive affect, and enjoyment. Concentration, creativity, and in some cases also arousal are characteristics for the anxiety channel. Finally, in the apathy channel only motivation is increased.

ESM studies conducted in the game context [8] have concentrated more on the temporal changes in UX rather than on the challenge-skill channels. The authors have concluded that ESM might not be the best way to assess game playing, because it is less sensitive to small time interval incidences as compared to studies with larger time constants conducted in everyday life context.

We extracted the ESM subcomponents from an empirical data, created the challenge-skill channels, and profiled UX in each channel. The data was collected with an Experimental Virtual Environment Questionnaire (EVEQ) [17], which is specifically designed to evaluate digital games [18] and Virtual Environments [16].

METHOD
Participants
EVEQ was administered to a total of 2,436 Finnish gamers - 2,180 males and 256 females, who filled in the questionnaire in three different laboratory experiments (n = 361) and two different Internet surveys (n = 2,075). Whether online or in the laboratory, the gamers first played a digital game and then filled in the questionnaire. In both cases, the instructions for completing the questionnaire encouraged the participants to reflect on their subjective playing experience in that one particular game session.

In the whole sample, the mean age of the respondents was 21.6 years (SD = 5.9). The average time of playing was 135 minutes (SD = 123). The most popular game genre played (32%) was first-person shooters. The second most popular genre (15%) was MMORPG and the third was single role-playing games (13%). Altogether, the sample included approximately 320 different games, various displays (HMD, Stereo3D), and contexts of play (home, laboratory).

Measures
EVEQ provides multivariate measures to evaluate previously used ESM subcomponents [6, 12] namely, challenge, skill, motivation, arousal, concentration, creativity, control, positive affect, satisfaction, and enjoyment. Table 1 divides the used subcomponents according to cognition, emotion, motivation, and concentration dimensions.

Motivation was measured with two subcomponents of the involvement construct, that is, importance and interest [13]. Interest is composed of emotional and value-related valences and importance is dominantly a cognitive subcomponent showing how meaningful and relevant the game was. Concentration was measured with subcomponents attention and arousal. Here concentration describes effortful awareness and Thus includes both the cognitive (attention) and physiological (arousal) components [9]. Feelings of both satisfaction and positive affect are included in the valence subcomponent. The previously used creativity concept was included in the playfulness, (e.g., being inventive and imaginative) subcomponent. Finally, skills are included in the competence subcomponent.

In addition to ten subcomponents used in previous flow studies, we analyzed impressiveness. Impressiveness assesses exceptional feelings such as awe and amazement, which are crucial part of many digital games [11, 14]. Factor scores for each subcomponent were calculated with Bartlett’s method and their internal consistencies were estimated with Tarkkonen’s rho ( > .70 acceptable) [19].

RESULTS
The challenge-skill channels were formed by splitting the challenge and competence subcomponents into ‘high’ and ‘low’ groups. This produced the four channels: apathy (n = 591) had low challenge and low competence, anxiety (n =

<table>
<thead>
<tr>
<th>Name and number of items</th>
<th>P</th>
<th>Description</th>
<th>Sample question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitions Competence (Skill)</td>
<td>11</td>
<td>86</td>
<td>Skilled with positive feelings of effectiveness</td>
</tr>
<tr>
<td>Challenge</td>
<td>5</td>
<td>76</td>
<td>Game was challenging and required my abilities</td>
</tr>
<tr>
<td>Emotions Valence (Affect &amp; Satisfaction)</td>
<td>10</td>
<td>77</td>
<td>Positive affect, happy, not bored or anxious</td>
</tr>
<tr>
<td>Impressiveness</td>
<td>9</td>
<td>79</td>
<td>Amazed and astonished by the game</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>7</td>
<td>77</td>
<td>Playing was pleasant and somewhat special</td>
</tr>
<tr>
<td>Playfulness (Creativity)</td>
<td>9</td>
<td>78</td>
<td>Cognitively spontaneous and creative</td>
</tr>
<tr>
<td>Control</td>
<td>5</td>
<td>74</td>
<td>Feeling of being in control and independent</td>
</tr>
<tr>
<td>Motivation Interest</td>
<td>6</td>
<td>32</td>
<td>Value-related valences towards the game</td>
</tr>
<tr>
<td>Importance</td>
<td>8</td>
<td>87</td>
<td>The meaning and relevance of the game</td>
</tr>
<tr>
<td>Concentration Attention (Concentration)</td>
<td>12</td>
<td>84</td>
<td>Time distortion and focus on the game world</td>
</tr>
<tr>
<td>Arousal (Activation)</td>
<td>5</td>
<td>70</td>
<td>Level of emotional arousal and activation</td>
</tr>
</tbody>
</table>

Table 1. The 11 subcomponents used in this study. The name of the subcomponent used in previous studies is in parenthesis.
interaction effect was found in either playfulness or attention, thus they can be experienced if either challenge or competence is high. Contrary to the flow channel, all the subcomponents but interest were very low in the apathy channel.

Both boredom and anxiety channels had clear characteristics of their own. Boredom channel was high in control, valence, and both motivation subcomponents but low in both the concentration subcomponents. Contrary, Anxiety channel was low in control, valence, and both motivation subcomponents, but high in both the concentration subcomponents.

CONCLUSION
This study profiles UX in the four channels of Csikszentmihalyi’s flow model [3]. First, an empirical user data was divided into four challenge-skill channels. Then, the cognitive, emotional, motivational, and concentration dimensions of UX in each channel were evaluated. Because of the interplay between challenge and skill has not been previously studied in this magnitude in digital games, we relate the results to flow studies conducted in other contexts. Despite the methodological (ESM – EVEQ; unbalanced gender), contextual (daily activity – one game), and cultural (Italy and USA - Finland) differences, our results were in line with the previous flow channel studies [6, 10, 12]. The UX profiles of the boredom, anxiety, and apathy channels suggest renaming the original channels as following: relaxation, overwhelm, and impassiveness.

Beyond boredom, anxiety, and apathy
Following the original theory, high and balanced challenge-skill evaluations in the flow channel were accompanied with high motivation, concentration, and positive emotions. Especially characteristic for the flow channel was impressiveness, which contributes both the intensity and excitement of UX.

Contrary, low challenge-skill ratio in the apathy channel indicates only mild increase in motivation (interest). This was also found in a previous study [10]. Although, in the

![Image](88x113 to 517x269)

Figure 2. The means of the four challenge-skill channels in nine subcomponents used. The subcomponents are connected to each other in order to create a profile and to enhance the readability of the results.
apathy channel, feeling of enjoyment was especially low, the name of the channel may be a too strong statement. Instead of apathy, the UX profile suggests gamers being indifferent, reticent, or insipid. Because of the mild increase in interest but lack of both excitement and positive emotion, we suggest renaming the apathy channel to **impassiveness**.

Similarly, the names of both boredom and anxiety channels do not support their UX profiles. Ellis and Voelkl [6] characterized boredom experience with high arousal and unpleasantness. However, gamers in the boredom channel experienced positive emotions and high motivation without high arousal. In their eight-channel flow model Massimini and Carli [12] named a low challenge-moderate skill condition relaxation. Later, Csikszentmihalyi [4] used relaxation to describe low challenge-high skill condition in his version of an eight-channel flow model. Thus, relaxation characterizes well the boredom channel in games.

The combination of high concentration (especially arousal), negative valence and low motivation in the anxiety channel resembles Ellis and Voelks’s conception of boredom [6]. However, gamers in the anxiety channel enjoyed high challenges, felt playful and were more impressed than anxious. Because of the high yet enjoying activation and challenges, we suggest renaming the anxiety channel to **overwhelm**.

The results provide insight to create better UX in games and to evaluate multiple outcomes related to games. Although the flow channel will always be the main focus in many studies, the need for a broader understanding of the UX in games increases as more people engage with games in new contexts, such as in education or training. What are the game components that would enhance UX outside the flow channel, or in which channel does learning take place? The answer for such questions is hardly found by analyzing single flow channel, but to broadly inspect the rich UX stemming from the gamer-game relationship. This relationship impacts millions of lives around the world.

**REFERENCES**

6. Ellis, G. D. and Voelkl, J. E. Measurement and Analysis