Personality-targeted Gamification: A Survey Study on Personality Traits and Motivational Affordances

Yuan Jia[1], Bin Xu[2], Yamini Karanam[1], Stephen Voida[3]

[1]School of Informatics and Computing
Indiana University–Indianapolis (IUPUI)
Indianapolis, IN 46202 USA
{jiayuan,ykaranam}@iupui.edu

[2]Information Science
Cornell University
Ithaca, NY 14853 USA
bx55@cornell.edu

[3]Dept. of Information Science
University of Colorado Boulder
Boulder, CO 80309 USA
svoida@colorado.edu

ABSTRACT

While motivational affordances are widely used to enhance user engagement in "gamified" apps, they are often employed en masse. Prior research offers little guidance about how individuals with different dispositions may react—positively and negatively—to specific affordances. In this paper, we present a survey study investigating the relationships among individuals' personality traits and perceived preferences for various motivational affordances used in gamification. Our results show that extraverts tend to be motivated by *Points*, *Levels*, and *Leaderboards*; people with high levels of imagination/openness are less likely to be motivated by *Avatars*. Negative correlations were found between emotional stability (the inverse of neuroticism) and several motivational affordances, indicating a possible limitation of gamification as an approach for a large segment of the population. Our findings contribute to the HCI community, and in particular to designers of persuasive and gamified apps, by providing design suggestions for targeting specific audiences based on personality.

Author Keywords

Gamification; motivational affordances; personality; user interface design.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Designers of information systems have increasingly used game design elements as one way to engage users and enhance user experiences [5, 11, 26, 51]. Researchers have defined the approach of using game design elements into a non-game context as *gamification* [10]. Recently, there are an increasing number of practitioners and researchers working to apply gamification in various domains such as education, commerce, health, intra-organizational systems, innovation, data gathering, and sustainable consumption [3, 5, 22, 47].

Gamification employs the use of interface affordances to motivate users to engage in the systems with "gameful" experiences [9, 11]. These specific affordances are often referred to as *motivational affordances*. The most common motivational affordances used in gamification are *Points*, *Badges*, and *Leaderboards* [1, 5, 38]. Other affordances found in academic studies and commercial applications include *Levels*, *Challenges*, *Rewards*, *Feedback*, *Clear Goals*, *Avatar/Theme*, and *Progress* [49, 51].

While gamification has been shown to provide a number of generally positive outcomes, studies have also pointed out negative consequences, such as increased effects of competition. Some researchers have found that different individuals are impacted by gamification differently, suggesting the effects of personality differences in responding to gamification [21, 22]. In a study applying gamification to an educational context, Codish & Ravid found significant differences between extraverts and introverts in how students perceive different motivational affordances in their courses; for example, extraverts reported a lack of playfulness in *Leaderboards* [5].

While some users find some affordances to be motivating, others may find that they detract from the experience—possibly even leading to technology abandonment. Based on the prior research, personality seems to serve as a key differentiator; however, little is known about how people with different personality traits relate to or prefer various specific motivational affordances. Therefore, in order to foster the design of applications that most effectively motivate and appeal to individual users, we need to better understand the relationship between personality traits and motivational affordances in gamified applications.

Many theories of personality exist, and they each focus on different personality traits. In this study, we utilized a derivative of the "Big-Five" model (extraversion, agreeableness, consciousness, neuroticism, and imagination/openness), which has been widely accepted and adopted in the research community [35].

Our initial interest in exploring this question was motivated by an interest in applying gamification to applications that

Motivational Affordances	Motivational Sources	Design Principles
Points, Badges, Levels, Clear goals, Feedback, Progress, Challenge, Rewards	Cognitive: Competence and achievement	Systems provide various challenge levels or immediate performance feedback
Leaderboard	Social & Psychological: Leadership and followership	Systems facilitate one's desire to influence others, or influenced by others
Story/Theme	Emotional: Affect and emotion; Psychological: Autonomy and the Self	Systems induce intended emotions via interaction with the system, or promote creation and representation of self-identity.
Rewards	Extrinsic motivators	Systems provide incentives for certain actions.

Table 1. Affordance types and their corresponding motivational source and design principles [22, 50]

promote health-related habit tracking. While many applications targeted at promoting a healthy lifestyle utilize gamification, they have not yet been proven effective for long-term engagement [31]. Most of these applications use various combinations of motivational affordances and are not designed for a specific user population.

In this study, we explore the relations between personality traits and people's perception of individual motivational affordances in a sample gamified personal informatics application. Our two main research questions are:

RQ1: In what ways do users consider particular motivational affordances to be helpful or unhelpful in the context of habit tracking?

RQ2: What relations exist (if any) between users' personality traits and their preferences for different types of motivational affordances?

With the findings of this study, we aim to provide a better understanding of how different people respond to various gamification approaches, as well to gain a better understanding about how persuasive and gamified apps might be customized based on users' personality traits.

RELATED WORK
Motivational Affordances
Motivation of human behavior is an important but often under-utilized theoretical perspective [50]. Studies on motivation have mainly examined two questions: (1) *what causes behavior* and (2) *why intensity of behavior varies* [44]. These questions help us understand how motivation gives behavior direction—the purpose of behavior, for example, why people start, continue, or terminate an activity—and energy—the strength of behavior, for example, how much or how often people conduct an activity.

The term *affordance* is defined as the set of "actionable properties between an object and an actor" [50]. Combining these notions of motivation and affordance, Zhang described motivational affordances as being "the properties of an object that determine whether and how it can support one's

motivational needs" [50]. He also commented that applications that promote motivation would attract usage and increase the sense that people "cannot live without it" [50].

By examining 24 empirical studies in literature, Hamari and colleagues categorized 10 types of motivational affordances used in gamification: *Points*, *Leaderboards*, *Achievements/Badges*, *Levels*, *Story/Theme*, *Clear Goals*, *Feedback*, *Rewards*, *Progress* and *Challenge* [22]. Among the research they reviewed, Hamari et al. found that *Points*, *Leaderboards*, and *Badges* were the most commonly used game-like motivational affordances [22]. To summarize the characterizations of motivational affordances provided by Zhang [50] and the 24 other studies selected by Hamari et al. [22], we compiled a taxonomy of motivational affordance types and their corresponding needs and design principles; this taxonomy appears in Table 1.

Personality Traits
Early research by Lucas indicated that personal factors affect the adoption of information systems [33]. He argued that it was simply because some people feel computers to be incomprehensible. However, the effect of personal factors on the success of information systems was largely ignored until the 1990s [36]. Nearly 20 years after Lucas' work, interest towards dispositional factors, such as personality, had re-entered the picture [36]. According to Maddi [34], personality is defined as "a stable set of characteristics and tendencies that determine peoples' commonalities and differences in thoughts, feelings, and actions." To comprehensively understand users' personalities, we base our research design on the widely-used "Big-Five" personality factors [8, 17, 35].

The Big-Five factors, a descriptive model of personality, has been used extensively in previous psychology and HCI research. The Big-Five factors are: Conscientiousness, Agreeableness, Neuroticism, Extraversion, and Imagination/Openness [17]. The model does not narrow down the personality differences to a simple set of five traits. Instead, each Big Five factor represents a collection of

	Big Five factors can represent the tendency to… (after [8])
Conscientiousness	…actively plan, organize and carry out tasks
Agreeableness	…help others and expect help in return
Neuroticism	..be fearful, sad, embarrassed, distrustful, and have difficulty managing stress
Extraversion	…seek out new opportunities and excitement
Imagination/ Openness	…devise novel ideas, hold unconventional values, and willingly question authority

Table 2. Definition of the "Big Five" personality factors

personality traits. Table 2 shows the definitions of each factor from the literature.

Personality Traits in Human Computer Interaction

In HCI, several studies have explored the relations between personality and persuasive strategies. A study by Kaptein and Eckles investigated how personality differences influence people's strategies and intentions relating to online purchases [29]. Kaptein et al. studied persuadability, a trait of individual differences, and its interaction with persuasive messages on people's participation in a health-related activity [30]. Halko and Kientz took these ideas and examined the relationship between people's acceptance of different persuasive technologies and their personality using an online survey [20].

In addition, a number of researchers have argued that the needs of individuals are different and suggested that the one-size-fits-all design approach needs to change [20, 39]. Ferro et al. discussed how individual differences may impact the design of gamified applications by investigating possible relations among Bartle's player types, personality traits, and game elements [5, 14]. Other experimental studies have investigated the interaction between UI design features and personality traits (e.g., [19, 37]). Arteaga et al. used the idea of personality differences to tailor the design of a mobile game used to prevent obesity trends in teenagers [2]. In their study, they used the Big-Five factors to make suggestions on game choice and to develop the motivational phrases employed to encourage users to play.

Instead of tailoring UI design to enhance usability, other studies have focused on studying a specific personality trait and investigating its effects on people's social behaviors, online activities and experience towards gamification. For example, *conscientiousness* has played an important role in previous studies of personality and social behavior. These studies found that conscientiousness was negatively correlated to social loafing, but positively correlated to "discretionary behavior which promotes effective functioning of the organization" [24, 40, 41, 43]. Extending these studies, Nov and Arazy investigated the relationship between conscientiousness and people's participation in online communities [39]. They found that manipulation of the community's activity indicators (e.g., critical mass) affected the high-conscientiousness and low-conscientiousness participants in opposite directions [39].

Codish and Ravid examined extraversion and its effects on students' perceived playfulness of a gamified course in an educational setting [5]. While they found no significant differences on the overall ratings of playfulness, the individual mechanisms by which playfulness was achieved were rated significantly differently by different respondents [5]. From their results, extraverts reported less playfulness reflected by the *Leaderboard* component, but perceived more enjoyable experiences than introverts instantiated in the *Rewards*, *Badges*, *Points*, and *Progress* facets of the system. Their study addressed the need for designing different educational solutions for extraverts and introverts and also suggested further investigation of personality traits and their relationship to different experiences of motivational affordances in gamification—the task that we have undertaken with this study.

STUDY DESIGN AND METHODS

In this study, we aimed to investigate the relations among people's self-reported experience of different motivational affordances and their personality traits. We instantiated motivational affordances as facets of a personal informatics application that promotes healthy habits—a common application with which many participants would have had prior exposure. We conducted a large-scale online survey with 248 participants by using demonstration videos depicting 10 different motivational affordances, hosted via SurveyMonkey[1] and Amazon Mechanical Turk (AMT)[2].

In accordance with Hamari et al. [22], we examined the design solutions associated with different types of motivational affordances from the research literature and created 10 interactive prototypes to demonstrate each type of motivational affordance that might be adopted as part of a personal "Habit Tracker" application. These 10 motivational affordances were presented through videos of a researcher using the interactive prototype. We chose to use videos because they provided a direct, visually communicated language that individuals from diverse backgrounds could understand, but did not require deployment and installation of an app on users' personal devices. This approach has precedent in the CHI research community, with videos serving as similar "archetypical" interaction sketches in prior research [44]. All of the videos used in this study contained illustrations of an example interaction with the application and a textual explanation of the specific affordance type at
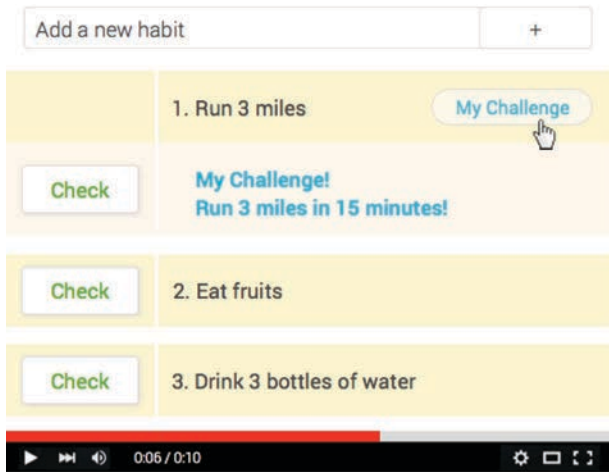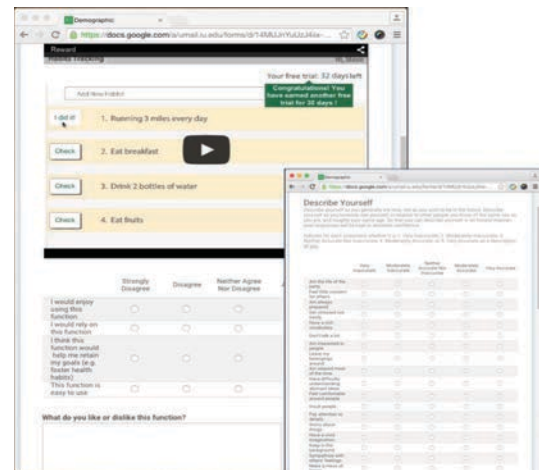
Figure 1. The participant experience of the survey. (a) The motivational affordance of the type "Challenge" is portrayed in an embedded video. In the video, a user is shown clicking on "My Challenge" associated with one of his habits, and a challenge of "Run 3 miles in 15 minutes" appears below. At the end of the video, a textual explanation of the "challenge" feature is displayed. (b) Screenshots of the online survey, delivered via SurveyMonkey.

the end. Figure 1 shows screenshots of one example, "Challenge", as used in the study.

Survey Design

Our survey contained four sections. The first section featured a series of multiple-choice questions about the participant's demographic background, such as gender, age, educational background, occupation, and ethnicity. Next, we asked participants to complete an assessment of the Big-Five factors of personality [8, 27]. We used the 50-item set of IPIP Big-Five Factor Markers, a free and validated inventory designed to measure the five factors of personality [17].

The third part of the survey was designed to elicit participants' perceptions of the 10 motivational affordances using videos showing an isolated implementation of each. Each video was followed by 5 questions: four 5-point Likert-scale questions probing the participants' opinions about each function in terms of *enjoyment*, the likelihood that the participant would *rely* on the function, *helpfulness* and *ease of use*. These questions were adapted from prior work by Halko and Kientz [20] and captured multiple facets of participants' perceptions on major themes of persuasive strategies. The fifth question was open-ended, allowing the participants to share their comments on aspects of the function that do (or don't) encourage the use of the application and reasons for which they like (or dislike) it.

Finally, participants were asked to order the motivational affordances from their most favorite to least favorite. We also asked several open-ended questions about participants' overall impression of personal informatics applications. The survey took approximately 15 minutes to complete.

Participant Recruitment

We recruited 248 participants, 40 of whom were recruited through the research team's social networks (via snowball sampling) and 208 of whom were recruited through AMT. We chose to use AMT to recruit due to the need for a large participant sample and AMT's efficiency of survey distribution and relatively low cost. Participants were recruited from the United States and paid USD $1.00, the payment rate suggested by the AMT platform.

RESULTS

Participant Demographics

To summarize demographic information of the participants, we present their responses (expressed as percentages of the overall sample population) to questions regarding their age, gender, educational level, occupation, and ethnicity (see Table 3). In general, we had a relatively diverse population, which we believe to be representative of the types of users who might be interested in using personal informatics applications.

In order to support our subsequent regression analyses, respondents' demographic responses were coded into numerical variables. For age, 18–24 was coded as 1, 25–34 as 2, and so on. For gender, male was coded as 1 and female as 0; for educational level, the eight response levels were coded from 1 to 8 from lowest completed education level to the highest.

Before processing to the regression analysis, we used zero-order correlations to test for correlations among independent variables and respondents' demographic variables (see Table 4). The independent variables of interest, i.e., the five IPIP personality traits, were positively correlated to one another, which was consistent with the literature [18]. The strongest correlation was between *conscientiousness* and *emotional stability* (the opposite end of the *neuroticism* trait spectrum, and a clearer operationalization of the construct for design purposes), $r = .40$, $p < .01$, which means people with high levels of emotional stability (or low levels of neuroticism)

	Total Participants (*n* = 248)	
Age	18–24 (8.5%) 25–34 (43.6%) 35–44 (23.8%) 45–54 (12.1%) 55 and older (12.1%)	
Gender	Female (52.8%) Male (47.2%)	
Educational Level	Some high school (0.4%) High school graduate/GED (6.5%) Vocational/Associate degree (9.7%) Some college (17.0%) Bachelors degree (34.7%) Some graduate school (6.5%) Masters degree (20.2%) Ph.D., law, or medical degree (5.2%)	
Occupation	Employed for wages (63.0%) Self-employed (16.6%) Student (11.3%) Retired (5.2%) Other (4.0%)	
Ethnicity	White (57.7%) Asian/Pacific Islander (28.6%) Hispanic or Latino (4.8%) Black or African American (6.5%) Native American or American Indian (2.0%) Other (0.4%)	

Table 3. Participant Demographics

tend to be more conscientious. People with higher extraversion levels tend to be more open to new experiences ($r = .34$, $p < .01$).

In the case of age, Table 4 shows that there is a strong and positive association between respondents' age and being emotionally stable, $r = .21$, $p < .01$. In the case of gender, Table 4 revealed a positive correlation between the coded gender variable and emotional stability ($r = .18$, $p < .01$) and a negative correlation between the coded gender variable and agreeableness ($r = -.22$, $p < .01$). This result can be interpreted for our sample (n = 248) that males were more emotionally stable but less agreeable than females. We found

no correlation between respondents' personality characteristics and their education levels.

Motivational Affordances

Across the 10 types of motivational affordances, our respondents responded favorably to the affordances of *Clear goals*, *Feedback*, *Rewards* and *Progress*, and had less preference for *Avatars* and *Levels*. On a scale from 1 to 5 (1 indicating strong disagreement and 5 indicating strong agreement), respondents rated the perceived ease of use and enjoyment for all types of affordances above 3.9 and 3.1, respectively, which suggests that respondents were able to understand the basic idea of each affordance in the videos and that the affordances do play a role of bringing joyful experience in the presented application. However, when asked about the degree to which they felt that they would be able to "rely" on the affordances, respondents rated all of the affordances significantly lower, especially *Badges*, *Levels*, *Leaderboard* and *Avatar*. More detailed descriptive results about the ratings given to each affordance are presented in Table 5.

We also tested correlations among dependent variables in the study to find out the differences of respondents' preferences among these affordances. These results show that all 10 types of affordances are positively correlated with one another. The highest correlations were respondents' preferences for *Points* and *Badges*, r = .763, p < .01; and for *Points* and *Levels*, r = .708, p < .01. These correlations demonstrate that people who prefer to use *Points* are more likely to prefer to also use *Badges* and *Levels* in gamified applications. Another relatively strong correlation was found between *Challenges* and *Clear goals*, r = .711, p < .01, which indicates that people who like customizing personal goals for their tasks also tend to set challenges for themselves. The two weakest correlations were found between *Avatar* and *Leaderboard* (r = .494, p < .01), and between *Avatar* and *Feedback* (r = .470, p < .01).

To test whether there was a relationship between our participants' personality traits and their perception of motivational affordances, we employed a multiple regression

	Mean	Std. Deviation	1	2	3	4	5	6	7
1. Extraversion	29.28	9.41							
2. Agreeableness	39.31	6.71	.32**						
3. Conscientiousness	38.05	6.51	.22**	.22**					
4. Emotional Stability	34.79	9.00	.32**	.27**	.40**				
5. Imagination/Openness	38.30	6.06	.34**	.25**	.27**	.27**			
6. Age	2.78	1.20	-.06	.15*	.16*	.21**	.01		
7. Gender	0.47	.50	.05	-.22**	.04	.18**	.05	-.13*	
8. Educational Level	5.05	1.60	.11	.08	.09	-.02	.09	-.11	.06

Table 4. Correlation matrix and descriptive statistics (*n* = 248). * indicates cells with *p* < .05 (2-tailed), ** indicates p < .01.

	Enjoyable	Reliable	Helpful	Usable
Points	3.3 (1.1)	3.0 (1.2)	3.2 (1.2)	4.0 (0.9)
Badges	3.3 (1.2)	**2.9 (1.2)**	3.3 (1.2)	4.0 (0.9)
Levels	3.1 (1.1)	**2.9 (1.2)**	3.1 (1.2)	3.9 (0.9)
Progress	3.4 (1.1)	3.2 (1.2)	3.5 (1.1)	4.1 (0.8)
Leaderboard	3.2 (1.3)	**2.9 (1.3)**	3.2 (1.3)	4.0 (0.9)
Challenges	3.4 (1.1)	3.1 (1.2)	3.4 (1.2)	4.0 (0.9)
Avatar	3.1 (1.1)	**2.6 (1.2)**	**2.8 (1.2)**	3.9 (1.0)
Feedback	3.5 (1.1)	3.4 (1.2)	3.6 (1.1)	3.9 (1.0)
Clear goals	3.5 (1.1)	3.4 (1.2)	3.6 (1.1)	4.1 (0.8)
Rewards	3.5 (1.2)	3.3 (1.3)	3.5 (1.2)	4.1 (0.8)

Table 5. Descriptive results for 10 types of affordances on 4 types of perception measures. Bolded numbers emphasize responses lower than 3.0, indicating respondents' negative feedback on perceived measures.

analysis. All individual Beta (β) values from 40 regressions (4 perception types × 10 affordance types) are summarized and the significant ($p < .05$) results presented in Table 6. Generally speaking, more extraverted people tended to prefer *Points*, *Levels*, and *Leaderboards*; people with higher levels of agreeableness tended to like *Challenges*; people with higher conscientiousness preferred *Levels* and *Progress*; people with lower emotional stability scores tended to like *Points*, *Badges*, *Progress*, and *Rewards*; and those people with lower imagination/openness scores were more likely to prefer using *Avatars*. In the remainder of this section, we report significant differences among perceptions (i.e., enjoyable, reliable, and helpful) for each affordance, both qualitative (from the Likert-scale ratings, see Table 6 for a summary) and quantitative (from our open-ended survey questions).

For **Points,** participants with higher levels of extraversion reported that this affordance is more "helpful" in supporting habit tracking ($\beta = .143$, $p < .05$). People with lower emotional stability scores report a stronger likelihood that *Points* would serve as a "reliable" tool ($\beta = -.147$, $p < .05$). Based on participants' responses to the open-ended question, *Points* were seen as helpful in facilitating goal setting (such as aiming to earn 1,000 points), and the accumulation of points helped participants feel a greater sense of accomplishment towards their goals. In addition, respondents felt that *Points* were "helpful" when used to represent progress concretely. Participants reported that monitoring *Point* totals made it easier to track their overall performance. On the negative side, respondents reported concerns about the "reliability" of *Points* because some felt

that a numerical value would have little motivational impact. Some sample comments are listed below:

I would be encouraged to earn as many points as possible to enable me to feel good about my goals. [P87]

Points are fine but only when I know they relate to something or can be used for something. They need to have greater value other than just feedback. [P142]

With regards to **Badges**, respondents with lower emotional stability scores were more likely to identify the affordance as being "helpful" ($\beta = -.190$, $p < .05$) and "enjoyable" ($\beta = -.145$, $p < .05$). As with *Points*, respondents explained that *Badges* are most "helpful" and "enjoyable" because of the feeling of accomplishment that they provide. Some of the reasons given to justify low preference scores for *Badges* included "silly" and "childish."

For **Levels,** people who were more extraverted were more likely to rate the affordance as being "reliable" ($\beta = .141$, $p < .05$), "helpful" ($\beta = .190$, $p < .05$), and "enjoyable" ($\beta = .148$, $p < .05$). Participants with higher conscientiousness scores also rated *Levels* as being highly "enjoyable" ($\beta = .142$, $p < .05$). In addition to the same positive and negative explanations reported for *Points* and *Badges*, *Levels* were also criticized by some participants because of the way that they felt like they were being labeled by an application employing the technique.

Table 6 shows how people with higher levels of emotional stability rated **Progress** as being less "enjoyable" ($\beta = -.172$, $p < .05$), "helpful" ($\beta = -.194$, $p < .05$), and "reliable" ($\beta = -.147$, $p < .05$). However, participants with higher conscientiousness scores did tend to rate the affordance as being more "reliable" ($\beta = .147$, $p < .05$). Above and beyond the sense of accomplishment that the affordance provided, respondents reported that *Progress* provided motivation by calling out specific opportunities for improvement. Negative comments about *Progress* focused almost exclusively on the sense of pressure introduced by the affordance.

No significant relation was found between personality traits and **Feedback** in our study. In respondents' comments, 67 out of 82[3] participants mentioned that they like seeing the "big picture" of what they have accomplished through *Feedback*. The other 15 participants mentioned various advantages about using this information to help them plan ahead. As with *Progress*, *Feedback* also received criticism because of the sense of pressure introduced by being confronted with evidence of prior lapses in performance.

People with higher levels of agreeableness were more likely to rate **Challenges** as being "enjoyable" ($\beta = .140$, $p < .05$) and "helpful" ($\beta = .142$, $p < .05$). Respondents commented that there is something enjoyable about exerting control over their own pace of performance by setting sub-challenges for each task. Negative comments about the affordance dealt

---

[3] Although the total number of participants in the study was 248, the number of qualitative responses reported in this section vary, because our open-ended elaboration/explanation survey prompt was optional (in the interest of balancing between expressiveness and time).

Affordance Types	Perception	Extraversion	Agreeableness	Conscientiousness	Emotional Stability	Imagination/ Openness
Points	Reliable	-	-	-	-.147	-
	Helpful	+. 143	-	-	-	-
Levels	Helpful	+. 190	-	-	-	-
	Enjoyable	+. 148	-	+.142	-	-
	Reliable	+. 141	-	-	-	-
Feedback	–	-	-	-	-	-
Clear Goals	–	-	-	-	-	-
Leaderboard	Enjoyable	+. 160	-	-	-	-
	Reliable	+. 182	-	-	-	-
	Helpful	+. 163	-	-	-	-
Challenges	Enjoyable	-	+.140	-	-	-
	Helpful	-	+.142	-	-	-
Badges	Enjoyable	-	-	-	-.145	-
	Helpful	-	-	-	-.190	-
Progress	Enjoyable	-	-	-	-.172	-
	Reliable	-	-	+.147	-.147	-
	Helpful	-	-	-	-.194	-
Rewards	Enjoyable	-	-	-	-.155	-
	Helpful	-	-	-	-.186	-
Avatar	Helpful	-	-	-	-	-.162
	Reliable	-	-	-	-	-.172

Table 6. Significant standardized coefficients ($p < .05$) as calculated by multiple regression.

mainly with the pressure of failure introduced by the addition of *Challenges*.

No significant result was found between **Clear Goals** and personality traits in our data. However, in the qualitative results, 73 out of 79 participants reported that they felt empowered with "more control on their own" when using *Clear Goals*. Only 6 out of 79 participants mentioned concerns about the additional pressure that setting additional goals might create.

Leaderboards received lower "enjoyable" (β = .160, $p < .05$), "reliable" (β = .182, $p < .05$) and "helpful" (β = .163, $p < .05$) ratings from people who self-rated as being more introverted. We found three reasons for this finding from among respondents' open-ended comments. First, some participants just did not like the sense of competition that this affordance introduced. Second, some participants do not want to share their tracking data with others, which implicitly occurs when *Leaderboards* are employed. Third, a few respondents believed that health-related daily activity was not an appropriate topic for

competition, for example: "*I don't want my usual routine to become some kind of competitive game*" [P57].

Respondents with higher levels of imagination/openness tended to feel that ***Avatars*** were less "helpful" (β = -.162, $p < .05$) and "reliable" (β = -.172, $p < .05$). There was no significant relation found between personality traits and the "enjoyable" ratings assigned to the affordance. However, based on the respondents' comments, 34 out of 44 respondents reported that they enjoy the feedback the avatar provided. Negative comments reported about *Avatars* included a lack of a personal connection with the Avatar and a sense that the Avatar was childish.

Participants with lower emotional stability scores were more likely to rate ***Rewards*** as being "enjoyable" (β = -.155, $p < .05$), and "helpful" (β = -.186, $p < .05$). No significant relation was found between personality type and assessment of the affordance's "reliability". From the qualitative responses, participants expressed a preference for *Rewards* as a motivator for two reasons: they like receiving concrete recognition for their efforts, and they appreciated the feeling of accomplishment that *Rewards* provide. For those

Motivational Affordances	"Demotivational" Concern
Points, Levels, Badges, Avatar, and Rewards	Lack of value
Challenges, Clear Goals	Pressure of failure
Progress, Feedback	Pressure of failure Visually confused
Leaderboard	Do not enjoy competition Don't want to share personal goals with others Health-related activity is not a competition

Table 7. Motivational affordances categorized by participants' concerns about how each might be demotivating.

participants who reported that they do not feel encouraged by Rewards, it either due to the added pressure of failure or because they felt the example *Reward* shown in the video would not provide adequate incentive.

While the effect we observed (i.e., the beta coefficients) may be somewhat small, the differences that we saw were nonetheless statistically significant. As a result, our findings demonstrate that personality traits might well *impact* the acceptance (or non-acceptance) of a gamified application based on which motivational affordances are employed. Although this effect will, of course, interact with other factors like individual differences, prior experience with these kinds of systems, and "player type" [5], we argue that any differentiating advantage that a designer might be able to employ could potentially improve the chances of success for a particular gamified application.

Furthermore, our participants' qualitative findings reported above help to elaborate how various motivational affordances were perceived and reinforce the idea that personality-based customization may play a meaningful role in the design of gamified systems. For example, based on an analysis of respondents' comments from our survey, we identified a number of reasons that the 10 types of affordances can be *demotivating* when used in gamification. We conducted an affinity mapping on these reasons, resulting in 4 categories of affordances, shown in Table 7.

DISCUSSION
In this section, we discuss how our findings can be applied to the design of gamified self-tracking applications, both to appeal to general users and to better fit the needs of specific user groups based upon their personality types.

Appealing to a Broad User Population
Our results show that, overall, *Levels* and *Avatar* were the two lowest-rated motivational affordances. Additionally, our participants' preference for *Points* was found to be positively correlated with their preference for *Levels*, *Badges* and *Rewards*. From our qualitative results, participants expressed a common concern across all five of these affordances, which

are a perceived "lack of value;" that is, the affordances were perceived as being disconnected from the primary purpose of the app. These results are consistent with the previous study conducted by Hamari et al. [22], which tested the usage of badges in a trading service platform, as well as with a study that examined *Points* and *Levels* and observed that the increase of the activities diminished shortly after the launch of their platform [13]. Gartner stated that the lack of interest toward such affordances could cause gamification to fail when users' motivations are extrinsic to the system [14].

Therefore, we suggest that when incorporating *Points*, *Levels*, *Badges*, *Avatars*, and other *Rewards* mechanisms into gamified self-tracking apps, instead of simply applying a scoring system or adding a series of titles, a few badge images, or smiling faces, designers should take steps to **contextualize the instantiation these affordances—for example, to tie the representations that are used to the main purpose of the application**. Doing so helps users to connect these affordances to the non-game activities that they were initially interested in, and thus the initial motivations of the application are more explicitly reinforced. For example, in our example habit tracking app, to award a user a level up from "tracker" to "super tracker" lacks real-world meaning. Instead, a way to provide a meaning by design is to let a super tracker unlock enhanced data collection capabilities or reveal more detailed information about how daily activity relates to enhancing one's health.

Our results show that *Clear goal* was the highest-rated affordance in our study, and it was strongly and positively correlated with *Challenges*. Our qualitative results also show that a large proportion of our respondents felt motivated by setting their own goals and challenges. These results are consistent with the prior literature (e.g., [32, 48]). For example, Dong et al. reported that all participants from their study commented positively about *Clear goals* and *Challenges* [12]. However, in our study, some respondents did express concern with these two affordances because of the pressure of avoiding failure. This concern was also reported in previous studies. Dong et al. found that engagement diminished when *Goals* and *Challenges* were too difficult [12]. Another study that examined *Clear goals* and *Challenges* demonstrated that setting a difficult—but attainable—goal could enhance users' performance [28].

Therefore, we suggest that **when applying *Clear goals* and *Challenges* in gamified applications, the design should also provide customization and goal-setting assistance features**. For example, when users are allowed to set their own sub-goals or challenges, the system should assist users by providing guidance or instruction so that users set "difficult but attainable" goals or challenges at the beginning and during the process.

Employing Motivational Affordances for Users with a Specific Personality Type
Our results show that people who are more extraverted are more likely to prefer *Points*, *Levels*, and *Leaderboards*. This

finding indicates that more extraverted people tend to like socially competitive activities and are more likely to be motivated by "showing off" their achievements. These results are consistent with the prior work by Nov & Arazy, who reported that extraverted people tend to contribute more to social participation systems when they perceived a large audience size [39]. In an educational setting, researchers found that extraverts perceived *Rewards* to be most enjoyable, but also found that *Leaderboards* had a negative effect on the perceived playfulness by more extraverted students [5], which is inconsistent with our results. An underlying psychological reason could be that these highly extravert people are more likely to enjoy being on "center stage" and keeping the spotlight on themselves in a larger crowd [23]. At the same time, these individuals can be very demanding and get bored quickly on repetitive tasks [23]. In contrast, introverts are described as not preferring to draw attention from a crowd unless they are familiar with everyone in the crowd. These individuals generally enjoy solitary tasks rather than being involved in groups [23], and thus in a gamification application, making their activities transparent to others might not be preferable.

Therefore, we suggest that if when designing an app that specifically appeals to users who are more extraverted, designers should consider utilizing *Points*, *Levels*, *Badges,* and/or *Rewards*. The down side to these choices is that the positive effect of their inclusion may be short-lived. **To invoke more sustained engagement from extraverted users, *Leaderboard* may be a better choice**, because it allows users to interact with a dynamic social group, which can respond to and evolve alongside an extraverted user's actions. On the other side, for users who are more introverted, *Leaderboard* could be a demotivating feature because of the public social impact. Therefore, we suggest that **to appeal to introverted users, designers should either omit *Leaderboard* functionality or implement the affordance in such a way that users only compete with a close circle of well-known (and approved) friends.**

People with high emotional stability (and low neuroticism) are defined as having "emotional maturity, self-confidence, and stability in their plans and affections" [42]. Our results show that emotional stability was negatively correlated with all motivational affordances, and significantly so with *Points*, *Badges*, *Progress,* and *Rewards*. This finding indicates that people with high emotional stability are not likely to be motivated by or interested in any particular affordance in a gamified system. We also found evidences supporting this conclusion from our qualitative results, where some respondents with higher levels of emotional stability commented that our example application was "just a toy" or "silly." Although few studies had examined the relation between emotional stability and motivational affordances in gamification, studies on social media platforms have consistently found that emotional stability is negatively related to online social activities [7, 39]. Our findings suggest that, to enhance user engagement, gamification is not a one-size-fits-all solution. There is a limit to what gamification can accomplish. **For those people with higher levels of emotionally stability, gamification may not be an effective approach**.

We also found that emotional stability is strongly and positively correlated with age and gender. This is consistent with prior findings from the study carried out by Correa et al. [7]. We do not have data that enable us to confirm a strong causal relationship between age or gender and their resistance to gamification, but the above results do suggest that there may be a relationship between age or gender and preferences on gamification *via* emotional stability, which suggests potential future research.

For people with higher levels of imagination/openness, our results show that they are less likely to be motivated by *Avatars* in gamified self-tracking apps. Higher imagination or openness is reflected by increased novelty seeking and curiosity [46]. The avatar in our study—a smiling cat picture that updated when users engaged with the application—was an implement from Tamagotchi, a handheld "digital pet" that was very popular during the 1990s. Results show that respondents with high levels of imagination and openness felt bored and, therefore, demotivated by the particular implementation of *Avatar* in our example application. Therefore, we suggest that, **to appeal to users with higher levels of imagination, designers should avoid applying Avatar in a conventional way.** For example, a novel way of presenting or interacting with an avatar might result in a more successful engagement with this class of users.

Few significant results were found that indicated specific solutions (or anti-solutions) for individuals with high or low agreeableness and conscientiousness scores; thus, we think that these personality traits may not affect preference in this space strongly enough for us to make any specific design suggestions for gamification designers. As a study that examined all the Big Five personality traits, our findings suggest that **extraversion and emotional stability (neuroticism) are the two traits that most significantly impact the design** of gamified self-tracking applications. In order to support personality trait-based customizations, it might be most effective to pre-screen or passive observe interactions that differentiate among these particular traits.

Other Design Implications—Looking beyond Personal Informatics and Habit-Tracking Applications
Besides the design suggestions discussed above, this work also suggests several theoretical and design implications for health applications in ubiquitous computing and, more broadly, for the human–computer interaction domain.

Personalized Interfaces
Our results show that for motivational affordances, users with different personality traits have different perceptions of and preferences for the same affordance. Many non–healthcare-oriented systems have focused on offering personalized data. For example, recommendation systems

like Netflix have been developed to offer users personalized suggestions in the entertainment domain. Facebook Newsfeed curates the contents displayed to users so that users are more likely to see information that they will perceive as being more interesting and relevant. However, these kinds of systems do not typically provide interface customizations based on users' behaviors or preferences, let along based upon their personality traits.

One reason that we may not have previously seen interface adaptations based on personality types is the lack of data from which users' personalities can be accurately modeled. Even through our results show that users' personality traits can help to predict which and how the affordances should be implemented in a particular application, doing so still requires *a priori* knowledge of their personality traits. Answering a short survey may be fine for a paid Mechanical Turk worker in the context of a research study, but this would likely not be an ideal part of a setup process for users of a commercial (and paid!) application. If personality traits can be implicitly modeled—perhaps based on a user's initial actions configuring an application or working with a system for the first few days—then the resulting model might effectively serve to bootstrap this process in a way that is less costly for users. Systems like IBM's system U [3] have leveraged users' online social media usage patterns to infer users' emotions, values, and beliefs. Computational approaches similar to IBM's suggest how a system might automatically classify a user to determine aspects of their personality; however, additional research is necessary to evaluate the practicality and efficacy of this technique.

System as an Actor
Based on our study results, we found that for a single affordance, different users have different perceptions, which is consistent with the original definition of affordances by Gibson [16]. However, his definition of an affordance as the "the actionable properties between an object and an actor" inherently positions computing systems as objects or instruments. Based on this framing, users adapt themselves to their tools, and they choose the right tool to suit their particular situation. However, as computing platforms continue to evolve, incorporating algorithms from artificial intelligence, new kinds of sensor technologies, and increased personalization, computing tools become much more adaptive to and conversant with the capabilities and limitations—including, for example, the personality traits—of their users. At this point, a case can be made that the computing tool ceases to be a simple tool and becomes an actor in its own right.

To explore the plausibility of designing systems that fill this kind of a *co-actor role*, additional research is needed to better understand the techniques for and implications of modeling users along a richer set of dimensions—including personality, which we have used as a lens in this paper. Researchers will also need to understand humans' cognitive and behavioral attributes above and beyond those associated with motivation. However, we see this work as a potentially important step in acknowledging the role of human motivation as a design resource for creating adaptive tools for general users, as well as more specific user groups with particular personality characteristics.

Limitations of Our Study
Habit formation is a long-term process; as a result, people may interact with motivational affordances differently over a period of time. As a result, using demo videos to communicate the instantiation of each affordance may have only elicited people's initial perceptions of these affordances and not the kind of mature thinking that would only emerge after using such an application over time. We are currently planning follow-on studies to address this limitation by examining longitudinal data on experimentally controlled use of a deployed version of our gamified application.

Additionally, gamification exclusively uses extrinsic rewards, while people internalize achievements such as the ones examined in the study. However, game mechanics do not provide means to measure users' progress along the continuum where they respond to extrinsic to intrinsic rewards. Gamified affordances can only supplement intrinsic motivation with extrinsic motivation. Hence, it doesn't provide a way of inculcating intrinsic motivation through other measures like creating awareness or comprehending cost-benefit analysis.

CONCLUSIONS AND FUTURE WORK
Overall, this paper contributes to the understanding of how people's personality traits relate to their perceived preferences of various motivational affordances that are widely used in system gamification. Our findings indicate that personality traits do play a role in people's perceived preferences on gamification, and they highlight opportunities to engage users—or, at a minimum, limit frustration and disengagement—by (1) tailoring the design of gamified applications based on users' personality traits or (2) making informed design choices that are not perceived as being demotivating by a large portion of an app's audience. We discovered that the two primary personality traits that serve to differentiate habit-tracking application users are extraversion and emotional stability (neuroticism), and we developed a number of guidelines that system designers might consider when targeting a broad spectrum of gamified system users—or a subset partitioned by individuals' personality types.

In our future work, we plan to take a closer look at the relationship between people's specific personality traits and their interactions with different motivational affordances in situ (e.g., in a real, deployed application) and over an extended period of time. We anticipate that this research agenda will continue to reveal effective ways to encourage engagement in gamified applications and provide a more detailed understanding of how people's perceptions of motivational affordances evolve and mature over time.

REFERENCES

1. Judd Antin and Elizabeth F. Churchill. 2011. Badges in social media: A social psychological perspective. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Workshop on Gamification*.

2. Sonia M. Arteaga, Mo Kudeki, and Adrienne Woodworth. 2009. Combating obesity trends in teenagers through persuasive mobile technology. *SIGACCESS Accessibility and Computing* 94: 17–25. http://doi.acm.org/10.1145/1595061.1595064

3. Hernan Badenes, Mateo N. Bengualid, Jilin Chen, Liang Gou, Eben Haber, Jalal Mahmud, Jeffrey W. Nichols, Aditya Pal, Jerald Schoudt, Barton A. Smith, Ying Xuan, Huahai Yang, and Michelle X. Zhou. 2014. System U: automatically deriving personality traits from social media for people recommendation. In *Proceedings of the 8th ACM Conference on Recommender Systems* (RecSys '14), 373–374. http://doi.acm.org/10.1145/2645710.2645719

4. Gabriel Barata, Sandra Gama, Joaquim Jorge, and Daniel Gonçalves. 2013. Engaging engineering students with gamification. In *Proceedings of the 5th International Conference on Games and Virtual Worlds for Serious Applications* (VS-GAMES '13), 1–8.

5. Richard Bartle. 1996. Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research* 1, 1: 19.

6. David Codish and Gilad Ravid. 2014. Personality based gamification-educational gamification for extroverts and introverts. In *Proceedings of the 9th CHAIS Conference for the Study of Innovation and Learning Technologies: Learning in the Technological Era*, 36–44.

7. Teresa Correa, Amber Willard Hinsley, and Homero Gil De Zuniga. 2010. Who interacts on the Web?: The intersection of users' personality and social media use. *Computers in Human Behavior* 26, 2: 247–253.

8. Paul T. Costa, Jr. and Robert R. McCrae. 1992. *NEO Personality Inventory–Revised (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) Professional Manual*. Psychological Assessment Resources, Odessa, FL.

9. Sebastian Deterding, 2011. Situated motivational affordances of game elements: A conceptual model. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Workshop on Gamification*.

10. Sebastian Deterding, Dan Dixon, Rilla Khaled, and Lennart Nacke. 2011. From game design elements to gamefulness: defining "gamification". In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments,* 9–15. http://doi.acm.org/10.1145/2181037.2181040

11. Sebastian Deterding, Miguel Sicart, Lennart Nacke, Kenton O'Hara, and Dan Dixon. 2011. Gamification. using game-design elements in non-gaming contexts. In *Extended Abstracts of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11), 2425–2428. http://doi.acm.org/10.1145/1979742.1979575

12. Tao Dong, Mira Dontcheva, Diana Joseph, Karrie Karahalios, Mark Newman, and Mark Ackerman. 2012. Discovery-based games for learning software. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '12), 2083–2086. http://doi.acm.org/10.1145/2207676.2208358

13. Rosta Farzan, Joan M. DiMicco, David R. Millen, Casey Dugan, Werner Geyer, and Elizabeth A. Brownholtz. 2008. Results from deploying a participation incentive mechanism within the enterprise. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '08)*, 563–572. http://doi.acm.org/10.1145/1357054.1357145

14. Lauren S. Ferro and Stefan Greuter. 2013. Towards personalised, gamified systems: an investigation into game design, personality and player typologies. In *Proceedings of The 9th Australasian Conference on Interactive Entertainment: Matters of Life and Death (IE'13),* 7. http://dx.doi.org/10.1145/2513002.2513024

15. Gartner. 2012. Gartner says by 2014, 80 percent of current gamified applications will fail to meet business objectives primarily due to poor design. Retrieved November 27, 2012 from http://www.gartner.com/it/page.jsp?id=2251015

16. James J. Gibson, 1977. The theory of affordances*. In *Perceiving, Acting, and Knowing: Toward an Ecological Psychology,* Robert Shaw and John Bransford (eds.). Lawrence Erlbaum Associates, Hillsdale, NJ, 67–82.

17. Lewis R. Goldberg. 1992. The development of markers of the Big-Five factor structure. *Psychological assessment* 4, 1: 26.

18. Samuel D. Gosling, Peter J. Rentfrow, and William B. Swann. 2003. A very brief measure of the Big-Five personality domains. *Journal of Research in personality* 37, 6: 504-528.

19. Dina Goren-Bar, Ilenia Graziola, Fabio Pianesi, and Massimo Zancanaro. 2006. The influence of personality factors on visitor attitudes towards adaptivity dimensions for mobile museum guides. *User Modeling and User-Adapted Interaction* 16, 1: 31–62.

20. Sajanee Halko, and Julie A. Kientz. 2010. Personality and persuasive technology: an exploratory study on health-promoting mobile applications. In *Persuasive Technology*, 6137: 150–161.

21. Juho Hamari. (2013). Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service. *Electronic Commerce Research and Applications* 12, 4: 236–245.

22. Juho Hamari, Jonna Koivisto, and Harri Sarsa. 2014. Does gamification work?: A literature review of empirical studies on gamification. In *Proceedings of the 47th Hawaii International Conference on System Sciences* (HICSS '14), 3025–3034.

23. Anthony Hilling. 2012. Extrovert and Introvert – What is the difference? Retrieved November 5, 2012 from: http://www.hillinghypnotherapy.co.uk/personality-test-online/personality-testing-explained/extrovert-and-introvert-what-is-the-difference/

24. Hwee Hoon and Tan Min Li Tan. 2008. Organizational citizenship behavior and social loafing: The role of personality, motives, and contextual factors. *The Journal of Psychology* 142, 1: 89–108.

25. Kai Huotari, and Juho Hamari. 2012. Defining gamification: A service marketing perspective. In *Proceedings of the 16th International Academic MindTrek Conference*, 17–22.

26. Kai Huotari and Juho Hamari. 2011. "Gamification" from the perspective of service marketing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Workshop on Gamification*. http://doi.acm.org/10.1145/2393132.2393137

27. Oliver P. John, Laura P. Naumann, and Christopher J. Soto. 2008. Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues. In *Handbook of Personality: Theory and Research* (3rd ed.), Oliver P. John, Richard W. Robbins, and Lawrence A. Pervin (eds.). Guilford Press, New York , NY, 114–158.

28. J.H. Jung, Christoph Schneider, and Joseph Valacich. 2010. Enhancing the motivational affordance of information systems: The effects of real-time performance feedback and goal setting in group collaboration environments. *Management Science* 56, 4: 724–742.

29. Maurits Kaptein and Dean Eckles. 2012. Heterogeneity in the effects of online persuasion. *Journal of Interactive Marketing* 26, 3: 176–188.

30. Maurits Kaptein, Joyca Lacroix, and Privender Saini. 2010. Individual differences in persuadability in the health promotion domain. In *Proceedings of the 5th International Conference on Persuasive Technology* (PERSUASIVE '10), 94–105. http://dx.doi.org/10.1007/978-3-642-13226-1_11

31. Yamini Karanam, Hanan Alotaibi, Leslie Filko, Elham Makhsoom, Lindsay Kaser, and Stephen Voida. 2014. Motivational affordances and personality types in personal informatics. In *Adjunct Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing* (UbiComp '14), 79–82. http://doi.acm.org/10.1145/2638728.2638800

32. Wei Li, Tovi Grossman, and George Fitzmaurice. 2012. GamiCAD: a gamified tutorial system for first time autocad users. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology* (UIST '12), 103–112. http://doi.acm.org/10.1145/2380116.2380131

33. Henry C. Lucas. 1971. *Computer-based information systems in organizations*. Science Research Associates, Chicago, IL.

34. Salatore R. Maddi. 1989. *Personality theories: A comparative analysis* (5th ed.). Dorsey Press, Chicago, IL.

35. Robert R. McCrae, and Paul T. Costa. 1989. Reinterpreting the Myers-Briggs type indicator from the perspective of the Five Factor model of personality. *Journal of Personality* 57, 1: 17–40.

36. James C. McElroy, Anthony R. Hendrickson, Anthony M. Townsend, and Samuel M. DeMarie. 2007. Dispositional factors in Internet use: Personality versus cognitive style. *MIS Quarterly* 31, 809–820.

37. Joanna McGrenere, Ronald M. Baecker, and Kellogg S. Booth. 2002. An evaluation of a multiple interface design solution for bloated software. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '02), 164–170. http://doi.acm.org/10.1145/503376.503406

38. Nitya Narasimhan, Silviu Chiricescu, and Venu Vasudevan. 2011. The gamification of television: Is there life beyond badges? In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Workshop on Gamification*.

39. Oded Nov and Ofer Arazy. 2013. Personality-targeted design: Theory, experimental procedure, and preliminary results. In *Proceedings of the 2013 ACM Conference on Computer Supported Cooperative Work* (CSCW '13), 977–984. http://doi.acm.org/10.1145/2441776.2441887

40. Dennis W. Organ. 1988. *Organizational citizenship behavior: The good soldier syndrome.* Lexington Books, Lexington, MA.

41. Dennis W. Organ. 1994. Personality and organizational citizenship behavior. *Journal of Management* 20, 2: 465–478.

42. Vladimir Pavlenko and S.V. Chernyi and D.G. Goubkina. 2009. EEG correlates of anxiety and emotional stability in adult healthy subjects. *Neurophysiology* 41, 5: 337–345.

43. Philip M. Podsakoff, Scott B. MacKenzie, Julie Beth Paine, and Daniel G. Bachrach. 2000. Organizational citizenship behaviors: A critical review of the theoretical and empirical literature and suggestions for future research. *Journal of Management* 26, 3: 513–563.

44. Maryam Tohidi, William Buxton, Ronald Baecker, and Abigail Sellen. 2006. User sketches: a quick, inexpensive, and effective way to elicit more reflective user feedback. In *Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles* (NordiCHI '06), Anders Mørch, Konrad Morgan, Tone Bratteteig, Gautam Ghosh, and Dag Svanaes (Eds.). ACM, New York, NY, USA, 105-114. DOI=http://dx.doi.org/10.1145/1182475.1182487

45. Johnmarshall Reeve. 2005. *Understanding Motivation and Emotion.* John Wiley & Sons, New York, NY.

46. Craig Ross, Emily S. Orr, Mia Sisic, Jaime M. Arseneault, Mary G. Simmering, and R. Robert Orr. 2009. Personality and motivations associated with Facebook use. *Computers in Human Behavior* 25, 2: 578–586.

47. Lee Sheldon. 2011. *The multiplayer classroom: Designing coursework as a game.* Cengage Learning, Boston, MA.

48. Penelope Sweetser and Peta Wyeth. 2005, July. GameFlow: A model for evaluating player enjoyment in games. *ACM Computers in Entertainment* (CIE) 3, 3: Article 3A.

49. Kevin Werbach and Dan Hunter. 2012. *For the win: How game thinking can revolutionize your business.* Wharton Digital Press, Philadelphia, PA.

50. Ping Zhang. 2008. Technical opinion: Motivational affordances: Reasons for ICT design and use. *Communications of the ACM* 51, 11: 145–147. http://doi.acm.org/10.1145/1400214.1400244

51. Gabe Zichermann and Christopher Cunningham. 2011. *Gamification by design: Implementing game mechanics in web and mobile apps.* O'Reilly Media, Sebastopol, CA.