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DECODING THE MOTIVATIONAL BLACK BOX – THE CASE OF RANKING, SELF-EFFICACY, AND SUBLIMINAL PRIMING

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Research paper

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Abstract

Game-based IS features are popular means to change behavior. While existing studies indicate a successful impact of gamified IS features, others show opposite effects. However, there are no studies that have investigated the underlying motivational processes of single gamified IS features and the additional possible support of subliminally primed IS features for the desired goal attainment. To address this gap, we examine the interaction between users and the gamified feature 'Ranking' on concentration enhancement, while studying the moderation effects of self-efficacy and a subliminally primed IS feature in a laboratory experiment (N=407). Therefore, our paper sheds light on the theoretically and practically relevant question: how can gamification features lead to proper interaction with the user to effectively support desired goal attainment. The results show varying reactions of either positive or negative feedback, to the ranking, depending on individual's self-efficacy. While test persons with low self-efficacy show better performance results receiving negative feedback, participants with high self-efficacy perceptions reveal better performance rates receiving positive feedback. Furthermore, we could not observe a significant impact of the subliminally primed feature regarding mechanisms of the consciously perceived game feature 'Ranking' on concentration enhancement.
Keywords: Gamification, Self-Efficacy, Subliminal Priming, Feedback

1 Introduction

In recent years the idea of encouraging behavior through information systems (IS) has experienced a rapid diffusion (Hamari et al., 2014), leaving IS as a popular tool to help people change their behaviors (Kankanhalli et al., 2012; Oinas-Kukkonen and Harjumaa, 2009). The ubiquity of mobile devices allows for the provision of feedback and motivational messages at anytime and anywhere (Hanus and Fox, 2014). The success of such persuasive IS is often fostered by implemented game-based design (Blohm and Leimeister, 2013; Hamari et al., 2014). Several companies (e.g., Samsung Nation, SIXT, Pepsi Soundoff) have already integrated points, levels, or badges into their loyalty programs to enhance customer engagement and strengthen customer brand relations (Robson et al., 2015). For example, the Nissan Leaf is equipped with a system that rewards drivers with points in return for ecological friendly driving, and enables competitions with friends via Facebook. Windows and Xerox are striking examples of how game features can be employed to motivate and train employees, using challenges and leaderboards to increase performance, i.e., in salesforce (Robson et al., 2015).

While previous studies have proven these so called "gamification systems" to be a prosperous tool for motivating users in various contexts (e.g., Flüchter et al., 2014; Jones et al., 2014; Kampker et al.,

2014; Murtagh et al., 2013; Ribeiroa et al., 2013; Thiebes et al., 2014), there are some cases where gamification is ineffective (e.g., Jung et al., 2010; Richter et al., 2015; Robots, 2014). This failed effect of gamification is especially a nuisance for organizations who invest heavily in the implementation of gamified systems in order to encourage, for e.g., employee's performance or customer relations. Therefore, it is important to analyze how gamification features lead to proper interaction with the user to effectively support desired goal attainment and thereby, decode the motivational black box regarding the failed and successful effect of gamification (Petkov et al., 2011). Several scholars have called for further research analyzing the motivational process that occurs through the interaction between users and single implemented gamified IS features in a laboratory experiment based on fundamental interdisciplinary theories (e.g., Deterding, 2011; Kankanhalli et al., 2012; Reitberger et al., 2010; Torning and Oinas-Kukkonen, 2009). Furthermore, there is a lack of research regarding the motivational processes of specific gamified IS features on users' concrete behavior (Kankanhalli et al., 2012). Majority of the previous studies either investigated the holistic impact of a specific artefact with several implemented game mechanisms on behavior (Hamari et al., 2014; Kankanhalli et al., 2012), or evaluated gamified mechanisms within existing artefacts (e.g., Herranz et al., 2013; Lee et al., 2013; Oduor et al., 2014; Shang and Lin, 2013; Simões et al., 2013).

To address the identified research gaps, we conducted a laboratory experiment that examined the motivational process during the interaction between users, a single implemented gamified IS feature, i.e., rankings, and users' performance, i.e., concentration and attention performance. Furthermore, we analyzed the effect of a subliminally primed IS feature on this interaction. Concretely, we study the following research questions (RQ) in this paper:

RQ1: How can the gamified IS feature 'Ranking' foster users' concentration and attention performance?
RQ2: How do individual's self-efficacy and subliminally primed IS features moderate this effect?

Rankings aim to motivate the user by stimulating competition with oneself or other participants within the system (Richter and Raban, 2012). From the set of game design elements, rankings are one of the most prominent and controversial mechanisms. Besides the proven positive impact of this mechanism on task performance and motivation (e.g., Christy and Fox, 2014; Domínguez et al., 2013; Eickhoff et al., 2012), recent studies have revealed that this kind of feedback may provide undesirable results by promoting demotivation, and thus, loss of interest (e.g., Farzan and DiMicco, 2008; Hanus and Fox, 2014). Therefore, we use this gamified IS feature to decode the motivational black box regarding the failed and successful effects of gamification. The idea to foster encouragement and concentration instead of global performance or motivation, with the aid of rankings is based on psychological studies (Eysenck, 2012). They suggest that concentration is the fundamental factor yielding high motivation and successful performance, and can be caused by feedback, incentives, as well as goal setting (Eysenck, 2012).

To encode the motivational process and analyze the additional effect of a subliminally primed IS feature for the desired goal attainment, we draw on psychological phenomena, i.e., self-efficacy and subliminal priming features, and the attribution theory successfully applied in the context of feedback and task performance (e.g., Nease et al., 1999; Renn and Fedor, 2001; Silver et al., 1995). Self-efficacy is defined as a kind of competence expectancy, influencing personal judgment about one's own possible actions in order to solve a specific challenging task rather than everyday routine (Schwarzer and Jerusalem, 2002). Richter et al. (2015) suggest that gamified digital environments provide users with enjoyable real-time performance experiences, and thus, are the most influential way of feedback in terms of impacting self-efficacy. However, to the best of our knowledge, current research on self-efficacy in the context of gamification and persuasive systems design is lacking. Subliminal priming involves the presentation of information for very short durations (<25 ms), which results in an unconscious processing of information (Dijksterhuis et al., 2005). To date, IS research has predominantly focused on design features that are perceived consciously by users, while entirely neglecting the examination of

unconscious features (Ham et al., 2009; Reitberger et al., 2010; Ruijten et al., 2011). Nonetheless, other domains have already successfully stimulated behavior changes by implementing unconsciously operated mechanisms without employing the potentials of IS (e.g., Bijleveld et al., 2009; Pessiglione et al., 2007).

2 Theoretical Background and Related Work

2.1 The Role of Rankings and Self-Efficacy Enhancing Performance

In IS research, persuasive systems are defined as systems that are designed to reinforce, change, or shape either attitudes or behaviors (Fogg, 2002; Oinas-Kukkonen and Harjumaa, 2009). Persuasive systems are intelligent approaches that interact with human behaviors and clearly strive to influence these behaviors in a desired direction (Fogg, 2002). By the implementation of gamified features within a persuasive system, the term 'gamification' is applied to describe the use of game design elements in non-game contexts (Deterding et al., 2011). Since 2008, gamification has been defined as the process of using game thinking and game mechanisms to dually solve problems (Deterding et al., 2011) along with promoting motivation and other desired behaviors (Lee and Hammer, 2011). The widening trend of employing game mechanisms to non-game environments occurs in various areas, including innovation, marketing, education, sustainability, employee performance, health, and social change (Hamari et al., 2014).

In this study we focus on the gamified IS feature 'Ranking' in order to enhance concentration and attention performance. Rankings are popular feedback mechanisms allowing the evaluation of an individual's performance relative to social norms (Codish and Ravid, 2014; Kluger and DeNisi, 1996). The social normative component within feedback is often responsible for a successful impact on behavior (Schultz, 1999), as people tend to evaluate a situation and consider what kind of behavior is acceptable and socially desired (Fischer, 2008). Moreover, it creates a situation of competition between users, leading to increased ambition among the participants (Loock et al., 2011). While feedback without the use of IS is limited to static visual or verbal expressions, IS-driven solutions offer a wide range of options. The advantages of computer-aided feedback lie in its inherently dynamic characteristics (Van der Kleij et al., 2012). Feedback can be provided more frequently, with a better design appeal, and interactively, through the integration of social functionality (Van der Kleij et al., 2012).

Few studies explicitly investigate the effects of rankings on performance, or the underlying motivational process (Hamari et al., 2014; Kankanhalli et al., 2012). In most studies, several game mechanisms are implemented and evaluated at once, with the objective of determining the ideal mechanism for the explored case (Hamari et al., 2014; Kankanhalli et al., 2012). Other remaining studies emphasize the effects of rankings as a driver for increased performance (Christy and Fox, 2014) and task engagement in terms of motivation (Domínguez et al., 2013; Eickhoff et al., 2012). However, concurrently, the literature has also stated the negative effects of rankings. The outcome strongly depends on the position of the participant within the ranking (Farzan and DiMicco, 2008; Hanus and Fox, 2014), the homogeneity of the group itself (Petkov et al., 2011), and the personality of the participant (Codish and Ravid, 2014). For instance, introverted people reject this form of feedback because they want to avoid exposure to their peers, regardless of their standing in the rankings, or desire to not participate in a competition at all (Codish and Ravid, 2014). Overall, research suggests that the utilization of rankings cannot be considered a universal solution. Therefore, IS research should identify further relevant factors which influence the interaction between rankings, the user, and behavioral outcome, contributing further to the decodification of this motivational black box (Petkov et al., 2011).

In order to elucidate this motivational black box explaining the different impact of rankings on users' performance, i.e., concentration and attention performance, we focus on different kinds of feedback. This focus is dependent on the position within the ranking list and its interaction with the individual's

self-efficacy. According to Bandura's fundamental social cognitive theory (Bandura, 1992, 1997, 2001), the perceived self-efficacy influences cognitive, motivational, emotional, and actional processes. Self-efficacy steers goal setting, along with decisions regarding effort and persistence, to attain goal achievement, independent from other skills. Therefore, self-efficacy is not an expression of individual intelligence (Bandura, 1997; Schunk, 1995) but a substantial construct to describe human expectations (Schwarzer and Jerusalem, 2002), referred to as an individual's beliefs in his/her own ability for successful performance (Bandura, 1997; Byrnes, 2007). Hence, self-efficacy is defined as a competence expectancy influencing personal judgment about own possible actions, necessary to solve a specific challenging task rather than everyday routine (Schwarzer and Jerusalem, 2002).

Several studies suggest that individual's self-efficacy value influence the reactions to feedback, and consequently task performance (Bandura, 1986; Nease et al., 1999). According to previous studies, in response to negative feedback, people with strong self-efficacy beliefs tend to increase their effort more than those with lower self-efficacy (Bandura, 1986; Blecharz et al., 2014; Luszczynska et al., 2011; Nease et al., 1999; Sari, 2015). The causes of this phenomenon are explained by the attribution theory (Heider, 1958; White, 2002). As a fundamental basis for further attribution theories, this theory initially distinguishes the attribution of events to internal or external causes. Internal attribution is when people see reasons for behavioral results within their inherent personality characteristics, thereby affecting motivation, effort, and intended actions. In contrast, external attribution justifies certain behavior with situational circumstances, e.g., task difficulty (Heider, 1985).

Studies dealing with attribution theories indicate that people's attribution of personal feedback (or the lack of) is in accordance to their self-efficacy value (Silver et al., 1995). In comparison to low-self-efficacy individuals, people with high self-efficacy are inclined to attribute unsuccessful performance to external and unstable causes such as an unkind fate (Nease et al., 1999). Accordingly, high-self-efficacy individuals tend to attribute successful performance to internal, stable factors, such as ability; whereas people with low self-efficacy show reverse attribution schemes. These differing forms of positive/negative feedback attribution towards internal/external determinants is important for the protection of one's self-efficacy value. Thus, high-self-efficacy people can accept feedback that is inconsistent to their efficacy beliefs, as they do not attribute the causes to themselves (Nease et al., 1999). Therefore, in contrast to people with low self-efficacy beliefs, those with high self-efficacy values accept feedback to increase motivation, task focus, and effort (Brown et al., 2001). This theory also remains if the recipient receives negative performance feedback (Banfield and Wilkerson, 2014). Furthermore, although positive feedback is attributed to internal causes by people with high self-efficacy beliefs and to external events by people with lower self-efficacy, people with diverging self-efficacy values do not significantly differ regarding their acceptance of positive ratings (Nease et al., 1999). Drawing on these results, we propose the following research model illustrated in Figure 1, with the related hypotheses.

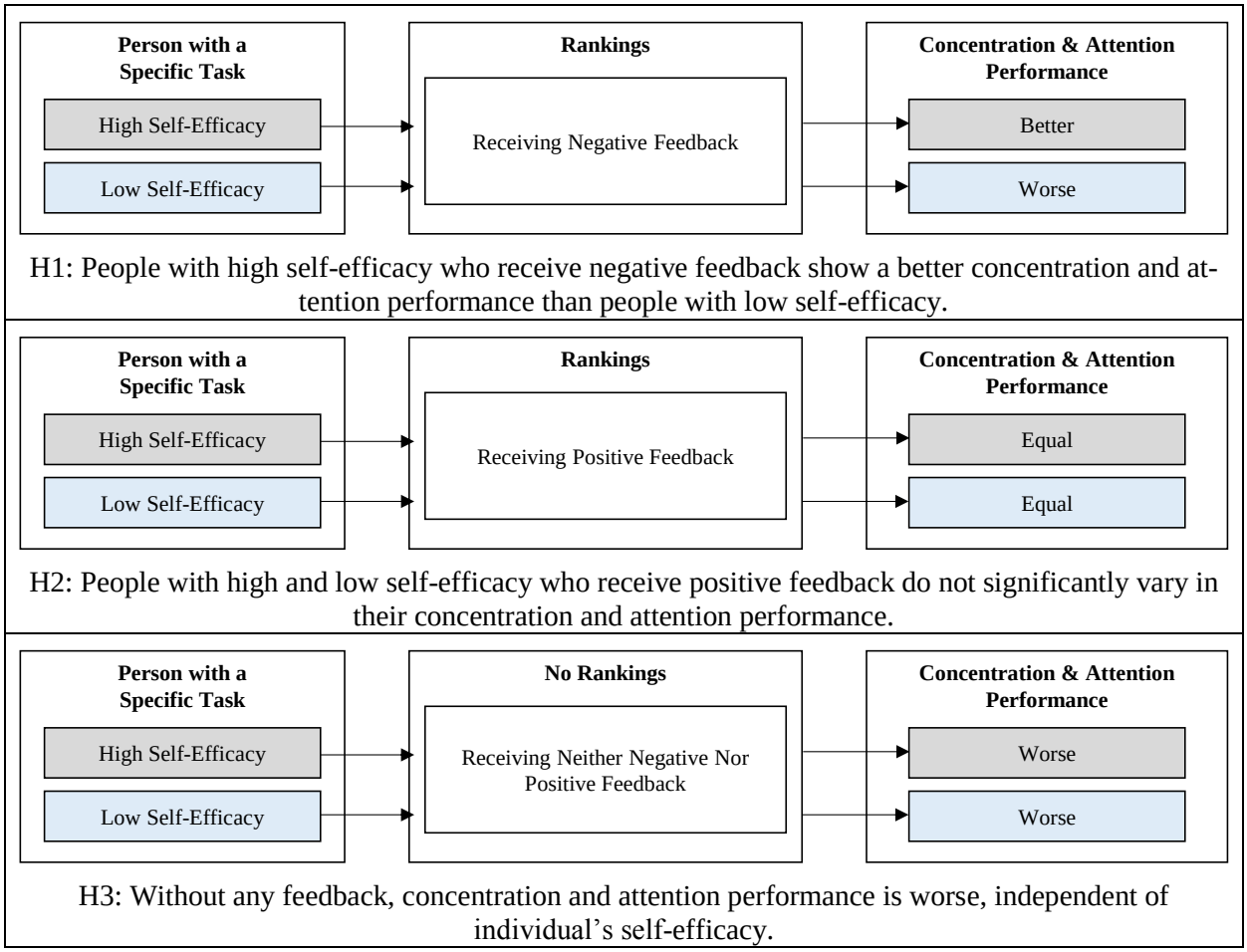

Figure 1. Research Model and Hypotheses.

2.2 The Impact of Subliminal Priming on Behavior and Performance

Early research in (cognitive) neuroscience and psychology have already investigated the impact of subliminally primed motivational mechanisms on behavior. These studies have shown that subliminally primed goals can influence participants' task performance (Custors and Aarts, 2010; Hart and Albarracin, 2009), fluid consumption (Strahan et al., 2002), and social behavior (Bargh and Williams, 2006). Furthermore, the effects of various types of subliminally primed rewards on physical force, as well as cognitive tasks have been proven (e.g., Bijleveld et al., 2009; Capa et al., 2011). For example, in an experiment conducted by Pessiglione et al. (2007), participants were informed that the harder they squeeze a hand grip, the greater their monetary reward would be. The results indicate that participants squeeze harder when they are shown high-value coins, even when these coins were presented subliminally. The case of physical activity and subliminal reward priming demonstrates that the squeezing force is correlated with the activation of the brain area pertaining to reward anticipation and effort mobilization (Pessiglione, 2007). These findings indicate that subliminally primed rewards can increase physical effort and performance, to the same extent that consciously perceived rewards can, but without overloading the user with excess information (Tosti, 1986). In the IS research domain, only a few studies focus on the role of subliminally primed motivational mechanisms to increase performance. In Ham et al. (2009)'s experiment about the impact of subliminally primed social feedback on attitude, participants were asked to decide which of three household appliances consumed the lowest amount of energy in an average household in an average week. Each of the 90 trials had one correct answer. After each decision, participants of the subliminal group received the feedback for 25ms;

no feedback was presented for participants of the control group. The results of this experiment revealed that participants of the subliminal group correctly responded more than those of the control group. Ruijten et al. (2011) extended the study of Ham et al. (2009) examining whether the successful impact of subliminally primed social feedback on performance can be increased by priming participants with performance-related words before the experiment. Prior to the execution of their experiment, participants of the primed group were shown 15 performance-related words, while the control group was shown 15 neutral words. This approach aimed to prime the participants of the first group to be successful in the experiment. The results highlight two main effects: generally, the participants who were given subliminally primed social feedback performed significantly better than those of the control group. Second, participants performed even better when they were primed with performance-related words.

In contrast to the study of Ruijten et al. (2011), our study joins the subliminally primed emotional feature in the form of a smiling face with consciously presented rankings. When emotions are subliminally primed, unconscious emotions arise (Zajonc, 2000). Unconscious emotions are characterized by three features: (1) It should be a result of an unconscious event (e.g., subliminal stimulus), (2) the unconsciously triggered emotion is perceived as diffuse, and (3) can be assigned to any target that comes along (Zajonc, 2000). Utilizing a subliminally primed facial expression successfully proved to trigger unconscious emotions by activating the limbic system circuits (Murphy and Zajonc, 1993; Whalen et al., 1998). In psychological and neuroscience research, studies could demonstrate that subliminally primed emotions are not actively recognized by the participants, but influence simple behavior such as immediate approach-avoidance movements (Lang, 1993). However, minimal research exists investigating the influence of subliminal emotional priming on more complex behavior (e.g., Murphy and Zajonc, 1993; Winkielman and Cacioppo, 2001).

Additionally, no study yet examines the interaction of subliminal priming and consciously perceived game-based features (Ham et al., 2009; Reitberger et al., 2010). This circumstance is remarkable because subliminal priming features have several advantages for the user (Ham et al., 2009), and can verifiably manipulate behavior (Chen and Bargh, 1999; Lang, 1993), by triggering personal needs, similar to game mechanisms (Hamari et al., 2014; Zhang, 2008). The interaction between rankings and subliminally primed emotions can be explained by the sequence of the brain's information processes and an emotion's motivational nature: resulting from early fade-in of subliminally primed emotions, the unconscious positive emotions are processed prior to cognitive information in the brain, thereby becoming dominant (Baumeister et al., 2007; Murphey and Zajonc, 1993). In theory, these dominant positive emotions then have the natural potential to increase motivation, and thus influence performance (Baumeister et al., 2007; Berridge and Winkielman, 2003). Therefore, we suggest a moderated effect of subliminal priming features on the impact of rankings on performance (see Figure 2). However, to date, no studies exist confirming the dominant character of subliminal stimuli once they are presented together with conscious IS design elements.

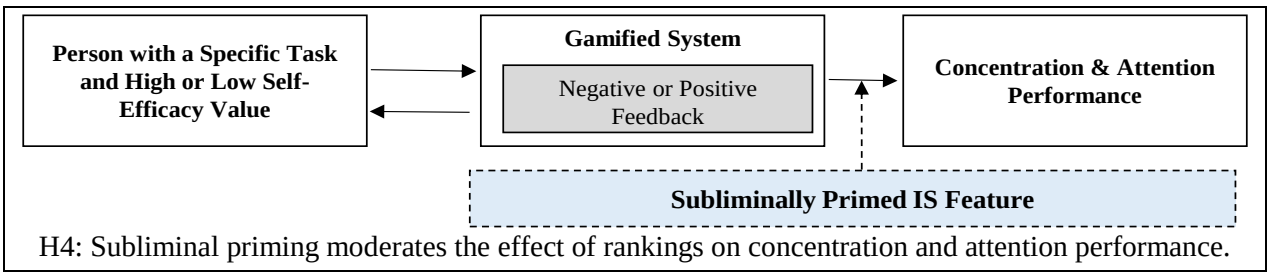

Figure 2. Research Model of Hypothesis 4.

3 Research Design and Methods

To empirically test our suggested hypotheses and research questions, we conducted a laboratory experiment with a between-subjects design (Boudreau et al., 2001). A laboratory experiment takes place in a controlled environment created by researchers to examine a certain phenomenon (Boudreau et al., 2001). In this setting, the researcher has control over the independent variable(s) and the random assignment of research participants exposed to various treatment and non-treatment conditions (Boudreau et al., 2001). These circumstances allow the researcher to study causal relationships between the independent variables and dependent variables.

3.1 Sample and Data Collection Procedure

Our study has a sample size of N = 407 participants ranging from 17 to 39 years old (mean: 23 years) with a share of 44% female and 56% male test persons. More than two-thirds of the participants had received a general qualification for university entrance (77%), while 19% had already earned a university degree. Before the experiment started, a computer randomly assigned participants into one of two high level groups, according to the subliminal priming conditions (with subliminal priming = index P, without subliminal priming = index N). Furthermore, each group was again divided in two sub-groups. We tested three ranking conditions (high position, low position, no rankings) and the effect of high and low self-efficacy values. Individuals' self-efficacy value was classified by the average of the self-efficacy scale. Participants above average were assigned to the group 'High Self-Efficacy Value' and participants below average of the self-efficacy scale were associated with the group 'Low Self-Efficacy Value'. In total, six different test groups for each of the two priming conditions exist. The partition of the subjects and the sample sizes (N; n) of the respective groups are illustrated in Table 1.

With Subliminal Priming: Research Design Priming Condition (N=203)		
	High Self-Efficacy Value (n = 102)	Low Self-Efficacy Value (n = 101)
High Position in Rankings (n = 71)	Group A_P (n = 39)	Group B_P (n = 32)
Low Position in Rankings (n = 66)	Group C_P (n = 32)	Group D_P (n = 34)
No Rankings (n = 66)	Group E_P (n = 31)	Group F_P (n = 35)
Without Subliminal Priming: Research Design No Priming Condition (N=204)		
	High Self-Efficacy Value (n = 102)	Low Self-Efficacy Value (n = 102)
High Position in Rankings (n = 72)	Group A_N (n = 39)	Group B_N (n = 33)
Low Position in Rankings (n = 67)	Group C_N (n = 32)	Group D_N (n = 35)
No Rankings (n = 65)	Group E_N (n = 31)	Group F_N (n = 34)

Table 1. Partition of the Test Subjects and the Sample Sizes.

The experiment took place in winter 2014/15 and winter 2015/16 respectively, over a span of several days. We asked students at the university campus to attend a 15-minute experiment and instructed participants to sit in front of a computer. The participants first received an explanation of the experiment's objective. We indicated that the experiment aims to measure the concentration and attention performance of students using a digital version of a paper-based test, and partly comparing individuals' performance through aid of an interactive ranking. In the second step, participants were asked to fill out a survey about demographic variables (gender, age, and education) and to answer the 10-item self-efficacy questionnaire according to Schwarzer and Jerusalem (1995).

Following the surveys, the test subjects were introduced to the test. The introduction included instructions on how to use the system, and on how attention and concentration would be scaled. We used the d2 test because it was originally designed and applied for the evaluation of processing speed, rule

compliance, and quality of performance, thus estimating an individual's attention and concentration (Brickenkamp and Zillmer, 1998). More importantly, the test is independent of education and knowledge (Brickenkamp and Zillmer, 1998), allowing application to a wide age range of ages between 9 and 60. In recent years, the d2 test has become one of the main tools for attentional assessments in Europe (Brickenkamp and Zillmer, 1998). The d2 test reliability is very high and the validity of the technique has been proven by many studies in various clinical and empirical contexts (Brickenkamp and Zillmer, 1998). The test subjects' objective was to select a certain set of symbols, a letter "d" with two streaks, as quickly as possible, without selecting a distractor (an incorrect symbol).

Before participating in the 'real' assessment situation, each participant performed a test trial to become familiar with the process. The entire test had 14 runs, with each run lasting 20 seconds and consisting of 57 total objects – comprising 25 or 26 target objects (correct symbols) and 32 or 31 distractors (incorrect symbols). After each run, a picture with three moving loading points in the center was shown for a timespan of three seconds. This loading screen was used to attract the test subjects' attention so they would be affected by the following priming mechanism (if they happened to be part of a primed group). Subsequently, in the priming condition groups (Groups A_P - F_P), a smiling face appeared for 17ms after the three-second counter elapsed. Members of the non-priming condition groups (Groups A_N – F_N) only received the picture with three loading points instead of a smiling face.

The duration of 17ms was chosen because previous studies indicate that participants perceive stimuli displayed for 17ms unconsciously (Pessiglione et al., 2007). When pictures are presented for very short durations, for example, 33ms or less, participants are not consciously aware of them (Pessiglione et al., 2007). We use an embodied virtual agent (smiley face) because research suggests these agents are able to function as persuasive technology (Grolleman et al., 2006; Midden and Ham, 2008). Moreover, existing work demonstrates that visualized feedback incorporating an avatar sends a more effective message than verbal feedback (Musch and Klauer, 2003).

In addition to the smiling face, after each round, participants – if assigned to the priming condition groups – received individual feedback with his or her position in a fictive ranking, thus comparing them with the last 100 anonymous participants, to create a uniform setting for all participants. The participants were informed that the ranking included test individuals from preceding rounds because some test groups consisted of only a few members. Participants of Groups A and B were given positions in the top third of the ranking, while participants of Groups C and D were presented with positions in the bottom third of the ranking. Groups E and F were considered as control groups regarding their ranking condition. Hence, they did not receive any ranking. After the experiment, we informed all participants about the fictive rankings and the priming condition. Furthermore, the participants received information about their real performance within the experiment. To evaluate and refine the experiment, we conducted a quantitative pilot study with a sample of $n = 20$.

3.2 Analysis

We used IBM SPSS Version 23.0 to analyze the data gathered. The data cleaning and calculation took place in three steps: first, the structure and distribution of the data was analyzed and verified with the aid of descriptive statistical approaches, to identify outliers and failed data records. In the second step, we tested the data regarding normal distribution and homogeneity. The normal distribution was confirmed with a histogram and a Gaussian distribution curve. The homogeneity was evaluated using the Levene test (Levene, 1960). Afterwards, to test our hypotheses, we ran a univariate analysis of variance (ANOVA). Since our study design comprises three independent, nominal-scaled variables (Ranking, Priming, Self-Efficacy) to analyze their impact on one dependent, metric-scaled variable (Concentration and Attention Performance), a univariate ANOVA as a form of General Linear Models can be used as 'all-in-one' empirical method (Huber et al., 2014). Furthermore, this method is more efficient than multiple single analysis, as interaction (known as moderation effects) can be identified at a glance. In our case, a three-way ANOVA with the factor's ranking, priming, and self-efficacy enables

to study both the main effects of the factor 'Ranking' on the 'Concentration and Attention Performance' and the interaction between 'Ranking' and 'Self-Efficacy' as well as 'Ranking' and 'Priming' on the 'Concentration and Attention Performance' (Huber et al., 2014). The 'Concentration and Attention Performance' is calculated by the sum of performance (*S*) of each subject in the d2 test across 12 trails. According to the evaluation procedure of the d2 test, the first and last round of the 14 rounds are withdrawn, as they tend to distort the data (Brickenkamp et al., 2010). The performance *O* and the sum of performance *S* are calculated as follows:

$$S = \sum_{i=1}^{12} O_i$$

with $O_i = C_{(possible\ correct\ responses)} - T_{(crossed\ target\ objects)} + D_{(crossed\ distractors)}$, *for i [1,12]*.

The performance value *O* is measured as the sum of mistakes ($C - T_{(crossed\ target\ objects)} + D_{(crossed\ distractors)}$), considering the amount of correct answers by subtracting $T_{(crossed\ target\ objects)}$ from *C*. Hence, high *O* values represent bad performance, because the lower the total count of *T* and the higher the total count of *D*, the higher *O* will be. *C* remains constant. Thus, sum *S* represents the accumulated performance values measuring the concentration and attention performance per subject over 12 trials, and is therefore, the total performance value considered in data analysis.

Subsequent to the initial descriptive statistical approaches, and a variance analysis to test whether ANOVA data conditions were fulfilled, we used the *F*-distribution (Philips, 1982). This distribution assesses the significant impacts of the main effects and interactions on *S* (*H1*, *H2*). If *H1* and *H2* cannot be falsified, the interaction between rankings and self-efficacy must be significant ($p \leq .05$). In the case of *H1*, the average *S* of Groups C should be lower than average *S* of Groups D, independent of the priming or the no priming condition. To provide evidence for *H2*, there should not be significant differences between the average *S* of Groups A and Groups B. Furthermore, to verify *H3*, the main effect of rankings has to be significant ($p \leq .05$). Furthermore, the average *S* of Groups E and F should not significantly differ ($p > .05$), but has to be lower than the average *S* of Groups A to D. To identify the parameters that cause intergroup differences, in case there are some, we used the Bonferroni correction. This eliminates the family wise error rate by dividing each comparison's error rate by the overall number of comparisons (Sarstedt et al., 2011). This neutralizes alpha error accumulation effects occurring in statistical analyses to make a comparison between multiple groups (Sarstedt et al., 2011). If the average *S* of Groups E and F is significantly higher than those of Groups A to D, *H3* cannot be falsified. Finally, to confirm the moderator effect of subliminal priming on the impact of rankings on *S* (*H4*), the interaction effect between subliminal priming and rankings has to be significant ($p \leq .05$).

4 Results

First, the structure and distribution of the data was analyzed and verified with the aid of descriptive statistical approaches. There were four invalid data records due to missing data. Therefore, four data sets had to be discarded. The requirements of the variance analysis approach were fulfilled. The normal distribution of all accumulated performance values *S* is given. Furthermore, the homogeneity of variance was successfully proven by the Levene test ($F(11, 395) = 0.769$; $p = .671$; Levene, 1960).

The results reveal a significant interaction effect between the ranking condition (high position, low position, no rankings) and the self-efficacy condition (high vs. low self-efficacy), independent of the subliminal priming condition ($F(2, 404) = 56.919$, $p = .017$). However, in contrast to our assumption in *H1*, participants with low self-efficacy values receiving negative feedback (Groups D, $M = 163$, $SD = 37$), show better performance results than those with high self-efficacy values (Groups C, $M = 168$, $SD = 34$). Furthermore, referring to *H2*, the results reveal a slightly higher concentration and attention performance of participants with high self-efficacy values (Groups A, $M = 165$, $SD = 31$), compared to subjects with low self-efficacy values (Groups B, $M = 169$, $SD = 34$). Regarding this, we did not ex-

pect any differences between the test subjects with high self-efficacy (Groups A) and the test subjects with low self-efficacy (Groups B).

H3 can be confirmed, as our study reveals significant differences between the types within the ranking list condition, independent of an individual's self-efficacy and subliminal priming. Test subjects that were presented a fictive ranking between the trials during the attention test (Groups A-D, M = 166, SD = 34), without relevance whether the feedback was positive or negative, delivered better performance results than the participants that did not receive any feedback (Groups E-F, M = 184, SD = 29, F(2, 404) = 7.604, p = .119). However, Bonferroni comparison revealed significant differences in the performance results between participants receiving positive feedback and those who did not receive any feedback (average S(E, F) = average S(A, B) + 18.778, p < .001). Similar results are observed for the comparison of the groups with negative performance feedback (Groups C-D) and no ranking groups (Groups E-F, average S(E, F) = average S(C, D) + 17.206, p < .001). Groups A-B and C-D do not differ significantly. The interaction effect is displayed in Figure 3.

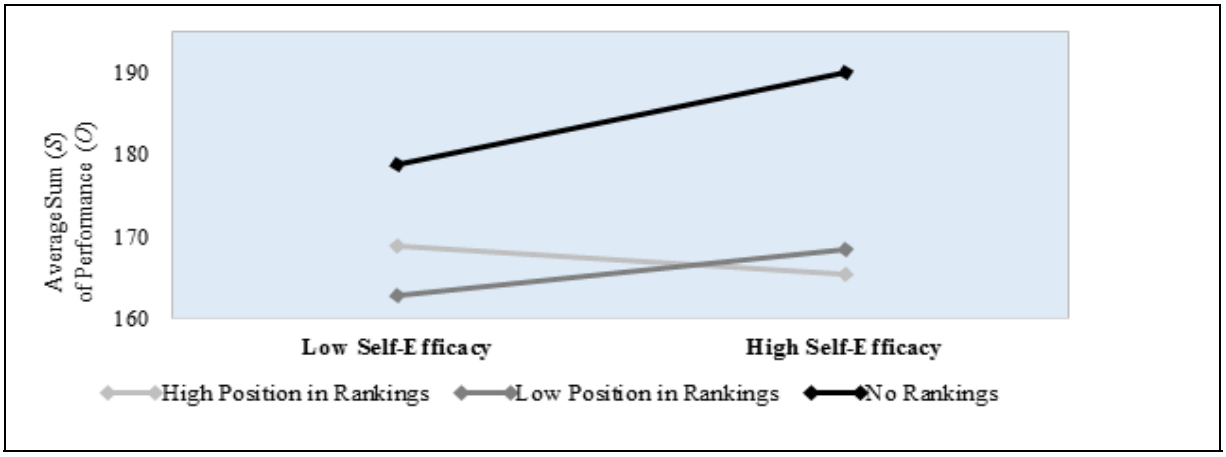

Figure 3. Interaction Effects between 'Self-Efficacy' and 'Ranking'.

Finally, we examined the moderating effect of the subliminal priming feature 'Smiling Face' (*H4*). The analysis reveals no significant differences between the subliminal primed test subjects and non-subliminally primed test subjects. Thus, in contrast to our assumption in *H4*, subliminal priming does not affect the effect of the game-based IS feature 'Ranking' on S in IS usage (F(2, 404) = 5.884, p = .717).

5 Discussion

This paper examines the theoretically and practically relevant question as to how gamification features lead to proper interaction with the user to effectively support desired goal attainment – in our case the boost of encouragement and concentration. To do so, we encoded the motivational process of a gamified IS feature and analyzed the additional impact of a subliminally primed smiling face. Concretely, we focussed on the game feature 'Ranking' and its impact on the individual's concentration and attention performance (RQ1; *H3*). Furthermore, the moderation effects on this relation of self-efficacy (RQ2; *H1* and *H2*) and subliminal priming smiling face (RQ2; *H4*) are examined.

For hypotheses *H1* and *H2*, we observed a significant interaction effect between rankings and participants' self-efficacy. Although we can confirm that people's reactions to positive and negative performance feedback depend on their self-efficacy level (Silver et al., 1995), the results reveal an interaction that is contrary to what basic research led us to assume. Test persons with low self-efficacy show better performance results when receiving negative feedback than those with high self-efficacy (*H1*). One possible explanation is that the participants perceive the feedback over a span of 12 trials repeat-

edly rather than as initial feedback, and therefore show different feedback reactions than predicted. Particularly, people with high self-efficacy, when applied the self-efficacy protection mechanism "feedback acceptance", question the accuracy of received performance feedback being inconsistent compared to the effort invested (Nease et al., 1999). Hence, test subjects with high self-efficacy values tend to reject repeated negative performance feedback because they attribute negative performance results to external circumstances, thus finding it difficult to accept information inconsistent to their expectations (Nease et al., 1999). In contrast, people with lower self-efficacy perceive the negative feedback as consistent with their judgment of self-capabilities, attributing the results' causes to internal factors. In response to this perception, they increase concentration and attention on the task, to achieve better results (Nease et al., 1999). Even though we did not assume significant differences in the event of positive performance feedback between the two self-efficacy conditions (*H2*), better performance rates among participants with stronger self-efficacy beliefs were recorded. Following the argumentation regarding *H1*, this is because positive achievements were attributed to internal causes, i.e., one's own ability to solve challenging tasks, and increase motivation and strive for better performance.

Furthermore, the confirmation of suggested hypothesis *H3* reveals the positive impact of the rankings on users' concentration and attention performance. Independent of the feedback type (positive or negative) and the individual's self-efficacy value (high or low), participants that received performance feedback performed significantly better in the attention test than those without any feedback. The cause might lay in the inherent dynamics of the game-based element 'Ranking' enhancing performance in IS usage by stimulating motivation through challenge (Jung et al., 2010; Zhang, 2008). In addition, the fictive rankings, displaying individual's performance relative to the results of the 100 participants before, also includes a social component as it mimicks a competitive environment. Considering recent studies that label rankings as a popular feedback mechanism in evaluating individual's performance relative to social norms (Kluger and DeNisi, 1996), the social normative component represents a crucial success factor in gamified IS feature designed in order to influence performance results (Schultz, 1999). This is because people strive for socially accepted and desired behavior (Fischer, 2008). These results underpin the effect of feedback mechanism rankings on users' performance, enhancing ambition among the participants (Loock et al., 2011). In this regard, the relationship between the competitors and the design of rankings are important factors to create an optimal challenge (Jung et al., 2010), and therefore must be considered when transferring our results to different contexts. A situation of anonymous rankings is a setting where the participants do not know each other and can create an environment with minor striving to competition, thus leading to decreased intrinsic motivation for performance enhancement. In contrast, high pressure is achieved in settings where the competitors know each other and the opportunity to compare their performance with their peers exists (Jung et al., 2010). Moreover, early studies indicate that the context in which rankings are applied is important. In this respect, previous field studies suggest that competition in a learning environment, such as a classroom or lecture hall, differs to those in organizational settings (Domínguez et al., 2013; Hanus and Fox, 2014). Since the laboratory experiment is an artificial setting, real competition via rankings probably will not occur. Additionally, the rankings might not be conforming to the efforts of the participants. While participants with no intention to perform well may end up in the top third of the rankings, dedicated participants, on the other hand, may be ranked low. Both conditions may result in frustration and consequently lead to decreased performance, particularly among people with high self-efficacy.

The results regarding hypothesis *H4*, examining performance differences between subjects with subliminal priming and without subliminal priming conditions, reveal that the implemented priming feature 'smiling face' does not have a significant impact on users' concentration and attention performance. Therefore, the early fade-in of subliminally primed emotions cannot overrule consciously presented gamification mechanisms. Consequently, there might not be a complementary impact of subliminally primed emotions in addition to rankings on performance in IS usage. We assumed differing

performance results according to studies showing that new information is deluged by subjective initial emotion (Murphy and Zajonc, 1993). Our experiment does not show any effects of subliminal priming, regardless of whether the feedback information is congruent to previous primed emotions. Although the usage of subliminally primed facial expressions was proved to be a successful measure to trigger unconscious emotions by activating the limbic system circuits (Murphy and Zajonc, 1993; Whalen et al., 1998), in our test setting, the emotional activation was probably not strong enough to impact concentration and attention.

5.1 Theoretical and Practical Implications

In contrast to studies where single feedback is given, our study contains repeated feedback and reveals evidence that users with high self-efficacy tend to decrease concentration on a specific task when they are provided with negative performance feedback. It was also observed that they react with higher motivation and better performance results when they repeatedly receive positive feedback. Since the results consistently indicate reverse effects for low self-efficacy people, many domains benefit from the research conducted. Considering the fact that companies call for helpful tools to influence their customers' behavior and enhance their employees' performance, our study delivers knowledge to application designers, by questioning how gamification features should be designed to facilitate effective interaction with users in order to reach desired goals. Currently, psychological, health, educational, or social applications increasingly use supplementary IS artefacts to stimulate motivation, and therefore influence users' performance (e.g., Ferron and Massa, 2014; Kaptein et al., 2012; Toscos et al., 2012). For example, current approaches like Fitbit or Nike track users' activities and show the potential of healthier lifestyles at the end of the day (Robson et al., 2015). Level Eleven provides gamification plug-ins to steer and motivate sales staff with the help of leaderboards. From a scientific perspective, the results show significant effects of real-time feedback through IS-based ranking mechanisms enhancing users' concentration. These findings comply with the desire of the modern always-online generation for immediate, gamified performance feedback in the digital age (Myers and Sundaram, 2012; Vodanovich et al., 2010).

Generally, the application of game-based features, i.e., rankings, might be interesting in various fields such as sports, education, software engineering, organizations, retail, advertising, financial services and banking, as well as insurance, in order to increase the performance of IS usage. According to our findings, an essential success factor regarding the design of effective gamification environments is the consideration of interpersonally differing reactions to performance feedback, which depend on an individual's self-efficacy beliefs. Therefore, supporting Petkov et al. (2011), the current research suggests that the utilization of rankings cannot be considered a one-size-fits all solution. Since the effect of one game mechanism could depend on its application field and design (e.g., Jung et al., 2010), software developers should rather focus on creating performance enhancing game environments that intrinsically motivate users. Referring to our study's results, the assessment of users' self-efficacy should be taken into account to effectively adjust IS game mechanisms to its users' personality characteristics. Moreover, we account for new findings about the impact of unconscious emotions, as well as their interaction with parallel existing conscious motivational mechanisms. Although our study supports the independence of emotions and cognition, we call for further research on how subliminal primed emotions can be used to increase concentration and attention performance. However, steering customer behavior and employee engagement by using subliminally primed emotions is not yet an option for the major number of organizations due to ethical concerns and uncertainty about the impact of the respective IS feature. They justify the negative attitude with the argument that employees have the right to know how they are influenced unconsciously. Regarding this, the huge potential of subliminal elements lie in its inherent characteristics so that there is no real smaller impact of unconscious stimuli, even though people are aware of them. Although our study could not find theory supporting results, we developed ideas of useful application areas of those mechanisms, and are further surveying the acceptance of subliminal priming feature in practical contexts.

5.2 Future Research and Limitations

Due to the complexity and interdependencies of underlying theories, our study suffers some limitations and generates further ideas for future research. Our sample predominately consists of students and does not represent society. Therefore, the transferability of the results to reality is questionable. Especially taking into account that gamification features should aim at sustainable behavioral impact, i.e., permanent performance enhancement, making the social normative component essential, with regard to the provision of feedback (Schultz, 1999). We suggest the extension of the competitive character of further test situations in a more realistic way. Moreover, the experiment lasts only 15 minutes overall, with a 15 second period between each trail. This results in a very restricted time window, where the motivation could be increased to enhance the concentration and attention performance, and vice versa. Hence, future research should investigate long term effects in longitudinal experiments. Additionally, further studies should investigate other unconscious motivational mechanisms, since scientific progress in other domains is far ahead. We suggest an interdisciplinary, closer connection of IS research with psychology and neuroscience, i.e., to observe the varying neuronal activation of certain areas in the human brain by different IS-based stimuli, such as gamified feedback elements. Multi-method approaches combining quantitative and qualitative research methods could be tools suited to dive-deep into human motivational processes and subjective feelings caused by subliminal primed emotions.

6 Conclusion

This paper aims to analyze the impact of the game-based IS feature ‘Ranking’ on concentration and attention performance. Additionally, we also study the moderation effect of users’ self-efficacy on this relationship. Our findings indicate that both positive and negative performance feedback can be a useful tool to increase users’ concentration and attention. In addition, the results show varying reactions to either positive or negative evaluative information, depending on the individual’s self-efficacy. To activate people with high self-efficacy, utilizing repeated positive feedback could lead to success, while negative information may reduce the activation. Likewise, low self-efficacy people’s motivation can be stimulated through repeated negative feedback. Furthermore, the other objective of the study was to examine the moderating effect of a subliminally primed IS feature on the impact of rankings on users’ concentration and attention performance. We could not observe a significant impact of subliminally primed emotions regarding the effect of the consciously perceived gamified IS feature ‘Ranking’, which increased performance. Therefore, our paper sheds light on the theoretically and practically relevant question as to how gamification features lead to proper interaction with the user to effectively support desired goal attainment – in our case the boost of encouragement and concentration. We encoded the motivational process of the gamified feature ‘Ranking’ and analysed the additional impact of a subliminally primed smiling face. However, we recommend that IS scholars from the research field of Human-Computer Interaction should specifically further investigate how messages and elements in gamified applications are perceived (either unconsciously or consciously), and the required design of interaction, in order to increase engagement and performance results among the respective target groups.

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