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WEB SURVEY GAMIFICATION – INCREASING DATA QUALITY IN WEB SURVEYS BY USING GAME DESIGN ELEMENTS

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Research in Progress

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Abstract

Researchers and survey designers face the challenge of low data quality as web surveys are often not compelling. Thus, participants' engagement declines while completing a survey resulting in participants tend to apply satisficing behavior (e.g., speeding, straight-lining) in order to complete the questionnaire or even break-off the completion of the questionnaire. Due to satisficing behavior, researchers are faced with the challenge of low data quality. Addressing this challenge, survey gamification promises to make web survey participation enjoyable, which might also engage participants to complete questionnaires by providing high-quality data. However, the research on the effects of gamifying web surveys (in particular on behavioral outcomes) is still inconclusive. Addressing this short-coming, we propose to examine the effects of two common game design elements – badges and a meaningful story – in an experimental study. Based on the theoretical background of gamification and the theory of cognitive absorption, we derive hypotheses and outline in detail our experimental design in this research-in-progress paper. Our proposed research study will contribute to research and practice by addressing an important challenge when conducting online surveys: the motivation to process surveys accurately.

Keywords: Gamification, Survey design, Data quality, Break-off rate, Experimental design.

1 Introduction

Completing web surveys is often not fun – in particular if respondent burden (Bradburn, 1977) is high, that is, if the questionnaire is long and covers a topic that participants perceive as not compelling. High respondent burden can lead to lower motivation to complete the survey and to an increase of satisficing behavior (e.g., speeding through the questionnaire, non-differentiation and straight-lining in grid questions). As a result, data quality decreases. Respondents experience a burden when answering a survey bases on four factors: (1) the length of the questionnaire, (2) the amount of effort to answer the questions, (3) the amount of emotional stress related to the answers, and (4) the frequency with which respondents are asked to participate in a survey (Downes-Le Guin et al., 2012). Consequently, the more researchers (and practitioners) rely on survey-based data collection using long and boring online questionnaires, the more participants will provide low-quality data due to careless responding or even break-off. Data sets having a high proportion of careless responses "could lead to spurious

within-group variability and lower reliability […], which, in turn, will attenuate correlations and potentially create Type II errors in hypothesis testing" (Meade and Craig, 2012, p. 437). To identify low-quality data and prevent Type II errors, researchers consider certain indices of careless responses. Examples of such indices are *bogus item flags* (items with a clear correct answer), *outlier analysis* (responses constantly far away from the mean of the item set), *consistency indices* (differences in highly similar items), *response patterns* (unlikely patterns like alternating between two scale points) (Meade and Craig, 2012), *speeding* (extremely fast responses) (Zhang and Conrad, 2013), or *straight-lining* (same response option for a set of items) (Cole et al., 2012; Schonlau and Toepoel, 2015).

A reactive way of dealing with low respondent motivation and careless responding is to identify satisficing behavior and discard the data. Making the survey participation experience to 'an enjoyable social event' (Downes-Le Guin et al., 2012, p. 614) by using game design elements is a more proactive approach, which might also engage participants to complete the questionnaires by providing high-quality data (Turner et al., 2014). In particular, game design elements that are easy to implement like points, badges, or rewards are examined regularly (e.g. Cechanowicz et al., 2013; Findlay and Alberts, 2011; Harms et al., 2014). In survey gamification research, most studies combine various game design elements in their research design and thus, a concrete attribution of the effects to single game design elements is difficult. In information systems (IS) research, the reported effects of such game design elements are also mixed. Points, for example, seem to increase purely the quantity of participation (e.g., in social networks) but not the quality (Mekler et al., 2013; Thom et al., 2012). On the contrary, badges seem to influence participants' intrinsic motivation (Denny, 2013; Li et al., 2012). Other studies (e.g., Haaranen et al., 2014), however, did not find any significant effect of badges and received highly varying feedback when asking participants with regard to badges. For more complex game design elements like the implementation of a meaningful story, the effects on psychological outcomes are anecdotal, not only in survey gamification but also in IS research. Summarizing, there is research studying the effects of game design elements on psychological outcomes (e.g., cognitive absorption, enjoyment). However, the results of the studies are mixed and do not allow drawing concrete conclusions. In addition, the influence of game design elements on behavioral outcomes (e.g., break-off rate, survey completion time, straight-lining) as measures of data quality is rather inconclusive. Thus, we address the following research question:

RQ: Does the implementation of badges and a meaningful story as game design elements affect data quality in web surveys and participants' cognitive absorption?

In order to address the proposed research question, we intend to conduct a laboratory experiment, which enables us to observe participants when completing a web survey in a controlled environment. The laboratory experiment allows us to gather insights on the effects of different game design elements on cognitive absorption as a psychological outcome and data quality as a behavioral outcome of gamification. Previous studies either considered only single game design elements or mixed them. In our study, we will observe the effects of two prominent game design elements – badges and a meaningful story – separate of each other and whether there is an interaction effect when both elements are implemented rather than only one of them. In doing so, our study addresses an important challenge in web survey designs: the motivation of participants to process surveys accurately. By adding two distinct game design elements, we argue that the overall data quality of the resulting data sets will be increased. Based on our study design, we will be able to explicitly attribute changes in different indicators of data quality to either the use of badges, the implementation of a meaningful story, or their combination. In addition, our study provides detailed insights into the effects of gamification on psychological and behavioral outcomes.

2 Theoretical Background and Development of Hypotheses

There is a growing body of literature on gamification in IS and other research areas. However, much research examines gamification from a conceptual perspective (e.g., by defining the concept, providing a literature review, or distinguishing gamification from other concepts such as serious games).

Empirical evidence for the effects of gamification on psychological outcomes is rare and evidence for its effects on behavioral outcomes is even scarcer. This holds true in the case of web survey gamification. In the following section, we briefly summarize the key findings on gamification and web survey gamification and derive our hypotheses that we test in our experimental study.

2.1 Prior Studies on Gamification

Gamification is defined as "the use of game design elements in nongame contexts" (Deterding et al., 2011, p. 7). Hamari et al. (2014) name game design elements that are used in nongame contexts, motivational affordances. These motivational affordances can produce psychological (e.g., user experience and fun) and behavioral (e.g., participation and performance) outcomes. In their review of empirical studies on gamification, Hamari et al. (2014) find that ten game design elements have been used most often in the literature: points, leaderboards, achievements/badges, level, story/theme, clear goals, feedback, rewards, progress, and challenges.

When studying existing gamification literature, we realized that prior studies mainly discussed and demonstrated positive effects of various game design elements on user participation in the context of online communities (Farzan et al., 2009; Li et al., 2012), advertising (Terlutter and Capella, 2013), recycling (Lessel et al., 2015), education and learning (Huang and Hew, 2015), and intra-organizational systems and work (Hamari et al., 2014). However, more and more researchers also consider gamification from a more critical perspective, in particular when only single game design elements are implemented. Points, for example, purely increase the quantity of participation (e.g., in a social network) but not the quality and can undermine initial, intrinsic motivation (Mekler et al., 2013; Mutter and Kundisch, 2014; Thom et al., 2012). On the contrary, the implementation of badges increases intrinsic motivation, and researchers realized that even negative badges (e.g., earned for asking questions that are never answered, commented, or viewed by others) have a positive effect on users' motivation (Denny, 2013; Li et al., 2012). Other researchers like Haaranen et al. (2014) could not find a significant effect of badges on students' learning outcomes. Rather, students' feedback on badges was to the same extent positive as it was negative or indifferent. On the one hand, students perceived the badges as a "wonderful idea" (Haaranen et al., 2014, p. 36). On the other hand, the participants criticized that they did not see its usefulness as they could not realize how the badges influenced their studying. Rather participants suggested to "make badges more epic by adding familiar concepts and humor from games" (Haaranen et al., 2014, p. 36). In addition to a missing link between the game design elements and users' personal goals and needs, users' personality is perceived as another possible explanation of the differing effects of gamification. In the case of badges, Codish and Ravid (2012), for example, observed a lower effect of badges for extroverted than introverted persons as extroverted personalities "maintain their real personality in offline communications" (p.9). Huang and Hew (2015) compare the effects of points, badges and leaderboards on students' engagement in pre-course activities. They realize that badges and leaderboards motivated students most and conclude that "in tertiary education, educators and practitioners may consider using gamification strategies, at least in the short term, to scaffold out-of-class learning" (Huang and Hew, 2015, p. 280).

When focusing on long term effects of gamification, researchers (e.g., Nicholson, 2012; Wiegand and Stieglitz, 2014) suggest to implement a meaningful frame. Only "if users have a positive and meaningful game-based experience that is well-connected to the underlying non-game setting, then the organization will benefit in the long term" (Nicholson, 2012, p. 7). Thereby, Mekler et al. (2013) define an activity as meaningful "when embedded within a narrative, supporting users' personal goals and interests, or having a purpose that is deemed valuable by users" (p. 1138). In their 2×2 experimental setup, Mekler et al. (2013) compared the effects of points and a meaningful frame as two prominent game design elements on the participants intrinsic motivation and performance in the context of an image annotation task. The researchers conclude that points motivated participants to produce more tags, but the meaningful frame increased the quality of the tags.

Summarizing, the research on the effects of gamification on psychological and behavioral outcomes is mixed. In order to design gamified systems that fulfill their purpose, more empirical studies are required to understand the effects of gamification. Based on prior studies and the inconclusive results in research, we therefore empirically test the effects of badges and a meaningful story as two prominent game design elements in a laboratory experiment. In doing so, we apply Hamari et al.'s (2014) framework and subdivide our research interest into two main hypotheses which are focusing on psychological and behavioral outcomes separately.

2.2 Hypotheses Development

In the context of surveys, gamification has been specified as "the application of game mechanics (or game thinking) to an interaction with respondents" (Downes-Le Guin et al., 2012, p. 615). Hamari et al.'s (2014) framework is also useful for categorizing the plethora of goals that survey designers try to achieve when gamifying a survey (see Keusch and Zhang (2015) for an extensive summary). When gamifying a survey, researchers hope that gamification provides respondents with a more challenging, relevant, involving, rewarding, and, therefore, a more positive survey experience. In turn, the positive survey experience should result in the psychological outcome that answering an online survey becomes more engaging, involving, and fun. In particular, by implementing various game design elements, researchers hope to make surveys more game-like, which may lead to a reduction of respondent burden and thus, increases the participation in surveys as well as decreases the likelihood of break-offs. In the long run, researchers hypothesize that survey gamification will minimize survey fatigue (Adamou, 2013), lower the costs of participant recruitment, and lead to more representative survey samples (Harrison, 2011). Furthermore, survey designers hypothesize that the elevated level of respondent engagement due to survey gamification decreases participants' tendencies for satisficing behavior, which in turn will result in an increase of survey data quality (Cechanowicz et al., 2013). In their systematic review of 14 experimental studies, Keusch and Zhang (2015) find that many of these hypothesized effects of survey gamification still lack empirical support. While several studies confirm the positive effect of using various game design elements in a web survey context on psychological outcomes (e.g., engagement, cognitive absorption, enjoyment), the influence of the same elements on behavioral outcomes, especially those that affect measurement error, is rather inconclusive.

Furthermore, Keusch and Zhang (2015) could identify only six (out of 14) studies that implemented some kind of an imaginary backstory, theme, or narrative. However, most of these studies could not find a significant reduction of break-offs. Two studies even reported more break-offs in the gamified survey compared to the control group. Keusch and Zhang (2015) "speculate that this negative impact of gamification on participation might result from the disconnection between the backstory and the survey topic" (p.11). Furthermore, they conclude that although gamified conditions without a story "could help to keep members of online panels and marketing research communities motivated […], it is unclear to what extend such techniques would also work in a cross-sectional survey" (Keusch and Zhang, 2015, p. 14).

In summary, narratives implemented in web surveys are often disconnected from the survey topic and thus, the story cannot be described as meaningful. However, in order to change individuals' behavior, researchers (e.g., Laschke and Hassenzahl, 2011; Lawley, 2012; Nicholson, 2012) call for the implementation of a meaningful frame, where the activities and goals in the application need to be derived from overarching goals and implemented accordingly. In addition, there is lack of empirical evidence for the influence of other game design elements. Badges, for example, are demonstrated to have an impact on users' intrinsic motivation to participate in social networks (Denny, 2013). The effect on survey participation and survey data quality, however, remains anecdotal and needs to be demonstrated empirically. Focusing on the effects of web survey gamification on behavioral outcomes by triggering an increase of data quality with game design elements, we hypothesize:

H1a: The implementation of badges and a meaningful story as game design elements influences data quality in web surveys.

H1b: Web surveys that incorporate both badges and a meaningful story as game design elements have a stronger impact on data quality than can be explained through the additional effects of the individual elements.

According Hamari et al.'s (2014) framework, psychological outcomes are an important antecedent of behavioral outcomes of gamification. Thus, our research not only addresses behavioral outcomes (manifested as data quality) but also psychological outcomes. One concept often mentioned in the context of gamification and strongly related to psychological outcomes is flow (Csikszentmihalyi, 1975). In the context of gamification, flow is defined as "an extremely enjoyable experience, where an individual engages in a […] game activity with total involvement, enjoyment, control, concentration, and intrinsic interest" (Hsu and Lu, 2004, p. 857). However, although the concept of flow is studied in IS and related research areas since decades, "the literature shows inconsistencies and discrepancies" (Finneran and Zhang, 2005, p. 97). In their overview on the flow concept and its operationalization, Finneran and Zhang (2005) perceive the diverse models and operationalization of flow, which are the result of different understandings of antecedents, as one of the main challenges researchers are faced with. Another concept is cognitive absorption, which is a "state of deep involvement with software" (Agarwal and Karahanna, 2000, p. 665). According to Agarwal and Karahanna (2000), cognitive absorption is a multi-dimensional construct that comprises five dimensions: focused immersion, heightened enjoyment, temporal dissociation, curiosity, and control. Based on prior literature, we assume that gamification – when appropriately designed – will have an impact on respondents' cognitive absorption. Thus, we hypothesize the following psychological outcomes of gamification:

H2a: The implementation of badges and a meaningful story as game design elements influences participants' cognitive absorption when completing web surveys.

H2b: Web surveys that incorporate badges and a meaningful story have a stronger impact on participant's cognitive absorption than can be explained through the additional effects of the single elements.

H3: Participant's cognitive absorption mediates the effect of survey gamification on data quality in web surveys.

Figure 1 depicts the hypotheses and the research model addressed by our research design.

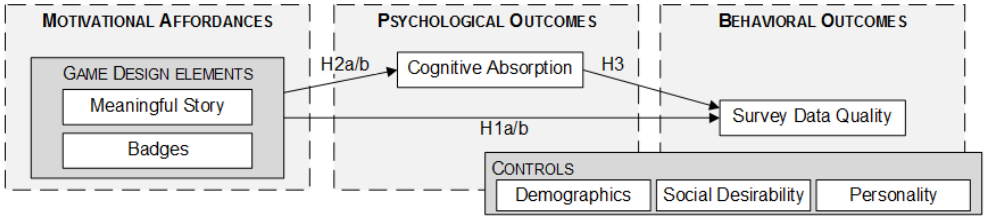

Figure 1. Research model for survey gamification based on Hamari et al.'s (2014) framework

3 Research Method

In order to examine the effects of survey gamification on psychological and behavioral outcomes, we will conduct a lab experiment testing the effects of badges and a meaningful story on participants' cognitive absorption and data quality. In this section, we present the design of our research in detail.

3.1 Experimental design

The stated hypotheses will be investigated by conducting a lab experiment, in which participants receive either a gamified or a conventional version of the same web survey. The gamified version includes either an implementation of badges, a comic comprising a meaningful story that is related to the survey topic, or both of them. Apart from the game design elements, the gamified survey conditions will not differ in any other aspects from the conventional survey condition. Hence, game design elements are implemented as two-level between-subjects factors: *badges* (badges vs. no badges) and a

meaningful story (meaningful story vs. no meaningful story) to control for main and interaction effects of these elements. The experimental set-up results in a 2×2 between-subjects design and participants are randomly assigned to the four experimental conditions. Figure 2 depicts a screenshot of the web survey containing both badges and a meaningful story. For participants who receive only one or no game design element, the particular areas of interest will remain empty.

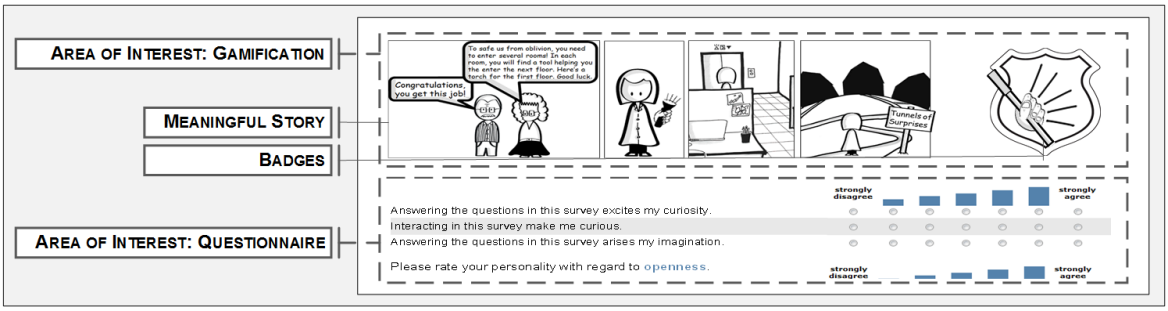

Figure 2. Screenshot of a gamified survey design (meaningful story and badges)

Conducting a lab experiment offers the possibility of including both subjective and objective (e.g., time for survey completion, participants' eye fixations, etc.) measures. Measuring the break-off rate, however, is difficult in a lab experiment as participants receive incentives for completing the questionnaire and might refrain from stopping to answer the questions due to the controlled environment and additional factors such as social desirability (Podsakoff et al., 2003). We therefore control for participant's social desirability. In addition, there is some evidence in literature (e.g., Codish and Ravid, 2012; Hall et al., 2013; Karanam et al., 2014) that the effects of gamification might be influenced by participant's personality. In order to control for these factors, we will hand out a non-gamified questionnaire to all participants prior to the experimental treatment. In this pre-experimental questionnaire, we will employ the 33-item adoption of the Marlow-Crowne Social Desirability Scale (MC-SDS) as provided by Crowne and Marlowe (1960) and the 15-item adoption of the BigFive Inventory as used by Lucas and Donnellan (2011).

In a second phase, we will conduct the actual experiment where participants receive either a fully gamified questionnaire (badges and meaningful story, see Figure 2), a partly gamified questionnaire (either badges or meaningful story), or a non-gamified questionnaire. Within this second part, we are collecting objective data on the effects of gamification on data quality. In survey research, data quality can be operationalized in many ways. Some researchers (e.g., Meade and Craig, 2012) consider bogus items flags, consistency items, or response patterns as indices of data quality. Others apply speeding indicators (e.g., Zhang and Conrad, 2013) or straight-lining indicators (e.g., Cole et al., 2012; Schonlau and Toepoel, 2015) to assess survey data quality. In order to assess data quality within our lab experiment, we, operationalize data quality by considering the indicators listed in Table 1.

Indicators for data quality	
1.	Voluntary continuing with the web survey • Number of additional items answered in voluntary part of the questionnaire • Additional time spent on voluntary part of the questionnaire
2.	Item nonresponse (Mavletova 2015)
3.	Length of answers to open questions (Mavletova 2015)
4.	Rounded answers to numeric questions (Schober et al. 2015)
5.	Straight-lining (Schonlau and Toepoel 2015)
6.	Speeding (Zhang and Conrad 2013)
7.	Bogus item flags (Meade and Craig 2012)
8.	Consistency items (Meade and Craig 2012)

Table 1. Indicators for data quality considered in laboratory experiment

In addition to indicators of data quality, we will record the participant's eye fixations to test whether or not the participants paid attention to the particular game design elements. Based on the eye-mind assumption (Just and Carpenter, 1980), we argue that fixating the game design elements with their eyes will most probably result in the cognitive processing of the elements by the participants. In doing so, the eye-trackers will record the time span of fixating the included game design elements while the participants are filling out the web survey. For the eye-tracking procedure, we defined areas of interest (see Figure 2), which are the same for all experiment groups. In addition, we will be able to collect objective indications for the effects of gamification on participant's enjoyment, which is one of cognitive absorption's five dimensions by using webcams and a software for emotion recognition.

Measurement of break-offs in a controlled environment like the laboratory is difficult. Therefore, we designed our experiment in a way that we can observe indications of potential break-offs. We will divide the experimental questionnaire into a mandatory and a voluntary part. All experimental groups are instructed that they will have to answer the mandatory part, which will take about 15 minutes, to receive their incentive. At the end of the mandatory part, participants will be asked whether they want to proceed with the voluntary part of the questionnaire. Participants are informed that they do not receive an additional incentive for the additional time they spend in answering. The topic of the experimental web questionnaire covers different topics and is not of interest for the hypothesized effects.

After finishing the mandatory (and voluntary) part of the experimental questionnaire, all participants will receive another questionnaire (post-experiment questionnaire). In addition to objectively measuring users' enjoyment by emotion recognition software, we will collect subjective data on users' cognitive absorption. In doing so and to test our second hypothesis, we will measure participants' cognitive absorption by administering a context-adapted version of the questionnaire by Agarwal and Karahanna (2000). The post-experiment questionnaire is not part of the treatment and thus, does not include any game design elements.

The procedure for all experimental groups only differs regarding the gamified design of the experimental questionnaire. Neither the overall procedure nor the configurations of the social desirability and Big Five pre-experiment questionnaire or the cognitive absorption post-experiment questionnaire at the end vary across groups. Figure 3 depicts the overall procedure of our study design.

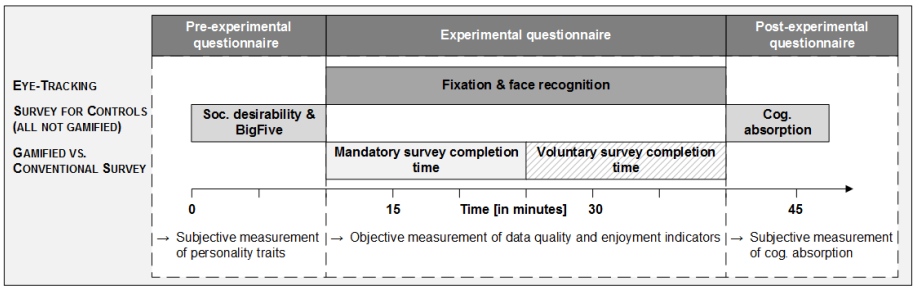

Figure 3. Overview on the experimental procedure

3.2 Recruitment of Participants

Participants for the experiment will be recruited from an existing pool of students provided by the laboratory facility used for this study. We are aware that students might be more receptive for gamification than other potential survey participants. For the lab experiment, however, the access to potential participants from the general population is limited. In a second stage (not described in this paper), we will conduct a large-scale field experiment inviting a more heterogeneous set of participants with diverse demographic characteristics.

With regard to the sample size, we conducted an a priori sample size calculation. Cohen (1992) recommends a maximum type II error (β) of four times the determined type I error (α). Given a significance level of $\alpha = 0.05$, a statistical power $1 - \beta = 0.95$ and an assumed medium effect size of $f = 0.20$ (Cohen, 1988) for the predicted interaction of the two two-level factors, a total sample size of $N = 327$

is required. Thus, we will invite 85 participants per group (in total 340 participants). For the sample size calculation, we used G*Power 3.1 (Faul et al., 2007).

3.3 Data analysis

To answer H1, we will use multiple regression including both main effects (H1a) and the interaction effect (H1b) of the use of badges and a meaningful story. Because we investigate effects of gamification on separate indicators for data quality, we use different inferential statistics depending on the different levels of measurement. We, therefore, apply linear multiple regression for metric dependent variables (e.g., response time, item omission) and logistic regression for categorical dependent variables (e.g., rounding on numerical questions, straight-lining). We will also include controls for personality (social desirability and Big Five) and respondent gender in our specified multivariate models. To answer H2, we will again use multiple linear regression to examine main effects (H2a) an interaction effects (H2b) of the gamified conditions on cognitive absorption. Testing whether cognitive absorption mediates the effect of gamification on data quality (H3), we apply the Sobel-test (Hayes, 2013). By measuring fixation times via eye-tracking, we can also use the camera recordings of the participants' faces to determine an indication of the experienced emotional states (McDuff et al., 2013). In doing so, at least the heightened enjoyment dimension of the cognitive absorption construct can provide some objective evidence on the effects of gamification on psychological outcomes like enjoyment. We will analyze the eye fixations and the emotions based on the individuals' facial expressions in an exploratory manner.

4 Conclusion and Outlook

The research project proposed in this paper presents the experimental design of testing the effects of web survey gamification on psychological outcomes, i.e., cognitive absorption, and behavioral outcomes, i.e., data quality. While there is already some empirical evidence on the effects of web survey gamification on psychological outcomes such as enjoyment or satisfaction, the effects on behavioral outcomes remain anecdotal. Based on the literature review by Keusch and Zhang (2015), we could not find any experimental study that examines the effects of individual game elements in a clean experimental design. Thus, our proposed study will contribute to research and practice in three ways. *First*, our study investigates the effects of two prominent representatives of game mechanics, namely the implementation of badges and of a meaningful story in a web survey. With regard to their implementation, these game mechanics differ in complexity and, thus, have received different attention in the literature with a stronger focus on easy to implement elements (e.g., badges, points). The experimental design of our study allows us to gain detailed insights into the effects of both game elements on data quality and cognitive absorption – not only by considering the elements individually but also by observing potential interaction effects. *Second*, as we are considering multiple indicators for careless responding, we will be able to draw conclusions about the specific effects the two game elements have on the individual indicators of data quality. This will enable researchers and web survey designers to adapt their survey gamification strategy to their specific needs. *Third*, by employing eye-tracking and an emotion recognition software, we are able to objectively collect data on the effects of game mechanics on participants' enjoyment. Up to now, fun or enjoyment is usually measured through verbal self-reports (i.e., subjective measures). In our study, self-reported evidence of enjoyment due to web survey gamification will be validated by objective data.

We are aware that our current research design comes with a main drawback. As the laboratory facility offers a pool of participants mainly consisting of students our data might be distorted due to a higher receptiveness of students for gamification. In addition, the lab setting aggravates the examination of the effects of game design elements on break-off rates. In order to mitigate the potential distortion, we plan to conduct another large-scale web survey experiment among a more heterogeneous set of participants with highly diverse demographic characteristics.

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