

A gamification effect in longitudinal web surveys among children and adolescents

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The paper measures a gamification effect in longitudinal web surveys among children and adolescents 7–15 years old. Two waves of the study were conducted using a volunteer online access panel in Russia among 737 children. Respondents were randomly assigned to one of the three conditions in the first wave without changing the treatment in the second wave: (1) a text-only survey, (2) a visual survey and (3) a gamified survey. Though in the first wave of the study respondents found it more enjoyable and easier to complete the gamified survey, no differences in participation rates were found between the conditions in the second wave. Contrary to expectations, a higher breakoff was found in the gamified condition. Moreover, it produced lower test-retest reliability correlations than the text-only and visual conditions in all survey questions. The promising gamification effect found in the first wave of the study faded in the second wave. It seems that implementing gamified elements in longitudinal web surveys might differ from the implementation of gamified elements in cross-sectional surveys.

Introduction

A number of researchers argue that gamified surveys increase data quality in web surveys (see Adamou 2010, 2013b; Puleston 2011, 2013). The main elements of a gamified survey include: (1) stating clear rules and goals for the participants; (2) involving participants with a relevant and entertaining narrative; (3) maintaining motivation by providing interesting and achievable tasks or quests; and (4) giving feedback on the progress and rewards for accomplishing tasks and answering questions (McGonigal 2011; Adamou 2013a; Puleston 2013). Adamou (2013a)

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suggests that gamified surveys are not about adding some fancy graphics, drag-and-drop questions, bright colours and images, or changing the fonts and the sizes. However, there should be a ‘noticeable aesthetic’ (Adamou 2013a). Puleston (2011, 2013) argues that applying creative questioning techniques and making it game-like is the core of a gamified survey. Several experiments compared gamified and non-gamified web surveys in cross-sectional research (Puleston & Sleep 2008, 2011; Puleston & Malinoff 2011; Downes-Le Guin *et al.* 2012; Puleston & Rintoul 2012; Cechanowicz *et al.* 2013; Koenig-Lewis *et al.* 2013; Puleston 2013; Mavletova 2014). However, to the author’s knowledge, none of the experiments showed that there is a gamification effect in longitudinal surveys.

In this paper, I test the gamification effect in longitudinal surveys among children and adolescents 7–15 years old. In particular, I compare non-response and measurement error in the second wave of the study between three conditions: a gamified survey, a text-only survey and a visual web survey with images. No changes in the question and response wordings of the gamified survey were implemented, to disentangle the effect of gamification from the effect of changing the text wording. Two waves were conducted using a volunteer online access panel in Russia among 737 children. Respondents were randomly assigned to one of the three conditions in the first wave with no change of the treatment in the second (no crossover design). In the next sections, I give the theoretical background, outline the hypothesis, describe the experimental design and present the results of the experiment.

Theoretical background and hypothesis

Gamified surveys are supposed to increase motivation among adults, and decrease both non-response rates and measurement error. Puleston (2013) suggests that surveys should be designed as a piece of entertainment. Gamified questions should have some puzzles (instead of asking ‘Describe yourself’ one can ask ‘Describe yourself in exactly 7 words’), quests (instead of asking ‘How much do you like these music artists?’ one can ask ‘Imagine you owned your own radio station and could play any music you liked, which of these artists would you put on the playlist?’), and competition (instead of ‘What brands of deodorant come to mind?’ one can ask ‘How many brands of deodorant can you guess?’). Puleston showed that this type of gamification produces lower item non-response rates, lower breakoff rates, a lower level of straight-lining (tendency

to select the same response in a scale) and middle-point response style, less speeding, lengthier responses in open-ended questions and a higher subjective evaluation of the survey in the experiments among adults (Puleston & Sleep 2008, 2011; Puleston & Malinoff 2011; Puleston 2013). The effects are comparable across different countries and cultures (Puleston & Rintoul 2012).

Downes-Le Guin and his colleagues (2012) compared four survey conditions among adults: a text-only web survey; a 'decoratively visual' version with basic elements; a 'functionally visual' version with Flash-based questions and images; and a 'gamified' version with game-like design, narrative, rules, avatar and rewards. The respondents in the gamified condition were positioned in a fantasy environment in which they were rewarded with various weapon and non-weapon assets. The game narrative and visual cues were not related to the survey content. The questionnaire wording was the same for all four conditions. They found a significantly higher breakoff rate in the gamified survey, which was mainly caused by the longer time needed to load the gamified version. At the same time, they found no difference in measurement error between the conditions.

Cechanowicz and his colleagues (2013) compared three conditions among adults: a standard web survey, a 'partial game' with an attractive design, and a 'full game' with some game-like features. They found the lowest item non-response rate in the fully gamified condition, however it was only lower at the beginning but not at the end of the survey. Koenig-Lewis *et al.* (2013) compared traditional and gamified surveys among respondents 18–30 years old and found similar breakoff rates between the conditions. Respondents enjoyed completing the gamified survey more, however they also found it more difficult to complete than the traditional survey. Moreover, respondents evaluated the survey as too long in the gamified condition (Koenig-Lewis *et al.* 2013).

Adamou (2013b) refers to 'research games' rather than 'gamified surveys'. In her opinion, the main disadvantages of typical gamified surveys are including a narrative not relevant to the content of the research objectives and a reward system not related to the content of the game narrative. The game narratives should be familiar, clear and helpful for the respondents, as well as relevant to the research. Turner *et al.* (2013) conducted 'research games' around the ways people engage with identity management practices, services and technologies among adults in the UK and US, and how they expect the future of identity management to change. Two surveys with game scenarios, rules and challenges were designed as a result of collaboration between researchers and designers. In the first

survey (called 'TESSA') respondents were positioned as undercover agents working for the organisation TESSA. Their mission was to reveal a rival spy's identity and advise the organisation as to what could be done in the future to stop hackers infiltrating the TESSA security system. The narrative was used to identify the means of identification and authentication perceived as important, and the means of identification and authentication people have used. In the second survey (called 'Dubious') respondents were living in the year 2030, but found themselves back in 2013 after their time machine broke down. The narrative was used to reveal what respondents think about the future in terms of identity management, online privacy and medical records (Adamou 2013b). After four months of completing the first survey, respondents were invited to participate in the second survey. The participation rate in the second survey was 64% (1,400 completed interviews in the first survey and 902 completed interviews in the second survey). In both surveys the narratives, design and music were used to evoke specific emotions that respondents could have felt in real-life situations. For example, respondents were evoked to feel stressed when asked their feeling and actions in the situation of losing some forms of identity (e.g. passport). Most of the respondents described both surveys as 'fun' and 'interesting'.

Link *et al.* (2014) measured some gamification elements in a mobile diary app, such as status upgrades, virtual badges and the use of social sharing. Though virtual badges were positively evaluated, especially by younger participants, getting the badges did not motivate respondents to complete the primary tasks. The authors argue that gamification techniques can be applied in cross-sectional surveys, but their application in longitudinal surveys is more evident. Innovative gamified features can motivate respondents to stay longer in the study; and the costs for designing longitudinal gamified surveys are lower than the costs for designing cross-sectional surveys (Link *et al.* 2014). However, they found no efficient way to produce a positive gamification effect in the diary app study.

Brewer and his colleagues (2013) explored the interaction of children aged 5–7 with mobile touch technologies in a laboratory experiment. Children were expected to complete some touch and gesture interaction tasks. Brewer and his colleagues found that gamification elements, such as receiving points and prizes, increased task completion from 73% to 97%. Adamou (2012) suggests that gamified questionnaires increase engagement among children and produce positive feedback. However, Puleston argues that there is no need to design gamified surveys for children. Children participate in surveys less often and are more motivated respondents than

adults. The design needs to be relevant for their age, but no additional gamification techniques are required (email communication with Jon Puleston, 7 April 2014). Mavletova (2014) conducted an experiment among 1,050 children and adolescents 7–15 years old, in which she compared data quality between a text-only, a visual and a gamified survey. A higher overall item non-response rate, a lower level of straight-lining and middle-point response style were found in both gamified and visual surveys. She found no difference in breakoff rates, rates of inconsistent and socially undesirable responses in closed-ended questions, and length of answers in open-ended questions. At the same time, she found that the gamified survey was easier and more enjoyable for the respondents. Moreover, children requested help to answer survey questions less often in the gamified condition. König (2011) conducted experiments, in which she compared a text-only survey with different versions of visual web surveys among children 8–13. She found lower breakoff rates, better quality in the negatively formulated questions, and lower primacy effects in visual web surveys. However, she also found more socially desirable responses in visual web surveys with an image of an interviewer than in text-only surveys (König 2011).

Some experiments among children explored data quality in cross-sectional studies (Amato & Ochilree 1987; Beebe *et al.* 1998; Borgers *et al.* 2000; Borgers & Hox 2001; Fuchs 2005, 2008). Some other experiments measured data quality among children in longitudinal surveys (Vaillancourt 1977; Borgers *et al.* 2003, 2004). Borgers *et al.* (2003, 2004) conducted a two-wave web survey using a representative panel among 91 children and adolescents 8–16. They found no effect of negatively formulated questions on the reliability measures, but lower reliability in the case of offering a midpoint in the response scale (Borgers *et al.* 2004). They also found higher reliability in fully labelled questions; however this effect was significant only among children above the 10–11 age group (Borgers *et al.* 2003). Vaillancourt (1977) conducted a three-wave panel survey of 1,000 children 9–15, and found a lower test-retest reliability in the questions on social and political attitudes (ranging from 0.25 to 0.62) and somewhat higher reliability in factual questions (ranging from 0.31 to 0.67), with older children producing more stable responses.

In this paper, I measure the gamification effect in the second wave of the study. Taking into consideration the results from the first wave (Mavletova 2014), I expect lower survey burden in the second wave in the gamified condition: respondents will enjoy completing it more, will evaluate the questionnaire as less difficult and will request help to fill out the questionnaire less often. Though the completion time in the gamified

survey in the first wave was significantly longer than in the two other conditions, no difference in the subjective evaluation of the completion time was found ($F(2,1013) = 0.617, p = 0.540$). A more positive experience in the gamified condition should result in a higher participation rate in the second wave. At the same time, no differences in the item non-response rate or level of straight-lining are expected. Due to Flash-based drag-and-drop questions in the visual and gamified surveys in the first wave, there was a higher overall item non-response rate and a lower level of straight-lining in these conditions than in the text-only condition. Since no Flash-based questions are used in the second wave, no differences are expected (see Drolet *et al.* 2009). In addition, no differences in test-retest reliability correlations between the conditions are expected. Though Sikkel *et al.* (2014) found that the drag-and-drop format produced lower test-retest reliability correlations than the clicking format in a two-wave web survey experiment among adults, I expect no differences in test-retest correlations between the conditions, since drag-and-drop questions were used only in a few questions in the first wave in the visual and gamified conditions.

H1: The gamified condition will produce a higher participation rate and lower survey burden than the text-only and visual conditions in the second wave of the study. Since no Flash-based questions are used in the second wave, no differences in the item non-response rate or level of straight-lining are expected. All three conditions will produce similar test-retest reliability correlations between the two waves.

Experimental design and data collection

Children aged 7–15 were randomly assigned to one of the three conditions in both waves of the study: (1) text-only survey; (2) visual survey; or (3) gamified survey. The experiment was conducted in Russia using a volunteer online access panel managed by Online Market Intelligence (see <http://omirussia.ru/en>). The first wave of the study was conducted from 17–27 February 2014, and the second wave two months later, from 16 April–18 May 2014. The participation rate in the first wave was 10.0%, with 1,050 children completing the survey; see more details in Mavletova (2014). The participation rate in the second wave was 70.7%, with 737 respondents completing both waves of the study (1,042 invitations sent, eight panellists in the first wave were not identified). After completing the first wave of the study and prior to sending an invitation for the second

wave, all respondents received a reminder to participate in the second wave of the study.

Three questionnaires were programmed using Unipark online research software (www.unipark.com). Both gamified and visual questionnaires included several Flash-based questions in the first wave. Thus, all conditions were not mobile optimised. Since there was a high item non-response rate in the Flash-based questions in the visual and gamified conditions in the first wave, these questions were programmed as grids in the second wave. The surveys were not mobile optimised, to make both waves as similar as possible.

Questionnaires

The questionnaires in both waves were the same. The questionnaire included 79 items. There were questions about school, internet usage and cognitive abilities, and an evaluation of the survey. Two additional questions were used in the gamified version: name (or nickname) of the respondent and the avatar. The text-only and visual questionnaires were presented on 22 pages, while the gamified questionnaire was presented on 28 pages (see Figures A1–A3 in the Appendix for the introductory page in all three conditions).

The text-only survey had no Flash or Javascript-based questions, and no images except the images in the cognitive test. The visual and gamified surveys included illustrative and functional images, Flash-based drag-and-drop questions (in the first wave) and Javascript-based slider bars (in both waves). The visual and gamified questionnaires included free images from the Pixabay website (<http://pixabay.com>). The design of the gamified survey was the same as in the visual survey. In addition, the gamified survey included some gamification features, such as a narrative, rules, personalisation, points, rewards and feedback. The narrative was based on a story of travelling around the Antarctic, experiencing a shipwreck and being saved by some penguins. The penguins were ready to help repair the ship, but expected the respondent to tell them something about him/herself. Respondents had to earn 500 points to travel back home. To earn these points, participants were expected to complete three levels by helping the penguins: on the first level they had to bring more ice to the penguins, on the second level they were supposed to catch fish, and on the third level they had to save penguins from leopard seals. On the second and third levels, the tasks were in the form of Javascript-based games. While completing the survey, respondents regularly received

feedback, were addressed by the nicknames they wrote at the beginning of the survey and were shown their avatars after completing each level. The basic elements of the gamified survey can be described as follows.

- *Narrative*: travelling in the Antarctic and helping penguins.
- *Rules*: time limit (in a cognitive test) and receiving points.
- *Challenges*: helping and saving as many penguins as possible.
- *Rewards*: points (receiving 500 points to travel back home).

Indicators

Three conditions are compared based on the following indicators.

1. Participation and breakoff rates.
2. Survey burden: survey completion time; subjective evaluation of the interview length (how many minutes it took to complete the survey); request for help to complete the survey; self-reported difficulty of completing the survey (5-point scale); self-reported enjoyment of completing the survey (5-point scale).
3. Item non-response rate.
4. Straight-lining: a tendency to select the same response category in all items, or all except one item, in at least one of the three grid questions (Q7, Q15 and Q21; see Figures A4–A6 in Appendix).
5. Test-retest reliability correlations are calculated based on Pearson product-moment correlation coefficients. Test-retest correlations are compared between the conditions in the following types of question.
 - Sensitive items (11 items): missing school without permission of teachers or parents; smoking cigarettes; drinking alcohol; having friends who drink alcohol at least once in a month; stealing in the shop; taking someone's belongings; finding and taking someone's wallet; being physically bullied at school; physically bullying other children; poor grades at school; subjective evaluation of academic performance.
 - Satisfaction with life and different aspects of life (8 items): family; friends; teachers; appearance; school; academic performance; free time; life in general (7-point scale).

- Positively formulated items (9 items): ‘I like going to school’; ‘In almost all situations I lose confidence’; ‘I have very good relationships with my classmates’; ‘Usually it’s difficult to get me angry’; ‘I feel happy’; and so on (5-point scale).
- Negatively formulated items (9 items): reversed-polarity items with the negatively formulated statements such as ‘I don’t like school’, ‘In almost all situations I don’t lose confidence’, ‘I do not have very good relationships with my classmates’, and so on (5-point scale).
- Knowledge questions: maternal and paternal education (2 items).
- Factual questions (20 items): internet usage (frequency and duration); social network websites usage; technical devices respondents have.
- Reported academic performance for particular subjects (10 items).

Generalised linear mixed models

Since the residual errors within an individual between two waves are correlated, generalised linear mixed models are applied to analyse data. The random intercept models with a single random effect associated with the respondents and fixed effects of the study wave and survey condition were estimated. The generalised linear mixed model predicting the completion times or item non-response rates has the following form:

$$Y_{ij} = \beta_{00} + \beta_1 \text{Condition}_i + \beta_2 \text{Wave}_i + u_{0j} + e_{ij}$$

The subscript i is for the respondents and subscript j is for the study wave. Y_{ij} is the completion time or item non-response rate at wave j for respondent i , β_1 is the fixed coefficient for the survey condition (with the ‘gamified condition’ as the reference category), β_2 is the fixed coefficient for the study wave (first wave = 1, second wave = 0), u_{0j} is the random error term at the wave level, and e_{ij} is the random error term at the individual level.

The generalised linear model using logit link function predicting dichotomous variables such as difficulty of completing the survey, satisfaction with the survey, request for help, or straight-lining has the following form:

$$Y_{ij} = \frac{e^{(\beta_{00} + \beta_1 \text{Condition}_i + \beta_2 \text{Wave}_i + u_{0j} + e_{ij})}}{1 + e^{(\beta_{00} + \beta_1 \text{Condition}_i + \beta_2 \text{Wave}_i + u_{0j} + e_{ij})}}$$

Results

Participation and breakoff rates

In total, 737 respondents completed the second wave with no difference between the conditions: 70.7% in the text-only, 72.1% in the visual and 69.5% in the gamified survey ($\chi^2(2) = 0.56$, $p = 0.756$; see Table 1). A multivariate logistic regression predicting nonresponse in the second wave shows a significant effect of the score in the cognitive test. The higher the score in the first wave, the higher the odds of completing the second wave (OR[odds ratio] = 1.88, $p < 0.05$). No effects of age, gender, academic performance, survey mode (PC or mobile), evaluation of the survey, difficulty of completing the survey or interest in receiving new survey invitations were found. The sample composition in gender and age was similar among the conditions: 47% boys; 26% 7–9, 28% 10–11, 12% 12–13 and 35% 14–15.

In the first wave of the study no significant differences in breakoff rates were found: 14.0% in the text-only, 18.0% in the visual and 17.5% in the gamified survey ($\chi^2(2) = 3.68$, $p = 0.159$; see Table 1). Contrary to expectations, the breakoff rate in the second wave was the highest in the gamified survey among the three conditions: 4.8% in the text-only, 5.7% in the visual and 10.3% in the gamified survey ($\chi^2(2) = 7.36$, $p < 0.05$). The finding is consistent with the results of the experiment among adults conducted by Downes-Le Guin and his colleagues (2012). Though no Flash-based questions were in the second wave of the study, the gamified condition produced a breakoff rate twice higher than the text-only

Table 1 Participation and breakoff rates

| | Text-only survey | Visual survey | Gamified survey | $\chi^2(df)$ |
|--------------------------------|------------------|----------------|-----------------|-------------------|
| <i>First wave</i> | | | | |
| Number of completed interviews | 372 | 324 | 354 | |
| Breakoff rate | 14.0% (77) | 18.0% (85) | 17.5% (100) | 3.68(2) (n.s.) |
| <i>Second wave</i> | | | | |
| Number of invitations | 368 | 323 | 351 | |
| Participation rate | 70.7% (260) | 72.1% (233) | 69.5% (244) | 0.56(2) (n.s.) |
| Breakoff rate | 4.8% (13) | 5.7% (14) | 10.3% (28) | 7.36(2)* |

Note: * $p < 0.05$

condition. About 89% filled out the questionnaire via PC, 7% via mobile phones, and 4% via tablets. No significant difference in the breakoff rates among PC (6.3%), mobile phone (10.0%) and tablet users (13.9%) were found ($\chi^2(2) = 3.97, p = 0.137$).

Survey burden

On average, 35% of the respondents found it very easy (the top response on the 5-point scale) to complete the first wave and 43% for the second wave. In both waves, significantly more respondents found it easier to complete the gamified survey than the text-only or visual survey ($F(2,1034) = 10.22, p < 0.001$ in the first wave and $F(2,730) = 7.04, p < 0.001$ in the second wave; see Table 2). A generalized mixed logit model predicting a top response based on both waves of the study showed that it was not as easy for the respondents to complete the first wave (OR = 0.71, $p < 0.01$; see Table 3), text-only (OR = 0.53, $p < 0.001$) and visual survey (OR = 0.56, $p < 0.01$). No interaction effect between the survey conditions and the number of the wave was found. While predicting the top two responses, no significant difference between the visual and gamified surveys was found.

The same percentage of the respondents were highly satisfied (the top response on the 5-point scale 'I liked it very much'), with the survey in both waves of the experiment (37% in the first wave and 36% in the second wave). A comparison of the mean values showed significant differences between the conditions in the first wave ($F(2,1036) = 15.58, p < 0.001$), with a higher evaluation in the gamified survey, but not in the second wave ($F(2,728) = 2.45, p = 0.087$; see Table 2). A generalised mixed logit model predicting the top response based on both waves of the study showed that respondents were less satisfied with the text-only (OR = 0.68, $p < 0.001$; see Table 3) and visual surveys (OR = 0.50, $p < 0.001$), but no effect of the number of the wave was found.

About 15% of the respondents requested help in the first wave, with significantly fewer in the gamified survey (11.4%) than in the text-only (17.1%) and visual surveys (17.7%, $\chi^2(2) = 6.33, p < 0.05$; see Table 2). Fewer respondents requested help in the second wave of the study (9.6%), with no difference between the survey conditions: 8.1% in the text-only, 11.8% in the visual and 9.1% in the gamified condition ($\chi^2(2) = 2.04, p = 0.360$). A generalised mixed logit model predicting a request for help based on both waves of the study showed that respondents requested help in the first wave more often than in the second wave (OR = 1.64, $p < 0.001$; see

Table 2 Survey burden, item non-response rates and straight-lining: first wave vs second wave (mean values)

| | Text-only survey | Visual survey | Gamified survey | Statistics |
|--|---------------------|---------------------|---------------------|------------------------------|
| Survey burden | | | | |
| Ease of completing the survey – <i>first wave</i> Scale: 1–5 (very easy–very difficult) | 2.09 (0.94) | 1.96 (0.83) | 1.80 (0.86) | $F(2,1034) = 10.22^{***}$ |
| Ease of completing the survey – <i>second wave</i> | 1.88 (0.82) | 1.80 (0.81) | 1.62 (0.80) | $F(2,730) = 7.04^{***}$ |
| Enjoyment of completing the survey – <i>first wave</i> Scale: 1–5 (I liked it very much–I did not like it at all) | 2.05 (0.95) | 1.86 (0.79) | 1.70 (0.82) | $F(2,1036) = 15.58^{***}$ |
| Enjoyment of completing the survey – <i>second wave</i> | 1.91 (0.95) | 1.89 (0.82) | 1.76 (0.79) | $F(2,728) = 2.45$ (n.s.) |
| Request for help to complete the survey – <i>first wave</i> | 17.1% | 17.7% | 11.4% | $\chi^2(2) = 6.33^*$ |
| Request for help to complete the survey – <i>second wave</i> | 8.1% | 11.7% | 9.1% | $\chi^2(2) = 1.92$ (n.s.) |
| The average completion time – <i>first wave</i> | 13.90 min (5.06) | 15.15 min (6.14) | 19.36 min (7.57) | $F(2,974) = 67.74^{***}$ |
| The average completion time – <i>second wave</i> | 12.73 min (5.42) | 13.08 min (5.38) | 15.57 min (6.23) | $F(2,671) = 16.82^{***}$ |
| Item non-response rate | | | | |
| Item non-response rate – <i>first wave</i> | 1.73% (4.43%) | 11.12% (16.33%) | 11.73% (16.32%) | $F(2,1047) = 63.42^{***}$ |
| Item non-response rate – <i>second wave</i> | 1.29% (3.35%) | 1.29% (5.07%) | 1.23% (3.59%) | $F(2,734) = 0.02$ (n.s.) |
| Straight-lining | | | | |
| Straight-lining – <i>first wave</i> | 11.4% | 2.8% | 3.2% | $\chi^2(2) = 25.24^{***}$ |
| Straight-lining – <i>second wave</i> | 15.4% | 9.2% | 14.5% | $\chi^2(2) = 4.76$ (n.s.) |

Notes: *** $p < 0.001$, * $p < 0.05$, standard deviation in parentheses

Table 3), and in the visual (OR = 1.51, $p < 0.05$) more often than in the gamified survey. No other significant effects were found.

Similar to the first wave, the average completion time was longer in the gamified survey (15.57 minutes) than in the visual (13.08 minutes) and text-only survey (12.73 minutes; see Table 2) in the second wave. A generalised linear mixed model predicting completion time based on both

Table 3 Generalised linear mixed models predicting survey burden, item non-response rate and straight-lining

| | Very easy to complete the survey (OR) | Enjoying a lot to complete the survey (OR) | Request for help (OR) | Completion time (minutes) | Item non-response rate (%) | Straight- lining (OR) |
|---------------------|--|--|--------------------------|------------------------------|----------------------------------|--------------------------|
| Intercept | 1.15 (0.94, 1.40) | 0.18 (0.02, 0.38)* | 0.09 (0.06, 0.12)*** | 16.51 (15.90, 17.13)*** | 6.75 (5.83, 7.66)*** | 0.15 (0.10, 0.20)*** |
| Text-only survey | 0.53 (0.42, 0.66)*** | 0.68 (0.44, 0.92)*** | 1.30 (0.91, 1.84) | -3.79 (-4.49, -3.09)*** | -5.04 (-6.14, -3.93)*** | 1.47 (1.02, 2.13)* |
| Visual survey | 0.56 (0.44, 0.71)*** | 0.50 (0.26, 0.74)*** | 1.51 (1.06, 2.15)* | -2.99 (-3.71, -2.27)*** | -0.45 (-1.60, 0.69) | 0.70 (0.45, 1.11) |
| First wave | 0.71 (0.58-0.86)** | 0.03 (-0.22, 0.17) | 1.64 (1.22, 2.21)** | 1.72 (1.13, 2.30)*** | 3.17 (2.25, 4.09)*** | 0.57 (0.41, 0.78)** |
| Corrected AIC | 7,635.35 | 7,663.03 | 8,948.36 | 10,519.16 | 15,867.09 | 8,464.00 |

Notes: Reference category = gamified survey

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, confidence interval in parentheses

waves of the study showed that respondents spent significantly less time on the second wave ($\beta = -1.72$, $p < 0.001$; see Table 3), as well as on the text-only ($\beta = -3.79$, $p < 0.001$) and the visual surveys ($\beta = -2.99$, $p < 0.001$). Similar to the first wave, no difference in the subjective evaluation of the completion time between the conditions was found in the second wave ($F(2,726) = 1.10$, $p = 0.335$).

Item non-response rate

The item non-response rates were significantly higher in the gamified (11.73%) and visual (11.12%) than in the text-only survey (1.73%) in the first wave of the study, due to Flash-based questions. No Flash-based questions were implemented in the second wave of the study. As a result, no difference in the item non-response rates was found: 1.29% in the text-only and visual surveys and 1.23% in the gamified survey (see Table 2). A generalised linear mixed model showed a higher item non-response rate in the first wave ($\beta = 3.17$, $p < 0.001$; see Table 3) and a lower item non-response rate in the text-only ($\beta = -5.04$, $p < 0.001$) than in the gamified survey. The interaction effect between the survey condition and study wave was also significant ($F(2,1781) = 41.50$, $p < 0.05$). A lower item non-response rate was found in the text-only survey in the first wave than in the gamified or visual survey.

Straight-lining

The text-only survey produced the highest level of straight-lining in the first wave of the study (11.4%) compared to the visual (2.8%) and gamified surveys (3.2%). In the second wave, Flash-based questions were programmed as grids. As a result, no significant difference was found between the conditions: 15.4% in the text-only, 9.2% in the visual and 14.5% in the gamified survey ($\chi^2(2) = 4.76, p = 0.093$; see Table 2). A generalised mixed logit model predicting straight-lining in the grids showed that significantly fewer respondents straight-lined in the first wave of the study (OR = 0.57, $p < 0.01$; see Table 3) and more respondents straight-lined in the text-only survey (OR = 1.47, $p < 0.05$) than in the gamified survey.

Test-retest reliability correlations

Test-retest correlations between the first and second waves of each condition showed lower correlations in the gamified survey in all types of questions (see Table 4). Similar correlations were found in the text-only and visual surveys. The highest response reliability was in the knowledge questions, in which respondents were asked to indicate the education of their parents: 0.73 in the gamified, 0.80 in the text-only and 0.85 in the visual surveys. The lowest reliability was found in the negatively formulated items: 0.23

Table 4 Average test-retest reliability correlations (Pearson product-moment correlation coefficients)

| | Text-only survey | Visual survey | Gamified survey |
|--|----------------------|----------------------|----------------------|
| Knowledge questions (2 items) | 0.80 (0.74, 0.84) | 0.85 (0.81, 0.89) | 0.73 (0.66, 0.79) |
| Academic performance (10 items) | 0.70 (0.61, 0.77) | 0.68 (0.57, 0.77) | 0.61 (0.49, 0.71) |
| Sensitive questions (11 items) | 0.67 (0.60, 0.74) | 0.61 (0.52, 0.69) | 0.54 (0.44, 0.63) |
| Factual questions (20 items) | 0.61 (0.53, 0.68) | 0.62 (0.54, 0.69) | 0.59 (0.51, 0.67) |
| Satisfaction with life and different aspects of life (8 items) | 0.60 (0.51, 0.67) | 0.56 (0.46, 0.64) | 0.48 (0.38, 0.58) |
| Positively formulated items (9 items) | 0.53 (0.44, 0.62) | 0.51 (0.39, 0.62) | 0.49 (0.37, 0.60) |
| Negatively formulated items (9 items) | 0.29 (0.17, 0.40) | 0.27 (0.12, 0.43) | 0.23 (0.09, 0.36) |

Note: Confidence interval in parentheses

in the gamified, 0.29 in the text-only and 0.27 in the visual surveys. Lower test-retest correlations were found in the other questions in the gamified condition: sensitive items, evaluation of life and different aspects of life, positively formulated items, academic performance and some factual questions (see Table 4). While analysing test-retest correlations separately for each age group (7–9, 10–11, 12–13, 14–15), different effects were found. A negative gamification effect was found in all except one age group (10–11; data not shown). A larger negative gamification effect was found among the youngest respondents 7–9. A small positive gamification effect was found in the age group 10–11.

Discussion

In the previous paper based on the results of the first wave of the study (see Mavletova 2014), lower survey burden was found in the gamified condition. Respondents found it more enjoyable and less difficult to complete the gamified survey. They reported a higher level of interest to receive new survey invitations and complete new game-like surveys. Moreover, fewer children requested help in the gamified condition. However, this engagement did not result in a higher participation rate in the second wave. Contrary to expectations, a higher breakoff rate was found in the gamified condition. Almost half of non-respondents broke off in the introductory text on the first page in the gamified survey. The introduction described the game narrative, challenging tasks and rewards (receiving points) for completing the tasks. The same game elements and game design produced lower motivation to complete the survey in the second wave. Link and colleagues (2014) found that presenting a mobile diary app with all gamified features at the start of the study increased breakoff rates and decreased compliance rates over time among participants than in the sequential condition with different gamified features introduced sequentially.

They also found that even sequential introduction of new elements and focus on the most appealing gamification features was not sufficient to motivate respondents to comply with the main tasks. They suggested two solutions: either no gamification features should be used in the mobile diary app or gamification features should be used with additional monetary rewards (Link *et al.* 2014). Consistent with these results, the current experiment shows that gamification features do not produce long-term compliance in web surveys among children and adolescents. To keep respondents engaged, some new gamification features should

be included in each wave. However, even adding new features may not bring higher participation rates: in the current experiment, no significant differences in start rates and participation rates between the three conditions were found.

Despite higher breakoff rates in the gamified condition, respondents found it easier to complete the gamified survey than the text-only and visual surveys. The results were similar to those of the first wave. In total, respondents found it easier to complete the second wave of the study in all conditions. Fewer respondents requested help to fill out the questionnaire in the second wave with no difference between the conditions. No difference in the item non-response and level of straight-lining were found. As a result, the added value of the gamified condition has been decreased in the second wave of the study.

Most importantly, however, is that the gamified survey produced lower test-retest reliability correlations. Consistent with the results of Vaillancourt (1977), low average test-retest correlations were found in most of the survey questions in all three conditions. The lowest test-retest correlations were found in the negatively formulated items (0.23–0.29), which resulted in an unacceptable data quality. The results do not support the findings of Borgers *et al.* (2004). While some researchers may suggest that gamification can improve data quality in cognitively demanding questions, results of the current experiment do not support that. The test-retest correlations were lower in all types of question in the gamified condition, with similar correlations in the text-only and visual surveys.

It seems that presenting more images and including a game narrative distracted the attention of the children and adolescents from the main task. Research on the development of attention showed that older children performed more efficiently in the situation of information overload, when the information on both task-relevant and irrelevant stimuli is provided (Hagen & Hale 1973). The experiments found that younger children maintained attention to all stimuli components equally, whether this is the central task or incidental information. Thus, I found a larger negative gamification effect on test-retest data reliability among the youngest respondents 7–9. At the same time a small positive gamification effect on test-retest correlations among the respondents 10–11 and a negative effect among the respondents 12–15 were found in the experiment. This suggests that the narrative was more relevant for the age group 10–11, though the analysis did not show a higher subjective evaluation of the survey in this age group.

Conclusion

Is it worth designing gamified longitudinal surveys for children? The same narrative and the same game elements produced a higher breakoff in the second wave. Adding some new game elements or changing the game narrative over time can decrease breakoff rates, however it appears to have minimal impact on overall participation rates. Taking into consideration lower reliability and longer completion times in the gamified condition, researchers should either prefer a more traditional option (text-only or visual survey) or design longitudinal gamified surveys, which do not distract the attention of children from the primary task of answering the survey questions. In terms of Ray Poynter and Betty Adamou this experiment can be ‘another poor example’ of a gamified survey together with the survey designed by Downes-Le Guin and his colleagues (2012). How can researchers design good gamified surveys for children and adolescents, which bring desirable results?

First, Adamou (2013b) suggests that the game narrative and all visual clues should be not only entertaining for the respondents, but clear and helpful. To make them helpful, the narrative should be clearly related to the survey content. The narrative, the rewards and the design should be not artificially but directly related to the survey questions, and used to explain the questions or evoke particular emotions (Adamou 2013b; personal communication with Ray Poynter at Webdatanet Conference on Mobile Research, 31 March 2014; personal communication with Florian Keusch at Internet Survey Methodology Workshop, 1 December 2014). The biggest challenge for the researcher is designing these kinds of narratives.

Second, it seems that there is no need to gamify all surveys. The gamification effect in the survey about school and everyday life can be lower than the gamification effect in the surveys in which there is a need to simulate experience to imagine the future, or to experience some emotions in order to answer the survey questions.

Finally, it seems that gamification can have a different effect on children and adolescents depending on the age group. It is worth further exploring if narratives should vary for different age groups. This leads, however, to substantial additional costs. All in all, this experiment shows that we need more research and experimental studies to explore a gamification effect among children. We need to analyse good and bad examples of the narratives, as well as to explore research topics and types of question in which gamified surveys can be helpful for both children and adolescents.

Limitations

The experiment has several limitations. First, the results are based on a non-random sample of active internet users who use the internet on a daily basis. The results might be different if less active internet users were included in the sample. Second, the author is not experienced in designing gamified surveys. The results might be different from the experiments conducted by a team of researchers and designers who have a long-term experience in designing gamified surveys. Despite the study limitations, the current findings show that gamified longitudinal web surveys should be designed carefully to keep children engaged in the survey over time, as well as to minimise the distraction of the gamification features and the narrative from the task of completing the survey itself.

Appendix

1. Introductory text in the text-only survey

We invite you to participate in a study that will help to draw a socio-psychological portrait of schoolchildren in Russia.

Completing the survey will take 10 minutes. To answer questions select a response and click on the 'Next' button.

If you do not want to answer a question, you can skip it.

We kindly ask you to complete the survey without the help of your parents. The survey data will be reported only as a group, and not individually.

We wish you good luck and thank you for your participation!

Приглашаем тебя принять участие в исследовании, которое поможет определить социально-психологический портрет школьников России.

Заполнение анкеты займет 10 минут. Для ответа на вопрос кликни на ответ и нажми «Дальше».

Если ты не хочешь отвечать на вопрос, ты можешь его пропустить.

Мы просим тебя ответить на вопросы без помощи родителей. Результаты опроса будут использоваться только в обобщенном виде.

Желаем удачи и благодарим тебя за участие!

Дальше

Figure A1

2. Introductory text in the visual survey

(The same introduction as in the text-only survey.)

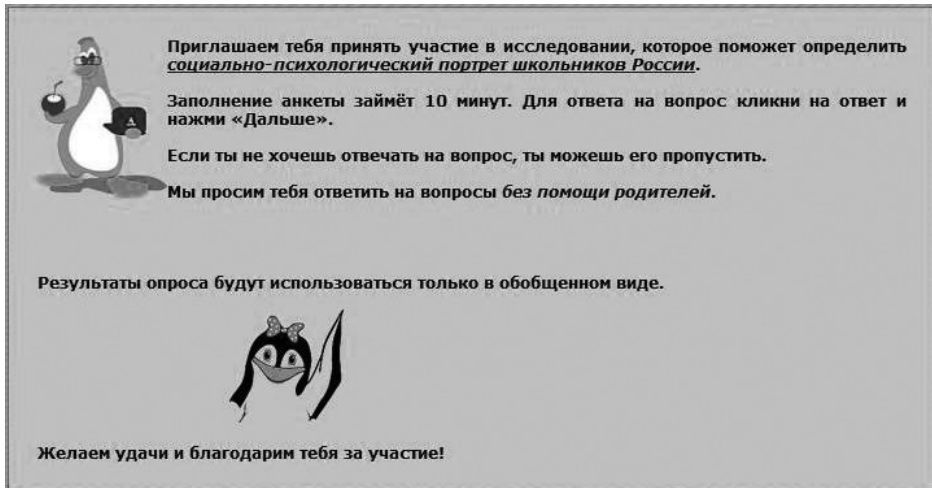


Figure A2

3. Introductory text in the gamified survey

Hi! This is a game like a survey. Imagine that you have been travelling in the Antarctic on a ship. One night the ship collided with an iceberg and you have experienced a shipwreck.

However, you have been saved by some penguins.

They are willing to help you with the ship, but they expect you to tell them about yourself. You can earn 500 points and pass the following three levels:

Level 1: help penguins with ice (there is deglaciation in the Antarctic)

Level 2: catch fish for them

Level 3: save them from leopard seals!

After passing level 3 the ship will be repaired.

You'll be able to continue your journey!


Instructions

Completing the survey will take 10 minutes. To answer questions select a response and click on the 'Next' button. If you do not want to answer a question, you can skip it. We kindly ask you to complete the survey

without the help of your parents. The survey data will be reported only as a group, and not individually.


We wish you good luck and thank you for your participation!

Привет! Это опрос в виде игры.



Представь, что ты совершал на корабле путешествие в Антарктиду.
Ночью корабль столкнулся с айсбергом, и ты потерпел кораблекрушение.

Но тебя спасли пингины!




Они готовы помочь починить корабль, но взамен ты должен рассказать им о себе, заработать 500 очков и пройти три уровня:

Уровень 1 - помочь льдом (в Антарктиде происходит таяние ледников)


Уровень 2 - поймать для них рыбу

Уровень 3 - спасти от морских леопардов!



Через 3 уровня корабль будет починен.
Ты сможешь возобновить свое путешествие!

Инструкция:
Заполнение анкеты займёт 10 минут. Для ответа на вопрос кликни на ответ и нажми «Дальше». Если ты не хочешь отвечать на вопрос, ты можешь его пропустить. Мы просим тебя ответить на вопросы без помощи родителей. Результаты будут использоваться только в обобщенном виде.



Желаем удачи и благодарим за участие!

Figure A3

4. Q15 – text-only survey

The next few questions are about how you feel about different aspects of your life. Please rate how much you are satisfied/ not satisfied: 1 = completely not satisfied, 7 = completely satisfied.

Scale:

- 1 = completely not satisfied
 - 2 = not satisfied
 - 3 = rather not satisfied
 - 4 = neither not satisfied, nor satisfied
 - 5 = rather satisfied
 - 6 = satisfied
 - 7 = completely satisfied
- Don't know

15. Следующие вопросы касаются разных аспектов твоей жизни. Оцени по шкале от 1 до 7, где 1- ты совсем НЕ доволен/НЕ довольна этим аспектом жизни, 7 – ты полностью доволен/довольна.

| | 1 - Совсем не доволен | 2- Не доволен | 3 - Скорее не доволен | 4 - Ни доволен, ни не доволен | 5 - Скорее доволен | 6 - Доволен | 7 - Полностью доволен | Не знаю |
|----------------------|--------------------------------|-----------------------|--------------------------------|--|--------------------------|-----------------------|-----------------------------|-----------------------|
| Твоя семья | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твои друзья | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твои учителя | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твоя внешность | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твоя школа | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твои оценки в школе | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твое свободное время | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Твоя жизнь в целом | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Дальше

Figure A4


5. Q15 – visual survey

15. Следующие вопросы касаются разных аспектов твоей жизни. Оцени по шкале от 1 до 7, где 1- ты совсем НЕ доволен/НЕ довольна этим аспектом жизни, 7 – ты полностью доволен/довольна. Для ответа на вопросы кликни на шкалы ниже:

| | 1 - Совсем не доволен | 2 - Не доволен | 3 - Скорее не доволен | 4 - Ни доволен, ни не доволен | 5 - Скорее доволен | 6 - Доволен | 7 - Полностью доволен | Не знаю |
|-----------------------------|--------------------------------|-------------------|--------------------------------|--|--------------------------|----------------|-----------------------------|---------|
| Твоя семья | <input type="text"/> | | | | | | | |
| Твои друзья | <input type="text"/> | | | | | | | |
| Твои учителя | <input type="text"/> | | | | | | | |
| Твоя внешность | <input type="text"/> | | | | | | | |
| Твоя школа | <input type="text"/> | | | | | | | |
| Твои оценки в школе | <input type="text"/> | | | | | | | |
| Твое свободное время | <input type="text"/> | | | | | | | |
| Твоя жизнь в целом | <input type="text"/> | | | | | | | |

Figure A5

6. Q15 – gamified survey



Aigul, прекрасно! Продолжай в том же духе!

15. Следующие вопросы касаются разных аспектов твоей жизни. Оцени по шкале от 1 до 7, где 1 - ты совсем НЕ доволен/НЕ довольна этим аспектом жизни, 7 – ты полностью доволен/довольна. Для ответа на вопросы кликни на шкалы ниже:

| | | | | | | | |
|---------------------------------|-------------------|-----------------------------|--|--------------------------|----------------|-----------------------------|---------|
| 1 - Совершенно не доволен | 2 - Не доволен | 3 - Скорее не доволен | 4 - Ни доволен, ни не доволен | 5 - Скорее доволен | 6 - Доволен | 7 - Полностью доволен | Не знаю |
|---------------------------------|-------------------|-----------------------------|--|--------------------------|----------------|-----------------------------|---------|

Твоя семья

Твои друзья

Твои учителя

Твоя внешность

Твоя школа

Твои оценки в школе

Твое свободное время

Твоя жизнь в целом

Figure A6

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