Computers in Human Behavior xxx (2016) 1–10

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Driven to drive? Investigating the effect of gamification on learner driver behavior, perceived motivation and user experience

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ARTICLE INFO

Article history:
Received 28 July 2014
Received in revised form
1 August 2016
Accepted 31 August 2016
Available online xxx

Keywords:
Gamification
Gameful
Game design
User experience
Learner driver
Motivation
Behavior change
Smartphone

ABSTRACT

Driving can be dangerous, especially for young and inexperienced drivers. To help address the issue of inexperience, a gamified logbook smartphone application was designed and developed for learner drivers in Queensland, Australia. The application aims to make it easy for learner drivers to record their mandatory practice sessions while the added gamification aims to encourage learners to undertake a wider range of practice. Previous research reported on a lab-based study of a gamified version and a non-gamified version of this application. This paper presents an updated design of the application and investigates the effect of the application when tested in the field. Results are provided from a within-groups field study undertaken with 25 learner drivers over a four-week period, during which the effect of the gamification on behavior change, perceived motivation and user experience was studied. Although results suggest that the gamified logbook was perceived as more enjoyable and motivating than the non-gamified version, no significant change in behavior was found. This encourages discussion on the effectiveness of gamification to encourage behavior change and the feasibility of using gamification in this particular context.

1. Introduction

Younger drivers are at a greater risk of death and injury from road crashes when compared to older, more experienced drivers. Road crashes are the leading cause of death for persons aged 16–25 years (e.g., OECD & ECMT, 2006; World Health Organization, 2014) and the second most common cause of disability for male and female adolescents alike (World Health Organization, 2014). In Australia in 2013, young drivers aged 17–25 years contributed 21.3% of the fatally-injured drivers (BITRE, 2013). In the Australian state of Queensland in 2014, 25.1% of all road user fatalities, and 34.7% of all road user hospitalized casualties, arose from a crash involving a driver aged 17–24 years. These drivers themselves totaled 18.8% of the state's fatalities (DTMR, 2013), despite only comprising 12.9% of the licensed population (DTMR, 2014a). In order to address this issue in Australia, state governments have employed a range of strategies. In Queensland, Australia, learner drivers are required to undertake 100 h of supervised driving practice. Although undertaking 100 h of mandatory practice can be seen as encouraging a greater amount of driving experience, it doesn't necessarily encourage a greater variety of practice (Scott-Parker, Bates, Watson, King, & Hyde, 2011). All drivers should be able to handle themselves in a variety of different road conditions, therefore, it is important that learner drivers undertake a wide range of practice while learning to drive with a supervisor.

This paper presents the design of a gamified logbook application that has been updated to address usability and playability issues found in a previous lab-based study (Fitz-Walter, Wyeth, Tjondronegoro, & Scott-Parker, 2013). A within-groups study was undertaken in the field using the update design, with 25 learner drivers recruited as participants. The effect of the updated gamification design on behavior change, motivation and user experience

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http://dx.doi.org/10.1016/j.chb.2016.08.050
0747-5632/

was studied. The results of the study suggest that the gamified logbook was more enjoyable and more motivating than a non-gamified version. However, no significant effect on behavior change was measured.

2. Previous research

2.1. Learning to drive

As of July 2007, all learner drivers in the state of Queensland, Australia under the age of 25, must undertake a minimum of 100 h of supervised driving experience (including 10 h of driving at night) before they can apply for a Provisional (intermediate) license (DTMR, 2014b). In Queensland, practice hours are logged manually in a large (approx. 16 cm × 22.5 cm) logbook. The information required to be logged for each driving session includes the date, the time at the start and end of the session, the driving duration (minutes), the car's odometer at the start and end of the session (kilometers), the license number of the supervising driver, the State in which the supervising driver is licensed, the car number plate, and if the person is a registered driving instructor. Once complete, the logbook is submitted to the state licensing authority, the Department of Transport and Main Roads, and audited for accuracy prior to permitting the young novice driver to undertake their practical driving assessment. In a previous study (Fitz-Walter et al., 2013) it was proposed that a transition to a smartphone logbook application would make this process easier and may be more appropriate for the technologically-oriented youth of today. A smartphone application could also streamline the logging process by using sensors on the smartphone (e.g., location, time and date) and could backup data to a server in case the smartphone is broken, lost, or stolen.

Given that a breadth of experience is an important part of driver safety, it is imperative that learner drivers undertake a wide range of practice while learning to drive. Although novice drivers represent those facing the greatest risk of death and injury on the road, the learning-to-drive stage itself is one the safest periods of any driving career. This is because learner drivers are required to be supervised by an experienced driver throughout this period. In the local context of Queensland, Australia, recent research suggests that learner drivers should aim to spread the driving practice over the learning period, be encouraged to continue to practice beyond the mandated one hundred hours, and drive in a variety of different circumstances that become progressively more challenging in nature (Scott-Parker et al., 2011). In order to motivate such driving practice, we employed the use of gamification.

2.2. An overview of gamification

Gamification is a design strategy where game design elements are used in non-game contexts to encourage behavior change. A game design element in this sense could include anything from game aesthetics, such as graphics and progress bars, to complete games with goals, rules, levels, quests, and achievements (Deterding, Dixon, Kahled, & Nacke, 2011). Results from previous studies have generally indicated that adding game elements can lead to positive behavior change (e.g., Cafazzo, Casselman, Hamming, Katzman, & Palmert, 2012; Chiu et al., 2009; De Oliveira, Cherubini, & Oliver, 2010; Farzan et al., 2008; Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011; Froehlich et al., 2009; Fujiki et al., 2008; Gustafsson, Katzeff, & Bång, 2009; Landers & Callan, 2011; Liu, Alexandrova, & Nakajima, 2011; Thom, Millen, & DiMicco, 2012). Gamification could also be explored further as a way to encourage learner drivers to undertake diverse practice. This theory is supported by a previous lab-based study that compared a gamified and non-gamified learner logbook application (Fitz-Walter et al., 2013). The results of this study suggested that there was potential for a gamified logbook to be more motivating than a non-gamified logbook. However, this study was a laboratory-based study using drivers who had recently graduated from learner to provisional (intermediate/restricted) licensure. Further research in the field is needed with learner drivers in order to properly evaluate the effect of a gamified logbook application.

2.3. Evaluating the effect of gamification

A popular construct investigated by empirical gamification studies has been behavior change (e.g., Chiu et al., 2009; De Oliveira et al., 2010; Fujiki et al., 2008; Landers & Callan, 2011; Li, Grossman, & Fitzmaurice, 2012). Behavior change has often been measured in previous studies by recording a participant's time and frequency spent on a gamified activity. This usage data is generally obtained automatically by the gamified system using various sensors. For example, Chiu et al. (2009) created a system that recorded daily intake of water, and De Oliveria et al. (2010) created a system that automatically recorded when medication was taken. Gamified usage data was often compared with usage data from either a pre-test or control group. A number of these studies in various domains have reported that the addition of game elements led to an increase in desired behavior during the study (e.g., Cafazzo et al., 2012; Chiu et al., 2009; De Oliveira et al., 2010).

However, behavior change is only one part of a user's experience. Most software applications also have usability goals, such as efficiency, learnability, good utility, and ease of use. Other hedonistic user experience goals exist as well, such as entertainment, fun, and emotional fulfilment (Rogers, Sharp, & Preece, 2011). Some empirical gamification studies have explored the effect of game elements on usability (e.g., ease of use). Interestingly, some studies have reported potential problems; for example, adding game elements to non-game contexts has led to usability issues (Guin, Baker, Mechling, & Ruylea, 2012), confused users (Montola, Nummenmaa, Lucero, Boberg, & Korhonen, 2009), and cheating (Singer & Schneider, 2012). This suggests that in addition to the effect of gamification on behavior change, it is worthwhile exploring the effect of gamification on usability and user experience constructs as well. Therefore, exploring the use of gamification in this study also allows for further contributions to be made to this area of research.

3. Gamified learner logbook design

This section briefly describes the first version of the gamified logbook evaluated in a previous study and then describes the updated design of the logbook used for the field study.

3.1. First version

A learner logbook smartphone application was developed. This application allowed learner drivers to record their driving practice using a smartphone device and view a summary of all previous practice sessions undertaken. The application made it easy to record practice by automatically capturing some of the information required (e.g., start time and location, end time and location, weather, time of day) using smartphone sensors. A gamification experience was subsequently designed for the logbook application by using a gamification design framework proposed in earlier research (Fitz-Walter et al., 2013). The activity of undertaking a virtual road trip around Australia formed the basis for the gamification experience. A road trip is something often associated with the primary target demographic, where it can be a coming of age activity that young people may often undertake when they attain their license (Tourism Australia, 2014). Using a road trip theme also

Please cite this article in press as: Fitz-Walter, Z., et al., Driven to drive? Investigating the effect of gamification on learner driver behavior, perceived motivation and user experience, Computers in Human Behavior (2016), http://dx.doi.org/10.1016/j.chb.2016.08.050