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ABSTRACT

Privacy issues are becoming prevalent in users' fitness app usage and hence gaining great attention from users and policymakers. A typical example is inappropriate authorization of access to app data. Yet, it is not clear what factors will influence users' third-party authorization. Specifically, users' situational states are rarely considered. This study thus investigates how an important situational state, i.e., physiological arousal, affects users' decisions of authorizing private data in fitness apps to SNS. We concurrently examine a factor of the decision context, i.e., message framing, a design heuristic to nudge people's privacy decisions. We hypothesize that both high physiological arousal and loss-framed message increase users' likelihood to grant third-party authorization, and there is a positive interaction between the two factors. We plan to conduct an experiment to test the hypotheses.

Keywords

privacy decision, physiological arousal, message framing, third-party authorization, fitness app

INTRODUCTION

Nowadays fitness apps are widely adopted by mobile app users. Albeit the benefits users can get from fitness apps, for instance getting informed of one's fitness and health state, getting training resources and social support, etc., the privacy issues surrounding the apps are at times severe and unneglectable. Fitness apps often access sensitive data (e.g., body information), and can even share the data with third parties (e.g., social networks sites). It is reported that sensitive personal information from fitness apps is often sent to Facebook without users' consent (Schechner, 2019). Such an issue of data breach from websites or apps to social networking sites (SNS) has received attention from policymakers. EU court in July 2019 (Bodoni, 2019) announced that websites inserting plugins that allow Facebook to harvest visitors' information and browsing activities are held responsible for the private data breach. Although such policy has been conducted as the first step to avoid data breaches, users often authorize third parties to access their private information incautiously. We are interested in what factors would influence fitness app users to grant third-party authorization to social media.

Existing research on privacy limits our understanding in two ways. Firstly, although privacy issues are well-acknowledged as context-specific (Acquisti and Grossklags, 2005; Martin and Shilton, 2016; Xu, Teo, Tan and Agarwal, 2012), research on context-related factors, e.g., the situational state of privacy decision-makers, are rarely considered. Secondly, emerging privacy research starts exploring some design heuristics for nudging privacy decisions, for example, framing (e.g., Adjerid, Acquisti and Loewenstein, 2019; Johnson, Bellman, and Lohse 2002; Lai and Hui, 2006). However, its effectiveness is inconclusive (Adjerid et al., 2019; Levin, Schneider and Gaeth, 1998), and it remains unknown how it works for users under different situational states.

To address these gaps, firstly, we investigate the role of one situational state, i.e., physiological arousal, in affecting fitness app users' decision making. Arousal is defined as "the level of alertness or activation on a continuum ranging from extreme drowsiness to extreme wakefulness" (Duffy, 1962; Humphreys and Revelle, 1984). Physiological arousal is the aspect of arousal shown by physiological responses, such as increases in blood pressure. As fitness apps are designed to track and record physical activities, users' physiological arousal is the situational state that can vary significantly from general settings in prior research. Literature from cognitive psychology has demonstrated that arousal can influence decision making by altering the allocation of attentional capacity between the proprioceptive feedback and the decision context (Kahneman, 1973; Mandler, 1975). Compared with dispositional characteristics of users (e.g., general privacy concern), physiological arousal as a situational state is of high relevance and importance when studying users' privacy decisions in the context of fitness apps.

Additionally, we study a representative design heuristic, message framing. Framing is defined as different presentations for the logically identical information (Cacciatore, Scheufele and Iyengar, 2016; Druckman, 2001). One typical framing is gain-loss framing (Tversky and Kahenman, 1981), which is evidenced to nudge people's decision making by highlighting either risk-aversive or risk-seeking tendency. We investigate how gain- vs. loss-framing would affect users' privacy decisions and, more importantly, how the effect interacts

with users' physiological arousal states. Formally, we propose our research questions as follows:

RQ: how would fitness app users' physiological arousal state and the app's message framing interact in affecting their authorization decisions?

We intend to conduct an experiment in our study. The study is believed to make two important theoretical contributions. Firstly, we explore how a situational state instead of the well-studied dispositional state can affect user's privacy decision. Secondly, we extend the research on design heuristics in nudging people's privacy decision by examining its interaction with users' arousal states. The study can also inform practical implication for both fitness app designers and fitness app users.

LITERATURE REVIEW

Privacy Decision Making

Previous research has considered different factors that affect users' privacy decisions. Broadly speaking, we identified two categories of factors. One is factors related to the decision context, and the other is the characteristics of the decision-maker.

Frequently studied factors related to the decision context include the risk of information disclosure (Adjerid, Peer and Acquisti, 2018), social network size (Li, Wang and Che, 2016; Teubner and Flath 2019), network commonality (Choi, Jiang, Xiao and Kim, 2015) and perceived anonymity (Jiang, Heng and Choi, 2013) on social media. Some awareness-enhancing designs were also found to influence users' privacy decision making (Egelman, 2013; Wang, Grossklags and Xu, 2013). Notably, an emerging stream of research emphasized the bounded rationality and started exploring how design heuristics can nudge users' privacy decisions. A typical design heuristic is message framing (e.g., Adjerid et al., 2019; Johnson et al., 2002; Lai and Hui, 2006). By directing people's attention to different dimensions of the decision context (e.g., gain vs. loss, benefit vs. cost), framing can influence people to adopt a privacy setting either more protective or riskier. Although framing effect has been well studied in the literature, a recent study (Adjerid et al., 2019) pointed that the effect of framing does not universally hold. This finding implies the need to further disentangle the framing effect on privacy decisions by considering its interaction with other factors.

Among the characteristics of the decision-maker, existing research extensively focuses on dispositional characteristics, for example, dispositional privacy concern (e.g., Choi, Wu, Yu and Land, 2018; Lim and Armstrong 2019); personality traits (Metzger and Suh, 2017); and personal innovativeness (Li et al., 2016). Users' privacy knowledge and privacy self-efficacy were also investigated (Crossler and Belanger, 2019). Surprisingly, however, users' situational states are rarely studied. One exception is Kehr, Kowatsch, Wentzel and Fleisch (2015)'s study of affect on users' information disclosure. Given that privacy decision is context-specific (Acquisti and Grossklags, 2005; Martin and Shilton, 2016; Xu et al., 2012), we believe it is important to investigate users' situational state which could vary largely in different contexts.

To summarize, we identify two research gaps in the literature of individual users' privacy decisions. Firstly, although privacy decision is well-acknowledged to be context-specific (Acquisti and Grossklags, 2005; Martin and Shilton, 2016; Xu et al., 2012), little research has investigated how users' situational states affect the decision outcomes. Secondly, recent privacy research started exploring some design heuristics for nudging privacy decisions, for example, framing. However, understanding is lacking in terms of how it exerts impact under different situational states of the user. To fill these research gaps, we consider users' physiological arousal as one important situational state and explore how it affects users' privacy decisions, both directly and through the interaction with message framing.

Arousal and Decision Making

Arousal has been demonstrated to affect people's judgment and decision making in various contexts. A well-studied explanation is that arousal influences attention control (Kahneman, 1973; Mandler, 1975). Mandler (1975) proposed that in high arousal state, the proprioceptive feedback, i.e., internal autonomic nervous system activity, is becoming salient and taking up increasing attentional capacity. In contrast, the limited attentional capacity is less allocated to external cues and activities, e.g., the decision context. A recent study with pupillometry evidence (Unsworth and Robison, 2017) also supported that fluctuation in arousal state can partially explain the deficits in attention control.

Stemming from the above theoretical argument, one consequence of such impaired attention control from high arousal is the heightened immediate benefit of the moment. Ariely and Loewenstein (2006) was among the first to demonstrate the effect of arousal on one's behavior. They showed that when participants were in high sexual arousal state, they were more willing to engage in morally questionable sexual behaviors or even unsafe sex to gratitude the desire. Subsequent studies showed that arousal level induced by sexual stimuli can even influence one's financial decision making, for instance delayed discounting (e.g., Van den Bergh, Dewitte and Warlop, 2008) and gambling loss (Lui and Hsu, 2018). The above studies constantly reveal that, when facing the immediate benefit, people are more risk-seeking in high arousal state.

Another related consequence could be that, under high arousal state, where attentional capacity is insufficient for external cues, people tend to rely on peripheral route or heuristics in decision making and attitude formation. Findings in psychology show that a high arousal state can crowd out rational consideration (Malhotra, 2010; Zillmann, Bryant, Cantor and Day, 1975). Similarly, it is revealed that habitual well-rehearsed responses are more

likely to be produced under high arousal states, since they are spontaneous and less effortful (Conrey, Sherman, Gawronski, Hugenberg and Groom, 2005). Sanbonmatsu and Kardes (1988) applied such theorization to the field of consumer research, showing that under high arousal states, customers' brand attitudes were more influenced by endorser status (i.e., a peripheral cue) than by argument strength (i.e., a central cue).

Taken together, it can be concluded that arousal affects decision making by altering the allocation of attentional capacity between internal and external cues. Accordingly, we theorize two consequences on decision making, one is the heightened desire to obtain the immediate benefit, the other is less rational consideration about the decision context and more susceptibility to heuristics.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

The proposed research model is illustrated in Figure 1. Below we theorize the effects of physiological arousal and message framing on users' authorization decision.
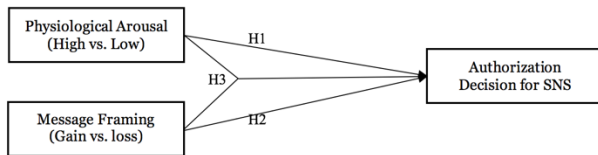

Figure 1. Research Model

A high arousal state associated with salient autonomic nervous system activity takes up more attentional capacity and results in the limited attentional capacity being less allocated to the decision context. Under such circumstances, people focus more on the fulfillment of immediate rewards, and even take risks to do so.

In our context, when users grant third-party authorization to social networking sites (e.g., Facebook), there are some expected social benefits, including relationship maintenance and improvement. For example, users can get more connected to his/her Facebook friends by sharing content on the focal fitness app to them, or exercising together using the app. Based on the above theorization, we propose that fitness app users under high (vs. low) physiological arousal state are more (vs. less) attentive to the above social benefits, and therefore more (vs. less) eager to gain such benefits through granting authorization to social networking sites, that is:

H1: when physiological arousal is high (vs low), users are more (vs. less) likely to grant authorization for social networking sites.

Message framing, which presents the logically identical information with different presentations, often influences people's decision making. Tversky and Kahneman (1981)'s "Asian disease problem" revealed that people were more risk-averse when the question was gain-framed (i.e., 400 out of 600 people would survive), but more risk-

seeking when it was loss-framed (i.e., 200 out of 600 people would die). Subsequent researchers examined the effect of message framing under the context of advertising (e.g., Keller, 1991) and privacy (e.g., Adjerid et al., 2019; Johnson et al., 2002; Lai and Hui, 2006).

In the context of third-party authorization, a gain-framed message tells users what they could do by granting authorization (e.g., sharing exercise record to Facebook), while a loss-framed message tells users they would not be able to perform the same actions if they do not grant such authorization. Consistent with the rationale of framing effect, we propose that the loss-framed message is more persuasive in authorization decision since when the potential loss of the social benefit is highlighted, users are more likely to make the decision to assure such benefit even with some privacy risks. While a gain-framed message will make users more risk-averse and thus make more protective privacy decisions. Thus, we hypothesize:

H2: loss- (vs. gain-) framed message will make users more (vs. less) likely to grant authorization for social networking sites.

We also consider the interaction effect between physiological arousal and message framing on fitness app users' privacy decision on authorizing SNS. As theorized before, due to the insufficient attentional capacity, people under high arousal states are less rational in considering the decision context and more susceptible to heuristics. Since message framing is a typical design heuristic affecting people's decision making, it is proposed that when users are in high (vs. low) arousal states, they would be more (vs. less) likely to be influenced by how the message is framed (e.g., gain- vs. loss-framed).

In the context of fitness app, users in high physiological arousal state will allocate their attentional capacity more to autonomic nervous system activities, but less to the cues in the decision context. Therefore, when facing the authorization decision, insufficient attentional capacity make it difficult for them to evaluate the risks and benefits in a perfectly rational manner. Instead, they would adopt the low effortful processing and rely on the design heuristics, e.g., message framing. So, we propose that:

H3: the effect of message framing on authorization decision would be stronger (vs. weaker) for users under high (vs. low) physiological arousal state.

METHODLOGY

Experimental Design

We plan to conduct a 2(physiological arousal: high vs. low) x 2(message framing: gain vs. loss) between-subject experiment. Participants will be recruited from the entrance of the university gym. They will be randomly assigned to one of the two physiological arousal conditions, where in the high physiological arousal group, they will do the exercise they are going to do, and then come back for the experimental task, and in the low physiological arousal group, they will start the experiment immediately.

Participants will first be measured skin conductance level with an electrodermal activity (EDA) meter, which has been widely used as an indicator of physiological arousal. Then they will experience the prototype of a fitness app as the main task. First, on a welcome page, they will input some basic information (i.e., age, gender, height, and weight). Then the system will calculate the BMI result for the participants. This step is to ensure realism, and to induce certain privacy concerns for the subsequent authorization decision. Next, the system will ask participants several questions about life and exercise habits, based on which it will provide some personalized healthy tips as said in the cover story. Then they will be shown an authorization dialogue asking if the they would like to authorize Facebook access from this fitness app. In this step, participants will be randomly assigned to one of the two conditions with either a gain-framed message (i.e., "if you grant Facebook authorization, you will be able to …") or a loss-framed message (i.e., "if you do NOT grant Facebook authorization, you will NOT be able to …"). Participants' choice of "agree" or "deny" the authorization will serve as the measurement for the dependent variable. Lastly, participants will be asked whether they are Facebook users. Noted that we use it as a filter question in the beginning, since mentioning Facebook in advance might intervene participants' responses due to the increased information accessibility, and it is not aligned with our cover story. Response from non-Facebook users will be terminated and excluded from analyses.

Facebook users will proceed to a post-task survey including questions for manipulation check and controls, e.g., general information privacy concern (Malhotra, Kim and Agarwal, 2004), perceived privacy risk (Dinev and Hart, 2006), previous privacy invasion experience (Awad and Krishnan, 2006), Facebook and fitness app usage. Besides, participants in high physiological arousal will answer questions about the exercise they have just done, including exercise mode, duration and intensity.

DISCUSSION

The study is believed to make several theoretical contributions. Firstly, we explore how a situational state, physiological arousal, instead of the well-studied dispositional states can affect users' privacy decisions. Our findings could also be able to generalize to other arousals in its relevant contexts, e.g., affective arousal on social apps. Secondly, we extend the research on design heuristics in nudging people's privacy decision by examining its interaction with physiological arousal.

For practical implication, the study can inform fitness app designers in designing the privacy settings and crafting messages. Also, we suggest fitness app users being aware of both their own situational state, i.e., physiological arousal, and the system design, i.e., message framing, in making privacy decisions.

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