Wait, Let's Think about Your Purchase Again: A Study on Interventions for Supporting Self-Controlled Online Purchases

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ABSTRACT

As online marketplaces adopt new technologies to encourage consumers' purchases (e.g., one-click purchases), the number of consumers who impulsively buy products also increases. Although some interventions have been introduced for consumers' self-controlled purchases, there have been few studies that evaluate the effectiveness of the techniques in the real environment. In this paper, we conducted an online survey with 118 consumers in their 20s to investigate their impulse buying behaviors and self-control strategies. Based on the survey results and literature surveys, we developed interventions that can assist consumers in controlling their online purchase habits, including *Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*. For evaluation, we enrolled 107 participants in a user study on a real-world e-commerce site. The results indicate that all interventions were effective in reducing impulse buying urges, with variations in user experiences. Our findings and design implications are discussed.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **User studies**.

KEYWORDS

HCI, Consumer Behavior, Behavior Change, Self-control

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1 INTRODUCTION

With advances in information technology and the tremendous growth of e-commerce, the number of people who shop online and who impulsively buy products has increased. About 40% of all online consumer expenditure is attributable to online impulse buying [30]. Many previous works have proposed investigating "a sudden, often powerful and persistent urge to buy something immediately" [44]. For example, some studies indicate negative aspects of impulse buying, such as over-shopping, compulsive buying disorder [38], shopping addiction, and causing consumers guilt and shame [55]. Moser et al. report consumers' desire to curb impulse buying behavior, calling for tools that could help consumers to make self-controlled purchases [37].

The main body of prior studies on supporting online impulse buyers include approaches utilizing digital interventions. These interventions give consumers a moment to meditate (Mindful shopping) [29], wait for 10 minutes, answer questions related to purchasing, or perform a distraction task [36]. However, only a few studies have evaluated the effectiveness of the different interventions in the real environment.

In this thesis, we aim to explore how these interventions impact consumers' self-controlled purchases against impulse buying urges during online shopping. To this end, we developed three research questions:

- RQ1. Do interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) reduce impulse buying urge?
- RQ2. Which intervention is the most effective in supporting self-controlled purchases?
- RQ3. How does each intervention affect user experience?

To answer the research questions, we first conducted an online survey with 118 consumers in their 20s to investigate their online shopping tendencies and impulse buying patterns (e.g., contexts and self-control strategies). We set our target users as 20s consumers because prior work demonstrates that young shoppers are more likely to buy impulsively [21] and are a key generation for online commerce [7]. We find that impulse buying usually occurs when being attracted by the product itself (motivational), purposing on saving (savings), and seeking positive emotion from shopping (shopping enthusiasm). Consumers usually try to curb their impulse buying behaviors by reframing the cost to be more salient, postponing, and encouraging their deliberation and reflection.

Based on our survey results and literature review, we developed four interventions–*Reflection*, *Distraction*, *Desire Reduction*, *Salient Cost*–that support consumers in making self-controlled online purchases and deliberative and reasonable consumer choices. We used *Postponement* as a baseline intervention, waiting two minutes freely without any specific guidance. We performed a between-subjective user study, in which 107 participants were randomly assigned to one of the interventions. The user study aimed to evaluate the interventions and to explore how consumers perceive and experience them.

The main contributions of this work include:

- Data from an online survey that captured online consumption behavior and impulse buying of 20s Korean consumers
- Four interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) designed to support self-controlled online purchases
- Useful insights from a user study that evaluated the interventions in a real-world e-commerce site
- A presentation of lessons learned and design implications for future studies

In the next section, we introduce prior works related to our research. In section 3, we report the results of our online survey on 20s Korean online consumption behavior. In section 4, we describe our intervention designs and user study, evaluating their impacts on self-controlled online purchases. Lastly, we discuss the lessons we learned, highlighting some design implications, limitations, and conclusions.

2 RELATED WORK

2.1 Impulse buying

Impulsive buying has been defined as "a purchase that is unplanned, the result of exposure to a stimulus, and decided on the spot" [40]. Beatty and Ferrell conceptualize the term in a more extensive way: "a sudden and immediate purchase with no pre-shopping intentions either to buy the specific product category or to fulfill a specific buying task" [11]. Hawkins categorizes impulse purchases into four types: pure impulse buying, reminder impulse buying, suggestion impulse buying, and planned impulse buying [49]. With the tremendous growth and importance of e-commerce and the prevalence of impulse buying today, more research has been conducted to understand consumer impulse buying behaviors online. Consumers are more likely to purchase impulsively online since online shopping is free from the constraints of the offline shopping environment [13].

Some previous studies identify factors that influence impulse buying, including demographic factors (e.g., gender [16, 52], income [25]), psychological factors (e.g., sensation-seeking [47], impulsivity [11], impulse buying tendency [45]), situational factors (e.g., amount of money [11], being with someone [31]). Others investigate how stimuli in websites affect consumers' online impulse buying. Dawson et al. use content analysis to investigate the external cues on apparel websites that encourage impulse buying [14]. More recently, Moser et al. conduct a systematic component analysis of 200 top e-commerce websites in the U. S. to investigate which features are being utilized by current e-commerce sites to encourage impulse buying [37]. How display formats (i.e., text, still images, and video) of a virtual store affect consumers' emotions and buying impulses [8] and determining the interplay between a consumer's inherent impulsiveness to buy and website quality (i.e., security, navigability, and visual appeal) [53] are the focus of some active research. Another study presents some traits of group buying websites (e.g., Groupon), such as a 24-hour countdown timer and status of deal's popularity that show how many persons have bought an item, which can pressure consumers into making a purchase without careful consideration [19].

One of the biggest challenges in consumer behavior research is the difficulty of capturing real impulse purchases. Capturing actual impulse behavior in controlled settings has proven to be quite challenging for researchers [31]. One of the reasons for this is that individuals are generally less inclined to engage in impulse buying when they are being observed. Beatty et al. also point out that it is very difficult to capture impulse purchases at the most appropriate time and in the most appropriate setting [11]. Research on online impulse buying has also experienced limited success in capturing actual impulse purchase behavior [26]. Given these difficulties and problematic aspects of capturing actual impulse buying behavior, many researchers utilize the urge to buy impulsively (UBI) to assess various factors that influence actual impulse buying behavior [44]. Other impulse buying research follows an indirect imaginary approach, asking participants to imagine certain situations in which they might participate [10, 42]. Prior studies suggest that an imagined-scenario approach may reduce the likelihood of social desirability biases [11, 45].

2.2 Behavior Change Research

Existing Human-Computer Interaction (HCI) studies on behavior-change cover a wide range of issues, such as diet and exercise [23], social networking service (SNS) [32], and phone use [22]. Simple methods, such as typing a fixed-length number [22], goal reminders, and removing the newsfeed of SNS [32], affect users' decision-making. Digital intervention games can support the control of

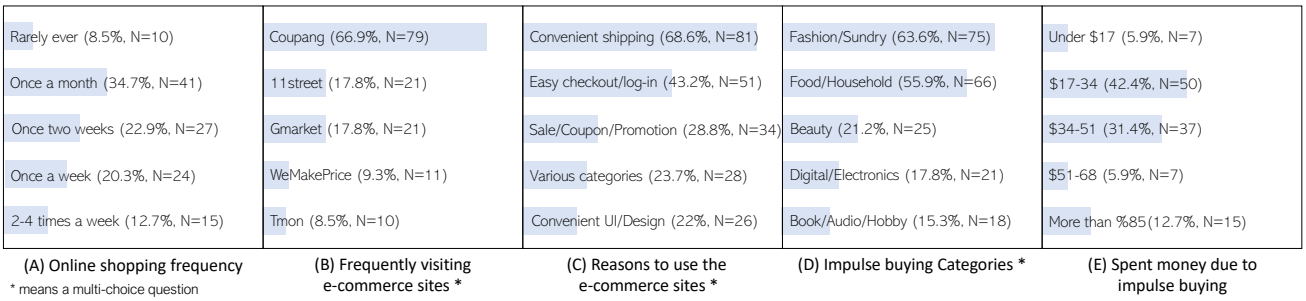

Figure 1: Online survey results about online shopping and impulse buying tendency (Note that we present here only the top 5 responses for each question)

mental disorders, such as impulse, anxiety, and stress [46]. While HCI behavior-change research covers a wide range of domains, self-controlled shopping and spending have received less attention. The studies by Liu et al. [29] and Moser [35] become the starting point for research on interventions to support self-controlled buying. Liu et al. [29] propose 'Mindful Shopping', which is a web-based tool designed to encourage deliberation, especially for people with compulsive buying disorder (CBD). Moser et al. [35] present research directions for the design and experimentation of interventions related to impulse buying. They also design the interventions waiting for 10 minutes, answering questions related to purchasing (reflection), and performing a distraction task [36] and present experimental results. The reflection and distraction interventions they designed significantly reduce impulse buying urges. However, studies evaluating and comparing the intervention techniques in a real environment are scarce.

Many studies in consumer behavior research have investigated why consumers make certain purchasing decisions. One of the key concepts is the "nudge" theory [51], which states that positive reinforcement can influence the motivations and decision-making of a person or group of people. For example, Tan et al. [50] investigate how different nudge evaluation modes of online customer reviews can impact consumers' preferences, and Otto et al. [39] describe the effect of strategies to nudge consumers to make healthier decisions. More recently, Lee et al. investigate how to nudge consumers into sustainable consumption [28].

In this study, we designed four interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) and performed an experiment with the interventions in a real-world e-commerce site. Our interventions are nudges that can influence the decision-making process of consumers. Our results confirmed the validity and effectiveness of our suggested intervention platform as a proof-of-concept.

3 PRELIMINARY STUDY: ONLINE SURVEY

We conducted an exploratory, anonymous, online survey of Korean consumers in their 20s who were familiar with online shopping. The goal of this survey was to determine the presence of online shopping tendencies (e.g., online shopping frequency, frequently visiting e-commerce websites, reasons for using the sites, money spent on impulse buying, and impulse buying product categories), the context of impulse buying, and self-control strategies to curb their spending. This survey was conducted as an initial step, reaching out to obtain background and insights for designing the interventions and a follow-up study. It was a volunteer-based survey in Google Form, distributed in recruitment ads linked to our survey questionnaires through social media. We recruited 118 participants (65 males) who were 26.2 years old on average (σ=2.6).

3.1 Method

We provided the participants with the goal of the study, the requirements, and a link to the survey. If the participants opened the link, we asked them seven questions. The first question addressed how often they shop online, and responses to this question were available on a seven-point Likert scale, which included 1=Rarely ever, 2=once a month, 3=once two weeks, 4=once a week, 5=2-4 times a week, 6=more than 5 times a week, and 7=every day. We then asked them to select all the e-commerce sites they often visited. We provided seven e-commerce sites in Korea, as provided by *Domestic Open Market Brand 2020 Jan Big Data Analysis* [43]. The participants were allowed to list additional sites they might have. We asked for their reasons for using the selected e-commerce sites with given examples, such as convenient shipping service, sale/coupon/promotion, various categories of products, convenient user interface/design, and easy checkout system/easy log-in service. We then asked what categories of products they usually buy impulsively online, providing 11 categories: Fashion, Beauty, Child, Automotive, Food/Household, Interior, Digital Devices, Leisure, Book/Hobby, Office, and Pet Supplies. These categories were extracted by surveying the categories of seven example e-commerce sites in the previous question. We asked the participants how much they spent when they made an impulse purchase by giving them a six-point scale, which included 1=under $17, 2=$17-34, 3=$34-51, 4=$51-68, 5=$68-85, and 6=more than $85. Lastly, using open-ended questions, the participants were asked the context of impulse buying they had experienced and their self-control strategies over impulse buying urge.

3.2 Results

We analyzed the survey results with descriptive statistics and thematically coded the qualitative answers. Descriptive statistics (e.g., frequency counts) are used to analyze results from multiple-choice questions. For qualitative analysis, the authors read through all open-ended text responses to identify high-level themes, followed by a second reading to develop an initial codebook for the responses

Context	Description	Example
Reminded (N=2)	Buying something impulsively as you are reminded of something related to purchase	• *"When the product I wanted to buy suddenly came up to my mind." (P 101)* • *"Oh, I'm running out of my shampoo and this one looks good!" (P 93)*
Suggested (N=4)	Buying something impulsively as you are persuaded by a marketing message or a recommendation system	• *"I discovered an attractive product among the ones introduced through* recommendation algorithms." (P 28) • *"When I see an advertisement that stands out while surfing the web." (P 3)* • *"I often purchase one of the recommended products in 'related product' section." (P 79)*
Motivational (N=44)	Buying something impulsively as you are strongly emotionally motivated to buy, being attracted by the product itself	• *"I often buy something else impulsively that attracts me." (P 103)* • *"When I find a product that stands out while looking at clothes." (P 7)* • *"I crushed into the product while looking around the shopping site." (P 73)*
Saving (N=37)	Buying something impulsively or more than you expect for saving money	• *"When I found a product with a pretty design, and free-shipping service. " (P 47)* • *"I buy in bulk on impulse when I run out of household goods. It is cheaper with no additional shipping cost." (P 72)*
Complementary (N=2)	Buying several things that are complementary to a purchase	• *"I buy a product when it is related to one of my necessities." (P 19)* • *"For example, when I buy a car wash, I also buy several types of towels together, based on their purpose. " (P 99)*
Fear of missing out (N=5)	Buying something that is limited in supply or sale out because of a fear of missing out	• *"If the goods are going to out of stock or on a limited time discount." (P 103)* • *"Product with special price or re-inventory of product that was out of stock." (P 48)* • *"Notification before the expire of discount coupon" (P 78)*
Shopping Enthusiasm (N=18)	Buying something impulsively because you seek positive emotion from shopping	• *"When I am stressed out but I cannot afford to relieve it, or when there is nothing interesting in my daily life." (P 9)* • *"When I want to make a gift for myself." (P 23)* • *'When I am depressed for no reason or anything bad happens." (P 89)*
Decision Fatigue (N=5)	Buying something unexpected as escaping shopping because you are tired of considering it	• *"If I cannot choose one, I just buy them all." (P 16)* • *"When I am too lazy to buy one by one" (P 61* • *"If think I need this and that, I buy products that I will not use once a year." (P 99)*
Financial Affordability (N=11)	Buying something impulsively because you have finances to spare.	• *"When I think I have saved more money than I thought at the end of the month." (P 4)* • *"When I got unexpected income." (P 83)* • *"After I got paid." (P 26)*
Social Accountability (N=7)	Buying something impulsively under the interpersonal social influence	• *"There is something that my friend strongly recommends, and while watching a review that look good on YouTube." (P 92)* • *"Buy when I want to follow the trend (e.g., Nintendo or frothy coffee)" (P 72)* • *"When there is no one around to stop me."(P 88)*

Table 1: The context for Impulse Buying.

for the context of impulse buying. Three authors reviewed, discussed, and revised the codebook. We codified the responses for self-control strategy questions following Moser et al.'s codebook [37].

3.2.1 Online shopping and impulse buying tendency. We summarize the results of the participants' online shopping and impulsive buying tendencies in Figure 1. Forty-one (34.7%) of the participants answered that they usually shop online once a month Twenty-seven (22.9%) of them reported that they shop online once every two weeks. Some participants shopped online more than two times a week (12.7%, N=15) or rarely did (8.5%, N=10). Only one participant (0.8%) answered that they shop online more than five times a week.

Coupang [2] was the most frequently visited e-commerce site (N=79, 66.9%). The participants also used WeMakePrice [6] (9.3%, N=11), Tmon [5] (8.5%, N=10), Auction [1](3.4%, N=4), and Interpark [3] (2.5%, N=3). There were 49 additional responses submitted by the participants, and 16 of them were related to Naver [4]. Naver is the most famous portal site in Korea that shows query results from multiple e-commerce sites. We excluded Naver from this study, as our focus was on online shopping on e-commerce sites.

The participants usually used an e-commerce site with a convenient shipping service (N=81, 68.6%) and an easy checkout/easy log-in service (N=51, 43.2%). There were sale/coupon/promotion (28.8%, N=34), various categories of products (23.7%, N=28), and convenient user interfaces and designs (22%, N=26).

They usually bought products of fashion/sundry (N=75, 63.6%), food/household (N=66, 55.9%) on impulse. They spent about $17–34 (N=50, 42.4%) when they made an impulse purchase. Some participants spent more than $85 (12.7%, N=15), $51-68 (5.9%, N=7), less than $17 (5.9%, N=7), and $68-85 (1.7%, N=2).

3.2.2 Context for Impulse Buying. We revealed ten thematic codes for the context of impulse buying: *reminded, suggested, motivational, saving, complementary, fear of missing out, shopping enthusiasm, decision fatigue, financial affordability,* and *social accountability*. To analyze the responses to these contexts, we initially reviewed prior studies that classified types of impulse buying [48, 49]. However, those categorizations did not fully cover our responses, as the question in our survey asked about the situation of impulse buying, including when and how. Therefore, we add to the categories of the context of impulse buying: *financial affordability* and *social accountability*. Table 1 shows the description of each context and examples.

The results of our analysis show that motivational impulse buying (N=44, 37.3%) was the most common situation, followed by saving (N=37, 31.4%), shopping enthusiasm (N=18), financial affordability (N=11, 9.3%), social accountability (N=7, 5.9%), fear of

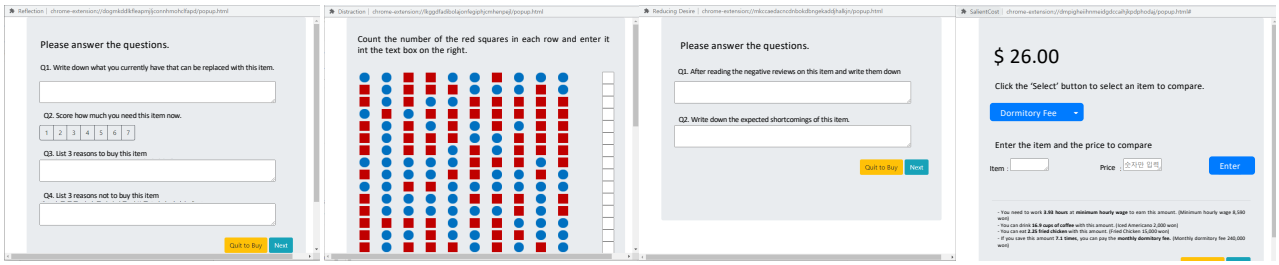

Figure 2: Four types of interventions: (from left to right) (A) *Reflection*; (B) *Distraction*; (C) *Desire Reduction*; (D) *Salient Cost*

missing out (N=5, 4.2%), and decision fatigue (N=5, 4.2%). Few participants responded to suggested (N=4), complementary (N=2), and reminded (N=2).

3.2.3 Self-Control Strategy. We codified the responses about self-control strategies according to the categorization of Moser et al.'s work [37]. They provide seven categories of desired self-control tools: *making costs more salient, encouraging reflection, enforcing spending limits, increasing checkout effort, forcing postponement, avoidance*, and *reducing product desire*. Our survey responses revealed that making costs more salient, forcing postponement, encouraging deliberation or reflection, enforcing spending limits, and avoidance were the most common strategies that the participants used (N=34, N=32, and N=30, respectively).

Making costs more salient (N=34): The participants reframed costs to be more salient, such as checking their account balance or card payment and converting to alternative uses of money: *"I decide not to buy if I cannot afford the credit card bills (...) calculating living expenses"* (P4) and *"Imagine how many servings of pork belly it is"* (P6). Some participants built financial plans or goals to prevent impulse buying: *"Make a financial plan for this year. Set goals such as buying my own house, (...) marriage funds"* (P97).

Forcing postponement (N=32): The participants postponed a decision to purchase a product, expecting themselves to forget the product, waiting in anticipation of a lower desire for the product, or taking additional time to deliberate: *"I can prevent my impulse buying by keeping products in my shopping cart and fixing them continuously"* (P11). Some of them try to distract themselves from shopping: *"Meet someone rather than shopping. I don't go shopping if I'm busy"* (P97).

Encouraging reflection (N=30): The participants tried to curb impulse purchasing by contemplating whether the purchase was really necessary: *"Consider and judge whether this product is necessary for me or an extravagant one"* (P29).

Some participants prevented impulse buying by adapting limits for themselves, creating rules, or opening an installment savings account (enforcing spending limits, N=15) and avoiding a shopping environment, such as deleting a shopping application (avoidance, N=13). Other participants reported that they curbed their impulsive buying by using social accountability (N=3): *"Ask for others' opinions"* (P26), reducing product desire (N=2): *"Watching review videos mentioning shortcomings decreases the desire to buy"* (P96), relying purely on willpower (N=2): *"Slap myself"* (P17), and increasing checkout effort (N=1): *"I do not use the automatic payment system"* (P110).

4 MAIN STUDY

In this section, we describe how we designed the interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) and the user study to evaluate the interventions.

4.1 Intervention Design

We first started the design from seven categories of desired self-control tools presented by Moser et al.'s survey [37] (Section 3.2.3). Among those categories, we selected *making costs more salient, encouraging deliberation, reducing product desire*, and *increasing checkout effort* as intervention methods. We excluded *avoidance*, which avoids all purchase environments (e.g., blocking shopping sites), as we aimed at investigating the effect of interventions that operate on online shopping websites. *Enforcing spending limit* was excluded because we gave the participants a shopping scenario with the spending limit of $26 in the user study. This budget was decided according to the online survey results in 3. We used *postponement* as a baseline intervention to compare the effect of the interventions, as all of our designed interventions included postponement for a certain amount of time before purchase by giving participants a task. According to Moser et al.'s work [36], pausing a purchase for 10 minutes with unguided postponement, which allowed participants to do any behavior during a waiting time, did not significantly lead to fewer impulse purchases. Thus, we used the base intervention, waiting 2 minutes without any guidance, which was the average time of performing tasks in the interventions for fairness. The following is a detailed explanation of the four interventions (Figure 2).

- ***Reflection*** (Figure 2 A) asks users to answer the questions to encourage deliberation or reflection. We asked users to write down replacements of the selected product, rate the necessity of the product (seven-point Likert scale), and write down three reasons to buy or not to buy.
- ***Distraction*** (Figure 2 B) requires users to perform a task before checkouts. We asked users to count the number of red squares in the two 15 × 10 tables (for a total of 30 sums), whose colors and shapes were all random.
- ***Desire Reduction*** (Figure 2 C) refers to users having negative impressions of the selected products. We asked users

to jot down expected shortcomings after they read negative reviews on the selected product to buy.
- ***Salient Cost*** (Figure 2 D) shows the opportunity cost of the selected product from different perspectives. We provided a drop-down list with commensurate and popular products to the selected products, which was generated based on a survey about purchasing trends of consumers in their 20s and price indexes [24, 27]. If a user chose an interesting item from the list, it showed messages like *"If you save this money N more times, you can go on a trip"*.
- ***Postponement*** gives a delay of two minutes before consumers to check out without any restriction or guidance. We set 2 minutes as a waiting, which was the average time for performing other intervention tasks.

We implemented the interventions as a Chrome extension to conduct an experiment on a real-world e-commerce site. The extension hid the 'My cart' (a button to see products in the cart) and the 'Check out' buttons of the e-commerce site to prevent users from purchasing products without experiencing the interventions. When the user clicked the 'Add to cart' button, the extension opened a new pop-up window that showed the intervention tasks. When the user finished the task of the intervention completely, the pop-up window was automatically closed and the extension scripts made the hidden buttons visible again.

4.2 Study Design

We conduct a user study to investigate if the interventions discourage impulse buying and how they affect user experience.

4.2.1 Online shopping site and participants. We selected Coupang, an e-commerce site, for the experiment to investigate how interventions affect consumers' impulse buying urges in the real environment. The reason is that our target consumers most frequently visited this site for their online shopping (N=79, 66.9%), as shown in Figure 1 (b). We also conducted a component analysis of Coupang, following the codebook of Moser et al. [37]. Our analysis result indicated that Coupang had 33 encouraging features (e.g., one-click purchase, expedited shipping), which was comparably high, as 200 online websites have 19.36 features on average. It also covered 17 of the top 20 impulse buys features (e.g., discounted price, sale page/list, returns/refunds).

We recruited participants through social media (e.g., Facebook) and posting flyers inside a university. We had three inclusion requirements: the participants should be in their 20s, have bought a product online, and have used Coupang on a desktop or laptop. We also recruited participants who wanted to control their impulse buying behavior, as self-control strategies are especially effective for highly motivated individuals [34].

4.2.2 Imaginary shopping scenario. We let the participants conduct a shopping task under a given imaginary shopping scenario. The scenario is as follows: *"Imagine that you are paid about $26 as a participation fee! Please browse the online shopping website freely and select a product that you want to buy and add it to your shopping cart. After this process, you can decide whether you will buy the product or not."* We used this scenario for two reasons. First, we wanted to clarify the "context of impulse buying". In our online survey (Table 1), the participants commented on financial affordability such as "when they have an unexpected income" as a situation in which they make impulse purchases. We induced them to imagine that they received an experiment participation fee as an unexpected income. Second, capturing the scene of impulse purchases at the most appropriate time and in the most appropriate setting is very difficult, as Beatty points out [11]. Thus, many impulse buying studies have utilized the scenario-based approach [10, 42] and report that the approach could reduce the likelihood of the social desirability biases [11, 45].

4.2.3 Questions. To measure the effectiveness of the interventions, we asked the participants several questions on impulse buying urge, intervention task workloads, user experience, and impulse buying tendency.

Felt urge to buy impulsively and Purchase Intent: To check the participants' felt urge to buy impulsively and purchase intent, we asked the participants two questions twice before and after experiencing the interventions. The first question measured felt urge to buy impulsively by asking *"At this moment, the urge I feel to buy the product that I selected can be described as:"* and using a seven-point Likert scale ranging from (1) I feel no urge to buy this product, to (7) I feel a very strong urge to buy this product (adapted from [15, 36]). The second question asked their purchase intention, *"Likelihood that I would purchase this product is:"* using a seven-point Likert scale ranging from (1) very low to (7) very high (adapted from [17, 18, 36, 41]). We asked the same questions once again after experiencing the interventions to confirm the change in their urge to buy and purchase intent.

NASA TLX: We used NASA TLX to measure participants' perceived difficulty of the intervention tasks [20]. The NASA TLX scale is a well-validated measure of workload in six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration.

Questions asking user experience: To investigate the user experience of the interventions, we asked five user experience questions with a seven-point Likert scale (1: strongly disagree, 7: strongly agree).

- UXQ1. While using this intervention, I feel that my desire for the product has become lower than before.
- UXQ2. The intervention is helpful in making a deliberative and reasonable consumer choice.
- UXQ3. If possible, I would like to use the intervention further when shopping online.
- UXQ4. I am willing to recommend the intervention to those who want to curb their impulse buying behavior.
- UXQ5. Please suggest improvements to the intervention or design a new intervention to support self-controlled purchases.

We also requested that the consumers provide reasons for their ratings and free-form feedback and comments.

Impulse Buying Tendency: We measured the impulse buying tendency (IBT) to capture a trait of impulsivity and an urge or motivation for actual impulse buying [54]. The IBT scale is a validated, widely used five questions, including "When I see something online that really interests me, I buy it without considering the

consequences." The responses are made on a seven-point Likert scale ranging from (1) Strongly disagree to (7) Strongly agree. The higher the total score, the higher the tendency to buy impulsively. We used a modified version of the IBT scale to focus on online impulse buying, as suggested by Moser et al. [37].

4.2.4 Procedure. The study consists of three parts: (1) demographic survey, (2) main study, and (3) post-survey and fully performed online. Figure 3 summarizes the study.

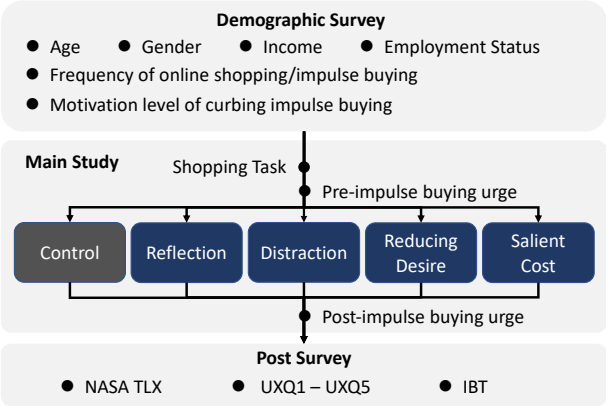

Figure 3: The procedure of the study.

We sent an invitation email to the participants that included a URL for the experiments and a tutorial for installing the interventions. For the experiment, the participants used a video conference platform and shared their screens. When asking them to share the screen, we indicated that the screen share and interaction logging were for preventing any technical issues and post-experiment analysis purposes, and the experimenter did not monitor the participants during the study. Once the participants finished installing the tool, they were directed to the website for the experiment, where they first read the instructions and cautions for the experiment and were informed of the consent form about recording, logging, and compensation. To preserve privacy, the extension only logged operation interactions, such as clicking or dragging elements, the number of mouse scrolls, and the URLs of pages that the participants have visited on the site, and did not store any identifying information.

As the participants became ready, the experimenters explained the procedure of the experiment. After this tutorial session, the experimenters turned off the videos and muted the mics to mitigate a possible Hawthorne effect [33], which refers to the tendency of some participants to perform harder and better when they feel someone is observing them in an experiment. However, when the participants had an issue or a question, the experimenters turned on their mics to resolve the issue or answer the question. The participants then answered the demographic survey questions, including age, gender, and income, as shown in Figure 3 top.

Following the demographic survey, the main study began. As the study was a between-subject, we randomly assigned each participant to one of the five groups–*Reflection*, *Distraction*, *Desire Reduction*, *Salient Cost*, and *Postponement* groups. Note that the *Postponement* was a baseline intervention, as we aimed at investigating the effectiveness of intervention methods, rather than impact due to time delay. The postponement group performed last, so that we can decide the waiting time by calculating the average intervention task time of other groups (i.e., 2 minutes).

The main study task began when the participants clicked a link for the e-commerce site. With the given imaginary shopping scenario, they browsed the Coupang website and selected one product that they would like to buy the most. As time limitations can encourage impulsive features [37], we did not restrict the time for the shopping task. When the participants selected a product that they felt the strongest urge to buy, they clicked the 'Add to Cart' button and saw a pop-up window asking questions about impulse buying urge. After answering those questions, the participants conducted the task of an assigned intervention. If the participants changed their minds not to buy the product during the shopping task, they could quit the intervention task and shopped for other products. If the participants completed the intervention task, questions addressing the impulse buying urge were shown again to record the changes after using the interventions. After answering all the questions, the participants went back to the experiment page for the post-survey session.

During the post-survey session, the participants were required to answer the workload questions. Then, we asked the participants if they had a plan to buy the selected product (YES/NO), reasons for selection (free text response), and whether they had pre-intended to buy the product (YES/NO). The participants rated their user experience with reasons for the interventions (UXQ1–UXQ5) and answered the impulse buying tendency questions. We included two trap questions to find out the participants' concentration and sincerity levels during the experiment (i.e., click the button with number 3, add the number of legs of a dog and a cock).

Overall, we recruited 108 participants, but one participant in the distraction condition was excluded because the participant expressed that she did not need to control impulse buying. We included all participants regardless of whether they already had been interested in the selected product or not, as an impulse purchase can occur in complex situations and it is difficult to clearly define impulse purchasing. Thus, we had 107 participants in total for our analysis (*Postponement*: 22; *Reflection*: 21; *Distraction*: 21; *Desire Reduction*: 22; *Salient Cost*: 21). The participants were between 20 and 29 years old (M=24.71, SD=1.801, male: 46). A total of 96 participants (89.71%) reported that they spent more than about $428 a month as living expenses. The majority of them (N=99, 92.5%) were in the bachelor's degree or completed the degree, and 52 (48.5%) reported working full-time or part-time. The participants scored 4.14 on average (SD=1.38) on the question asking their need assessment to control impulse buying online. One hundred participants (93.4%) reported that they had experienced impulse buying and were still making online impulse purchases more than once every month. Among those, 50 participants impulsively made online purchases several times per month. The participants scored 23.88 on average (SD=6.1), ranging from 5 to 35 on the IBT scale. Compared to other consumers of other studies who scored 14.7, 21.3 [54], and 25.4 [37] on average, we believe our participants had a high tendency to impulse buying. One-way ANOVA results indicated that there was no significant difference in the IBT scores among the groups (F=0.967, p=0.429). The participants took 23 minutes 29 seconds on average for the experiment, and we paid them $4.3 as compensation. We

additionally pay $4.3 to the top 10% of participants who answered the responses sincerely.

5 RESULTS

In this section, we present quantitative and qualitative analyses of the experiment results, answering the research questions. Of the 23 minutes total time spent on average, the participant spent 7 minutes 5 seconds on average for shopping and 2 minutes for performing the intervention's task, respectively. The average price of the selected products by the participants was $16.53 (SD=6.45, median=16.48). We found that 31 participants selected products in the Food/Household (28.97%), 18 in the Digital devices (16.82%), and 15 in the Beauty (14.02%). A total of 65 participants (60.75%) expressed that they would buy the product that they selected during the shopping task, and 27 of them (41.53%) had no prior intention to buy the product (i.e., impulsive buying). Next, we investigated the answers to the research questions below.

RQ1: Do the interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) reduce impulse buying urge? During the experiment, we asked about *'felt urge to buy'* and *'purchase intent'* before and after experiencing the interventions. Since the two questions are highly correlated with each other (Pearson Correlation r=0.762, p<.001), we averaged the two scores to create one main dependent variable, impulse buying urge (IBU), as Moser et al. did in their study [36]. To confirm if the urge was significantly reduced due to the use of interventions, we used paired samples t-tests for each group.

Group	Pre-IBU	Post-IBU	Significance
Control	5.5 (SD=0.866)	5.068 (SD=1.376)	t(20)=1.89, p=.073
Reflection	5.548 (SD=0.754)	3.190 (SD=1.096)	t(19)=8.81, p<.001***
Distraction	5.333 (SD=1.062)	4.286, (SD=1.314)	t(19)=3.35, p<.01**
Desire reduction	4.886 (SD=1.331)	3.045 (SD=1.544)	t(20)=5.95, p<.001***
Salient cost	5.571 (SD=0.760)	4.262 (SD=1.532)	t(19)=4.76, p<.001***

Table 2: The difference in IBU for all interventions.

We found that all interventions reduced participants' IBU, except *Postponement* (Table 2). Among the participants in the control group, 14 (63.64%) continued shopping during the waiting time. We inferred that this result was because they were still engaged in the shopping context while they were waiting: *"It made me want to buy more. Waiting time felt like just waiting time, and purchasing the product felt like just a matter of time."*, P4 stated. This result aligns with that of Moser et al.'s study results [36].

RQ2: Which intervention is the most effective in supporting self-controlled purchases? To investigate the competitive advantages of the interventions, we compared the changes in IBU by interventions, using one-way ANOVA with Tukey's HSD post-hoc analysis (F=6.99, p<.001).

Table 3 summarizes the test results, where*Reflection* and *Desire Reduction* interventions (p<.001, p<.01, respectively) were better than the baseline intervention, *Postponement*.

We additionally found that *Reflection* was more effective than *Distraction* (p<0.05). We found it interesting that this result does not align with the results of Moser et al.'s study [36], in which no significant difference was found between *Reflection* and *Distraction*. We can guess two reasons for the different results. First, the shopping environments in which the shopping task was conducted were different in both studies. In this work, we conducted the experiment on a real-world e-commerce site to support its ecological validity as much as possible, so that participants concentrated on shopping and reflected on their real shopping patterns. However, the experiment of Moser et al. was performed on a simulated e-commerce site. Although the simulated site provided 200 products and when consumers clicked any of the products, they were led to the product web page on Amazon, it did not support several features, such as the shopping cart and advertisement banners. Second, we asked two more questions for the *Reflection* task, compared to those in the previous study. We asked the participants to write down the replacements of the selected products and rate the necessity, which were not considered in the previous work. We decided to add those questions because we assumed those questions could be more helpful to the participants' self-reflection according to our survey results in Section 3.

Group comparison	The difference in IBU change	Significance
(**Reflection**, Control)	1.925	p=.001**
(**Distraction**, Control)	.616	0.524
(**Desire Reduction**, Control)	1.409	p<.01**
(**Salient cost**, Control)	0.877	p=0.180
(**Reflection**, Distraction)	1.31	p<.05*

Table 3: Comparisons between interventions in terms of IBU changes.

RQ 3: How does each intervention affect user experience? In this section, we present the results on the user experience of the interventions based on the ratings. We conducted qualitative and correlation analyses to investigate user experience. Table 4 summarizes the ratings on the user experience question (UXQ1-UXQ4). Note that we indicated the participants in each intervention group as P_r, P_d, P_{dr}, P_{sc} representing the participants in the groups *Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*, respectively. Next, we present an in-depth analysis of each intervention.

***Reflection*:** The participants in the *Reflection* group felt the intervention was helpful to reduce their desire for impulse buying and make a deliberative and reasonable consumption choice. A Tukey post-hoc test revealed that the score of *Reflection* intervention for UXQ1 (M=5.714, SD=0.956) was significantly higher than that of the baseline intervention (p=.001). The test also showed that the score of the intervention for UXQ2 (M=5.857, SD=0.854) was significantly higher than that of the baseline intervention (p<.01).

We attribute this result to the task of the *Reflection* that helps the participants to look back on their buying objectively with specific statements and thoughts: *"As I wrote down three reasons why I should and should not buy the product, I could contrast the reasons. It could help (...) choose which reasons are more convincing to me"* (P_r 13). We found it interesting that even those who decided to buy the product were also satisfied with their decisions because they realized the products were really worth the money to them. P_r 2 commented, *"The intervention helps (...) having enough time to check my consumption, and whether it is worth spending the money before purchasing."*

Another interesting point is that as the participants wrote more on items that could replace the selected product, the effect of the intervention increased (Pearson correlation r=0.702, p<.001). We additionally observed that the effectiveness of the intervention was

Questions	Control	Reflection	Distraction	Desire Reduction	Salient Cost	Post-hoc Analysis
UXQ1	3.73 (SD=1.64)	**5.71** (SD=0.96)	4.52 (SD=1.57)	4.82 (SD=1.97)	4.95 (SD=1.50)	(**Reflection**, Control : p=.001**)
UXQ2	4.46 (SD=1.50)	**5.86** (SD=0.85)	5.00 (SD=1.52)	**5.68** (SD=0.89)	5.33 (SD=1.35)	(**Reflection**, Control : p<.01**) (**Desire Reduction**, Control : p<.05*)
UXQ3	4.23 (SD=1.85)	5.43 (SD=1.17)	4.57 (SD=1.75)	5.05 (SD=1.68)	**5.52** (SD=0.93)	(**Salient Cost**, Control : p<.05*)
UXQ4	5.14 (SD=1.46)	5.95 (SD=1.12)	5.38 (SD=1.63)	**6.36** (SD=0.73)	6.05 (SD=0.59)	(**Desire Reduction**, Control : p<.01**)
NASA TLX	2.64 (SD=0.80)	2.86 (SD=0.87)	**3.50** (SD=1.14)	2.27 (SD=0.54)	2.44 (SD=0.63)	(**Distraction**, Control : p<0.001***) (**Distraction**, Desire Reduction : p=.001**) (**Distraction**, Salient Cost : p=.001**)

Table 4: Scores for each user experience questions (UXQ1–UXQ4) and NASA TLX.

correlated to the number of characters on the reasons not to buy (r=0.526, p<.05). This result implies that if consumers can write many replacements and reasons for not buying, they realize that they do not need the product that much. Lastly, we found that if the participants ponder longer while experiencing the intervention, the effect of the intervention becomes larger (r=0.52, p<.05).

***Distraction*:** We found two types of participants based on their behaviors: (1) those who turned their attention from shopping to the counting task and (2) those who kept thinking about the necessity of the product while doing the task. P_d 9 is an example of the first group thought that distraction worked well: *"Focusing on the system for a while, my focus on the product was momentarily dispersed."* In other case, P_d 22 used the intervention for self-reflection, having more time to consider the purchase of the product: *"I thought it was helpful because it gave me more time to think about whether buying this would be a reasonable purchase."*

The participants did not want to buy a product when they had to perform such a cumbersome task, especially if it was impulse buying or if the product was not really necessary. We assumed that this effect was due to the fatigue caused by the counting task of the intervention, which recorded the highest score in the NASA-TLX survey. One-way ANOVA with Tukey's HSD post-hoc analysis result revealed that the NASA-TLX score of the *Distraction* group was significantly higher than that of the control, *Desire Reduction*, and *Salient Cost* groups (Table 4). This high task workload has a negative effect in terms of preference in user experience. *Distraction* had the lowest score for the UXQ3 (M=4.57, SD=1.75) and UXQ4 (M=5.38, SD=1.63), among the interventions. The participants who gave low scores commented that the high fatigue caused by the task was the main reason for the low preference score: *"It is too much to buy one thing as it takes too much energy and mental effort."* (P_d 22). In addition, those who evaluated it as ineffective commented on the task as separate from purchasing: *"I did not put much weight on it because it seems separated from buying products"* (P_d 2).

***Desire Reduction*:** The participants in *Desire Reduction* considered that they made a deliberative and reasonable choice than the control group. One-way ANOVA with Tukey's HSD post-hoc analysis revealed that the UXQ2 score was significantly higher than the control group. The participants had an objective decision-making process after comparing the pros and cons of the products. They confirmed the shortcomings that might have been overlooked by reading the reviews left by those who actually used products. As such information on shortcomings was not provided on the product detail page, recognizing the negative aspects of the product could be one of the main reasons that made the intervention effective: *"I could see the shortcomings in detail, which were not found on the product detail page"* (P_{dr} 1). They decided not to buy when they considered the shortcomings critically: *"I quickly knocked down the impulse buying desire. (...) My trust in the product has suddenly dropped"* (P_{dr} 20).

We found it interesting that the participants tended to predict or imagine their future after reading negative reviews in two different ways. Some participants focused on their future emotional state, such as anger or dissatisfaction: *"Because the future that I might get upset by the thought of having wasted money after receiving the goods no longer exists"* (P_{dr} 14) and *"After seeing the unsatisfactory opinion, I felt like I was going to regret it"* (P_{dr} 9). The others cared about in a rational perspective, such as reducing unnecessary consumption or probability of failing purchase: *"I think this system helped me choose rational consumption because it could reduce unnecessary consumption"* (P_{dr} 22) and *"This is because the probability of failure is likely to decrease when buying things"* (P_{dr} 15).

We found a negative correlation between NASA-TLX and the effectiveness of the intervention (r=-0.66, p<.001). We can infer that the participants felt a task workload while having a cognitive load when they did not agree with the reviews and thought that it was hard to find negative reviews [12]. If the negative reviews and expected downsides are clear or crucial to them, it would be easy to perform the *Desire Reduction* task.

We observed that the effectiveness of the intervention may differ depending on the number of reviews and review scores. The average number of reviews of products selected by the participants in the *Desire Reduction* group was 3150.9 (SD=6734.69) and the average review score was 4.54 (SD=0.26). The participants decided to buy the product if there were not many reviews for the selected product or if the shortcomings written in the reviews were already expected or acceptable: *"I already anticipated drawbacks of the clothes, and can tolerate them even before deciding to buy"* (P_{dr} 3). The *Desire Reduction* intervention had a lower effectiveness for those who did not rely on others' subjective opinions: *"Because reviews are subjective opinions and I may feel differently as I use it"* (P_{dr} 15).

***Salient Cost*:** The participants in the *Salient Cost* group preferred the intervention because they could easily compare the price to other opportunity costs. A Tukey post-hoc analysis revealed that the participants in the group had an intent to continue using the intervention (M=5.524, SD=0.928) significantly more than those in the control group (p<.05). In fact, the task workload of the Salient Cost was the lowest among all interventions (M=2.44, SD=0.626). P_{sc} 10 said, *"I can make a simple comparison with other products without complication"*.

The *Salient Cost* group compared the value of the selected product with what they needed for living (e.g., cost of using public

transport, dormitory fee) or what they like to do (e.g., cost to play a game or drink): *"Considering that $17 was a lot more fuel economy than I thought. When assuming I can use public transportation more than 20 times with the price, the purchasing sentiment was psychologically dampened"* (P_{sc} 21) and *"It allowed me to think about over-spending because I could see the cost relative to what I usually want to spend"* (P_{sc} 19). Those responses reveal that the product list of the intervention works well for our target group, the consumers in their 20s.

6 LESSONS, DESIGN IMPLICATIONS, AND DISCUSSION

We present our lessons learned and intervention design implications.

A conflict between e-commerce sites and consumers: The current e-commerce sites promote consumers' purchase by simplifying the buying process, such as the one-click checkout. According to the results of our survey, consumers consider easy checkout/log-in as a great advantage of e-commerce, but they are also concerned about the possible reckless over-consumption due to the simplified buying process. Online impulse buyers desire tools that require more effort for the check-out [37]. In this study, we also observed the consumers' anxiety toward those marketing strategies with fast and easy payment systems, as they understood that the strategies would result in their impulsive purchases in the end. We speculate that this implies a conflict of interest between e-commerce sites and consumers. The participants in the study welcomed any disturbance in their shopping process so that they could make reasonable decisions by having a chance to consider their purchasing at a distance: *"Recently, online shopping malls have created simple payment methods in their own ways. (...) I prefer the old complex payment process"*, P_d 18 stated. We posit that this experiment result indicates the necessity of an intervention to help online impulse buyers control their purchases by complicating process and the methods and making consumers feel satisfied with their purchases.

Interventions work as a brake for the flow of shopping: We found that all interventions resulted in suppressed online impulse purchases, regardless of the tasks given by the interventions. The participants in all groups, including the control group, reported that the intervention worked as a brake in shopping to stop the instant flow from product selection to an actual purchase: *"In impulse buying, the time until a consumer sees and buys a product is short, so extending the time for the purchase flow would be helpful for impulsive buyers"*, P_{dr} 8 commented. This feedback implies that the time between adding a product to a shopping cart and actual purchase helps consumers to control their desire. However, as reported in Secion 5, an intermission without any specific task does not have a significant effect in reducing IBU, because the consumers are easily engaged in the shopping context during the intermission. For a greater effect of suppression, we recommend designing an intervention with a certain task that can break consumers' attention on products or induce them to look back on their purchases.

Interventions induce self-reflection: Although the participants went through different tasks with different intervention types, they all experienced the self-reflection process. *Reflection* asked questions regarding production substitution, product necessity, and reasons for purchases. Answering the questions, the participants reflected on their purchases more specifically and continuously. P_r 15 reported: *"It helps me to understand myself, what I want to have (what I like), and why I do not really need them (what I need)."* The participants in *Desire Reduction* and *Salient Cost* explored various aspects of products, reviewing consumers' reviews and reconsidering the opportunity cost of their purchase. This approach is an indirect one compared to *Reflection*, but the participants had a chance to sufficiently cogitate on the value of the product they were buying and review their choices: *"After reading the negative reviews, I thought what I could replace the products with, and I felt that my desire to buy them was lower than before"*, P_{dr} 2 reported. This reply underlines the influence of previous consumers' decisions and the effectiveness of offering reasons for not buying in controlling the impulse. *Distraction* aimed at dispersing one's interest in purchasing by giving a counting task. We found that the participants showed two aspects of self-reflection with the intervention. One group regarded the task time as the change toward self-reflection. P_d 6 said, *"The calculation process seems to have given me a reasonable question of whether I really need them."* The other group thought that the intervention cleared their minds and allowed them to review their purchase desire again: *"After I've had time for mental training (with the intervention), I've come to my senses"* (P_d 15). Based on these findings, we recommend designing an intervention that can induce consumers to reflect on themselves.

"Must Buy" is an important criterion for defining impulse buying: We found that participants identified their impulse buying by asking themselves if they really needed the selected product and realized their impulse buying behaviors during self-reflection. This implies that "Must buy?" is an important criterion for the participants in defining their behavior as impulse buying. If they realize that they try to buy things that are not necessary, they define their purchasing as impulsive and want to suppress it. We found many keywords, such as "need to buy" or "necessity of the product" in their responses. For example, P_{dr} 1 commented, *"After reading the negative reviews about the product and thinking about its shortcomings, I could realize that my choice was impulse buying."* Moreover, the correlation between the necessity rating (Q2) result of the *Reflection* group, and the change in IBU before and after the intervention shows a highly negative relationship ($r=-0.638$, $p<.01$). This result indicates that the more users feel the necessity of the product, the less effective the intervention. Thus, we suggest designing an intervention in a way that consumers can assess purchasing needs in a self-reflection process.

Interventions provide a comparison point for decision making: The participants in each intervention group build their own comparison point to decide whether to buy the selected product. However, their comparison points vary based on intervention types. For example, the participants of the *Reflection* group made purchase decisions, focusing on finding reasons to buy and not to buy: *"If I finally decide to buy a product, after searching reasons to buy and not to buy, it can be thought of as reasonable consumption"*, P_r 21 stated. The participants in the *Distraction* group compared the cost (e.g., time and effort, fatigue) of the task and desire or expect gratification of purchasing the product before they made the final decision. Examples include the comment from P_d 16: *"I thought, 'Should I buy*

it while doing this task?' when I did the task." This relates to the theory of planned behavior (TPB), in which an individual's perceived ease or difficulty of performing a behavior influences behavioral intention [9]. The participants in the *Desire Reduction* group listed and compared the pros and cons of the products before their final decision. Examples include *"I think we will have time to check both positive and negative reviews, which will allow us to compare various products"* (P_{dr} 5) and *"I was able to decide whether its disadvantage was tolerable or not"* (P_{dr} 1). Lastly, *Salient Cost* group's participants compare the value of the chosen product to other opportunity costs. Examples include the comment from P_{sc} 3: *"Because I felt that this system can prevent me from buying anything that is really necessary, because it provides me opportunities to compare."* We found that participants thought that they had made a reasonable consumption when they decided after comparing products based on a certain boundary related to the purchasing. Interventions are the media that trigger consumers' deliberation by disclosing the other side of the purchase not considered before. Therefore, we recommend designing an intervention that can present users with a criterion to decide a purchase.

High workload may result in adverse effects: Among the interventions we designed, the NASA-TLX score of the *Distraction* was comparably higher than other interventions. We found that some participants in the *Distraction* group reported fatigue and difficulty of the task: *"I have headaches when I keep separating circles and rectangles and counting the numbers"* (P_d 22). We guess this is one of the reasons for the low scores of the questions on future use (UXQ3) and recommendations for others (UXQ4). The results indicate that an intervention should allow an appropriate level of fatigue or task workload to avoid providing unpleasant shopping experiences to consumers.

Interventions need to consider personal shopping habits: We found that the proposed interventions were less effective for self-controlled purchase, when consumers already have shopping habits similar to the tasks of interventions. For example, P_r 17 said it would take too much time to make a decision if she used the intervention because she originally tends to have a lot of thoughts when shopping. Other participants commented similarly: *"I do not think I need to use it because I usually read the review of the product carefully even when I want to buy it on impulse"* (P_{dr} 5) and *"I'm willing to recommend it, but I don't think it's a system that's very helpful for people who are already careful with their purchases"* (P_r 9). This result implies that careful consideration of consumers' shopping patterns or habits is required to design an effective intervention that can help consumers change their purchase behaviors.

Interventions help consumer build a good shopping habit: While using interventions, the participants examined their own consumption patterns, as P_r 4 reported: *"It was a shopping that made me reflect on my purchase pattern without much consideration and shocked how easily I was spending without thinking!"* We also observed that those without a shopping habit or with bad shopping habits were willing to build positive consumption habits through the experience of interventions: *"I want to use it because it seems to change the habit of consuming without much thought into rational consumption without putting much effort"* (P_d 15). This result indicates the necessity of an intervention that can help online impulse buyers to build their deliberative consumption habits.

Not always, but only when consumers really need it: Even though all our interventions were effective in reducing impulse buying urges, participants wanted interventions to only be shown in the impulse buying context rather than always. Specifically, the participants wanted the intervention to work only when they tried to purchase a product in certain categories, when they paid much more than their pre-set spending limit, or when they turned on the interventions with the on/off button. P_r 18 stated that, *"I think it would be effective if the intervention checks consumers' order history, such as shopping categories with high spending in the past. (...) When putting an item that is in the pre-established impulse buying categories to the shopping cart, the intervention can pop up."* We also found that the participants who gave a low score to UXQ3 had no willingness to use the intervention hereafter because they would consider the intervention cumbersome even when they buy something really needed: *"It may be a necessary tool to prevent impulse buying, but it may be a little annoying to ask why you should keep buying for every purchase,"* and *"The system is good, but I think I'd want to skip the system when I'm busy with things I really need, not impulse buying!"*, P_r 7 and P_d 17 commented, respectively. When designing an intervention, efforts must be made to recognize consumers' impulsive purchasing so that the intervention only works when the consumers try to buy something impulsively, rather than on every purchase.

7 LIMITATION AND FUTURE WORK

Generalizing to the extended sample: Our study was limited by our restriction of the sample target group of our survey to those in their 20s. Although people in this age group tend to make more impulse buying and the motivation level is central to self-control, a future study is needed to generalize our findings.

Long-term in-the-wild study: To best control diverse factors, we conducted an in-lab study in this work under a more controlled setting (e.g., budget, purchase situation), as we were interested in participants' immediate responses and description of their experience with our tool, which could be obtained through in-depth interviews with the in-lab study. Future research can examine the long-term effectiveness and efficiency of customers' impulsive buying control with interventions while tracking consumers' natural shopping behavior. We believe that the tool and experiment results presented in this work can be considered in designing interventions and experiments for long-term user studies.

Supporting interventions on multiple devices: We conducted a user study in a real e-commerce site with a laptop environment and did not quantify the interventions' effect on other environments, such as mobile devices. As we witness tremendous growth in mobile shopping, it is of interest to perform similar experiments to determine if interventions on mobile devices could have the same or similar effect. This presents an opportunity for future work.

8 CONCLUSION

We determined the online consumption behavior and impulse buying of Korean online consumers in their 20s using an online survey. We presented interventions (*Reflection*, *Distraction*, *Desire Reduction*, and *Salient Cost*) to support consumers' self-controlled online purchases. To confirm the effectiveness of the designed interventions,

we conducted a user study with 107 participants by deploying the interventions in a real-world e-commerce site. The experimental results indicate that all four interventions reduced impulse buying urges while providing different user experiences.

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