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# Surprising Consequences of Innocuous Mobile Transaction Reminders of Credit Card Use

Jikyung (Jeanne) Kim, Yeohong Yoon, Jeonghye Choi, Hang Dong, and Dilip Soman

## Abstract

Excessive credit card use has been a serious concern across the world since the introduction of the payment method. In South Korea, credit card companies and the government collaborated on a behavioral intervention, the transaction reminder service, to help consumers better manage their credit. Credit card transactions trigger text message confirmations sent to users' mobile phones, increasing the salience and memory of expenses and resulting in more controlled spending.

Experimenting in an institutional setting in which one group receives reminders and the other does not, the authors combined difference-in-differences methodology with inverse probability treatment weighting to assimilate random assignment. The empirical findings show that this intervention counterintuitively brings an overall increase in spending. This increase is substantial among those who had been light to medium spenders before the implementation, whereas historically high spenders experience little to no change after receiving the transaction reminders.

The results are consistent with a theory that users reallocate the mental effort of remembering their past spending (mental recordkeeping) to digital devices, leading to higher spending due to poor recall. These findings attest to the value of evaluating a policy before scaling it broadly.

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## INTRODUCTION

Using a credit card as a payment method poses a challenge in personal finance management. Consumers tended to overspend when they used credit cards instead of cash or checks (i.e., “credit card effect,” Prelec & Simester, 2001), and this had led to personal credit crises in various markets in the past (Kang & Ma, 2009; Bertaut et al. 2009). While inflated credit card bills may help with the shortterm revenue for credit card companies, it may hurt their longterm profitability if consumers chronically struggle to meet the payment and eventually default. Public policymakers all around the world have collaborated with the private sector to help consumers better manage their credit to tackle the issue (see the case of Canada, Trites et al. 2013, and South Korea, Lee & Yoon, 2011).

Reasons for such credit card effect were explored in other studies. Using credit cards weakened memories of past expenses (Feinberg, 1986; Raghurir & Srivastava, 2008; Soman, 2001), and thus, consumers underestimated past spending when contemplating future expenses. On the other hand, consumers who used checks or cash were more likely to remember expenses, and these memories made them more vigilant about incurring future expenses. In short, feedback or reminders of the previous spending mitigated the credit card effect (Soman, 2001).

Given the robustness of such effects, an innocuous mobile transaction reminder intended for fraud prevention of credit card use may result in an unintended effect. That is, by strengthening

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the memory trace of past spending, consumers may regulate their spending (Soman, 2001): As a result, they decrease the credit card use. On the contrary, the very fact of receiving the message may encourage consumers to slack in mental record keeping [ref], resulting in an increased credit spending. This may have different profitability outcomes for the credit card service providers as well as policymakers who endeavor to help mitigate problematic behaviors of consumer public (i.e., overspending caused by credit card use).

In recent years, measures designed to influence consumers' behavior and improve company's profitability as well as public welfare without incurring much monetary cost have been gaining much traction (Chen et al. 2017, Halpern, 2016).<sup>1</sup> Such measures are popularly referred to as "nudges" (Thaler & Sunstein, 2008), a behavioral intervention to prevent undesirable actions and encourage beneficial behaviors of public in general. Typically, a nudge has the following features: it does not (1) use coercion, (2) limit choices, or (3) significantly alter economic incentives (Benartzi et al. 2017; Thaler & Sunstein, 2008). Additionally, often the objectives of nudge are subtly displayed, as in the case of donation default nudges (Goswami & Urminsky, 2016) or salience (or "reminder") nudges of emphasizing the opportunity cost of not

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<sup>1</sup> Lately, many governments have embraced behavioral research to achieve public policy goals and formed agencies to develop and implement proper interventions (Halpern, 2016; Thaler & Sunstein, 2008). The Behavioral Insights Team in the U.K. and the Impact and Innovation Unit in Canada are examples (Chen et al. 2017).

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performing some actions (Thunström et al. 2018).

In the context of reminder nudges, simply sending reminder text messages was shown to significantly increase contributions to pensions or savings accounts (Karlan et al. 2016) or improve loan repayment rates (Cadena & Schoar, 2011) of well-intentioned people. Similar ideas have been tested in other areas, such as financial protection (Campbell et al. 2011), public health (Krishna et al. 2009), public education (Damgaard & Nielsen, 2018) and environmental protection (Byerly et al. 2018).

In our context, we examined the effect of transaction reminders in South Korea as a form of behavioral intervention. To be more specific, in 2010, credit card companies implemented the transaction reminder program under the recommendation of financial policymakers. The transaction reminder service sent text alerts to consumers shortly after each credit card transaction. The intent in informing consumers through push notifications was twofold— to encourage judicious use of credit cards and to prevent fraudulent use (Lee & Yoon, 2011). That is, the use of transaction reminder service was expected to help consumers monitor their credit card spending, control credit card balances, and prevent excessive credit card debts. While not all heavy credit card users were over-spenders, those who abused credit cards tended to have large spending. If the intervention worked as policymakers intended, the overall effect of the intervention would be a decrease in average spending. Thus, we evaluated whether the

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intervention indeed led to an overall decrease as intended.

Our empirical findings showed that the intervention did not result in the expected outcome of decreasing credit card spending but rather achieved an opposite outcome. Credit card spending increased on average after transaction reminders were sent. However, deeper analyses demonstrated that those who increased spending had been spending less before the intervention, and consumers who had been spending more historically did not increase their card use as much. These findings suggest that interventions may not have the desired effect on the target public and may even lead to an opposite outcome for consumers at large.

Among many possible drivers, we found that digital memory delegation to be the most likely and well-supported one. We conjectured that unlike rehearsing expenses through physically writing them down (Soman, 2001), receiving messages through a digital device provided consumers with a reliable way to automatically record credit card spending. This, in turn, would encourage otherwise meticulous consumers to relegate budget keeping to an external device (Sparrow et al. 2011). While we did not have the direct measurement of consumers' cognitive process to test our conjecture, much indirect evidence and alternative explanations being ruled out supported that it was the most plausible driver of the observed phenomena.<sup>3</sup>

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<sup>3</sup> To explore and rule out alternative explanations, we conducted a survey in December 2018 on 370 credit card users who matched the experimental conditions. We did not find significant differences between heavy and non-heavy users. Jeanne Kim is Assistant Professor, IE Business School, IE University, Spain (email: jeanne.kim@ie.edu). Yeohong Yoon is a graduate student, Goizueta Business School, Emory University, USA (email: yeohong.yoon@emory.edu). Jeonghye Choi (corresponding author) is Professor of Marketing, School of Business, Yonsei University, South Korea (email: jeonghye@yonsei.ac.kr). Hang Dong is Assistant Professor, IE Business School, IE University, Spain (email: hang.dong@ie.edu). Dilip Soman is Canada Research Chair in Behavioural Science and Economics, Rotman School of Business, University of Toronto, Canada (email: Dilip.Soman@rotman.utoronto.ca).

Our study contributes to the relevant literature in the following ways:

1. We showed that the reminding method (i.e., text messages) played a critical role in the outcome of behavioral intervention regarding the “credit card” stream of research. Specifically, consumers increased (not decreased) their spending upon receiving transaction reminders.
2. Consumers showed heterogeneous responses: medium to light spenders increased spending while heavy spenders did not.
3. We suggested and indirectly tested a potential driver: the use of digital devices demotivated consumers from keeping track of their credit card spending and thus resulted in increased spending.

The rest of this paper is divided into five sections. We first reviewed the related literature on credit card and reminder effects. Second, we provided details on our data and variables and offered model-free evidence. Third, we described methodology, including propensity score matching (PSM) and difference-in-differences (DID) models. Fourth, we presented our empirical findings as well as additional analyses to deepen our understanding of the phenomena. Lastly, we

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heavy spenders on changes in their level of loyalty or payment method switching before and after receiving transaction reminders. These findings rule out alternative drivers such as increased loyalty due to receiving messages or change of payment methods from cash to credit cards. See Section E of the Web Appendix for more details.

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discussed key findings and potential mechanisms and concluded with recommendations.

## **LITERATURE REVIEW**

### **The Credit Card Effect**

Our interest in the transaction reminders as a behavioral intervention tool stemmed from the recommendation made in 2010 by Korean authorities to all credit card companies to provide transaction reminder services to consumers. A transaction reminder was a text message sent to consumers via push notification on a mobile phone every time they used credit cards, regardless of the amount spent. The purpose of this intervention was twofold: to help consumers better monitor their spending and allow early detection of fraudulent use (Lee & Yoon, 2011).

Previous studies showed that using credit cards to pay (instead of cash or checks) induced overspending, referred to as the credit card effect (Feinberg 1986; Hirschman, 1979). All things being equal, credit cards might lead to overspending of about 30% over other payment methods. Three potential explanations were proposed. First, using credit cards removed liquidity constraints; thus, consumers could afford higher ticket items (Watkins, 2000). Second, consumers enjoyed consumption more and suffered pain of payment less because of the decoupling of consumption and payment (Prelec & Loewenstein, 1998), which led to overspending. Third, using credit cards made it harder for consumers to remember past

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transactions, inducing them to overestimate available resources and subsequently exceed their budgets (Soman, 2001).

Given the imperfect recall of credit card transactions, reminders could be used as a means of a behavioral intervention to curb overspending. Previous works showed that when consumers were asked to rehearse their credit card spending by writing down the amount spent after each transaction, they later spent less overall because of the mental salience of past transactions or mental budgeting (Soman, 2001). Mental budgeting is a form of mental accounting pertaining to a set of cognitive activities to organize and keep track of personal financial activities (Thaler, 1999). Thus, reminders were especially effective for mental budgeting of discretionary expenses where consumers had more flexibility with budgets (Heath & Soll, 1996; Soman, 2001).

The findings from previous research, on the one hand, suggested that if the reminders of credit card transactions truly helped consumers better recall spending, they would lead to better mental budgeting, more prudent planning and subsequent lower spending, as in the case of Soman's (2001) pencil-and-paper reminders decreasing future spending of the same expense category. On the other hand, mental budgeting was a cognitively demanding task since consumers tracked expenses by comparing spending against proportioned budgets in mental accounts (Heath & Soll, 1996). Any condition to do less of it might lead to less mental budgeting, as in the case of too much decision support leading to less cognitive effort and

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suboptimal decisions (Tan et al. 2010). We investigated which scenario was more likely at work in our setting.

### **The Reminder Effect**

Previous research demonstrated that reminders texted or emailed to consumers significantly affected consumers' financial decisions in various domains. Specifically, a few studies examined the effectiveness of text reminders in terms of content, timing, context and framing. For instance, Karlan et al. (2012) showed that messages containing loan officers' names increased rates of loan repayments; Karlan et al. (2016) found that reminders help consumers stick to saving goals. These reminders, however, also had the potential to result in unintended side effects (Roberts 2017). Medina (2021) showed that because of the limited attention spans of consumers, reminders for one financial obligation (e.g., late payment fees for credit card usage) might negatively impact the management of another (e.g., account overdraft fees). Damgaard and Gravert (2018) found that although email reminders boosted the number of charitable donations, they also induced unsubscribing from the mailing list. Thunström et al. (2018) tested the effect of reminding consumers of the opportunity costs to regulate their spending. They found that such reminders could backfire: low spending consumers who should spend more reduced their spending, whereas spendthrifts who should spend less were unaffected.

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The studies above examined infrequent and highly noticeable reminders that prompted specific actions. In contrast, the transaction reminders studied in our context were trivial, uninformative and frequent. Moreover, because reminder messages of credit card transactions could be considered salience nudging (Thunström et al. 2018) owing to their value-neutral content, our study can be considered an investigation of the unintended side effects of nudging reminders. Given the frequency with which transaction reminders arrived and given the lack of specific “follow-up” actions that consumers needed to take, inferences drawn from similar patterns of behavioral outcomes found in prior studies may provide misleading insights. Thus, we examined the unexplored effect of ambient and numerous reminders associated with low-risk outcomes with the aim to offer new insights into the reminder effect.

### **Heterogeneity in the Transaction Reminder Effect**

The reminder in our setting may have distinct implications for private and public sectors. Credit card issuers in private domain may not welcome the implementation of reminder if it leads to an immediate revenue decrease. Public policy makers may welcome a subtle intervention that improve consumers’ welfare through spending regulation. However, if the intervention targets only those high at risk, it may spell a good news for all parties involved.

Public policies and interventions were often designed to target the parts of a population

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deemed most vulnerable to specific perils (Hawkins et al. 1992). As such, the measures that selectively affected at-risk groups contributed more to public welfare (Khan et al. 2015). In our setting, the implementation of transaction reminders better served the purpose of policymakers if it helped over-spenders monitor spending more than it helped moderate spenders. If it helped overspenders selectively, it may also benefit private credit card issuers in the long term by reducing the instance of default by such at-risk customers.

Consumers nowadays rely on digital devices to record information and remember activities (Loh & Kanai, 2016; Sparrow et al., 2011), leading to worse recall than what would occur without digital devices. For instance, the readers of an online version of a magazine remembered less of its content than readers of a printed version (Magee, 2013). Mobile phone use during shopping trips distracted shoppers, resulting in more unplanned purchases (Grewal et al. 2018; Hui et al. 2013). Applied to our setting, receiving transaction reminders on mobile phones might have undermined consumers' motivation to remember credit card spending (unlike in Soman's 2001 study in which subjects used pencil and paper to record transactions).<sup>4</sup> Consumers were aware that the text messages were automatically stored in their devices and kept as transaction

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<sup>4</sup> Soman (2001) notes that credit card use results in temporal memory reallocation in that consumers delay recall of expenses until they check their monthly bills. Similarly, receiving reminders via push notification on mobile phones may lead to digital memory delegation in which consumers delay recall until a need arises.

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records if they needed to refer to them. As a result, these reminders may have disincentivized consumers from further mental budgeting and consequently increased spending instead of decreasing it. We call this the digital memory delegation effect.

The digital memory delegation effect should be more pronounced for consumers previously willing and able to do mental budgeting. Consumers systematically differed in terms of their capacity for mental budgeting; that is, their capability and willingness to do mental budgeting. With the implementation of transaction reminders, the effect of digital memory delegation should be greater for those who were more engaged in mental budgeting previously than those who had little willingness and ability.

As a personal tendency, highly impulsive people did less mental budgeting (Antonides et al. 2011) and spent more. In a similar vein, mental budgeting was often used as a self-control mechanism by those motivated to regulate spending (Cheema & Soman, 2006). Low income was related to more mental budgeting because limited resources motivated better mental planning (Antonides et al. 2011). In terms of behavioral indicators, larger monthly bills were associated with less mental budgeting, everything else being equal. This was because of (1) the greater difficulty consumers had in keeping mental track of individual expenses when bills contain a large number of items and (2) the less motivation to keep track of spending because of less consciousness to spending limits (Stango & Zinman, 2009). For example, bills containing

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numerous petty cash items were indicative of little mental budgeting because these expenses regularly escaped consumers' scrutiny (Thaler, 1999; Gourville, 1998).

In our study, we considered one behavioral indicator, past spending, as a good proxy for the amount of mental budgeting.<sup>5</sup> First, less spending was associated with low transaction frequency, which posed less cognitive load. Everything else being equal, lower spending should be associated with a higher ability for mental budgeting (Muehlbacher & Kirchler, 2019). Second, more spending was the indication of lower motivation to do mental budgeting. (Sotiropoulos & d'Astous, 2020; Heath & Soll, 1996). In sum, we assumed that higher past spending amount was associated with less mental budgeting and vice versa, leading to the heterogeneous effects of transaction reminders from credit card users.

## **DATA, VARIABLES AND MODEL-FREE EVIDENCE**

### **Market Context and Data**

Our research setting was the implementation of the transaction reminder service in 2010 by credit card companies acting on the recommendation of the South Korean government. Although the increase in household debt because of the use of credit cards was not unique to Korea, certain

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<sup>5</sup> We thank the anonymous reviewer who helped us define and operationalize the concept of mental budgeting.

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situational factors there aggravated the problem. In an effort to speedily recover from the Asian financial crisis of the late 1990s, the Korean government approved a series of leniency measures to boost the economy, such as tax benefits for using credit cards and dramatic deregulation of card issuers (Kang & Ma, 2009). Because of these sudden and ill-advised policies, household debt soared. By 2003, 16% of the economically active population in Korea had defaulted on the credit card obligations (Choe, 2007), and the largest credit card company was driven to near bankruptcy (Len, 2003). In response, policymakers instituted various programs to help consumers better manage their credit. These included hard measures such as raising the minimum capital ratio for credit card companies and banning aggressive marketing practices (Kang & Ma, 2009). In addition to regulatory actions, the Korean government and credit card companies collaborated on the use of subtler behavioral interventions. We investigate the effectiveness of one such effort, the transaction reminder service implemented in June 2010.

As noted earlier, the transaction reminder service was designed to inform consumers of their credit card spending through reminder texts sent to their mobile phones as push notifications immediately after each transaction. The content of each text includes the last four digits of the card number, purchase amount, date and time of purchase and the name of the retailer.<sup>6</sup> To

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<sup>6</sup> The reminder service started including cumulative spending in September 2012 (Lee and Yoon, 2011). Our data do not cover this period. However, because of the way payment dates are handled, it is highly likely consumers still Jikyung (Jeanne) Kim is Assistant Professor, IE Business School, IE University, Spain (email: jeanne.kim@ie.edu). Yeohong Yoon is a graduate student, Goizueta Business School, Emory University, USA (email: yeohong.yoon@emory.edu). Jeonghye Choi (corresponding author) is Professor of Marketing, School of Business, Yonsei University, South Korea (email: jeonghye@yonsei.ac.kr). Hang Dong is Assistant Professor, IE Business School, IE University, Spain (email: hang.dong@ie.edu). Dilip Soman is Canada Research Chair in Behavioural Science and Economics, Rotman School of Business, University of Toronto, Canada (email: Dilip.Soman@rotman.utoronto.ca).

encourage the use of the transaction reminder service, the credit card companies called credit card users when they launched the service to solicit their enrollment in what was essentially a free service. The companies charged a nominal \$0.25 a month, and even this small amount was often financed by points accumulated in a loyalty program.<sup>7</sup> The reminder function was also accompanied by immediate and practical benefits such as early fraud detection and transaction record-keeping, making the service attractive for consumers. Note that the data provider did not have any records of the reasons why some consumers did not sign up for the service.<sup>8</sup> We addressed any potential bias arising from such omission by using the PSM strategy (Datta et al. 2018; Rishika et al. 2013) and conducting Rosenbaum's sensitivity analyses (Bapna et al. 2016).

We obtained consumer transaction data from one of the five leading credit card companies in South Korea.<sup>9</sup> The observation period was 13 months (from December 2009 to December 2010), covering the six months before the launch of the service, the month of its launch in June 2010, and six months after its launch. One thousand users were randomly sampled from a pool of

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have difficulty in tracking their balances, giving further support to our findings. See Figure 1 for an illustration of a typical transaction reminder message.

<sup>7</sup> All customers were automatically signed up to the loyalty program of credit card brands as part of the contract. We thank an anonymous reviewer for suggesting to clarify this point.

<sup>8</sup> The reasons may have been related to the treatment effect (e.g., is busier and less accessible, intend to use the credit card more in the future) or unrelated (e.g., in a meeting, left home without the phone). Also, note that management confirmed that only a few users signed up online after missing the solicitation call.

<sup>9</sup> The credit card company remained anonymous. It had about a 20% market share at the time of data collection.

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consumers who signed up (the treatment group) and another 1,000 from a pool of consumers who did not (the control group).<sup>10</sup> Thus, our initial data consisted of 2,000 credit card users. Transaction data included amount spent, date of transaction, product category and whether the amount is to be paid in full or in installments. Demographic information included age, gender, occupation, and the city of the billing address. We eliminated consumers who did not use their credit cards for more than three consecutive months and those who used credit cards only to pay bills through standing orders. After eliminating the under-users, we were left with the full data of 1,704 users.<sup>11</sup>

## Variables

The main outcome variable was weekly spending of user  $i$  in week  $t$ ,  $Spending_{it}$ . To capture the reminder effect, we constructed two indicator variables for the treatment group and the post-reminder period,  $TR_i$  and  $Post_t$ , respectively. We further divided the post-reminder period by using three indicator variables for the launch month and the subsequent first and second quarters,  $PostMI_t$ ,  $PostQ1_t$  and  $PostQ2_t$ , respectively. That is,  $PostMI_t$  corresponded to the launch month

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<sup>10</sup> Samples were taken only from the group of customers who had joined at least one year previous to the implementation of the transaction reminder.

<sup>11</sup> We also followed Rego et al. (2013) in dealing with other anomalies. We winsorized the data at the top 0.1% of the transaction value (\$1,712.75) to ensure that extreme observations did not drive our results.

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of June 2010,  $PostQ1_t$  to July–September 2010 and  $PostQ2_t$  to October–December 2010.

[Insert Table 1 about here]

We constructed additional variables as a moderator and controls in the main analyses. As we argued previously, we considered the credit card bill size for the previous month to be a good indicator of the amount of mental budgeting. Thus, we used credit card spending in the preceding month of week  $t$ ,  $PastBillSize_{it}$  as the main moderator. The product categories were as follows: housing, medical, clothes, dining, shopping, leisure, and others. Using the Herfindahl-Hirschman index,  $PastCategoryDiversity_{it}$  was computed as one minus the squared sum of the category shares of spending in the preceding month of week  $t$ .  $PastInstallmentWeight_{it}$  is the proportion of spending to be paid in installments in the preceding month of week  $t$ .

Additional variables were constructed to provide initial evidence of the reminder service and to include in PSM, including  $BillSize_{it}$ ,  $CategoryDiversity_{it}$  and  $InstallmentWeight_{it}$  using credit card spending in the month of week  $t$ . We also decomposed monthly spending into purchase frequency ( $TransFreq_{it}$ ) and average spending per purchase ( $TransAmount_{it}$ ) to reflect the shopping frequency and the basket size. Among the six product categories, the first three categories (housing, medical and clothes) were classified as necessity spending and the next three (dining, shopping and leisure) as discretionary spending. To reflect the difference between the two types of spending, we created  $DiscretionaryWeight_{it}$ , indicating the proportion of the

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amounts spent in discretionary categories. *BillTrend<sub>i</sub>* captured the spending pattern leading up to the service launch, computed as the log difference in spending between the two quarters preceding the launch (Shi et al. 2017).

Variables to capture demographics were as follows. *Age<sub>i</sub>* was user *i*'s chronological age and *Retiree<sub>i</sub>* was those of retirement age, which was 55 in Korea at the time of data collection. *Gender<sub>i</sub>* equaled 1 for females and 0 otherwise. Although users' income was not directly observed, we identified three tiers of income based on their occupations. Specifically, *HighEarner<sub>i</sub>* indicated members of high-income occupation groups such as lawyers, doctors, conglomerate employees and business owners; *MidEarner<sub>i</sub>* identified those in the next tier, including government officials, employees of state-owned companies, educators and employees of middle-sized companies, and the lowest tier constitutes the baseline. *UrbanResident<sub>i</sub>* indicates billing addresses in urban areas.

### **Model-Free Evidence: Pre- and Post-Reminder Spending**

We began by exploring spending behavior using the full data of 1,704 users without the use of empirical models. Table 2-A displayed both summary statistics of the variables and basic evidence of the reminder service. The treatment group spent, on average, about 30% more monthly than the control group throughout the observation period, hinting that reminders might

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have created an upward shift in monthly credit card usage. When broken down to the pre- and post-reminder periods (Table 2-B), two interesting points emerged. First, the averages of the control and treatment groups in the pre-reminder period (i.e., \$499 vs. \$605) differed significantly. This systematic difference in both groups was to be addressed by matching samples to eliminate observed differences across groups. Second, in terms of differences before and after the implementation within each group, there was no significant shift in spending for the control group (\$499 vs. \$508), but the difference in the treatment group was considerable (\$605 vs. \$699). This model-free evidence demonstrated that there was a noticeably large impact of transaction reminders on credit card usage even before applying formal analyses.

[Insert Table 2 about here]

## **METHODOLOGY**

Given the research setting, we aimed to examine (1) the effect of the reminder service on credit card usage, (2) potential mechanisms by testing the moderating effect of past spending behavior and (3) whether such effects were of short or long duration. Before moving on to models, we used the PSM strategy to address any potential bias because of the non-random assignment.

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### Mitigating Self Selection Issue

Our full data (of 1,704 users) was subject to the potential issue of endogeneity in the selection process because of the non-random assignment (Meyer, 1995). Those who signed up for the reminder service might have been likely to spend more in the future regardless of receiving reminder texts, leading to a self-selection problem. As with previous studies that used similar settings (Datta et al. 2018; Jo et al. 2020), we performed Inverse Probability Treatment Weighting (IPTW) combined with DID models to alleviate this problem. The idea behind the IPTW procedure was use a 'synthetic' IPTW sample that balances the observed covariates between the treated and control groups (Giorcelli 2019; Zhang et al. 2021). Specifically, we estimated a logit model to compute treatment probability using an extensive list of observable variables to control for related tendencies and assigned weights for each spender. Thus, PSM helped approximate a randomized experiment setup closely (Rishika et al. 2013; Bakhtiari et al. 2013).<sup>12</sup>

[Table Comparison needs to be added later]

All notable discrepancies between the two groups across the observed variables before matching became insignificant after IPTW; this outcome indicated that we had two groups that

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<sup>12</sup> Bias might have still remained after the PSM procedure if there were unobserved variables that correlated with the treatment process. We discussed this remaining potential issue in the *Rosenbaum's Sensitivity Analyses* section. Jikyung (Jeanne) Kim is Assistant Professor, IE Business School, IE University, Spain (email: jeanne.kim@ie.edu). Yeohong Yoon is a graduate student, Goizueta Business School, Emory University, USA (email: yeohong.yoon@emory.edu). Jeonghye Choi (corresponding author) is Professor of Marketing, School of Business, Yonsei University, South Korea (email: jeonghye@yonsei.ac.kr). Hang Dong is Assistant Professor, IE Business School, IE University, Spain (email: hang.dong@ie.edu). Dilip Soman is Canada Research Chair in Behavioural Science and Economics, Rotman School of Business, University of Toronto, Canada (email: Dilip.Soman@rotman.utoronto.ca).

had statistically equal chances of being assigned to the treatment group before the service implementation.

[Insert Table 3 about here]

We revisited the model-free investigation of spending behavior by using the matched data in Table 4. Table 4-A showed summary statistics across the pre- and post-reminder periods, and Table 4-B presented differences in spending in both groups caused by the reminder service. Recall that the PSM procedure ensured that the control and treatment groups were as similar as possible before the treatment based on observed variables. As such, in the pre-reminder period, the treatment group presented closely matched monthly spending behavior with respect to the control group (\$607 vs. \$578). When the pre- and post-differences in spending of both groups were compared, a significant difference emerged only in the treatment group (\$578 vs. \$678). Put differently, model-free computation of differences in spending between both groups remained substantial, roughly around 20%, suggesting a significant effect of the reminder.

[Insert Table 4 about here]

### **Difference-in-Differences (DID) Models**

We measured a “difference in differences” (DID) in spending behavior between the treatment and control groups *after* controlling for confounding factors (cross-sectional as well as

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temporal) by using empirical models. Tobit regression is repeatedly used throughout the analyses to reflect that some users did not spend any money in a certain week or in a certain category. We began by estimating a baseline DID model to measure the average effect of the reminder service and then built up additional terms to assess the moderating role of past behavior and the long-term effect of the reminder service.

The baseline model, Model 1, contained the term that measured the average effect of receiving transaction reminders on weekly spending.

$$(1) \quad \textit{Spending}_{it} = \beta_{11} \cdot \textit{TR}_i \cdot \textit{Post}_t + \boldsymbol{\theta}_1 \cdot \textit{Controls}_{it} + \varepsilon_{it}$$

where  $\textit{Spending}_{it}$  was modeled in log form to account for the skewness.<sup>14</sup> As explained earlier,  $\textit{TR}_i$  was a dummy indicating whether user  $i$  belonged to the treatment group, and  $\textit{Post}_t$  indicated whether month  $t$  belonged to the post-reminder period. To capture the main reminder effect,  $\beta_{11}$  measured the differential in spending between the pre- and post-reminder periods of users in the treatment group and contrasted that with the differential in the control group.  $\textit{Controls}_{it}$  consisted of various control variables, including the past values of spending-related behavior:

$\textit{PastBillSize}_{it}$ ,  $\textit{PastCategoryDiversity}_{it}$ , and  $\textit{PastInstallmentWeight}_{it}$ . Individual and weekly fixed

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<sup>14</sup> We conducted the same analyses without log-transformation of the dependent variable. Both the main and moderating effects remained consistent, suggesting that our findings were not an artifact of variable transformation. We thank the anonymous reviewer for this suggestion.

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effects were included as controls to minimize biases caused by any unobserved individual and temporal heterogeneity. Finally, we clustered the error terms at the individual level to further control for heteroscedasticity and serial correlation (Bertrand et al. 2004).

We investigated whether the mechanism behind the reminder effect was related to mental budgeting. We conjectured that because text reminders would affect how consumers remembered card transactions, the magnitude of the reminder effect should be affected by the amount of credit card use (Antonides et al. 2011).

(2)  $Spending_{it}$

$$= \beta_{21} \cdot TR_i \cdot Post_t + \beta_{22} \cdot TR_i \cdot Post_t \cdot PastBillSize_{it} + \theta_2 \cdot Controls_{it} + \varepsilon_{it}$$

In Model 2, we tested this potential mechanism by using the amount of spending in the previous month ( $PastBillSize_{it}$ ) (Gilbride et al. 2015; Jo et al. 2020).

The interaction term  $TR_i \times Post_t$  was further interacted with  $PastBillSize_{it}$ , allowing  $\beta_{22}$  to capture the moderating effect of  $PastBillSize_{it}$  on the main reminder effect.<sup>15</sup>  $Controls_{it}$  included the corresponding lower-order interaction terms in addition to those in Model 1.

Model 3 examined the long-term effect of the reminder service. If the effect of transaction

---

<sup>15</sup> Alternative proxies were tested instead of  $PastBillSize_{it}$ . These included past values of purchase frequency, spending diversity across categories, variance in purchase amounts, and proportion of installment. All four additional proxies produced consistent results. See Sections A and B of the Web Appendix for detailed explanations of each variable and their corresponding estimation results.

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reminders was short-lived, policymakers could not expect this measure to have a meaningful impact on consumers' behavior. As described earlier, the post-reminder period was divided into three parts: the launch month ( $PostM1_t$ ) and the subsequent first and second quarters ( $PostQ1_t$  and  $PostQ2_t$ ). Each indicator variable was interacted with  $TR_i$ . Here,  $\beta_{31}$  captures the short-term reminder effect immediately observed in the launch month, whereas  $\beta_{32}$  and  $\beta_{33}$  capture the reminder effects, if any, for up to six months beyond the launch month.

$$(3) \quad \begin{aligned} Spending_{it} = & \beta_{31} \cdot TR_i \cdot PostM1_t + \beta_{32} \cdot TR_i \cdot PostQ1_t + \beta_{33} \cdot TR_i \cdot PostQ2_t \\ & + \theta_3 \cdot Controls_{it} + \varepsilon_{it} \end{aligned}$$

Finally, in Model 4, we investigated whether the potential mechanism was also persistently at work over long periods. That is, we asked if mental budgeting (proxied by past spending amount) affected the reminder effect on purchase decisions long after the shock of the service launch had passed. In Model 4,  $\beta_{41}$  through  $\beta_{43}$  captured the time trend of the baseline reminder effect in the post-reminder period.  $\beta_{44}$  through  $\beta_{46}$  captured the time trend of the moderating effect of past spending on the main effect.  $Controls_{it}$  included all other control variables and the remaining lower-order interactions.

$$(4) \quad \begin{aligned} Spending_{it} = & \beta_{41} \cdot TR_i \cdot PostM1_t + \beta_{42} \cdot TR_i \cdot PostQ1_t + \beta_{43} \cdot TR_i \cdot PostQ2_t \\ & + \beta_{44} \cdot TR_i \cdot PostM1_t \cdot PastBillSize_{it} + \beta_{45} \cdot TR_i \cdot PostQ1_t \cdot PastBillSize_{it} \end{aligned}$$

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$$+\beta_{46} \cdot TR_i \cdot PostQ2_t \cdot PastBillSize_{it} + \theta_4 \cdot Controls_{it} + \varepsilon_{it}$$

Using the matched data of treatment and control groups, we estimated Model 1 through Model 4. Throughout the estimation procedure, we ensured that the main reminder effect, as well as the moderating effect of past spending, remained robust and consistent.

## EMPIRICAL FINDINGS

In this section, we first detailed our application of the DID models to the matched data in our investigation of the effect of the transaction reminder service on credit card spending. We then discussed potential mechanisms behind the transaction reminder effect. Next, we assessed how the effect differed for necessity and discretionary spending. Finally, we addressed the potential issue of selection bias because of unobserved variables, examined boundary conditions, and provided the results of robustness analyses.

### Estimation Results

Table 5 shows the estimation results of Models 1 through 4. The terms capturing the main reminder effect were positive and significant across the models ( $\beta_{11} = .244$ ,  $p < .01$ ;  $\beta_{21} = 1.810$ ,  $p < .01$ ;  $\beta_{31} = .447$ ,  $p < .01$ ;  $\beta_{41} = 3.247$ ,  $p < .01$ ), demonstrating that receiving transaction reminders increased weekly card spending. The change in magnitude was substantial, measuring

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about 20% across different models. In Model 2, the moderating effect of past spending amounts was negative and significant ( $\beta_{22} = -.267$ ,  $p < .01$ ) in support of our prediction that the reminder effect was related to past spending. The signs and magnitudes of  $\beta_{21}$  and  $\beta_{22}$  in Model 2 together implied that while the primary reaction to receiving reminders was an increase in weekly credit card spending, this effect became weaker as the past spending increased. In other words, those who had used credit cards heavily before receiving reminders did not increase spending after receiving as much as those who had little spending before. We also applied mean-centering to interactions in the model, and the results were qualitatively consistent.

[Insert Table 5 about here]

Recall that in Models 3 and 4, the post-reminder period was divided into three parts to measure the progression of the reminder effect. The reminder effect stayed consistently positive and significant not only in the launch month but also the subsequent two quarters ( $\beta_{31} = .447$ ,  $p < .01$ ;  $\beta_{32} = .171$ ,  $p < .01$ ;  $\beta_{33} = .187$ ,  $p < .01$ ;  $\beta_{41} = 3.247$ ,  $p < .01$ ;  $\beta_{42} = 1.259$ ,  $p < .01$ ;  $\beta_{43} = 1.483$ ,  $p < .01$ ), indicating the increased spending after receiving reminders was significant and persistent over the seven-month post-reminder period. Moreover, the reminder effect was largest in the launch month and then exhibited positive, albeit smaller, upward shifts afterward.

In Model 4, the terms capturing the impact of past spending were interacted with the indicators of time periods to test whether the heterogeneity of the reminder effect was maintained

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over time. The results showed that indeed, past monthly bills negatively moderated the increase in weekly spending after transaction reminder services, and this pattern was persistent ( $\beta_{44} = -.478, p < .01$ ;  $\beta_{45} = -.187, p < .01$ ;  $\beta_{46} = -.222, p < .01$ ). As in the results of Models 2 and 3, the signs and magnitudes of estimates of  $\beta_{41}$  through  $\beta_{46}$  implied that top spending consumers reduced their spending after the service launch and this effect was sustained for long periods.

At first glance, the positive transaction reminder effect on average might seem unexpected and unfavorable from a policy standpoint. The service produced an unintended consequence for consumers overall because it encouraged them to spend more. However, the moderating effect of past spending behavior indicates that this reminder effect was not uniform across all consumers. To illustrate, we identified light, average and heavy spenders as those who are at the first, second and third quartile (25, 50 and 75%, respectively) according to their past monthly bills before reminders and computed their estimates ( $\beta_{q1}$ ,  $\beta_{q2}$  and  $\beta_{q3}$ ) of the reminder effect based on Model 2. The estimates for the light and average spenders were sizeable ( $\beta_{q1} = 0.419$  and  $\beta_{q2} = 0.199$ ) while the heavy spender's estimate became notably smaller ( $\beta_{q3} = 0.020$ ).<sup>16</sup>

This asymmetric effect of increased use for consumers who had historically spent less was not necessarily a red flag from a policy perspective. Those who used to have larger bills and

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<sup>16</sup> We computed the change in spending for those whose past bill size was at 25%, 50% and 75% levels based on Model 2 estimates and the resulting figures were 52.0%, 22.2% and 2.2%.

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might be at greater risk were, at least, not encouraged to spend more.<sup>17</sup> In fact, past studies in public policies showed that interventions that selectively affected groups contributed more to public welfare (Khan et al. 2015; Hawkins et al. 1992). In our context, the heterogeneous effect of the intervention indicates that targeted consumers were relatively unaffected, and the unexpected outcome from non-targeted consumers required reassessment.

### **Potential Mechanisms Behind the Transaction Reminder Effect**

As mentioned earlier, prior research showed that the increase in spending via credit cards was in part because of imperfect recall of past spending (Feinberg, 1986; Hirschman, 1979; Prelec & Simester, 2001). When consumers were asked to rehearse their credit card expenses, they ended up spending less (Soman, 2001). This stream of research implied that the transaction reminder service would spur an overall decrease in spending. Counter to this expectation, our empirical findings showed that receiving transaction reminders through push notification on mobile phones increased credit card spending on average, suggesting these reminders did not consistently help consumers recall credit card transactions.

Our findings showed that this digital memory delegation effect (which drives an increase in

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<sup>17</sup> Use of credit cards in general promoted fluidity in commercial transactions and improved macroeconomic indices (Choe, 2007), and thus average spending consumers increasing card use would not be detrimental to their welfare if they were using their credit cards judiciously (Thunström et al. 2018).

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spending) would be intensified for those with lower monthly bills. Consumers vary in their capacity to do mental budgeting (Larson & Hamilton, 2012; Stillee et al., 2010). If the use of digital devices hindered mental budgeting, those who had been doing more of it would be affected asymmetrically more after they adopted the reminder service. In other words, the digital memory delegation effect would be greater for those previously engaged more in mental budgeting and subsequently lead to greater behavioral change. The mental budgeting capacity could not be directly observed from our data; however, the size of monthly bills could be a good proxy since larger monthly bills are associated with less mental budgeting, all else being equal (Thaler, 1999). In sum, larger bills would dampen the digital memory delegation effect in support of our potential mechanism.

The empirical evidence further demonstrated that this digital memory delegation effect was persistent. That is, the reliance on the reminder service by credit card users would be repeated and become a habit. Studies on the use of information technology (IT) purported that repeated IT use and its eventual evolution into habit formation critically depended on the ease of use and the usefulness of the technology (de Guinea & Markus, 2009; Kim & Malhotra, 2005). We evaluated the reminder service as extremely easy to use (i.e., passive acknowledgment of receipt is sufficient, and no reply is required) and useful (i.e., fraud detection). Thus, we expected consumers to persist in using it. Accordingly, the long-term effect observed in our result appealed

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to our intuition. Furthermore, the capacity for mental budgeting was shown to persistently impact the reminder effect over a longer timeline.

### **Category-Level Differences**

The literature on mental accounting emphasized that money used in different categories was treated differently (Sussman & Alter, 2012; Thaler, 1999). Specifically, the effect of changing contexts on spending manifested itself most clearly in accounts categorized as discretionary (or consumption flexible, Ailawadi & Neslin, 1998) such as leisure and shopping rather than in those considered necessities (or consumption inflexible) such as residential bills or health care (Soman, 2003). In our context, we proposed that the changes in responses to receiving transaction reminders owed more to changes in mental budgeting and less to careful financial consideration to change payment decisions for inflexible accounts. Thus, we expected to see the reminder effect more in categories of discretionary spending.

[Insert Table 6 about here]

As explained earlier, the six product categories were sorted according to whether they are necessities or discretionary, excluding un-assorted “others.” We used Model 2 in testing the effects in each category. Interestingly, the main reminder effect and the moderation effect by past spending were all significant for discretionary spending categories (i.e., dining, shopping and

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leisure) and insignificant for the necessity spending categories (i.e., housing, medical and clothes). This category-level difference demonstrated that digital memory delegation and the subsequent attenuation of mental budgeting were most prominent for those categories in which consumers had the flexibility to show behavioral change through a subconscious process (Krishnamurthy & Prokopec, 2010).<sup>18</sup> The results also provided additional support for our proposed mechanism.

### **Rosenbaum's Sensitivity Analyses**

Studies using observed data that were generated through any non-random assignment could be susceptible to an omitted variable bias even after applying the PSM strategy. The PSM used only observed variables and performed well when the selection process (e.g., signing up to the reminder service) was unrelated with the treatment effect (e.g., reacting to transaction reminders by the treatment vs. control groups). A selection bias might remain if variables related to the selection process were not used in the matching process (Datta et al. 2018). Following Rosenbaum's (2005) procedure, we conducted sensitivity analyses using our dependent variable,

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<sup>18</sup> Another evidence that mental budgeting was affected at the subconscious level is shown in the analyses of purchase frequency (*TransFreq<sub>it</sub>*) and average spending per purchase (*TransAmount<sub>it</sub>*) (see Section C of the Web Appendix). Table C.2 implied that consumers increased purchase frequency of similar products rather than purchase more expensive products, a pattern indicative of subconscious change in behavior.

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$Spending_{it}$ , to examine how robust the main findings were to the magnitude of the possible selection bias. The procedure and its results were in Section D of the Web Appendix. The results for weekly spending showed a threshold value ( $\Gamma$ ) of 1.40, meaning that for the results to be nullified, any selection bias must change the odds of assignment to the treatment group by at least 40%. Although no minimum value of  $\Gamma$  had been established for toleration of unobserved bias, 1.4 seemed an acceptable level in the management literature (Ransbotham et al. 2019). We concluded that our main findings were robust to the issue of correlated unobservables.

### **Boundary Conditions**

Knowing “for who, where and when” the potential mechanism operated was useful in enriching a theoretical understanding of phenomena (Busse et al. 2017). Accordingly, we tested some boundary conditions in which the mechanism behind the transaction reminder effect was augmented, diminished or unaffected. In this line of investigation, we included additional effects of the following two variables to the full data: whether user  $i$  was a retiree ( $Retiree_i$ ), and to which income tier she belonged ( $HighEarner_i$  and  $MidEarner_i$ ). Table 7 presents the estimation results. We also discussed findings obtained from a simple consumer survey.

[Insert Table 7 about here]

First, we posited that past spending was less likely to moderate the reminder effect on Jikyung (Jeanne) Kim is Assistant Professor, IE Business School, IE University, Spain (email: jeanne.kim@ie.edu). Yeohong Yoon is a graduate student, Goizueta Business School, Emory University, USA (email: yeohong.yoon@emory.edu). Jeonghye Choi (corresponding author) is Professor of Marketing, School of Business, Yonsei University, South Korea (email: jeonghye@yonsei.ac.kr). Hang Dong is Assistant Professor, IE Business School, IE University, Spain (email: hang.dong@ie.edu). Dilip Soman is Canada Research Chair in Behavioural Science and Economics, Rotman School of Business, University of Toronto, Canada (email: Dilip.Soman@rotman.utoronto.ca).

retirees. All else being equal, retirees have a higher motivation to keep track of their spending (Thaler, 1999; Bernheim et al. 2001) and would likely have been performing comparatively greater amount of mental budgeting than non-retirees regardless of the past bill sizes. As expected, the empirical result demonstrated that the past spending amount effect was not significantly moderated by past bill size in the case of retirees, suggesting the equal effect of transaction reminders among retirees regardless of past spending amount. This finding made a case for a life stage as a boundary condition for past spending in moderating the treatment effect.

Second, we attempted to address possible confounding factors for the past spending effect. It was quite likely that consumers who used credit cards excessively did not have room for increasing because of limited funds, not because of any mental budgeting at play. If such a “spending ceiling” is at work, income levels should further moderate the role of past spending amounts. That is, consumers with low incomes were less likely to increase their card use after the service launch, but high-income consumers were capable of increasing their spending. However, Table 7 showed that income levels did not moderate the past spending effect; this implied that a spending ceiling was not a critical factor in dampening the treatment effect for big spenders.

### **Robustness Analyses**

We conducted robustness analyses to ensure the consistency of the empirical results. We first Jikyung (Jeanne) Kim is Assistant Professor, IE Business School, IE University, Spain (email: jeanne.kim@ie.edu). Yeohong Yoon is a graduate student, Goizueta Business School, Emory University, USA (email: yeohong.yoon@emory.edu). Jeonghye Choi (corresponding author) is Professor of Marketing, School of Business, Yonsei University, South Korea (email: jeonghye@yonsei.ac.kr). Hang Dong is Assistant Professor, IE Business School, IE University, Spain (email: hang.dong@ie.edu). Dilip Soman is Canada Research Chair in Behavioural Science and Economics, Rotman School of Business, University of Toronto, Canada (email: Dilip.Soman@rotman.utoronto.ca).

established that our findings remained robust to datasets of different sample sizes by applying the same DID analyses to the initial data of 2,000 users and the full data of 1,704 users (See Section N of the Web Appendix). Second, we aggregated the dependent variable to monthly level to test whether the result was sensitive to different units and verify that the result was maintained (See Section N of the Web Appendix). Lastly, we demonstrated that our results did not capture spurious effects. As with other observational studies that did not use random assignments, we could not rule out the possibility that the reminder effect is a pure coincidence. To verify that our analysis was not picking up a spurious effect, we conducted a pseudo-treatment test. The coefficients for the main and moderation effects were not statistically significant for any analysis suggested above, confirming that our main results were neither a statistical artifact nor a coincidental spurious effect (See Section N of the Web Appendix).

## **DISCUSSION AND CONCLUSIONS**

Our study evaluated the collaborative effort by credit card companies and policymakers in Korea to inform and remind credit card consumers of their spending by implementing the transaction reminder service. We used observational data from one major credit card company to test what effect this transaction reminder service had on credit card usage behavior. We highlighted the main findings and described the potential mechanism, followed by a discussion

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of the implications. We also suggested further research that could add to our contributions.

## **Main Findings**

Results showed that receiving transaction reminders on mobile phones promoted overall credit card spending instead of curbing it. The result is a “good news” for credit card companies in a sense that they can achieve an unexpected revenue boost with an innocuous transaction reminder. An added advantage is that the positive effect is asymmetrical and has greater impact on previously non-heavy credit card users, which mitigates the risk of their customers defaulting. For policymakers, they expected better financial planning of the credit card abusers due to reminders that would manifest as a reduction in average overall spending. Considering this, the outcome might look discouraging. However, a deeper look into this phenomenon revealed that the reminder service did not encourage consumers with larger historical bills to use credit cards more. Because the at-risk group who abused credit tended to have larger spending, we concluded that the intervention did not harm those who were vulnerable.

We suggested a plausible explanation as to what may be the driving force behind the increase in credit card spending for average and light users after implementing transaction reminders.

Through PSM and DID approach, we accounted for the discrepancies between those who received reminders and those who did not as much as possible given the non-experiment setting.

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Although we could not obtain direct evidence for mechanisms behind the transaction reminder effect, we identified one major driver called the digital memory delegation effect. Recent findings on the use of digital media such as smartphones showed the common pattern that the users delegated costly cognitive tasks such as memorizing to the digital device. We conjectured that the reminders served as a recording tool for financial activities, and this disturbed mental budgeting which required memorizing the transactions as a prerequisite. Consequently, the effect of receiving transaction reminders should have an asymmetrically larger impact on those who previously did more mental budgeting.

To test our idea, we had to find a proxy for the amount of mental accounting done by consumers because we could not directly observe the capacity for mental budgeting. We used past spending as the proxy for two reasons: the amount of spending was directly related to how much mental budgeting consumers could perform and also indicative of consumers' motivation to do such activities. All of our analyses showed the same results: The more mental budgeting capacity a consumer demonstrated previously, the greater the increase in card spending after the start of transaction reminders. This reminder effect was not short-lived but persisted for a long time. Moreover, the increase in spending manifested exclusively in discretionary categories such as dining, shopping, and leisure, which also supported our mental budgeting conjecture (Sussman & Alter, 2012). That is to say, the transaction reminder service reshaped how

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consumers tracked their credit card transactions, leading consumers to do less mental budgeting and, in turn, promoting more use of credit cards.

## **Implications**

*For Academics.* Our study added insights to the growing body of literature on spending behavior, mental budgeting and reminder effects. Past research established that the credit card effect came mainly from a disruption in mental budgeting because of the payment method. Soman (2001) showed that rehearsal of past expenses should result in better budgeting and hence reduced spending. One fundamental feature of Soman's (2001) experiments was that the participants could not escape the rehearsal intervention. In contrast, consumers could easily choose to ignore the reminders in the intervention studied here. Thus, we add to the literature by delineating conditions in which the extent of mental budgeting changes.

Past reminder studies were centered on messages that were highly salient and few in number. They contributed to our understanding of when reminders were more effective in terms of content, timing, context, and framing. However, content and timing are unlikely to matter for reminders of transactions because these extremely frequent reminders are not informative. Instead, we found personal or behavioral indicators strongly moderating the outcome for these ambient reminders. We contribute to this stream of research by examining a novel setting of

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reminders and extensively exploring their potential mechanism.

*For Practitioners.* Counter to the industry expectation of reduced spending due to the transaction reminder service, we found that credit card companies might have experienced increased profits emerging from the heterogeneous change in spending. The back of the envelope calculation using the estimates of Model 2 indicated that surprisingly the credit card company could have gained an extra profit of about \$121 for the 300 consumers who received transaction reminders.<sup>19</sup> If a profit were at stake, companies would send transaction reminders only to consumers who would increase spending and subtly disenfranchise at-risk consumers who used credit heavily from the benefit of the service by making them sign off. However, such profit-oriented approaches would not only interfere with the government's policy goal but also could incur unhealthy financial habits and backfire in the long run. Thus, it would be in the best interest of credit card companies to cooperate with policymakers in helping consumers become better financial planners, given that such efforts would not lead to significant financial losses to them.

As a way to further collaborate with policymakers and improve the effectiveness of the transaction reminder intervention, practitioners could introduce additional "tweaks." The reminders encouraged mental budgeting negligence instead of diligence, and thus any tweaks

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<sup>19</sup> For the sake of this back of the envelope calculation, a profit margin was assumed to be 2% after subtracting variable costs and the cost of sending a text message was assumed to be 2 cents.

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should be devised to help targeted consumers actively rehearse credit card expenditures. While actual tweaks were outside the scope of this study, there were studies and practices that suggested viable methods (see, for example, Karlan et al. 2016). Assuming that effective tweaks were devised, the tweaked messages could selectively target consumers who were more at risk, especially retirees, and those who overspent in discretionary categories (see Table 6 and 7). Finally, practitioners should be wary of wear-outs of such tweaks and find appropriate measures for both contents and timing.

*For Policymakers.* Recent research has shown that interventions can and should be customized based upon a better understanding of consumer heterogeneity (Reimer et al. 2014; März et al. 2021) because an intervention targeting a certain segment of consumers might produce a different effect for another segment (Jo et al. 2020). Results from this study provided additional supporting evidence for consumer-level heterogeneity, and these, in turn, reinforced the need for customizing interventions even when subtle behavioral interventions were being discussed. Interestingly, recent debates on the use of evidence-based approaches to developing interventions to improve consumer welfare have highlighted the need to test intervention ideas in the context in which they will be used prior to scaling them up (Soman, 2015). Because of context-dependence (i.e., an intervention that works well elsewhere might not work in a different context), this in-situ testing before full implementation might often be the key to ultimate

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success.

### **Limitations and Further Research**

Technology has advanced significantly to allow the design and testing of additional behaviorally informed interventions. In our setting, a text message was sent shortly after completion of a transaction; as a result, its arrival might be redundant from the viewpoint of strengthening a memory trace. Further research may experiment with sending a transaction reminder after a significant delay so that it truly reinforces a fading memory of the past expense. Moreover, although text messages were not curated in the 2010 version of the intervention, providing customized information is another factor worth consideration. To the extent that consumers use mobile wallets, technology might now allow these wallets to provide just-in-time budgeting information as consumers are about to make their next purchase. The provision of timely information consistent with the mental accounting and budgeting strategies could boost the effectiveness of the reminders (Halpern, 2016; Soman, 2015).

Regarding our suggested mental process, our strategy was to test it using a proxy variable: past spending amount. Although we attempted to establish that this variable was a good indicator of the amount of mental budgeting, future studies can use a more direct measurement through experimental manipulation such as imposing a highly taxing cognitive task (Tan et al. 2010).

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Another direction for future research is to test the idea on various platforms. Our setting was limited to one payment method (i.e., a credit card) and one medium (i.e., mobile text messaging). The current commercial landscape hosts a variety of payment tools and communication media. Specifically, the topic of mobile payments is being investigated actively in marketing, and the impact of such payments on consumer welfare is being discussed. Although a credit card contract is ultimately behind various payment methods, consumers may perceive mobile payments, Internet transactions, and payment via physical plastic cards as distinct methods of payment. An interesting follow-up study would be to examine the effect of coupling mobile payment methods with transaction information communication media.

Method of reminding and organizing transaction records are also advancing. Apps provided by bank services are growing in popularity, and management tools associated with each mobile payment platform are widespread (e.g., Apple Pay, Samsung Pay). There are third-party financial management apps such as Mint (Brown, 2019) that consumers use to manage their budgeting. Future studies can investigate interactions between payment methods and information management tools and how they jointly affect spending behavior.

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