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Less carrot more stick: promoting health behavior change with deposit contracts

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Chapter 7

Summary and General Discussion

Financial rewards can be effective to promote initiation of health behavior change, but there is little evidence for maintenance of behavior change after incentive removal. Deposit contracts, a specific type of financial incentive, require people to deposit their own money, and allow them to earn it back contingent on successful behavior change. Because deposit contracts are provided by the person attempting the behavior change, they do not require external funding, and could thus more easily be implemented on a large scale. Additionally, deposit contracts might be more effective than other types of financial incentives, because they capitalize on our tendency to be loss averse. Therefore, deposit contracts are a promising tool for improving population health. In this dissertation, we investigated the application of deposit contracts to improve health behavior change. We focused on physical activity specifically, because it potentially has important health benefits, is relatively easy to implement in daily life, and is therefore also suitable for deprived, vulnerable and older populations. Also, deposit contracts can be designed in many different ways, and it is currently unknown which features of deposit contracts make them more effective. While deposit contracts do not require external funding, they require participants to put their own money at risk. This requirement deters part of the population from participating in a deposit contract, and it is important to explore methods for increasing deposit contract uptake. Finally, health behavior change is most urgent in populations such as those with chronic conditions like cardiovascular disease.

The main aim of this dissertation was to assess the potential of deposit contracts for health behavior change. More specifically, we aimed to (1) establish the effects of deposit contracts, (2) explore which features of deposit contracts make them more effective, (3) identify strategies that help increase the uptake of deposit contracts, and (4) assess the acceptability of deposit contracts for people with cardiovascular disease. In this final chapter, a summary of the main findings per empirical study will be given in relation to these aims. Thereafter, we discuss the main findings of this dissertation, and then outline the strengths and limitations of our methods. Finally, we provide an agenda for future research into deposit contracts for health behavior change.

Summary of the main findings

Chapter 2 contributed towards our aims of (1) *establishing the effects of deposit contracts on physical activity*, and (2) *exploring which features of deposit contracts make them more effective*. Previous research has used loss framing of a financial reward (without requiring a deposit) to mimic the feelings of loss involved in a deposit contract, and leverage loss aversion. Previous studies operationalized loss framing by first giving participants a reward and then subtracting money from that reward when participants were not successful. Gain framing consists of participants simply earning rewards for every goal

success. We investigated whether loss framing a financial incentive increases effectiveness (measured as participant days goal achieved), compared to gain framing. Furthermore, we compared the effectiveness of deposit contracts with that of financial rewards. Healthy participants ($N = 126$) with an average age of 22.7 years participated in a 20-day physical activity intervention that aimed to improve daily step counts. We used a 2 (incentive type: deposit or reward) $\times$ 2 (feedback frame: gain or loss) between-participants factorial design with a no-incentive control condition. Interestingly, and contrary to what we expected, we found that, in a healthy population aiming to improve daily step counts, loss framing of financial incentives led to reduced effectiveness. Our results showed that deposit contracts were not more (but also not less) effective than financial rewards, while they did have lower uptake (measured as agreeing to participate and paying the deposit). Furthermore, we found that gain framed incentives resulted in higher effectiveness, which is why we applied gain frames in our follow up study in chapter 3.

Chapter 3 aimed to (3) *identify strategies that help increase the uptake of deposit contracts for physical activity*. Secondly, this chapter also contributed towards (1) *establishing the effects of deposit contracts on physical activity*, and (2) *exploring which features of deposit contracts make them more effective*. Low uptake is a crucial obstacle to the large-scale implementation of deposit contracts. Therefore, we investigated whether (1) matching the deposit 1:1 (doubling what is deposited) and (2) allowing for customizable deposit amounts increased the uptake (measured as agreeing to participate and paying the deposit) and short-term effectiveness (measured as participant days goal achieved) of a deposit contract for physical activity. Healthy participants ($N = 137$) with an average age of 21.6 years participated in a 20-day physical activity intervention that aimed to improve daily step counts. We employed a 2 (deposit customization: fixed or customizable) $\times$ 2 (deposit matching: not matched or matched) between-participants factorial design. The deposit contract intervention used in this study was effective in helping people increase their step counts, and customization and matching did not have additional effects. However, both matching and customization did increase the uptake of a deposit contract for physical activity. Therefore, both matching and customization might be considered to overcome lack of uptake, with a preference for customization since matching a deposit imposes significant additional costs.

In **Chapter 4** the purpose was (1) *establishing the effects of deposit contracts on physical activity*, and (2) *exploring which features of deposit contracts make them more effective*. To assess their potential for improving population health, research has to investigate implementation of deposit contracts outside the research setting and among larger and more diverse samples. Therefore, we performed a naturalistic evaluation of StepBet gamified deposit contracts, for whom they worked best, and under which conditions they were most effective to help increase physical activity. We analyzed ($N = 72,974$) unique first time StepBet challenges that were offered on the StepBet smartphone

application. The modal challenge consisted of a \$40 deposit made prior to a 6-week challenge period during which participants needed to reach daily and weekly step goals in order to regain their deposit plus possible additional earnings, paid out from the money lost by those who failed their challenge. We measured the challenge success ratio and compared the average step count during a challenge to a baseline that was determined on a 90-day historic step count retrieved before a challenge started. Findings show that, in a real-world setting, and among a large and diverse sample, participating in a physical activity challenge using gamified deposit contracts was associated with a large increase in step counts (+ 31.2%). The average challenge success rate was 73% and while winners increased their step count by 44%, losers in fact decreased their step count by 5.3%. Exploratory analyses indicated that males and older people had larger increases in step counts and higher odds of succeeding in their challenge. Finally, New Year's resolution challenges were more effective than regular challenges. Overall, this chapter showed that in real world conditions, gamified deposit contracts are associated with clinically relevant increases in physical activity.

Chapter 5 focused on (4) *assessing whether deposit contracts are suitable for people with cardiovascular disease*. There is an urgent need to find new approaches that improve long-term adherence to a healthy lifestyle among people with cardiovascular disease (CVD), but it is unknown whether they would find deposit contracts acceptable. Therefore, we investigated the acceptability of a deposit contract for physical activity with a survey among ($N = 659$) members of the Harteraad patient panel of the Dutch CVD patient organization. Findings confirm the idea that cardiovascular disease patients feel they need extra commitment to maintain their lifestyle changes. Yet, only a small part of this sample responded positively to using deposit contracts to maintain physical activity behavior change. When exploring subgroup responses, younger patients, and male patients, showed higher acceptability. All in all, this chapter revealed that deposit contracts have a limited acceptability among the CVD patient group.

Chapter 6 contributed towards our aim of (4) *assessing whether deposit contracts are acceptable for people with cardiovascular disease*. It is unknown whether healthcare professionals (HCPs) involved in cardiovascular disease (CVD) care find it acceptable to provide financial incentives to patients with CVD as support for lifestyle change. Therefore, we investigated HCPs' perspectives on using financial incentives to support healthy living for patients with CVD. We performed ($N = 16$) semi structured, in-depth, face-to-face interviews with Dutch HCPs involved in supporting patients with CVD with lifestyle changes. Findings show that HCPs perceived an incentive system for healthy living for patients with CVD as possibly effective and showed generally high acceptance. However, there were concerns related to focusing too much on the extrinsic aspects of lifestyle change, disengagement when rewards are insignificant, paternalization and threatening autonomy, and low digital literacy in the target group. Together, these

findings reveal that, according to HCPs, financial incentives might be suitable for patients with CVD if contextual factors, design of incentives, and target groups are accurately considered.

Discussion of the main findings

In this section we bring together the main findings from the separate empirical studies in light of our aims.

Aim 1: Establish the effects of deposit contracts

An important finding of this dissertation is that deposit contracts potentially have large, clinically relevant effects on physical activity, among those who decide to participate in them. The existing research to date showed promising results, but was either underpowered (Donlin Washington et al., 2016; Krebs & Nyein, 2021; Stedman-Falls & Dallery, 2020), or did not require participants to make a deposit of their own money (Budworth et al., 2019; Burns & Rothman, 2018). The results from our two field experiments (chapters 2 and 3) were consistent with the findings from our real-world observation (chapter 4), and provide additional evidence that deposit contracts can successfully be applied to increase step counts. Our current findings are in line with existing research on promoting physical activity with financial incentives generally (Mitchell et al., 2019), and deposit contracts specifically (Boonmanunt et al., 2022). Although it is important to show that deposit contracts are effective in promoting initiation of physical activity, we did not study behavior change maintenance in the current dissertation. Meta-analysis across studies has provided indications that financial rewards, lottery incentives, and deposit contracts all had short term effects on physical activity, but deposit contracts were the only type of incentive which led to maintenance of improvements in physical activity up to 4 months after incentive removal (Boonmanunt et al., 2022). Furthermore, this dissertation (chapter 4) has identified that those who fail in a deposit contract challenge might be at risk of decreased physical activity. After a deposit contract challenge is failed, participants might become less motivated to track their step counts (by carrying their smartphone or wearing their external activity tracker) or to actually increase their step counts. This finding is important because it points to a possible setback effect (see Wenzel et al., 2020) among those who fail their deposit contract, and may stimulate further research into understanding setback effects, and ways to mitigate them. Overall, based on the existing evidence, supplemented by our current findings, deposit contracts appear to have potential to help improve physical activity, and potentially also other health behaviors.

Aim 2: Explore which features of deposit contracts make them more effective

Previous research had indicated that several features of financial incentive interventions (longer duration, more immediate incentive delivery, higher incentive amounts, less active target population) are associated with larger effects on physical activity (Mitchell et al., 2019). This dissertation investigated whether matching (chapter 3), customization (chapter 3), and loss framing of a financial incentive (chapter 2) increased effects on physical activity. Unexpectedly, we found that matching (although it doubled the incentive amount), and customization did not result in larger effects of a deposit contract. These results are in contrast to previous findings which showed that higher incentive amounts (Mitchell et al., 2019) and customizable deposit contracts were related to larger effects (Sykes-Muskett et al., 2015). We explain these findings through a ceiling effect, because the overall intervention was highly effective in all experimental conditions (chapter 3). Furthermore, we found that loss framing a financial incentive for improving physical activity decreased the effectiveness of the intervention compared with gain framing (chapter 2). This unexpected finding stands in contrast with previous findings on loss framed financial rewards (Patel et al., 2016), and provides evidence that (perceptions of) losses are not always more impactful than (perceptions of) gains. Instead, this finding supports arguments made by others that loss aversion is a context-dependent tendency with boundary conditions, instead of a ubiquitous phenomenon (Gal & Rucker, 2018). Possibly, differences in regulatory fit between the samples of our study and the study by Patel et al. (2016) help explain the discrepancy in these findings. Our findings might form the starting point for new research into how incentive framing might interact with regulatory focus or other features of health goals, behaviors or characteristics of participants. With regards to when deposit contracts are best initiated, we found that deposit contracts started as a New Year's resolution were more effective than when they were started during any other period of the year. Our finding extends on previous findings on the Fresh Start Effect by showing that people are not only more inclined to pursue behavioral goals around the passage of the year (Dai et al., 2014), but these goals might also be pursued with greater success. Therefore, our findings suggest to make use of this temporal landmark to increase the odds of successful behavior change.

Aim 3: Identify strategies that help increase the uptake of deposit contracts

Previous research on deposit contracts clearly identified that they suffer from a lack of uptake (Giné et al., 2010; Kullgren et al., 2016; Royer et al., 2015). The findings from our field experiment in chapter 2 confirmed that deposit contracts for physical activity have lower uptake than financial rewards. Additionally, previously no experimental evidence was available on how to increase uptake of deposit contracts for physical activity

behavior change. Our field experiment in chapter 3 identified that both matching and customization of a deposit contracts have the potential to increase uptake. This finding might be relevant for the large-scale implementation of deposit contracts in practice. Through matching and customization of deposit amounts, a broader population can benefit from using deposit contracts to increase their physical activity, and perhaps other health behaviors as well. Matching might convince people who are hesitant to put their money at risk, because an extra reward can be earned. Customization creates the opportunity for people with lower incomes to self-tailor a deposit contract amount that does not cause financial harm when lost. Thereby, customization of deposit amounts might make deposit contracts more attractive for targeting vulnerable subgroups.

Aim 4: Assess the acceptability of deposit contracts for people with cardiovascular disease

Although opinions of healthcare professionals (HCPs) were generally positive towards using financial incentives to support health behavior change among people with cardiovascular disease (chapter 6), most people with cardiovascular disease showed reluctance towards using deposit contracts (chapter 5). These findings are in line with existing research that showed high acceptability of financial incentives among HCPs (Hoskins et al., 2019), but indications of low acceptability among patients themselves (McGill et al., 2018; Mitchell et al., 2014). It is important to note that we did not study the acceptability of deposit contracts specifically among HCPs, but rather gauged acceptability of a financial incentive system generally. Nevertheless, assuming that healthcare professionals would also show acceptability towards deposit contracts, the suitability of deposit contracts would be limited if people with cardiovascular disease themselves do not accept them. These findings are important for practitioners who consider applying monetary deposit contracts to CVD patient populations. The high level of acceptability we found among HCPs provides support for further investigation and development of a financial incentive system for lifestyle change in CVD. However, because only a subgroup of CVD patients found deposit contracts for lifestyle change acceptable, it is important to offer them as an optional, additional element to existing interventions that patients can opt-in to. Because we did not offer deposit contracts in practice, (but merely gauged their hypothetical acceptability) actual uptake and acceptability in practice might be higher, especially when methods of customization or matching are applied (chapter 3). Finally, to reach a broader target group among CVD patients, it might be relevant to further identify strategies that leverage similar commitment principles as used in deposit contracts, but that do not have a cash deposit requirement (e.g., picture of the person sitting in a lazy pose on the couch will be spread on social media if challenge is failed).

Strengths and limitations

The empirical studies that make up this dissertation had several strengths and limitations. We applied a mixed methods approach to study the potential of deposit contracts for improving health behavior change. We performed both qualitative and quantitative research, and used both observational and experimental methods to further understand the potential of deposit contracts for health behavior change. While experimental and observational studies allowed us to get insight into the (real world) effects of deposit contracts, qualitative methods helped us to gain insight in acceptability and opinions on financial incentives and deposit contracts among relevant populations. An additional strength of the studies in this dissertation is the diversity of samples and settings that were studied. Firstly, we performed theoretically informed field experiments among healthy students (pre-dominantly living in the Netherlands) that shed light on features of deposit contracts that increase uptake and effectiveness. In addition, we collaborated with a business partner that allowed us to perform a naturalistic evaluation of deposit contracts in the real world, among a general (pre-dominantly living in the United States) population that purchases deposit contracts as a service to achieve behavior change. These observations provide additional evidence for the real-world feasibility of deposit contracts, something that is crucial when one aims to assess the potential of this intervention to increase population health. Thirdly, we studied financial incentives and deposit contracts for lifestyle change among cardiovascular disease patients in the context of the Dutch healthcare system. All in all, the multitude of these perspectives paints a broad picture of the short-term effectiveness, real world efficacy, subgroup differences, and acceptance in healthcare. We believe this adds to the real-world applicability of our findings. Another strength of the experimental studies is that we did not rely on self-reported outcomes, but used behavioral outcomes, such as automatic registration of step counts and deposit contract challenge outcomes. This increases the internal validity of our findings and avoids some of the common concerns associated with biases in self-reported health behavior change. By using smartphone registration of step counts, we were also able to personally tailor intervention goals based on historic step counts saved on participants' smartphones. Finally, a strength of the experimental and observational studies is that we investigated a strict operationalization of a deposit contract. Namely, a contract in which the participant prior to participating has to transfer an amount of his or her own money through credit card (chapter 4) or a direct digital bank transfer (chapter 2 and 3). Other studies relied on loss framing of a financial reward (Burns & Rothman, 2018) or provided participants with vouchers first (Budworth et al., 2019) which participants could then use a deposit. Because we used deposit contracts with actual deposits of participant's own money, we were able to accurately assess uptake, ways to increase uptake, and effectiveness of deposit contracts.

An important limitation of this dissertation is the short time horizon on which effects of deposit contracts were studied. Our two field experiments investigated initiation of behavior change during 20 intervention days, while our real-world observation investigated initiation of behavior change during 41 intervention days. To increase population health, maintaining behavior change is the ultimate aim (see Dunton et al., 2022). The current work does not yet provide evidence for maintenance of behavior change. A second limitation is that we determined the effectiveness of deposit contracts (chapter 2, 3, 4) by analyzing those who decided to participate in them (per protocol analysis). Instead, analyzing the effectiveness of deposit contracts among the entire sample, instead of only those who decided to participate (intention to treat analysis) would provide stronger, and perhaps more realistic, evidence for their efficacy when deposit contracts are offered in the real world. Because deposit contracts generally have low uptake (in our two experiments around 50%), those who decide to participate might be differently (more strongly) motivated than those who decide not to participate, and thus show greater improvements as a result. This introduces a selection bias that confounds the comparison that is subsequently made with financial rewards conditions. This selection bias operates on several levels. People might be deterred at the stage of recruitment when the intervention is described (for example on a flyer), at the stage of informed consent (when ethical guidelines require researchers to mention the deposit contract), and at randomization (when participants are explained the details of their deposit contract). Furthermore, some of our studies (chapter 2 and 3) were performed during a period in which COVID-19 related lockdowns and a stay-at-home advice were issued by the Dutch government. Although all of the conditions in these studies were probably impacted equally, it is possible that the overall intervention effects we found were different than they would be under non-lockdown circumstances. Finally, the deposit contracts we investigated consisted of several additional behavior change components (goal setting, daily progress feedback, peer support) on top of the deposit contract (see Michie et al., 2013). Therefore, we are not able to disentangle which part of the effects found can be attributed to the monetary deposit. It would be relevant to compare challenges with a monetary deposit to similar challenges without this deposit to isolate the effect of the monetary component.

Future research

In this section we provide suggestions for future research based on the findings of the studies performed in this dissertation.

How can deposit contracts facilitate long term maintenance of behavior change?

Although it is crucial to first show that deposit contracts are effective for initiation of behavior change (chapter 2, 3, 4), an important challenge is to investigate whether deposit contracts can also promote maintenance of behavior change in the long term. We envision three avenues that future research can follow.

Firstly, deposit contracts could be offered as a tool that people can repeatedly use to strengthen their commitment to lifestyle goals (Erev et al., 2022). Motivation for health behavior change is dynamic over time (Dai et al., 2014), and whenever there's a peak in motivation (such as when people pursue New Year's resolutions or when they want to become beach fit for summer), people could repeatedly use deposit contracts to support their lifestyle goals. In this way, each behavior change attempt can gradually help people experience the benefits of new behavior and incrementally improve their lifestyle in the long term. Future research could investigate whether this application of deposit contracts is feasible and effective to promote long term maintenance of behavior change. Future studies could do this by giving a group of people long-term access to a tool that allows them to enter into repeated deposit contracts for different health behaviors. By systematically evaluating who uses this tool, for which health behavior, and to which effect, researchers could then investigate to what extent people are willing to use deposit contracts over the course of several behavior change attempts. It is especially relevant to analyze whether people are willing to participate repeatedly in deposit contracts (for the same or different health behaviors), and which chronological (e.g., New Year's resolutions) or life events (e.g., upcoming beach holiday) trigger the initiation of new deposit contracts.

Secondly, deposit contracts with a (really) long time horizon could be offered. In the current dissertation we tested deposit contracts with a 20-day (chapter 2, 3) or at maximum 41-day duration (chapter 4). However, it is interesting to investigate the uptake and effects of deposit contracts with a duration of a full year (perhaps started as a New Year's resolution), or even longer. No research to date has studied deposit contracts for physical activity with a duration extending past 3 months (Boonmanunt et al., 2022), but there is no reason to expect that longer durations will be less effective. On the contrary, longer intervention durations have shown to increase maintenance of behavior change effects produced by financial incentives (Mitchell et al., 2019). For example, deposit contracts have been shown to increase weight loss outcomes with a post-incentive follow up period of up to 12 months (Finkelstein et al., 2017). Future research could study long duration deposit contracts by offering participants a deposit contract with a 1- or 2-year time horizon, and measure uptake and effects on behavior change maintenance.

Finally, the ultimate goal is to develop healthy habits that are self-supportive and do not require any external incentive. Previous research has shown that when financial

rewards were provided on intermittent reinforcement schemes (either at increasing time intervals or with unpredictable timing) they were more effective than fixed (per visit) payments in facilitating long term maintenance of behavior change in gym visits (Arad et al., 2023). Future research could design dynamic deposit contracts that gradually fade out while habits develop, or that provide intermittent reinforcement, and measure their impact on long term maintenance of behavior change during active deposit contract, and with long term follow up measurements.

Who benefits most from deposit contracts?

Understanding the factors that influence the effectiveness of deposit contracts is crucial to tailor the intervention to specific subgroups. In this dissertation (chapter 2, 3, 4) we explored the impact of several demographic and psychological variables on uptake and effectiveness. Our findings suggested that males, and older people might have greater improvements in physical activity as a result of participating in a deposit contract challenge (chapter 4). Future research should be done to confirm these findings and explore why this might be the case. Research could also investigate the role of other psychological variables. For example, individual variation in present bias has been shown previously (see Hunter et al., 2018), and those who show a greater level of present bias might respond especially strong to immediate financial incentives. A second interesting psychological variable to investigate is loss aversion. Although many studies on deposit contracts posit they should have superior effects compared to regular financial rewards because of loss aversion (see for example Budworth et al., 2019; Burns & Rothman, 2018), we are not aware of studies that have actually measured loss aversion. Future research might measure present bias and loss aversion (see Abdellaoui et al., 2007), to investigate their moderating role in producing effects of deposit contracts.

How can incentive frames be tailored to increase deposit contract effects?

One key element when it comes to deposit contract tailoring is how to frame the incentive. This dissertation showed that in a healthy population aiming to improve their daily step counts, gain framed financial incentives were more effective than loss framed incentives (chapter 2). This finding might be explained by an interaction between incentive framing (loss or gain framed) and participants' regulatory focus (prevention or promotion focused). People with a promotion focus aim for desired end states, while people with a prevention focus aim for avoiding undesired end states (Ludolph & Schulz, 2015). It has previously been shown that the persuasiveness of a health message is increased when its frame is congruent with the regulatory orientation of the individual. This has been

labelled regulatory fit (Ludolph & Schulz, 2015). Following this line of reasoning, it is possible that the healthy students we studied (in chapter 2 and 3) were pre-dominantly promotion focused (on becoming more fit rather than avoiding health problems), and therefore responded better to a gain-framed financial incentive. Future research on whether the regulatory fit effect also applies to incentive framing (and not only to framing of persuasive health messages) could further our understanding of incentive framing effects. Ultimately, this might help tailor the framing of financial incentive interventions to specific target populations and their regulatory orientations.

How to overcome low uptake of deposit contracts?

A key obstacle to large scale implementation of deposit contracts is low uptake (Giné et al., 2010; Kullgren et al., 2016; Royer et al., 2015). In our two experiments (chapter 2, 3), uptake of deposit contracts was around 50%, while our financial reward conditions had over 95% uptake. In order to overcome issues with uptake of deposit contracts, more research is needed to further understand what causes it. For example, future research should shed more light on which demographic or psychological variables predict (a lack of) uptake.

A demographic variable that is potentially relevant to deposit contract uptake is participants' income. People with lower incomes (and educational attainments) have been shown less likely to participate in health interventions generally. For example, cardiac rehabilitation is less likely to be attended by people from low income areas after they have been hospitalized with a heart condition (Lemstra et al., 2013). Therefore, it can be expected that these people are also deterred from participating in a health behavior change intervention that involves a monetary deposit of their own money. In order to improve uptake among subgroups with lower incomes, customization of deposit amounts could be offered. This would allow individuals to select a deposit amount that motivates them, but does not cause financial harm when it is forfeited upon failure (Sykes-Muskett et al., 2015).

A psychological variable that might be relevant when trying to understand uptake of deposit contracts is sophistication with regards to future self-control abilities (Bryan et al., 2010). In order to take a measure such as risking one's own money to improve lifestyle, one has to have the self-critical insight that future self-control might be limited. Here, a distinction can be made between sophisticates, those who foresee that they will have self-control problems in the future (e.g., Odysseus who ties his hands), and naives, those who don't foresee such self-control problems (O'Donoghue & Rabin, 1999). Naives are supposed to need extra commitment, but do not recognize this fact, and might therefore be less likely to use a commitment device such as a deposit contract (Bryan et al., 2010). Future research could measure and intervene on sophistication with regards to self-control and investigate whether this predicts and increases uptake of deposit contracts.

Finally, low uptake of deposit contracts creates a selection bias that makes comparisons with other types of financial incentives difficult. Low uptake of deposit contracts might filter out those with different levels of motivation, resulting in a selection bias when comparisons are made to financial incentives that have a much higher (near perfect) uptake. Therefore, it is possible that the existing evidence over-estimates the effectiveness of deposit contracts compared to other types of financial incentives (see Boonmanunt et al., 2022). Analysis of deposit contract uptake in future research should take into account that there are several phases during which uptake should be measured (recruitment, informed consent, after randomization). Future research should take a broader approach, and also include (lack of) uptake during recruitment and informed consent when studying the relative effectiveness of deposit contracts and financial rewards.

How can setback effects among those who fail a deposit contract be mitigated?

Some people will inevitably fail their deposit contract challenge (chapter 2, 3, 4). Not much research has been done yet on what effect failure has on motivation, self-efficacy and the subsequent propensity for sustained or repeated effort in pursuing behavior change. Our findings (chapter 4) showed that upon failure in a deposit contract, possibly a setback effect occurs in which people become demotivated to continue their behavior change attempt. Others have shown that setback effects are related to a decrease in self-efficacy (ten Broeke & Adriaanse, 2023), and that people can be protected against it by helping them make external attributions (“the weather was just too bad to go outside”), rather than internal attributions (“I am a lazy person”) for their self-regulation failure (Adriaanse & ten Broeke, 2022). Experimental field research in various populations might give insight into the motivational and behavioral dynamics around failing a deposit contract, and how possible setback effects can be mitigated. For example, a future study could offer a deposit contract for physical activity and randomly assign participants to one of two experimental conditions. An intervention condition that helps facilitate external attributions for failure (“You did not make it this time, but cheer up! – the weather was really bad this month and that made it difficult for you to achieve your goal this time”), and a filler control condition. A reduction in self-efficacy among those who fail would provide support for a self-efficacy mediated setback effect. A less strong reduction in self-efficacy among those who received the intervention would provide evidence for how external attributions for failure can help protect against the setback effect. Measuring the amount of newly started challenges among the people who initially failed, might shed additional light on how external attributions for failure might influence the actual propensity for repeated effort in pursuing behavior change.

How can large scale implementation of deposit contracts be facilitated?

The short-term effectiveness (chapter 2, 3) and real-world efficacy (chapter 4) of deposit contracts provide evidence to support their large-scale implementation to increase health behavior change. Future research should implement deposit contracts and measure their uptake and effects among specific target groups such as those with lower levels of education, income and existing chronic conditions, such as cardiovascular disease. When certain groups are not reached, interventions such as matching and customization of deposits should be introduced to improve uptake among specific subgroups. Secondly, deposit contracts could be used by people themselves, without an intervention provider. In practice, people could set their own lifestyle goals, agree (with others publicly or with themselves privately) on the terms for regaining or losing the deposit, and start a deposit contract by themselves. In this way, deposit contracts operate as a tool that people can use to self-incentivize themselves with (see Lesser et al., 2018). Future research should study how feasible, acceptable and effective these self-initiated deposit contracts are, and what instructions would be needed to help people construct optimal deposit contracts for themselves. In addition, an interesting future direction is to explore how the working mechanisms of deposit contracts could be leveraged without money. For example, one could capitalize on the principle of loss aversion by having people commit to a bet with some level of social discomfort at stake (e.g., picture of the person sitting in a lazy pose on the couch will be spread on social media if challenge is failed). Others refer to these different types of commitment as ‘hard’ and ‘soft’ commitments (Bryan et al., 2010). Hard commitments involve monetary consequences (such as losing money), and soft commitments involve psychological consequences (such as shame). Deposit contracts with soft commitments are under researched up to date (Manthri Savani, 2019). Exploring soft commitment strategies without a cash deposit requirement can help reach subgroups that would benefit from extra commitment to their lifestyle goals.

Finally, future research should identify business models that help increase the scale at which deposit contracts can be offered. In current practice, customers of health insurance companies can purchase a wearable device and by achieving their daily step goals earn a cashback on the purchase of this device (Hafner et al., 2020). This deal in essence constitutes a deposit contract, because a certain amount of money is transferred and can be earned back by achieving behavioral goals. These forms of deposit contracts appear attractive to consumers and are already being applied with some form of success in practice (Hafner et al., 2020). There are many other possible health promoting products or services that could be purchased by consumers, under the agreement that upon verified behavior change (using the service or product), discounts can be earned. For example, fitness gyms can offer contracts wherein customers receive a discount on their annual subscription fee when they achieve a certain number of objectively verified gym

visits. Whether these deals facilitate sustained improvements in health behavior change remains an interesting topic for future research.

Conclusion

This dissertation showed that deposit contracts have potential to facilitate health behavior change, and can be offered to large populations without requiring external funding of incentives. Our research showed that deposit contracts can be effective in supporting short term improvements in physical activity (chapter 2, 3, 4). Because of their strong and clinically relevant effects among those who elect to use them, we recommend intervention providers to consider offering deposit contracts to support health behavior change. Deposit contracts were more effective when daily feedback was gain framed (emphasized wins instead of losses) (chapter 2). Deposit contracts were also more effective for males, older people, and when they were started as a New Year's resolution (chapter 4). Although effective, deposit contracts will not reach everyone because their uptake is limited (chapter 2, 3). When one aims to improve deposit contract uptake, our findings show that both matching and customization are effective strategies (chapter 3). Although healthcare professionals are generally positive towards using financial incentives to support lifestyle change of cardiovascular disease patients (chapter 6), patients themselves are generally skeptical towards using deposit contracts (chapter 5). Because only certain subgroups are interested in using them, and deposit contracts involve a risk of financial harm, deposit contracts might be offered on an opt-in basis. Additionally, we recommend exploring how non-monetary forms of commitments can help people achieve health behavior change. Finally, researchers and intervention providers who aim to enhance health behavior change interventions with financial incentives have both carrots (financial rewards) and sticks (deposit contracts) at their disposal. The evidence base for the effectiveness of carrots was already convincing, and this dissertation showed that sticks can be at least equally effective. We hope that this dissertation, by providing evidence for the potential of deposit contracts, stimulates a broader use of the tools available in the financial incentive toolbox. Hence, it's title: less carrot more stick.

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