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(iii) Abstract:

Behavior often deviates from standard predictions because individuals evaluate the consequences of choices separately (narrow bracketing) rather than jointly. The main existing theories classify different narrow bracketing phenomena as (i) choice errors caused by cognitive limitations, or (ii) strategies to achieve self-control. Using an online experiment, we find consistent evidence for (ii): mental budgets and narrow goals are related to each other and to measures of self-control, but are distinct from other forms of narrow bracketing. Evidence for the complementary theory (i) is less consistent: few choice bracketing phenomena are related to each other and to cognitive skills.

(iv) JEL Classification: D03, C91, D81, D91

(v) Keywords: Narrow bracketing, mental accounting, risky choices, cognitive skills, self-control

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I Introduction

It is a puzzle why people often evaluate consequences of choices separately (narrow bracketing) rather than jointly (broad bracketing). Two main, complementary explanations exist. On the one hand, certain phenomena of narrow bracketing are considered to be a choice error (Rabin and Weizsäcker, 2009), explained by cognitive limitations or cognitive inertia (Read et al., 1999).

For example, expected utility theory predicts that individuals are approximately risk neutral for small stakes (Arrow, 1971). Yet, many people would reject a favorable gamble with equal odds of winning \$200 or losing \$100 – suggesting implausibly high levels of risk aversion under expected utility theory (Rabin, 2000). Narrow bracketing in conjunction with loss aversion can explain this result. A loss averse individual suffers more from losing \$100 than he gains from getting \$200. Yet, the impact of loss aversion would be attenuated if the individual bracketed broadly the lottery with other risks and wealth he faces (Benartzi and Thaler, 1995). To see this consider two repetitions of the gain \$200 or lose \$100 gamble. If an individual aggregates (bracketed broadly) the outcomes of the gambles, then integrating a possible loss of \$100 in one gamble with a gain of \$200 in the other gamble implies that most outcomes of the aggregated gamble (3 out of 4) are in the gain domain. Thus, loss aversion has little impact and the individual would accept the aggregated gambles. In contrast, not integrating the two gambles would lead to a rejection of each gamble, which can be considered an error.

On the other hand, in some domains, narrow bracketing appears to be beneficial. People bracket decisions narrowly to achieve self-control – a phenomenon termed “motivational bracketing” (e.g., Shefrin and Thaler, 1988; Fudenberg and Levine, 2006; Koch and Nafziger, 2016). For example, individuals who can choose their working hours, such as taxi drivers, often appear to

have narrow, daily income targets (Camerer et al., 1997). At first glance, it seems suboptimal for a taxi driver to stop driving when reaching his daily income target. He could earn more by working longer when hourly earnings are high and shorter when they are low. The reason that taxi drivers set narrow, daily income targets is that these help to mitigate self-control problems, as Camerer et al. (1997) conjecture.

The aim of this paper is to examine whether different phenomena of narrow bracketing correlate with each other and with individual characteristics, such as cognitive skills and self-control, as predicted by the complementary theories that classify particular narrow bracketing phenomena as a choice error (*choice bracketing*) or as a response to self-control problems (*motivational bracketing*). Further, on a more exploratory level, the correlations help shed light on the question of whether choice bracketing and motivational bracketing are distinct phenomena or whether different bracketing phenomena can be captured by one parsimonious model of narrow bracketing. For example, narrow bracketing can be seen as a feature of Kahneman and Tversky's (1979) prospect theory. It tightly links phenomena of narrow bracketing to reference dependent preferences and loss aversion, because the reference point against which gains and losses are evaluated is often tied to a single, specific decision. That is, the individual is assumed to bracket this decision narrowly (e.g., Thaler, 1999).

We conduct an online survey experiment among university entrants at Aarhus University. The survey includes questions and incentivized tasks related to choice bracketing and motivational bracketing, as well as several individual characteristics. We hypothesize that (i) the choice bracketing phenomena are related to each other and to measures of cognitive skills; (ii) the motivational bracketing phenomena are related to each other and to measures of self-control.

We collect several measures related to choice bracketing. *Endowment Integration* reveals the extent to which a subject integrates her endowment when making risky choices. The remaining

measures capture phenomena where narrow bracketing goes hand in hand with reference dependent preferences that can be described by a value function with three main features (Kahneman and Tversky, 1979): loss aversion, s-shape, and a reference point.

Insurance counts how many categories of small-scale insurance (such as insuring a laptop against theft and damage, or buying travel insurance) a subject reports to have purchased. Paying a high insurance premium to get rid of such small risks is inconsistent with expected utility, but can be explained by narrow bracketing in conjunction with loss aversion (Rabin and Thaler, 2001). *Lottery Isolation* builds on an incentivized version of a question by Tversky and Kahneman (1981) that is designed to detect whether people integrate multiple lotteries or view them in isolation. The question presents two concurrent lotteries. One has outcomes in the gain domain and the other has outcomes in the loss domain. A narrow bracketer with reference dependent preferences tends to make a risk averse choice in the gain lottery and a risk seeking choice in the loss lottery – choices that are dominated when considering the broadly bracketed compound lottery (Rabin and Weizsäcker, 2009). *Topical Account* builds on two questions by Kahneman and Tversky (1984) that reveal whether a subject brackets narrowly costs and benefits associated with a particular consumption decision. Specifically, a narrow bracketer will evaluate the loss of an already purchased theatre ticket differently from losing an amount of money of equal value.

The variables *Loss Aversion* and *S-Shaped* relate to parameters of the value function that we elicit with price lists. We predict a correlation with the other choice bracketing phenomena not only because of the theoretical link between reference dependent preferences and narrow bracketing, but also because of a practical link. One can only observe reference dependent preferences from choice lists if the individual brackets the choices presented to her narrowly.

Loss aversion, for example, would play no role for decisions if the individual integrated the

experimental risk with her experimental endowment.

We collect two measures related to motivational bracketing. *Mental Budget* asks whether subjects use mental budgets to monitor expenses in separate categories. Doing so indicates that they narrowly bracket each category. *Narrow Goal* is based on a vignette question that reveals whether or not subjects would set narrow goals in a hypothetical exam preparation scenario. We hypothesize that these two phenomena are related to self-control. Mental budgets can help a person avoid overconsumption of “vice goods” by setting spending limits for specific consumption categories (e.g., Heath and Soll, 1996). A broad (effort) goal allows the individual to slack off today and tell himself that he will make up for today’s shortfall by working harder tomorrow – a narrow goal precludes such excuses (Koch and Nafziger, 2016).

Finally, we collect measures of cognitive skills and self-control to test whether they are associated with narrow bracketing phenomena in the way that the choice bracketing or motivational bracketing hypotheses predict.

Our findings support the motivational bracketing hypothesis. Setting narrow goals or having mental budgets are associated with each other and with higher self-control. Yet, having mental budgets is also associated with lower cognitive skills. This indicates that mental budgets are not only used as a self-control tool, but also to simplify complex choice problems. We find mixed support for the complementary hypothesis that choice bracketing phenomena are related to each other and to cognitive skills. Ignoring the endowment when making risky choices is correlated with a failure to integrate multiple, concurrent lotteries. In both cases, subjects seem to disregard important pieces of information. Yet we do not find the consistent correlations with low cognitive skills that we would expect if narrow bracketing was due to cognitive limitations causing choice errors. Moreover, none of the other choice bracketing phenomena correlate with each other as predicted, except for a correlation of a failure to integrate multiple, concurrent

lotteries with the loss aversion measure of reference dependence.

Related Literature. The narrow bracketing literature goes back to Tversky and Kahneman (1981), Simonson (1990), and Herrnstein and Prelec (1991). The phenomenon is also referred to as narrow framing (Kahneman and Lovallo, 1993) or mental accounting (Thaler 1999).

Narrow bracketing often is thought to be a choice error (Rabin and Weizsäcker, 2009). Several papers consider narrow bracketing as a tool to overcome self-control problems. Shefrin and Thaler (1988) model how assigning wealth to distinct, narrow accounts allows consumers to control their short-run urge to overspend. Fudenberg and Levine (2006) model mental accounts as “pocket cash constraints” on a short-run self with no access to other accounts. Heath and Soll (1996) document how people control their expenditures in mental accounts for narrowly defined categories, such as entertainment, clothing, or food. Koch and Nafziger (2016) and Hsiaw (2018) theoretically investigate under which circumstances narrowly bracketed goals are better than broadly bracketed goals. Koch and Nafziger (2017) exogenously assign the goal bracket (daily goals or a weekly goal) in an experiment and find that under the daily goals condition subjects choose higher (non-binding) goals and provide more effort in a real effort task than subjects in the weekly goal condition.

Our contribution is to examine the relation between several narrow bracketing phenomena, including both motivational and choice bracketing. We go beyond studies that consider how one particular narrow bracketing phenomenon correlates with individual characteristics. Rabin and Weizsäcker (2009) correlate the anomaly of viewing multiple lottery choices in isolation with education, race, gender, and math skills. They find only weak evidence for correlations. While we confirm that choice bracketing phenomena are mostly unrelated to cognitive skills, we find that women are more likely to exhibit certain choice bracketing phenomena than men. Abeler

and Marklein (2017) find a correlation between narrow bracketing in consumption decisions and math skills. Similarly, we find that the use of mental budgets is correlated with cognitive skills.

Our study makes a distinct contribution to the literature examining the correlation of behavioral phenomena with each other. Most similar in spirit to our study is ?. They examine whether correlations support a unifying behavioral theory for a range of behavioral phenomena related to time, risk, and social preferences. While our paper is different by its focus on narrow bracketing, we overlap in studying the correlations of loss aversion with individual characteristics. They find limited support for a relation between cognitive skills and loss aversion. We find mixed support. Burks et al. (2009) and Benjamin et al. (2013) observe that cognitive skills are positively associated with accepting (rejecting) fair (unfair) small-stakes lotteries.

II Experimental Design and Measures

The study uses data from a survey experiment among students at Aarhus University (Epper et al., 2018a). All first semester students in business and social science programmes in Fall 2013 received an email invitation with a link to an online survey. Subjects had to complete the entire survey to receive payment from several incentivized tasks in addition to a fixed payment of 50 Danish kroner (kr.). The survey took around one hour and average earnings were 148 kr. (\$25 at the time). Our final sample has 638 subjects (response rate 22%; we discuss selection in Section V). Subjects who completed the survey could earn another 200 kr. by participating in a follow-up study that elicited time preferences, which 314 subjects did. We informed subjects that payments would be made 2-6 weeks after the study by bank transfer, via a payment system through which Danish public bodies and companies can send money to a person using

their social security number. This is a standard payment method in Denmark and required by Aarhus University.

In the following, we describe only those parts of the survey that are relevant for the current study. The full survey includes an additional incentivized task to elicit preferences for competition (maximal earnings 65 kr.) and additional survey questions (cf. online appendix E).

Narrow Bracketing

Reference Dependent Preferences (incentivized). We elicit reference dependent preferences using multiple price lists, with the parameters given in Table 1. Upon entering this part of the survey, subjects learn that they will face 9 price lists. In each, they have to state which of two alternatives, A and B , they prefer. Under A , subjects get an amount of money for sure. Under B , the amount of money they receive is uncertain, and it is equally likely that the subject receives x_1 kr. or x_2 kr., where $x_1 > x_2$. Each price list has 21 choices. The amount under alternative B is fixed, while the amount under alternative A ranges from x_2 to x_1 . We induce a unique switching point by asking subjects to mark the lowest sure amount of money at which they prefer alternative A over B . The computer automatically ticks alternative A for all higher sure amounts and alternative B for all lower sure amounts.

Some lotteries display losses. For this reason, each question has an endowment w kr. from which any loss is deducted and to which any gain is added. Endowments are displayed at the top of the page for each question, separately from the outcomes.

After subjects complete all 9 price lists (in randomized order), the computer randomly selects one of them as the ‘question that is paid’. For the ‘question that is paid’ the computer randomly selects one of the 21 rows as the ‘row that counts’. For the ‘row that counts’ the computer checks whether the subject preferred alternative A or B . If he preferred A , then he gets the

Table 1: Lottery Configurations

Type	ID	w	x ₁	x ₂	t ₁	t ₂	EV	EV + w
Configuration 1								
Loss	1	80	0	-80	80	0	-40	40
Mixed	2	40	40	-40	80	0	0	40
Gain	3	0	80	0	80	0	40	40
Configuration 2								
Loss	4	160	-40	-120	120	40	-80	80
Mixed	5	80	40	-40	120	40	0	80
Gain	6	0	120	40	120	40	80	80
Configuration 3								
Loss	7	160	0	-160	160	0	-80	80
Mixed	8	80	80	-80	160	0	0	80
Gain	9	0	160	0	160	0	80	80

Notes: w : endowment. x_1, x_2 : outcomes under lottery $(x_1, x_2, 0.5)$. t_1, t_2 : terminal outcomes ($t_i = x_i + w$, $i = 1, 2$). $EV(EV + w)$: expected value of the lottery (terminal outcome).

sure amount listed in that row. If he preferred B , then the computer randomly selects outcome x_1 or x_2 . In addition, the subject gets the endowment w associated with the price list.

The 9 price lists allow us to estimate the parameters of a value function of the form (Köbberling and Wakker, 2005):

$$v(x) = \begin{cases} \frac{1-e^{-\mu x}}{\mu} & \text{if } x \geq 0 \\ (\lambda + 1) \left(\frac{e^{\nu x} - 1}{\nu} \right) & \text{if } x < 0. \end{cases} \quad (1)$$

The value function is linear if $\mu = \nu = 0$, s-shaped if $\mu, \nu > 0$, inverted s-shaped if $\mu, \nu < 0$, and globally concave if $\mu \geq 0 \geq \nu$. A subject is loss averse if $\lambda > 0$ and gain seeking if $\lambda < 0$.

The estimation procedure follows Epper et al. (2018b) and is summarized also in Epper et al. (2018a). Identification of the parameters rests on individuals narrowly bracketing the lottery payment. We discuss the implications of this assumption in the context of our research question in Section V. In the following, we use the parameter λ (variable *Loss Aversion*) and construct the dummy variable *S-Shaped* that is equal to 1 if $\mu, \nu > 0$ and 0 otherwise.

Endowment Integration (incentivized). We use the price lists to capture whether a subject integrates the experimental endowment when evaluating lotteries. First, the lotteries with IDs 2 and 5 in Table 1 have the same x_1 and x_2 , but due to different endowments w they have different terminal outcomes $t_1 = w + x_1$ and $t_2 = w + x_2$. A subject who brackets narrowly and

disregards the endowment should make the same choice in both questions. Hence, if a subject makes different choices, we cannot reject that he integrates the endowment. Second, all three lotteries within a configuration have the same terminal outcomes. Thus, a broad bracketer would make the same choices within each configuration. Different choices suggest that the subject is a narrow bracketer.

Based on this reasoning, we construct the variable *Endowment Integration*. First, for all lottery pairs that have the same terminal outcomes, we count the number of times a subject chooses the same switching point in both price lists. Second, we increase the counter by 1 if a subject has different switching points for the lotteries with IDs 2 and 5. *Endowment Integration* ranges from 0 to 10 – the higher the value, the more often the choices are consistent with integrating the endowment.

Lottery Isolation (incentivized). We implement an incentivized variant of the question by Tversky and Kahneman (1981). It is designed to detect whether people integrate multiple lotteries or view them in isolation. Subjects face the following two, concurrent decisions. Decision 1: (A) *Win 24 kr.* versus (B) *A 25% chance of winning 100 kr. and a 75% chance of not winning or losing any money.* Decision 2: (C) *Lose 75 kr.* versus (D) *A 75% chance of losing 100 kr. and a 25% chance of not winning or losing any money.*

For budget reasons, the computer randomly selects one subject as the ‘participant who is paid’. This subject receives the outcome from both decisions and is given an extra 100 kr. to cover any possible losses. We list the endowment of 100 kr. separately, to frame the outcomes in the second decision as losses.

From the choice data we create a dummy variable *Lottery Isolation* that is equal to 1 if the subject chooses (A,D) and equal to 0 otherwise. Choosing (A,D) indicates that the individual

views the lotteries in isolation. Specifically, (A,D) leads to a compound lottery with a 25% chance of gaining 24 kr. and a 75% chance of losing 76 kr. However, (B,C) leads to a compound lottery with a 25% chance of gaining 25 kr. and a 75% chance of losing 75 kr. So (A,D) is first-order stochastically dominated by (B,C), and thus inconsistent with rational choice (Rabin and Weizsäcker, 2009).

Small-scale Insurance (survey question). Subjects are asked which categories of small-scale insurance they have ever bought (bicycle, phone, baggage, travel, computer/laptop). The variable *Insurance* aggregates these answers. Its range is from 0 (never bought any of these) to 5 (bought all of them).

Topical Account (survey question). This question replicates the “lost ticket versus lost money” vignette by Kahneman and Tversky (1984). Subjects are asked to imagine that they decided to see a theatre play. In the first scenario, they paid the admission price of 200 kr., but then lost the ticket on the way to the theatre. In the second scenario, on the way to buying a ticket at the theatre, they lost 200 kr. For each scenario, they state, on a 5-point Likert scale, how likely it is that they would pay 200 kr. for a ticket. If a subject is less likely to buy the ticket if he lost the previous ticket than if he lost the money, we set the dummy variable *Topical Account* equal to 1, and equal to 0 otherwise. The former choice suggests that the subject has a narrow topical account for the theatre play.

Mental Budget (survey question). We ask subjects whether they divide their monthly budget into several separate budgets (such as budgets for housing, clothes, leisure expenditures, study related expenditures). The answer on a 5-point Likert scale defines the variable *Mental Budget*. A higher value indicates that a subject is more likely to have a mental budget.

Narrow Goal (survey question). Subjects consider a hypothetical situation where two weeks before an exam the lecturer hands out 30 practice exams. All questions for the actual exam are drawn from these practice exams. It takes 4 hours to work on a practice exam. Subjects are asked how they would set goals for the number of practice exams they solve: daily goals, weekly goals, an overall goal for the two weeks, or no goal. We set the dummy variable *Narrow Goal* equal to 1 if the subject chooses a daily goal and equal to 0 otherwise.

Individual Characteristics and Skills

In addition to the gender of the subjects, we have four measures that relate to the cognitive and non-cognitive skills of an individual.

Cognitive Reflection (incentivized). Subjects complete a cognitive reflection test (Frederick, 2005) consisting of three simple math exercises. There is an impulsive, but wrong answer. For example, the question “A bat and a ball cost 110 kr. in total. The bat costs 100 kr. more than the ball. How much does the ball cost?” has the impulsive answer 10 kr., while the correct answer is 5 kr. Subjects receive 2 kr. for each correct answer. The variable *Cognitive Reflection* encodes the number of correct answers of a subject.

Strategic Thinking (incentivized). Subjects participate in a beauty contest. They choose a number between 0 and 100, and they know that all the other participants do the same. The average of all entered numbers is computed and multiplied by two thirds. The subject whose entry is closest to this number wins the beauty contest and receives 200 kr. All others receive nothing. The Nash equilibrium of the beauty contest is that all players choose the number 0. The variable *Strategic Thinking* encodes the number chosen by a subject in the beauty contest.

The lower the number, the closer it is to the equilibrium action, indicating that the subject is more strategically sophisticated.

Other studies found that lower numbers (or a structural measure of strategic reasoning, like level- k reasoning) correlate with cognitive ability (e.g., Burnham et al., 2009) or with the score in the cognitive reflection test (e.g., Georganas et al., 2015).

Math Grades (survey question). We ask subjects about their math grades in the university qualifying exam. The variable *Math* codes math grades as $1 = F, 2 = E, \dots, 6 = A$. Abeler and Marklein (2017) proxy for cognitive skills with the math grade and examine what role it plays for narrow bracketing. Indeed, math grades correlate with the score in intelligence tests (e.g., Deary et al., 2007). Yet, math (and other) grades do not only reflect cognitive skills, but also non-cognitive skills such as self-control (e.g., Duckworth and Seligman, 2005).

Brief Self-Control Scale (survey questions). The Brief Self-Control Scale (Tangney et al., 2004) consists of 13 items that relate to the perceived ability of an individual to exercise self-control, such as the ability to break habits, resist temptation, and keep good self-discipline. It includes questions such as “I am good at resisting temptations” or “Pleasure and fun sometimes keep me from getting work done”, measured on a 5-point Likert scale. After reverse coding some items, the average score across all 13 items provides the variable *Brief Self-Control Scale*. Its range is from 1 to 5, where higher values indicate higher self-control.

Principal Component Analysis. We conduct a principal component analysis of the above four skills. Parallel analysis (Horn 1965; Patil et al. 2008) suggests two components, which we extract and report in Table 2. One component encompasses the variables *Math* and *Brief Self-Control Scale*. The other component encompasses the variables *Strategic Thinking* and

Table 2: Principal Component Analysis of Individual Characteristics

	Cognitive Skills Component	Self-Control Component
Math	0.42	0.52
Cognitive Reflection	0.73	-0.21
Strategic Thinking	-0.52	-0.10
Brief Self-Control Scale	-0.15	0.82

Notes: Principal component analysis after orthogonal varimax rotation (eigenvalues averaged over 10,000 replications, parallel analysis suggests 2 components). $N = 626$.

Cognitive Reflection. As discussed above, the existing literature suggests that math grades both reflect cognitive and non-cognitive skills. In our sample, math grades appear to be more strongly related to self-control. Henceforth, we call the first component *Self-Control Component* and the second *Cognitive Skills Component*.

Present Bias (incentivized). For a subpopulation of the participants we have a structural estimate of the present bias parameter β of a quasi-hyperbolic utility function (Laibson, 1997). For $\beta < 1$, the individual underweights the future relative to the present (compared with exponential discounting). Such a present bias implies time-inconsistent preferences that may cause self-control problems.

Our elicitation procedure measures preferences over the timing of disutility from effort in a real effort task. All of our 638 subjects were eligible to participate, which 314 subjects did (see Section II). We can only estimate the individual *Present Bias* (β) for 293 of them. A summary of the procedure is given in online appendix A – for full details and estimation procedures we refer to Augenblick et al. (2015) on which we base our procedure. As the *Present Bias* is available only for a subpopulation, we use it for robustness checks. The main analysis is based on the *Self-Control Component*.

Table 3: Theoretical Constructs Needed to Generate a Bracketing Phenomenon

	Endowment integration	Lottery Isolation	Insurance	Topical account	Reference dependence	Narrow goal	Mental budget
Choice bracketing:	x	x	x	x	x		x
Choice bracketing 1: ignore overall wealth		x	x	x	x		x
Choice bracketing 2: ignore other risks/lotteries		x	x	x			
Choice bracketing 3: ignore experimental endowment	x	x			x		
Reference dependent preferences		x	x	x	x	x	x
Expectation based reference dependent preferences			x	x			
Motivational bracketing						x	x
Self-control problem						x	x

Table 4: Predictions on Correlations

	Endowment Integration	Lottery Isolation	Insurance	Topical Account	Reference Dependence	Narrow Goal	Mental Budget
Endowment Integration							
Lottery Isolation	-						
Insurance	-	+					
Topical Account	-	+	+				
Reference Dependence	*	+	+	+			
Narrow Goal							
Mental Budget						+	
Cognitive Skills	+	-	-	-	-		-
Self-Control						+	+

Notes: * Reference dependence is only identifiable if experimental endowments are not integrated. Note that there are two measures of reference dependence and of self-control, respectively.

III Predictions

The literature suggests two forms of narrow bracketing: choice bracketing (variables *Lottery Isolation*, *Endowment Integration*, *Insurance*, *Topical Account*, *Loss Aversion*, and *S-Shaped*) and motivational bracketing (*Narrow Goal* and *Mental Budget*). We discuss each group in turn and point to correlations that are consistent with a particular theory. Our empirical analysis tests for these correlations. That is, we check for consistency with particular behavioral models but do not identify causal effects. A certain correlation may arise for other reasons than those outlined (see Section V). Table 3 lists the components that from a theoretical point of view are needed to generate a particular narrow bracketing phenomenon. Table 4 summarizes how variables in our study are expected to correlate with each other if a particular behavioral model is correct.

Motivational Bracketing. According to theories of motivational bracketing, people bracket narrowly to achieve self-control. To understand how a narrowly bracketed goal facilitates self-control, consider a student who is prone to procrastinating during exam preparation on account of his present bias. To motivate himself, he could set a narrow goal to study 8 hours each day. Or he could set a broad goal to study 40 hours per week. For each type of goal, the individual compares his effort with the goal. If the person falls short of his goal, he suffers a psychological loss proportional to the short-fall relative to the goal. The fear of a loss makes the individual strive harder than he would without a goal. Narrow goals are better at motivating the student than broad goals because a broad goal tempts the student to engage in “effort substitution”: Faced with the goal of studying 40 hours per week, the student might study very little in the beginning of the week, reassuring himself that he will make up (partly) for his shortfall later in the week. This results in a skewed effort pattern over time and less overall effort than with narrow goals (Koch and Nafziger, 2017).

Similarly, mental budgets can facilitate self-control. Consider, for example, a diner at a restaurant who is tempted to overspend on drinks. Having a narrow mental budget for “drinks” prevents him from spending more than the amount assigned to this account. Indeed, Abeler and Marklein (2017) find evidence for separate bracketing of drinks and food among restaurant diners.

To sum up, we hypothesize that the two variables *Narrow Goal* and *Mental Budget* are positively correlated with each other and with the *Self-Control Component*, which measures realized self-control. Higher realized self-control could stem from having less severe self-control problems or from the use of self-regulation strategies. According to the motivational bracketing hypothesis, *Narrow Goal* and *Mental Budget* are self-regulation strategies. Hence, they should lead, ceteris paribus, to higher realized self-control measured by the *Self-Control Component*, i.e., a higher

score on the *Brief Self-Control Scale* and higher math grades.

As a robustness check, we use the related, yet, conceptually different variable *Present Bias*. While the *Self-Control Component* measures realized self-control, *Present Bias* captures proneness to self-control problems (see Section V and online appendix C for further discussion of the relation between the two variables). Individuals who have more severe self-control problems are more in need of self-regulation strategies to overcome them. Thus, we predict that the uptake of the self-regulation strategies *Narrow Goal* and *Mental Budget* is negatively associated with *Present Bias* (having a lower value of the variable *Present Bias* means having more severe self-control problems).

While theoretical models show that goals (or mental budgets) work because of reference dependent preferences, do not deliver sharp predictions on how the choice between broad and narrow goals depends on loss aversion or the exact shape of the value function (the variable *S-shape*). Using the theoretical models of Koch and Nafziger (2016, 2017), one can show that the utility difference between broad and narrow goals can be increasing, decreasing, or independent of the loss aversion parameter. Lacking a clear hypothesis, we include the testing of the relationship between motivational bracketing and reference dependent preferences under our exploratory analysis.

Prediction 1 (Motivational Bracketing) *Mental Budget and Narrow Goal are positively correlated with each other and with the Self-Control Component.*

Choice Bracketing. Next we discuss choice bracketing phenomena: people bracket narrowly because they make a mistake. Cognitive capacity limitations or cognitive inertia can explain such choice errors (Read et al., 1999). Cognitive capacity limitations may simply prevent an individual from processing different pieces of information together. But even if an individual

is able to adequately process such information, cognitive inertia may lead the person to simply follow the frame in which the problem is presented.

The variable *Endowment Integration* is our purest measure of narrow bracketing. Subjects who ignore the endowment in the risk elicitation task commit a choice error. They chose differently across lotteries with the same terminal outcomes, or they chose the same way across lotteries with different terminal outcomes. Under standard assumptions, such choices cannot maximize a strictly increasing utility function (note that only one of the lotteries is randomly drawn for payment).

For the other choice bracketing phenomena, explanations require not only the decision maker to be a narrow bracketer but also reference dependent preferences in the form of a value function (Kahneman and Tversky, 1979). *Lottery Isolation* captures whether a subject views multiple lotteries in isolation. Reference dependent preferences may then lead to the first-order stochastically dominated choice (A, D) . Choosing A in the first decision indicates risk aversion in the gain domain, and choosing D in the second decision indicates risk lovingness in the loss domain. Both features are captured by an s-shaped value function. In addition, an individual who chooses (A, D) ignores the experimental endowment of 100 kr., because otherwise all outcomes would be in the gain domain.

Insurance captures whether a subject purchases small-scale insurance. Expected utility theory predicts that subjects are approximately risk neutral for small risks, such as losing a cell phone. As a risk neutral individual has no desire to buy (slightly unfairly priced) insurance, one has to assume first-order risk aversion (Segal and Spivak, 1990) to explain the demand for small-scale insurance. One prominent case of first-order risk aversion is the combination of reference dependent preferences with narrow bracketing. The individual buys small scale insurance because she focusses narrowly on the possible loss of the phone. If she broadly bracketed it with the risks

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she faces in life, loss aversion would play no role for the decision to insure the phone because the outcomes of other risks would mostly determine whether states are coded as gains or losses. Sydnor (2010) points out that expectation based reference points (Kőszegi and Rabin, 2007) can explain the demand for small-scale insurance, while a status quo reference point cannot.

Topical Account refers to a decision without uncertainty. Yet, the anomaly is closely related to the other choice bracketing phenomena because it can be explained by narrow bracketing (having a narrow topical account) in conjunction with expectation based reference dependent preferences (see online appendix B).

Not only from a theoretical point of view does narrow bracketing go hand in hand with reference dependent preferences. When eliciting reference dependent preferences with price lists, one needs to assume narrow bracketing. To identify *Loss Aversion* and *S-Shaped*, subjects need to bracket narrowly the experimental decisions. If they integrated their experimental endowment, all outcomes would be in the gain domain. This would make it impossible to observe loss aversion, or a difference in curvature of the value function in the gain and loss domains.

To sum up, we hypothesize that *Lottery Isolation*, *Endowment Integration*, *Insurance*, *Loss Aversion*, *S-Shaped* and *Topical Account* are related. Under all these phenomena, the subject narrowly focuses on the decision at hand – ignoring important pieces of information, such as the endowment, lifetime wealth, and other risks. As doing so is a choice error, we hypothesize that these phenomena are correlated with the *Cognitive Skills Component*.

Prediction 2 (Choice Bracketing) *According to the signs in Table 4, Lottery Isolation, Endowment Integration, Insurance, Topical Account, Loss Aversion, and S-Shaped are correlated with*

a. *each other,*

b. the Cognitive Skills Component.

In a theoretical model, Gilboa et al. (2010) point to the computational complexity of the consumer choice problem as a reason for mental budgets. Thus, a complementary hypothesis to Prediction 1 is that lower cognitive skills make it more likely that a person uses mental budgets, i.e., that mental budgets are a choice error.

Prediction 3 (Choice Bracketing) *Mental Budget is negatively correlated with the Cognitive Skills Component.*

Exploratory Data Analysis. We examine whether choice bracketing phenomena are related to motivational bracketing phenomena. A consistent pattern of cross-correlations would support a parsimonious theory of narrow bracketing. Alternatively, the correlations might shed light on interesting new, unexpected connections. In addition, to explore some of the mechanisms and to examine the driving forces behind some unexpected results, we report further exploratory data analysis in Section V.

IV Results

Summary Statistics

The full set of variables is available for 610 subjects (283 subjects with *Present Bias*): for 10 out of the 638 subjects the reference dependent preference parameters cannot be estimated, and not all subjects took math in their high school finals. The summary statistics in Table 5 show that narrow bracketing is a prevalent phenomenon. We briefly discuss two findings and return to the other findings below.

Table 5: Summary Statistics

	N ^e	Average	Std.dev.	Min	Max	
Narrow Bracketing Measures						
Endowment Integration	628	2.08	1.87	0	9	
Lottery Isolation	628	0.32	0.47	0	1	
Insurance ^a	628	1.68	1.46	0	5	
Topical Account	628	0.33	0.47	0	1	
Narrow Goal	628	0.49	0.50	0	1	
Mental Budget	628	2.79	1.37	1	5	
Loss Aversion ^b	628	2.01	4.01	-1	10	<0: 0.47, =0: 0.00, >0: 0.53
S-Shaped	628	0.50	0.50	0	1	
Individual Characteristics and Skills						
Female	626	0.55	0.50	0	1	
Math ^c	626	4.55	1.15	1	6	
Cognitive Reflection	626	1.32	1.12	0	3	
Strategic Thinking	626	41.35	23.25	0	100	
Brief Self-Control Scale	626	3.30	0.58	1.54	4.92	
Present bias ^d	283	13.79	95.08	0	1285	<1: 0.46, =1: 0.16, >1: 0.39
Cognitive Skills Component	610	0.02	1.09	-2.92	2.51	
Self-Control Component	610	0.00	1.05	-3.22	2.91	

Notes: ^a No. of small-scale insurance categories purchased. ^c < 0 gain seeking, > 0 loss averse. ^c Math grade: 1=F, 2=E, 3=D, 4=C, 5=B, 6=A. ^d < 1 present-biased, = 1 no present bias, > 1 future biased. ^e Not all measures are available for all subjects, as, e.g., not all have taken math in their high school finals (*Present bias* is only available for a subsample of 283). All measures are available for $N = 610$ (279).

32% of subjects reveal that they view multiple lotteries in isolation. Tversky and Kahneman (1981) report that 60-73% of participants do so, but with hypothetical stakes. Rabin and Weizsäcker (2009) replicate their experiment with real stakes and find that 28-34% of participants violate dominance, similar to our finding.

Interestingly, two thirds of the subjects give the same answer in the lost-ticket and lost-money questions (i.e., *Topical Account*=0). This is in contrast to Kahneman and Tversky (1984), where 88% of participants would buy a new ticket when having lost the money, but only 46% would do so when having lost the ticket. One reason for the difference might be that we ask each subject both questions.

Correlations

Overview. The Spearman correlations in Table 6 and the principal component analysis in Table 7 provide a general overview of the data. We test our formal hypotheses using regressions of the form

$$y_i = \alpha + \beta_H x_{i,H} + \beta_{NH} x_{i,NH} + \delta_H z_{i,H} + \delta_{NH} z_{i,NH} + \epsilon_i, \quad (2)$$

Table 6: Spearman Correlations

	Endowment Integration	Lottery Isolation	Insurance	Topical Account	Loss Aversion	S-Shaped	Narrow Goal	Mental Budget
	Correlations Between Narrow Bracketing Variables							
Endowment Integration	1.00							
Lottery Isolation	-0.14***	1.00						
Insurance	-0.00	0.01	1.00					
Topical Account	0.07 $\diamond$	-0.08 $\diamond$	-0.02	1.00				
Loss Aversion	-0.04	0.08 $\diamond$	0.01	-0.01	1.00			
S-Shaped	-0.33***	0.03	0.02	-0.02	-0.03	1.00		
Narrow Goal	-0.00	-0.02	0.06	-0.04	0.02	0.06	1.00	
Mental Budget	-0.05	0.06	0.09*	-0.01	-0.04	0.06	0.16***	1.00
	Correlations Between Narrow Bracketing Variables and Individual Characteristics							
Female	-0.10*	0.03	0.13**	0.04	-0.02	0.13***	0.22***	0.18***
Math	-0.02	0.02	-0.10*	0.03	0.05	-0.02	0.06	-0.01
Cognitive Reflection	0.10*	-0.13**	-0.09*	0.05	-0.03	0.01	-0.08*	-0.10*
Strategic Thinking	-0.06	0.00	0.00	-0.00	0.06	0.00	0.01	0.12***
Brief Self-Control Scale	-0.02	0.03	0.03	0.04	-0.03	-0.01	0.19***	0.12**
Present bias ^a	0.06	-0.07	0.02	0.07	-0.04	-0.04	-0.06	0.03
Cognitive Skills Component	0.10*	-0.09*	-0.10*	0.04	-0.03	0.00	-0.06	-0.16***
Self-Control Component	-0.03	0.07	-0.00	0.03	0.01	-0.02	0.20***	0.10*

Notes: $\diamond p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Bonferroni correction for multiple comparisons at 5-percent significance level). $N = 610$ (^a $N = 279$).

Table 7: Principal Component Analysis

	Component 1	Component 2	Component 3	Component 4
Endowment Integration	0.03	-0.63	-0.21	-0.03
Lottery Isolation	0.10	0.15	0.60	-0.06
Insurance	-0.19	-0.05	-0.08	0.53
Topical Account	0.06	-0.10	-0.32	0.03
Narrow Goal	0.58	0.02	-0.13	0.14
Mental Budget	0.28	0.06	-0.03	0.34
Loss Aversion	-0.001	-0.17	0.60	0.11
S-Shaped	-0.02	0.70	-0.15	-0.03
Female	0.20	0.16	-0.15	0.48
Cognitive Skills Component	0.11	0.08	-0.23	-0.57
Self-Control Component	0.70	-0.07	0.12	-0.14

Notes: Principal component analysis after orthogonal varimax rotation (eigenvalues averaged over 10,000 replications, parallel analysis suggests 4 components). $N = 610$.

where y_i is the narrow bracketing measure serving as independent variable, $x_{i,H}$ are the narrow bracketing variables for which we have a hypothesis about their relation to y_i , $x_{i,NH}$ are those for which we do not have a hypothesis (exploratory data analysis), $z_{i,H}$ are the individual characteristics for which have a hypothesis about their relation to y_i , and $z_{i,NH}$ are those for which we do not have a hypothesis.

We report three specifications in Tables 8-10. Specification 1 includes gender, the *Cognitive Skills Component*, and the *Self-Control Component* (see Table 2); specification 2 includes all the other narrow bracketing variables; and specification 3 includes the full set of variables. In online appendix D, we report regressions that replace the two components with the individual variables from which the components are constructed. In our reporting we focus on specification 3. It reveals whether a bivariate association between two narrow bracketing variables arises simply because they both are related to, say, gender. When summarizing results, we state standardized coefficients.

Multiple Hypothesis Testing. The more tests one performs, the higher the probability that one rejects at least one true null hypothesis. We predict 23 correlations (see Table 4; note that we have two measures for both reference dependent preferences and self-control). If the tests are mutually independent, and if one takes a p-value of 0.05, then the probability that

Table 8: Regressions: Endowment Integration, Insurance, and Topical Account

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Endowment Integration (OLS)		Insurance (OLS)		Topical Account (Logit)				
Endowment Integration				-0.03 (0.03)		-0.02 (0.03)	0.02 (0.01)		0.02 (0.01)
Lottery Isolation	-0.57*** (0.13)		-0.55*** (0.13)	-0.03 (0.13)		-0.04 (0.13)	-0.06 (0.04)		-0.07 [◇] (0.04)
Insurance	-0.05 (0.04)		-0.03 (0.04)				-0.01 (0.01)		-0.01 (0.01)
Topical Account	0.21 (0.15)		0.24 (0.16)	-0.08 (0.12)		-0.08 (0.12)			
Loss Aversion	-0.03 [◇] (0.02)		-0.03 [◇] (0.02)	0.01 (0.01)		0.01 (0.02)	-0.002 (0.004)		-0.002 (0.005)
S-Shaped	-1.27*** (0.14)		-1.25*** (0.14)	-0.03 (0.13)		-0.02 (0.13)			
Narrow Goal	0.05 (0.14)		0.14 (0.15)	0.12 (0.12)		0.06 (0.12)			
Mental Budget	-0.07 (0.05)		-0.05 (0.05)	0.11* (0.04)		0.08 [◇] (0.04)	-0.0002 (0.01)		0.001 (0.02)
Female		-0.45** (0.15)	-0.32* (0.14)		0.34** (0.12)	0.29* (0.13)		0.05 (0.04)	0.06 (0.04)
Cognitive Skills Component		0.07 (0.08)	0.08 (0.06)		-0.11 [◇] (0.06)	-0.08 (0.06)		0.01 (0.02)	0.01 (0.02)
Self-Control Component		-0.02 (0.07)	-0.03 (0.07)		-0.05 (0.06)	-0.04 (0.06)		0.01 (0.02)	0.02 (0.02)
Constant	3.15*** (0.24)	2.36*** (0.13)	3.18*** (0.24)	1.42*** (0.19)	1.51*** (0.09)	1.36*** (0.20)			
R^2	0.16	0.02	0.17	0.02	0.02	0.03			
N	628	624	610	628	626	610	628	626	610

Notes: OLS regression coefficients or logit marginal effects. Robust standard errors in parentheses. [◇] $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Bonferroni correction for multiple comparisons at 5-percent significance level).

we reject at least one true null hypothesis is $1 - 0.95^{23} = 0.69$. On a more exploratory level, we also test for all other possible correlations in Table 4 (except *Endowment Integration* with reference dependent preferences) and the correlations of the narrow bracketing variables with a gender dummy. This gives 52 possible correlations. The most conservative correction for multiple comparisons, the so called Bonferroni method, is to divide the 5-percent significance level by the number of hypotheses (e.g., Romano et al., 2010), which in our case gives a cut-off p-value of 0.002 for 23 hypotheses, or 0.001 for 52 hypotheses. We denote coefficients that have a p-value below 0.001 as significant and coefficients that are significant at the conventional levels 0.01, 0.05, and 0.1 as borderline significant. Results reported in Section V are not included in the multiple hypothesis correction because they are conducted post-hoc to investigate some mechanisms.

Choice Bracketing. We find mixed evidence for our hypothesis that *Endowment Integration*, *Lottery Isolation*, *Insurance*, *Topical Account*, *Loss Aversion*, *S-Shaped*, and the *Cognitive Skills*

Table 9: Regressions: Lottery Isolation and Reference Dependent Preferences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Lottery Isolation	Lottery Isolation	(Logit)	S-Shaped (Logit)	S-Shaped (Logit)	S-Shaped (Logit)	Loss Aversion (OLS)	Loss Aversion (OLS)	Loss Aversion (OLS)
Endowment Integration	-0.05*** (0.01)		-0.05*** (0.01)	-0.13*** (0.02)		-0.13*** (0.02)	-0.17 [◊] (0.10)		-0.16 (0.10)
Lottery Isolation				-0.02 (0.05)		-0.01 (0.05)	0.81* (0.37)		0.79* (0.38)
Insurance	-0.002 (0.01)		-0.003 (0.01)	-0.002 (0.01)		-0.003 (0.02)	0.06 (0.11)		0.05 (0.11)
Topical Account	-0.06 (0.04)		-0.07 [◊] (0.04)	0.01 (0.05)		0.003 (0.05)	-0.15 (0.33)		-0.10 (0.34)
Loss Aversion	0.01* (0.005)		0.01* (0.005)	-0.01 [◊] (0.01)		-0.01 [◊] (0.01)			
S-Shaped	-0.02 (0.04)		-0.01 (0.04)				-0.62 [◊] (0.35)		-0.61 [◊] (0.36)
Narrow Goal	-0.03 (0.04)		-0.05 (0.04)	0.05 (0.04)		0.06 (0.05)	0.08 (0.32)		0.13 (0.34)
Mental Budget	0.02 (0.01)		0.02 (0.01)	0.01 (0.02)		0.01 (0.02)	-0.07 (0.12)		-0.09 (0.12)
Female		0.02 (0.04)	0.004 (0.04)		0.14*** (0.04)	0.10* (0.05)		-0.28 (0.33)	-0.28 (0.35)
Cognitive Skills Component		-0.04* (0.02)	-0.02 (0.02)		0.01 (0.02)	0.02 (0.02)		-0.47** (0.16)	-0.42** (0.16)
Self-Control Component		0.03 (0.02)	0.03 [◊] (0.02)		-0.02 (0.02)	-0.03 (0.02)		0.14 (0.15)	0.11 (0.16)
Constant							2.52*** (4.42)	2.19*** (8.67)	2.70*** (4.56)
R ²							0.02	0.02	0.04
N	628	626	610	628	610	610	628	610	610

Notes: OLS regression coefficients or logit marginal effects. Robust standard errors in parentheses. [◊] $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Bonferroni correction for multiple comparisons at 5-percent significance level).

Component are related. These variables load onto three different components in the principal component analysis in Table 7. Under our hypothesis, they should load onto a single component. *Endowment Integration* and *S-Shaped* load onto component 2. However, the relation between the two is not included in our hypothesis because, by construction, we can only observe an estimated s-shaped value function if subjects do not integrate their endowment. *Lottery Isolation*, *Loss Aversion*, and *Topical Account* load onto component 3, but *Topical Account* enters with the wrong sign. Component 4 compromises *Insurance* and the *Cognitive Skills Component*, that both enter as expected. *Mental Budget* has a similar loading onto components 1 and 4 (which we discuss later).

This mixed picture continues to hold when we look at the raw correlations (Table 6) and the regressions (Tables 8 and 9). The *Cognitive Skills Component* is borderline significantly correlated with *Endowment Integration*, *Lottery Isolation*, and *Insurance*, but the correlations are not, or not robustly significant in the regressions. The picture looks similar if one uses the individual characteristics instead of the components (see online appendix D). One explanation

is that some of the correlations, say between *Insurance* and the *Cognitive Skills Component*, arise because both variables are correlated with gender and disappear when controlling for gender. Conversely, *Loss Aversion* is borderline significantly correlated with the *Cognitive Skills Component* in the regressions, but not in the raw correlations. This might be because the regressions control for additional factors and thereby take out some noise present when estimating the raw correlations.

We next examine the relationships between the narrow bracketing variables. *Topical Account* and *Insurance* are not significantly related to any of the variables as hypothesized in Prediction 2. The signs of the borderline significant relations between *Topical Account* and *Lottery Isolation* ($p < 0.1$), between *Topical Account* and *Endowment Integration* ($p < 0.1$, not significant in the regressions), and between *S-Shape* and *Loss Aversion* ($p < 0.1$, not significant in the raw correlations) contradict the prediction. However, in line with Prediction 2, people who view lotteries in isolation are more likely to ignore the endowment. Further, people who view lotteries in isolation are more loss averse. The effect shows in the regressions ($p < 0.05$), but at a lower level of significance in the raw correlations – hinting that the regression takes out some noise.

Result 1 (Choice Bracketing)

- a. *The Cognitive Skills Component is related to Loss Aversion* ($\beta_{CS}/\sigma_{LA} = -0.42/4.01 \approx -0.10$, $p < 0.01$).
- b. *Lottery Isolation is related to Endowment Integration* ($\beta_{LI}/\sigma_{EI} = -0.55/1.87 \approx -0.29$, $p < 0.001$), *Loss Aversion* ($\beta_{LI}/\sigma_{LA} = 0.79/4.01 \approx 0.20$, $p < 0.05$), and (with the wrong sign) *Topical Account* ($\beta_{LI}/\sigma_{TA} = -0.07/1.87 \approx -0.04$, $p < 0.1$).

Motivational Bracketing. *Narrow Goal*, *Mental Budget*, and the *Self-Control Component* all load onto component 1 in the principal component analysis in Table 7 (with *Mental Budget*

having a similar loading onto component 4). In line with Prediction 1, setting narrow goals and having narrow mental budgets are both associated with better realized self-control, though the relation between *Mental Budget* and the *Self-Control Component* is only borderline significant in the regressions (Table 10, $p < 0.1$) and raw correlations (Table 6, $p < 0.05$). Moreover, and as predicted, *Narrow Goal* and *Mental Budget* are positively correlated (significant Spearman correlation, borderline significant in the regressions, $p < 0.01$).

We investigate the robustness of our results using the variable *Present Bias* that we have available for a subsample. The estimated coefficients are close to zero and not significant (see online appendix D). We conduct some exploratory data analysis to better understand this result. When looking at the descriptive statistics in Table 5, one reason becomes obvious. More than half of the subjects appear to have no present bias or a future bias. Yet, we do not have a hypothesis for how these people should behave. When we restrict the sample to those with a present bias ($Present\ Bias < 1$), we observe that the coefficient on *Present Bias* has the expected sign in the regressions with *Mental Budget* as the independent variable ($\beta_{PB}/\sigma_{MB} = -0.99/1.37 \approx -0.72$, $p = 0.05$). In the regressions with *Narrow Goal* as the independent variable, *Present Bias* is not significant, but has the expected sign. The lack of significance might be due to the small sample size and the noisiness of the estimated *Present Bias* parameter.

Result 2 (Motivational Bracketing)

- a. *Setting narrow goals and having mental budgets are related phenomena of narrow bracketing* ($\beta_{NG}/\sigma_{MB} = 0.31/1.37 \approx 0.23$, $p < 0.01$).
- b. *Better realized self-control is associated with setting narrow goals* ($marg.effect_{SC} = 0.09$, $p < 0.001$) and *having mental budgets* ($\beta_{SC}/\sigma_{MB} = 0.09/1.37 \approx 0.07$, $p < 0.1$).

Table 10: Regressions: Motivational Bracketing

	(1)	(2)	(3)	(4)	(5)	(6)
	Narrow Goal (Logit)		Mental Budget (OLS)			
Endowment Integration	0.004		0.01	-0.04		-0.03
	(0.01)		(0.01)	(0.03)		(0.03)
Lottery Isolation	-0.03		-0.05	0.14		0.13
	(0.04)		(0.05)	(0.12)		(0.12)
Insurance	0.01		0.01	0.09*		0.06 [◇]
	(0.01)		(0.01)	(0.04)		(0.04)
Topical Account	-0.04		-0.06	-0.002		0.01
	(0.04)		(0.05)	(0.12)		(0.12)
Loss Aversion	0.001		0.002	-0.01		-0.01
	(0.01)		(0.01)	(0.01)		(0.01)
S-Shaped	0.05		0.06	0.05		0.06
	(0.04)		(0.05)	(0.11)		(0.11)
Narrow Goal				0.42***		0.31**
				(0.11)		(0.12)
Mental Budget	0.06***		0.04**			
	(0.02)		(0.02)			
Female		0.21***	0.20***		0.45***	0.28*
		(0.04)	(0.04)		(0.11)	(0.12)
Cognitive Skills Component		-0.01	0.002		-0.13**	-0.12*
		(0.02)	(0.02)		(0.05)	(0.05)
Self-Control Component		0.09***	0.09***		0.12*	0.09 [◇]
		(0.02)	(0.02)		(0.05)	(0.06)
Constant				2.47***	2.56***	2.40***
				(0.15)	(0.09)	(0.15)
R^2				0.04	0.06	0.07
N	628	626	610	628	626	610

Notes: OLS regression coefficients or logit marginal effects. Robust standard errors in parentheses. [◇] $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (Bonferroni correction for multiple comparisons at 5-percent significance level).

Mental budgets can also be motivated by a desire to simplify complex choice problems. In line with Prediction 3, *Mental Budget* is negatively correlated with the *Cognitive Skills Component* (significant Spearman correlation, borderline significant in the regressions with $p < 0.05$).

Result 3 (Choice Bracketing) *Subjects with higher cognitive skills are less likely to have mental budgets ($\beta_{CS}/\sigma_{MB} = -0.12/1.37 \approx -0.09$, $p < 0.05$).*

Exploratory Results. To refine our test for the relationship between cognitive skills, self-control, and motivational bracketing, we also included an interaction term between the *Cognitive Skills Component* and the *Self-Control Component* in the regressions. The coefficient on the interaction term is not significant (results are available upon request).

The absence of significant correlations between choice bracketing and motivational bracketing phenomena suggests that they are mostly distinct phenomena. An exception is the borderline significant correlation of *Insurance* with *Mental Budget* ($p < 0.05$ for the raw correlation and $p < 0.1$ in the regressions). The correlation is in line with a recent theoretical paper by Fels

(2016), which shows that small-scale insurance is attractive for a mental budgeter because it protects him against the risk of a loss that exceeds the mental budget available for remedying the loss. Consider, for example, a person who has a mental budget for vacation travel. If he missed a flight, he would not buy a new airline ticket in case his travel budget was tight – even though he could afford the ticket if he bracketed his income and wealth broadly. This result, together with the correlation between *Mental Budget* and the *Cognitive Skills Component*, does suggest that mental budgets both have elements of a choice error and of a self-control tool.

Finally, we observe that several of the narrow bracketing phenomena are related to the gender of the subjects. Women seem to be more prone to narrow bracketing than men. We observe a significant correlation between being female and motivational bracketing (*Narrow Goal* and *Mental Budget*, though the latter relation is only borderline significant in the regressions with $p < 0.05$). Further, being female is associated with a lower degree of endowment integration ($p < 0.05$ for the raw correlation and in the regressions), more small-scale insurance ($p < 0.01$ for the raw correlation and $p < 0.05$ in the regressions), and being more likely to have an s-shaped value function ($p < 0.001$ for the raw correlation and $p < 0.05$ in the regressions).

Result 4 (Exploratory Results.)

1. *Choice bracketing and motivational bracketing appear to be distinct phenomena, with the exception that having mental budgets is associated with being more prone to buying small-scale insurance.*
2. *Women are more likely to engage in motivational bracketing than men.*
3. *Women are more likely to exhibit certain choice bracketing phenomena than men: they are less likely to integrate experimental endowments, more prone to buying small-scale insurance, and are more likely to have an s-shaped value function.*

V Discussion

Our results did not confirm all the predicted correlations. For example, *Lottery Isolation* is theoretically explained by narrow bracketing *in conjunction with* reference dependent preferences. Yet, we do not find a correlation between *S-Shaped* and *Lottery Isolation*. The absence of significant correlations does not necessarily imply that the behavioral theories from which the predictions were derived are wrong.

Further, our study is purely correlational and points to correlations that are consistent with a certain theory. We cannot identify whether, for example, self-control problems are causal for setting narrow goals. In the following we discuss possible confounds, potential alternative explanations for our findings, and possible reasons for unexpected non-correlations.

Weak Predictive Power Across Situations. The estimated parameters of the value function may have a weak predictive power across situations. Such weak predictive power has been observed in other contexts. Blanco et al. (2011) let the same subjects play four games where inequity aversion plays a role. They use two of the games to estimate the parameters of inequity aversion and observe that the elicited parameters have little predictive power in the other two games. Similarly, Georganas et al. (2015) observe that the estimated strategic sophistication (level- k reasoning) in one game does not predict play in another similar game.

Noise in the Measures. The study ran online, and thus subjects might have read the instructions with less care than in a lab experiment. Even in the lab one cannot rule out that subjects click randomly through questions and choice tables. Further, some of our measures are self-reported, and the literature suggests such measures to be more noisy than incentivized measures (e.g., Camerer and Hogarth, 1999). The individual skills variables are only proxies

for the labeled skills. Thus, some of the unexpected non-correlations might arise because the variables are measured with too much noise.

Elicitation of Reference Dependent Preferences. As noted in Section III, to rationalize small-scale insurance or different answers in the lost ticket v. lost money question (i.e., *Topical Account*=1), one needs to augment standard prospect theory models by assuming that the reference point is expectation based. People might have reference dependent preferences, but not expectation based reference dependent preferences. Similarly, loss aversion might refer to different reference points in the price lists, in small-scale insurance, in the topical account, or when comparing pairs of lotteries. This could explain our finding that buying small-scale insurance and having a topical account do not correlate with the parameters of the value function.

In fact, the literature is inconclusive on what determines the reference point in price lists. Sprenger (2015) suggests that the fixed side of a price list serves as the reference point, while Castillo and Eil (2015) argue for the status-quo. Subjects might exhibit less risk aversion because they are drawn to the fixed option in the choice list, which is a lottery in our setting, or because of a status quo bias. Thus, some of the observed non-correlations could arise because our estimates are biased against finding loss aversion.²

Small-Scale Insurance and Liquidity Constraints. Sydnor (2010) points out alternative reasons for buying small-scale insurance: overweighting of small probabilities and social pressure by the salesman, which we cannot test for with our data. Further, our participants are students,

²More broadly, Karni and Safra (1987) show that if subjects violate the independence axiom, choice list experiments may fail to be incentive compatible. For pairwise choices that involve a certain payment (like in our setting), Freeman et al. (2015) find that subjects exhibit less risk aversion when choices are embedded in a choice list than if choices are presented as a single decision problem. On the other hand, the delay in payments may bias towards finding more risk or loss aversion, because Keren and Roelofsma (1995) observe that subjects make more risk averse choices when payments are delayed by a year than if they are immediate.

who often are cash- and borrowing-constrained. Because of such constraints a student may anticipate that he could, for example, not buy a new bicycle to replace a stolen one. Small-scale insurance hence could be due to such constraints rather than narrow bracketing (cf. Fels, 2016).

In the survey, we ask students about the maximum amount of money they are able to pay out of their own pocket within the next 3 days (350 kr., 700 kr., 1500 kr., 2000 kr., 3500 kr., 7000 kr., more than 7000 kr.) Those whose liquidity within the next 3 days exceeds 7000 kr. (\$1170) less often buy small-scale insurance than those whose liquidity is below 7000 kr. We reject that insurance choices for the two groups are drawn from the same distribution (Mann-Whitney, $p=0.04$).

What are the implications for our correlations with *Insurance*? In additional regressions, we observe that if we consider the subsample with liquidity less than 7000 kr. ($N = 314$), *Mental Budget*, *Female*, and the *Cognitive Skills Component* are no longer significant. But for the subsample with high liquidity ($N = 296$), results are qualitatively similar to our earlier findings in Table 8.³ These results suggest that liquidity constraints do play a role in small-scale insurance. However, for subjects who do not face binding liquidity constraints (e.g., they could easily replace a stolen bike), having mental budgets makes them more prone to buying small-scale insurance.

Self-Reported Measure of Self-Control. While self-reported measures have some disadvantages, so does eliciting time preferences with incentivized tasks. Duckworth and Kern (2011, p.265) suggest that there is “no evidence for differences in convergent validity among hypothetical, repeated trials, sustained, or real choice delay of gratification tasks.” The Brief Self-Control

³ $\beta = 0.10$, $p=0.06$ for *Mental Budget*, $\beta = 0.34$, $p=0.04$ for *Female*, and $\beta = -0.11$, $p=0.17$ for the *Cognitive Skills Component*.

Scale exhibits good external validity, correlating for example with grades and substance abuse (Tangney et al., 2004).

Reassuringly, our findings are robust to using either the survey-based *Brief Self-Control Scale* or the incentivized measure *Present Bias*. Note, however, that the scale is not a direct proxy for the present bias, i.e., the two are conceptually different measures. The scale measures a person's perception of actual self-regulation, and thus has some limitations. Perceived good self-regulation can stem from a lack of self-control problems (i.e., a high β) or from a low β coupled with good self-regulation skills of the person. Consequently, *Present Bias* and the *Brief Self-Control Scale* can in theory be positively or negatively correlated (see online appendix C). The observed correlations indeed are inconclusive. If we consider the full sample, both measures correlate positively (Spearman $r = 0.19$, $p = 0.002$). If we consider only subjects with $\beta \leq 1$, they do not correlate (Spearman $r = 0.04$, $p = 0.56$).

Elicitation of Time and Risk Preferences and Narrow Bracketing. When eliciting time and risk-preferences, we follow the literature before us in implicitly assuming that a subject brackets narrowly the experimental decisions (see, e.g., Andersen et al., 2008 and Dean and Sautmann, 2016 for discussions of the bracketing issue). That is, any loss aversion or evidence of an s-shaped value function that we observe in this experiment is evidence for narrow bracketing. As a consequence, we count the elicited parameters of the value function as another form of narrow bracketing.

A similar caveat applies for the variable *Present Bias* (the procedure by Augenblick et al., 2015 alleviates the concern, but not fully). A correlation with the motivational bracketing variables could arise because *Present Bias* captures another form of narrow bracketing and not because the variable captures self-control problems. The alternative, survey-based *Brief Self-Control*

Scale does not have this issue.

Selection into the Study. Using data from the student registers of Aarhus BSS, we observe that the proportion among survey participants of women (0.55) and econ students (0.09) is significantly higher than for the overall cohort (0.49 and 0.06, respectively) but that there is no significant difference in age. As we observe a tendency that women are more prone to narrow bracketing, we might have a slight upward bias in the occurrence of narrow bracketing. A dummy variable for being an econ student is always insignificant if added to the regressions for the narrow bracketing measures.

VI Conclusion

We examine whether different phenomena of narrow bracketing relate to each other and to certain individual characteristics in the way predicted by the main behavioral models of narrow bracketing. We find evidence for motivational bracketing. Consistent with the hypothesis that mental budgets or narrow goals are strategies to achieve self-control, the two narrow bracketing phenomena are correlated with each other, and they are associated with higher self-control. We find mixed evidence for a unifying explanation of choice bracketing phenomena. Only few of the relevant narrow bracketing phenomena correlate with each other or with cognitive skills. Finally, it appears that motivational bracketing and choice bracketing are distinct phenomena because they are not correlated with each other, with the exception that people with mental budgets appear to be more prone to buying small-scale insurance – as predicted by the recent theoretical model of Fels (2016).

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