Scarcity of time and saving behaviour

The effects of time scarcity on cognitive functioning and time saving: an online experiment

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Table of Contents

Abstract

Scarcity of any kind of resource leads to cognitive load followed by poor decision-making. Time scarcity is a frequently occurring problem and has a negative impact on economic behaviour such as borrowing. Previous research has shown that saving behaviour is also affected by money scarcity as the act of saving requires cognitive capacity, however, scarcity of time has not been linked to it yet. This study examines the relationship between time scarcity and saving behaviour. An online experiment was conducted (n = 170) to test whether scarcity of time affects decision-making with regard to saving while one performs on a cognitive test. In the 2 x 2 between-subjects design, participants were assigned either a high (time-rich) or a low (time-poor) time budget to manipulate time scarcity. Moreover, in two conditions a saving option was implemented to observe saving behaviour. Raven's Progressive Matrices test was used to alter cognitive capacity and task performance was determined by the score on this test. Results show that the option to save has a positive effect on performance for the time-rich and no effect for the time-poor. Moreover, participants experiencing scarcity had lower relative saving rates but a higher score efficiency. No narrowed visual attention effects were found. Implications are in line with the existing scarcity literature, suggesting creating slack to escape one's scarcity loop. In addition, it is suggested that the enhanced focus that scarcity induces should be used to increase saving rates. Future research should focus on ways to implement the proposed solutions and identify other solutions.

Introduction

Spending is more fun than saving. It leads to pleasure in the moment by having a new fancy product or amusing experience right now. Most humans are born to seek for this instant gratification as can be concluded from the marshmallow test. In this famous experiment, toddlers are left behind in a room with one marshmallow. They are instructed not to eat the candy in order to get another one. The conclusions drawn from the experiment have received some criticism over the years, but the main observation is clear: a lot of the children prefer to eat the marshmallow rather than save it (Mischel, Ebbesen, & Zeiss, 1972).

According to a survey of Bankrate, 20% of Americans do not save at all (Tepper, 2018). In another survey, GOBankingRates found that 57% of the Americans have less than $1000 on their savings account (Huddleston, 2017). In the Netherlands, where it is encouraged by the Nibud (National Institute for Family Finance Information) to save at least €3.400 for people without a family, around 37% has less than €3000 as savings (Prins & de Boeck, 2018). Moreover, a declining trend in saving rates can be observed (see also figure 1): personal saving rates dropped with ten percent between 1980 and 2004 (Garner, 2006) and American's high spending and low saving behaviour in 2018 was not so extreme since the period before the great depression (La Monica, 2018). The declining saving rates cannot be explained by other economic trends since the economy in 2019 is booming and the unemployment rate in the US is 3.9%, the lowest since the 1970s (Tradingeconomics.com, 2019). Saving too little is not

only bad for the far future, but lacking a sufficient saving account may also result in an inability to deal with financial setbacks such as a broken fridge or medical issues. Moreover, Econsult Solutions (2018) and UK Essays (2018) have indicated that poor personal saving rates can negatively influence the state of a country as there is less money for investments.

Figure 1: United States personal savings rate from 1959 to 2019. The y-axis represents the ratio of personal income saved to personal net disposable income. Source: Tradingeconomics.com; U.S. Bureau of Economic Analysis

Another trend in today's society is the increased time pressure people experience (Menzies, 2009). Time is a big factor in consumer behaviour and affects spending behaviour (Hornik & Zakay, 1996). It is nowadays possible to send a work-related email while having drinks in a bar or buy tickets for a popular concert while being on the train. As a result, it becomes the norm to multi-task. When deadlines are approaching or subjectively feel close, people work harder and deal more effectively with their time to finish a specific task (Ariely & Wertenbroch, 2002; Kurtz, 2008). However, focussing on one deadline comes at the cost of other tasks as they these other tasks now get less attention, for example enjoying the bar or having a chat with the person next to you in the train. For these tasks and activities, there is not enough time: scarcity of time arises.

Scarcity is the state in which an individual is lacking a resource which he or she requires at a specific point in time such as money, time, or knowledge (Mullainathan and Shafir, 2014). In their book 'Scarcity', Mullainathan and Shafir (2014) explain that scarcity of any kind affects cognitive functioning, therefore influencing decision-making and behaviour. The scarcity-mindset is an important phenomenon to understand as it can help explain economic behaviour such as borrowing and saving. For example, people with a low-income relatively save less even though saving would be highly beneficial for them (Shurtleff, 2009) and tend to borrow at high interest rates (Aleem, 1990). One might argue that for the poor there is nothing to save and in order to meet their needs and obligations they sometimes have no choice other than to borrow. However, the cognitive functioning theory of Mullainathan and Shafir (2014) which will be discussed in the literature review explains why scarcity

is rather a cause of poor saving behaviour instead of a consequence. It is important to note that a reference to 'poor people' does not necessarily mean people who have no money. Poor in the scarcity literature means people who are scarce in any kind of resource. This will be applied throughout this whole paper.

The solution for the scarcity problem that is widely proposed throughout related literature is creating slack. Creating slack implies having temporarily too much of a resource which reduces the stress to obtain that resource. This can often be achieved by a higher instance such as the government or a company. For example, management of an organisation can induce organisational slack by offering its employees more time for development during work instead of keeping tight deadlines for assignments (Kerfoot, 2006). Researchers such as Lurtz (2019) proposed creating slack after studying the effects of time and financial scarcity on economic behaviour and Monahan and Cotteleer (2016), who consult leadership, also recommend the slack solution for people experiencing scarcity.

Time scarcity is a concept that belongs to the general scarcity phenomenon. Although the effects of time scarcity have been researched and reviewed extensively (Shah, Mullainathan, & Shafir, 2012; Shah, Shafir, & Mullainathan, 2015; Tomm & Zhao, 2017), the impact on saving behaviour is not yet widely studied. A variety of interventions like partitioning of earmarked money (Soman & Cheema, 2011) and saving reminders (Karlan, McConnell, Mullainathan, & Zinman, 2016) to increase savings rates have successfully been tested on individuals and households with low income, but these treatments were mainly focussed on people who were scarce in money. Little is known about the time-scarce factor in saving behaviour. This paper attempts to study the relationship between scarcity of time and saving behaviour in order to suggest alternative and more effective policies and interventions to increase savings rates.

Literature review

Scarcity trap

The scarcity-mindset is a different way of thinking and functioning due to lack of any kind of resource (Mullainathan & Shafir, 2014). As the mindset causes a vicious circle, a scarcity trap is created (Monahan & Cotteleer, 2016), also referred to as poverty trap or poverty loop in the literature. The decisions made due to scarcity of any kind of resource lead to situations in which scarcity can be even more present. Haushofer and Fehr (2014) describe the poverty loop more precisely. They argue that poverty causes stress and negative affective states which are followed by time discounting, valuing a good received at an earlier stage more than receiving that same good later (Frederick, Loewenstein, & O'Donoghue, 2002), and risk-averse decision-making, where one's decisions are made in order to lower

uncertainty. Time discounting and risk-aversion strengthen the effect of poor decision-making, resulting in a self-sustained scarcity loop (Haushofer & Fehr, 2014). Boswell Dean, Schilbach, and Schofield (2018) confirm the poverty trap theory and specifically highlight the role of cognitive functioning. According to their research, when cognitive functions such as attention and inhibitory control are affected due to reduced bandwidth, poverty loops are created and vice-versa. Such a cycle might be the most concerning effect of scarcity: once one is trapped in it, it is hard to get out.

Reduced bandwidth

"Poverty itself taxes the mind (Mullainathan & Shafir, 2014, p.60)". This ambiguous statement implies that having scarcity of any kind of resource affects the mental functioning of an individual. Lacking sufficient resources creates cognitive load and reduces bandwidth: the capacity to perform activities such as solving a problem and paying attention is getting depleted (Mani, Mullainathan, Shafir, & Zhao, 2013; Mullainathan & Shafir, 2014; Schilbach, Schofield, & Mullainathan, 2016; Zhao & Tomm, 2018).

First of all, scarcity affects one's cognitive capacity, also called fluid intelligence. Mani et. al (2013) showed that performance on a task which requires logical thinking and problem-solving skills decreases when people are cognitively loaded beforehand. In their research, Mani et. al (2013) created cognitive load by giving participants hard financial situations to think about. Participants with a low-income were required to fully use their cognitive capacity as the presented financial situations were evoking their own financial state. Only these people showed a significant decrease in test scores on a cognitive task after the presentation of the situations, while for participants with a high-income presenting the financial situations did not influence task performance. There is also field evidence for this particular relationship between scarcity and cognitive capacity. The fluid intelligence used for thinking and reasoning abstractly in order to solve problems is lower for farmers during the period before harvest compared to after harvest (Mani et. al, 2013). Due to their money scarcity before harvest, farmers have more difficulty in dealing with their financial obligations, thereby depleting cognitive capacity.

Secondly, scarcity negatively impacts executive control. Poor people tend to do more secondary eating (unconscious eating while doing another activity) during shopping (Spears, 2011). This bad habit is harder to resist for them compared to rich people as inhibiting actions is part of executive control. In addition, people who are faced with difficult trade-off choices are more likely to choose the 'bad' outcome such as unhealthy food instead of healthy and an entertaining movie instead of an educative one (Wang, Novemsky, Dhar, & Baumeister, 2010). Furthermore, when people are either money or calorie scarce (when they are only allowed to choose food up to a specific number of calories), they focus more on information on a menu which is relevant for them (Tomm & Zhao, 2016). By having attentional prioritisation on either calories or prices, they are more likely to remember and recall the

information relevant to the scarce resource. However, simultaneously, other information that might be useful to these scarce people such as discount advertisements are more neglected. This narrowed attention of the poor is conceptualised by Mullainathan and Shafir (2014) as tunnelling: "scarcity leads us to tunnel and neglect other, possibly more important, things (Mullainathan & Shafir, 2014, p.29)". Another function of executive control which can also be depleted is self-control (Beaver, Wright, & Delisi, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010). Self-control enables one to inhibit and regulate both temptations and impulses. Once depleted, people start acting less resistant to undesired behaviour such as impulse buying (Vohs & Faber, 2007). Moreover, self-control is also linked to time-discounting. Self-control problems can be explained by models of hyperbolic discounting, a form of time-discounting (Angeletos et. al, 2001; Laibson, 1994). People who behave according to hyperbolic discounting have a present bias in which gaining utility in the present is preferred over utility in the future (Frederick et. al, 2002). Relating to scarcity, Haushofer and Fehr (2014) put time discounting as an important component in the poverty loop. To conclude, combined with the effects on cognitive capacity, affecting one's executive control leads to irrational decision-making and undesired behaviour.

A test that is often used to impact or assess cognitive capacity is the Raven's Progressive Matrices test (Raven, 2000). The original test includes 60 matrices which a participant has to solve within 45 minutes. These matrices are a way to test fluid intelligence: the cognitive capacity that is used to solve problems independent of prior knowledge (Boswell Dean et. al, 2018; Engle, Tuholski, Laughlin, & Conway, 1999; Raven, 2000). Hence, at the same time, it can be a way to cognitively load an individual. As the test does not rely on acquired knowledge or skills, it is widely used in the scarcity literature (Mani et. al, 2013; Mullainathan & Shafir, 2014; Tomm & Zhao, 2017). For example, Mani et. al (2013) assessed the farmers with a Raven's Matrices test before and after harvest to determine the effect of scarcity on fluid intelligence. The test is a convenient universal tool to measure or alter one's cognitive capacity.

Scarcity of time

In general, poverty implies scarcity of financial resources. Nevertheless, various papers have studied the topic time scarcity and how it affects decision-making. Time scarcity is present when people are limited in their time budget to complete a task or activity. With regard to executive control, the attention of people is affected when being in a time-poor situation (Tomm & Zhao, 2017). This conclusion was based on an experiment in which people under time pressure did not monitor time-saving cues. These cues were created to improve one's score on the Raven Progressive Matrices test. In contrast, time-rich people were able to identify and make use of these hints. Besides spatial texts and objects, other contextual clues are also neglected during scarcity. When estimating the valuation of a potential loss in time budget during a trivia game in which time limits play a role, time-poor people are less biased by the phrasing in which the valuation question is asked (Shah et. al, 2015): contrary to the time-rich, time-poor participants were indifferent in incurring the loss when primed to think of their overall budget

compared to when they were primed to think of their budget per trivia question. Furthermore, time scarcity reduces creativity, adequacy, and originality on planning tasks, resulting in lower quality of work performance (Karau & Kelly, 1991). Based on several experiments, Shah et. al (2012) identified the effect of time scarcity on borrowing behaviour. They concluded that those who had a low time-budget to complete a trivia game borrowed more time than they needed: they overborrowed. This conclusion was confirmed by observing that the time-poor people, people scarce in time, performed worse during the game when they had the option to borrow compared to those who did not have the borrowing option. In other words, the time-poor participants could not deal with the possibility to borrow time, affecting their behaviour. In contrast, the time-rich, those with a large time budget, showed no difference in performance regardless the borrowing option. Similar results were obtained in a second experiment, where participants played a video game and had to shoot targets. Furthermore, in another experiment in which all participants were shown a preview of the next question as a tool to help them decide whether to borrow time or not, time-poor people still overborrowed (Shah et. al, 2012). The discussed paper proves that scarcity of time affects cognitive functioning in both cognitive capacity, as task performance decreases, and executive control, as the attention for the preview of the next question in the trivia game is absent. Therefore, time scarcity cannot be neglected when studying the behaviour of individuals.

Cognitive load for saving behaviour

The scarcity trap implies that poor people make certain decisions that keep them poor. Economic behaviour is the type of behaviour in which such a vicious circle can be best described since cognitive functioning plays a large role in it. Affected cognitive functioning is resulting in less saving and more borrowing (Mullainathan & Shafir, 2014; Shah et. al, 2012). For example, self-control, a cognitive function, is crucial for saving (Jamal, Ramlan, Mohidin, & Osman, 2016; Karlan, Ratan, & Zinman, 2014; Nyhus, 2002; Schilbach, 2019) and borrowing (Angeletos, Laibson, Repetto, Tobacman, & Weinberg, 2001; Heidhues & Köszegi, 2010). Moreover, people with lack of self-control have trouble with saving and resisting borrowing as a result of their time preference (Angeletos et. al, 2001; Daminger, Hayes, Barrows, & Wright, 2015; Mullainathan & Shafir, 2014). In addition, Lawrance (1991) found that time preference for permanently low-income families is greater than for the high-income ones, arguing that this affects consumer behaviour such as different savings patterns among the poor. Hence, executive control, with self-control in particular, is an important factor in saving and borrowing behaviour. When challenged by scarcity, it can get depleted and alter economic decisions.

The act of saving seems to demand a part of the bandwidth for cognitive functioning. Since people can fully neglect important information or cues when cognitively loaded due to scarcity (Tomm & Zhao, 2016; Tomm & Zhao, 2017), it is expected that *Time-poor people are more likely to neglect the possibility to save (H1)*. Furthermore, cognitive load decreases cognitive capacity (Mani et. al, 2013).

With regard to scarcity of time, this has already been tested on borrowing behaviour (Shah et. al, 2012). The current study focuses on saving behaviour, and based on the results of those previous experiments, the following hypotheses are suggested: first of all, *Time-rich people have an overall higher performance on a task when they have the option to save compared to when they are not allowed to save (H2a)* as people not experiencing scarcity can make use of the saving option to increase their wealth or performance. Secondly, *For time-poor people, having the option to save does not influence overall performance on a task (H2b)* since poor people are tunnelled on the main task, failing to utilise the saving option to increase their overall performance. For these hypotheses it is assumed that saving comes with certain benefits such as an interest rate and the need for resources in the future.

Decrease in saving and increase in borrowing due to scarcity

When two similar people face identical constraints to achieve a goal, but one is poorer in budget than the other, the one with the low budget will borrow more if he wants to reach the same target as the one with the high budget (Mullainathan & Shafir, 2014). As borrowing often comes with extra costs by means of an interest rate, the financially poorer person eventually spends more. To get a better understanding of the relationship between scarcity and economic behaviour, several other studies have been conducted in the field of scarcity. These studies, presented in the following two paragraphs, have shown that the scarcity mindset directly impact saving and borrowing behaviour.

Sawady and Tescher (2008) argue that low-income people have a deviating reasoning system compared to people who are richer. This system is established as a consequence of being poor since being poor results in a more fluctuating and insecure life, leading to a greater focus on short-term needs. Such reasoning evokes different financial decision-making when it comes to borrowing and saving (Sawady & Tescher, 2008). The behavioural motives countering the intuition that these people are just unable to save become clearer when looking at middle-class people. These people have a stable income over time. Lurtz (2019) marked the low-income households within this middle-class as objectively scarce and compared them with the top ones, keeping in mind that low-income here does not necessarily mean poor. She found that financial scarcity, both objective (factual scarcity) and subjective (perceived scarcity), increases the chance of saving for short-term needs, while it decreases savings for retirement (Lurtz, 2019). Even though these people are able to save for future needs, they prefer spending their money on things they want in the present. In addition, Lurtz (2019) found that especially subjective financial scarcity results in an increase of luxurious products purchased due to the desire to compensate for one's perceived poverty. As a result, long-term goals and savings are the victims of this behaviour. Moreover, Banerjee and Mullainathan (2010) show with models of declining temptation for goods that poverty traps do not occur randomly as people with a low income in the present save too little: poor people tend to have a greater consumption urge for goods which provide temptation relative to rich people, resulting in less savings. Saving is often outside the tunnel – the narrowed focus – of an

individual experiencing scarcity and without any extra effort or help, it is extremely difficult for poor people to start the act of saving (Karlan et. al, 2016; Mullainathan & Shafir, 2014).

The same tunnelling theory applies for borrowing. When people are scarce in resources, they tend to borrow at the cost of future needs as they are focussed on the present (Mullainathan & Shafir, 2014). Comparable to the reluctance to save, where the consequence is that resources are lacking in the future, borrowing creates debt which has to be dealt with later. For example, borrowing time from the future by postponing a task, so that there is more time for something else in the present, can put someone in the scarcity mindset cycle (Monahan & Cotteleer, 2016). Objective time scarcity can also lead to higher financial debt for households since they spent less time considering their borrowing decisions (Lurtz, 2019). The time scarcity experiments of Shah et. al (2012), where time-poor participants overborrowed time during a trivia game, are another example. Furthermore, routinely borrowing instead of only lending money for emergency cases is often observed under poor people (Banerjee & Mullainathan, 2010). In the end, whether it is due to saving too little or borrowing too much, people under scarcity make their decisions in a way that they are unnecessarily worse off.

Although Shah et. al (2012) studied the effect of time scarcity on borrowing behaviour, previous studies have only considered money scarcity as scarce resource in relation to saving behaviour. There is a gap in the literature when it comes to time scarcity and saving behaviour. Hampshire Trust Bank (2018) discovered that businesses often fail to open savings accounts as they are short of time, but this cannot be generalised to individuals. Therefore, this paper targets this gap by conducting an experiment to identify the relationship between scarcity of time and saving behaviour. Considering the negative effects of scarcity on other behaviours (Mani et. al, 2013; Shah et. al, 2015; Tomm & Zhao, 2017) with borrowing in particular (Shah et. al, 2012), it is expected that *Time-poor people relatively save less than people who do not experience time scarcity (H3)*. Relative numbers should be measured for this hypothesis. Time-poor people have less time to save and therefore absolute values between time-poor and time-rich individuals cannot be compared to make a valid conclusion.

Positive side effects of scarcity

Despite the negative impact of scarcity on cognitive functioning, there are some short-term advantages. The upside of tunnelling is the enhanced focus one can get for what seems important in the moment. Karau and Kelly (1991) explored this by giving participants planning tasks and different time limits. Those who experienced time scarcity had a greater attentional focus on task-related activities than the ones with optimal time or time abundance. On the other hand, non-task activities were given less attention, which is in line with the tunnelling phenomenon that scarcity induces. Improved memory encoding of information related to the scarce resource is another benefit that comes along with the enhanced focus (Tomm & Zhao, 2016). Various other researches also demonstrated the upside of

scarcity. Group meetings are more efficient in the second half of the meeting as time is running out (Gersick, 1988), undergraduates are better at proofreading essays when given tighter deadlines (Ariely & Wertenbroch, 2002), and when playing a shooting game, those who are allowed to release less shots shoot more accurately (Shah et. al, 2012). In addition, Shah et. al (2015) find consistent results regarding the positive effect of scarcity and explain that scarce people rely less on external factors and are more effective in trade-off thinking. Because this paper wants to capture the whole relationship between time scarcity and saving behaviour, these findings should not be neglected. The increased focus that scarcity can induce is therefore also studied in this research: *(H4) Time-poor people have a higher efficiency on their main task*.

Current study

Taken together, scarcity of time affects cognitive functioning (Mani et. al, 2013; Mullainathan & Shafir, 2014; Schilbach et. al, 2016; Zhao & Tomm, 2018) and therefore economic behaviour such as borrowing (Lurtz, 2019; Mullainathan & Shafir, 2014; Shah et. al, 2012). Saving is also affected by scarcity, but previous research has only identified a relationship with financial scarcity (Lurtz, 2019; Karlan et. al, 2016) and not time scarcity. The current study attempts to fill in this gap by looking at the impact of time scarcity on saving behaviour based on an experimental study. In addition, none of the studies who examined time scarcity and borrowing behaviour used cognitive tests in their experiments. For example, Shah et. al (2012) used a trivia game to measure performance under scarcity. However, a trivia game partly relies on prior knowledge and does not fully impair subjects with cognitive load. The current study implemented Raven's Progressive Matrices test proposed by Mullainathan and Shafir (2014) and used by scarcity studies of Mani et. al (2013) and Tomm and Zhao (2017). The original test consists of 60 matrices, each designed as a puzzle, and is proven to rely on cognitive capacity only (Raven, 2000). Hence, it is powerful tool for measuring the effects of scarcity. In the end, conclusions drawn from the test with regard to the relationship between time scarcity and economic behaviour are more reliable. For the current study, a 12-item version was created according to the method of Arthur Jr and Day (1994) due to limited recruitment resources.

An online experiment was conducted. A higher expected recruitment rate was the main argument to conduct the experiment via an online platform rather than recruiting participants in person one by one. First of all, distributing an online link to the experiment was less time consuming than conducting it in the lab, considering the little time available for recruitment. The convenience for potential subjects to participate in the experiment was also greater as they could do it in their own time, place, and on their own device. In addition, since time was an important variable in the experiment, a digital experiment would make measurements more accurate. In the experiment, a 2 x 2 between-subjects design was used

in order to analyse saving behaviour and time scarcity. Participants were randomly assigned to one of the four conditions and had either no saving option or a saving option combined with either a high time budget or a low time budget. Comparing different treatment groups, the effect of time scarcity on saving behaviour could be tested as well as the effect of the saving option on task performance and task efficiency. As a result, conclusions regarding the five hypotheses could be drawn with as main goal to identify the relationship between scarcity of time and saving behaviour.

Methodology

For this experiment, ethical approval by the Erasmus School of Economics has been registered under nr 2019/06/10-66842svz.

Participants

The G*Power calculator (Faul, Erdfelder, Lang, & Buchner, 2007) was used to determine the minimum required sample size. With an effect size of 0.6, similar to Tomm and Zhao (2017), a minimum of 37 subjects per condition was required to have a power of 80%. As there were four conditions in the experiment, the aim was to recruit at least 148 participants. The recruitment was done by online distributing the link to the experiment via email and WhatsApp. Any individual above 18 was able to participate.

Initially, 279 people were recruited and started the experiment. The Raven's Progressive Matrices test which was included in the experiment requires a participant to complete the whole test. Otherwise, the measured fluid intelligence is not accurate. Therefore, the recordings of 104 people were not saved in the dataset as they did not finish the experiment. From the remaining 175 participants, five subjects were removed from the sample. Three participants did not understand the saving option and saved their full budget every round. As a result, they unintentionally skipped three rounds of questions, which highly affected their test score. Two other subjects had very deviating scores compared to those in the same condition: with both a score of 2, their performance was laying more than three standard deviations from the mean of the condition they were in. Therefore, these observations were also removed. Eventually, 170 subjects, more than the minimum requirement, successfully completed the experiment and were included in the dataset for the analysis. From this sample, 74 were females, and the age ranged from 18 to 72 (mean = 27.23, SD = 11.78). Considering education, 57 subjects had high school as their highest achieved level, 81 people completed a bachelor's degree at either university (60) or university of applied sciences (21), and 32 subjects had obtained a master's degree. In 136 cases,

The Netherlands was the country of birth. Nineteen participants were Indonesian, while the rest of the sample had various backgrounds with three or less respondents per different country. The duration of the experiment ranged between 3.5 and 20.5 minutes (mean = 8.5, SD = 3.2). The different assigned time budgets for the implemented Raven test caused the large variation of the experiment's duration. Cognitive capacity was required to complete the assessment. To ensure that the participants performed to their capacity they were incentivised by a monetary reward via the binary lottery incentive system: for each point on the test they earned a ticket with which they could win a prize, so the higher their test score, the greater their chance for a prize. The prizes were two gift cards of their choice to the value of 30 and 20 euros. The prizes also served as an incentive for people to initially participate in the experiment.

Design

A 2 (time-rich vs. time-poor) x 2 (option to save vs. not the option to save) between-subjects design was used in the experiment. The independent variables were time budget (time-rich vs. time-poor) and saving option (option to save vs. no option to save). Subjects were randomly assigned to one of the four conditions (sample sizes per condition are shown in table 1). Both saving option and time budget were binary variables.

Table 1: Sample sizes of the four conditions of the 2 x 2 between-subjects design.

	Saving option		
Time budget	*No option*	*Saving option*	*Total*
Time-poor	43	42	85
Time-rich	44	41	85
Total	87	83	170

The main dependent variables of this study were performance and relative amount of time saved. Performance was determined by the number of correctly solved matrices. Each matrix in the first five rounds was worth one point, whereas the matrices of round six were worth three points. The same logic was applied for the lottery tickets participants could earn: correct matrices in the first five rounds gave a respondent one ticket, a correct matrix in round six was worth three tickets. The relative amount of time saved was derived from the questions in which subjects could indicate how much time they wanted to save in each round. Standardised savings were used in order to compare the time-poor with the time-rich group. This was calculated by taking the total amount of a subject's time saved divided by the total amount of time that could maximally be saved. In addition, the binary variable any savings was created. Participants in the two groups which were able to save were assigned a 1 if they used the saving option

at least once and a 0 if they did not use it at all. Lastly, the efficiency per minute variable was computed. Dividing the test score of a participant by the minutes he or she spent on the test resulted in the rate of number of correct questions per minute. The higher this number, the more matrices the subject solved correctly relative to the time he or she spent on the test. The time spent on the test was measured from the time the participant entered round one of the assessment to the moment he or she proceeded to the demographics page after round six.

Materials

The experiment was created using the software Qualtrics. A survey format was used so that both demographic questions and the assessment could be implemented. The assessment consisted of 12 Raven's Advanced Progressive Matrices. These matrices are a way to test fluid intelligence, therefore testing the cognitive capacity that is used to solve problems independent of prior knowledge (Boswell Dean et. al, 2018; Engle et. al, 1999; Raven, 2000). The original test includes 60 items. However, the time limit for this number of matrices is 45 minutes. Such a long test would highly increase the difficulty of recruiting participants given the offered incentive to participate. Arthur Jr and Day (1994) developed and tested a 12-item Raven's Advanced Progressive Matrices test and demonstrated that this shortened version was still effective in measuring fluid intelligence. The effectiveness of the short version was later confirmed by Arthur Jr, Tubre, Paul, and Sanchez-Ku (1999) based on normative data. As a result, the 12-item test by Arthur Jr and Day (1994) was used in this experiment.

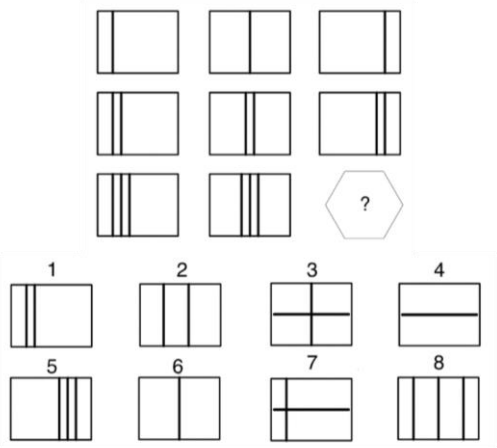

Figure 2: A Raven Progressive Matrix. The participant has to choose one of the 8 figures that fits on the '?'.

Each item of the Raven test is a three by three matrix of figures representing a vertical and horizontal sequence (figure 2). The bottom right figure is left empty. The goal of the participant is to find this

matching figure based on the patterns of the other eight figures. One can choose the right figure from eight possible answers: it is a multiple-choice test. Furthermore, the difficulty of the matrices gradually increases as the test proceeds.

Procedure

Subjects could complete the experiment on any device with a web browser such as a phone, tablet, computer, or laptop. Considering the different formats, the experiment was made mobile-friendly. Depending on the device, subjects were shown the appropriate version of the experiment. Since a non-distracting environment is an important factor when completing the Raven's Progressive Matrices test, participants on their phone were asked to turn on the 'do not disturb' feature to prevent them from receiving notifications. The experiment consisted of three main blocks: the instructions, the assessment (the matrix test), and demographic questions. Only the assessment had a particular time limit. A randomiser element in the software assured equal distribution among the four conditions. The element counted the number of participants in each group who finished the experiment and then assigned any new subject to the group with the lowest number. As a result, participants who quit during the experiment did not count for the number of subjects per condition. After a subject was randomly assigned to one of the four conditions in the 2 (time-rich vs. time-poor) x 2 (option to save vs. not the option to save) design, instructions were shown in which Raven's Progressive Matrices test was explained. Moreover, a practice round was implemented including two practice questions and, if applicable, the saving question was presented to give the participant a better understanding of the assessment. Performance and behaviour during this round did not affect any score used for the analysis and participants were made aware of this. In the two conditions with the saving option, subjects were explained how they could save time. Lastly, the assigned time budget to complete the assessment was given in the instructions. Overall, the instructions and incentives were designed so that the ultimate goal of the participant was to have as many correct matrices as possible. Highlighting this as the main task was important for the hypotheses related to cognitive load.

The matrices of the Raven test are normally shown one by one. To implement the saving option in this experiment, the assessment was divided into six rounds. Each round included two items of the 12-item Raven's Progressive Matrices test and was displayed on a separate page. There was no break between each round. According to Arthur Jr and Day (1994), the 12-item version has an average completion time of 15 minutes. Therefore, time-rich subjects were given 15 minutes to complete the 12 matrices, taking into account that a Raven test is not designed to let a participant complete the whole test. In contrast, the time budget of the time-poor participants was only four minutes which is approximately one fourth of the high time budget, a ratio similar to the experiment of Tomm and Zhao (2017). As a

result, the time-rich had 2.5 minutes to complete a round while the time-poor got 40 seconds. Two timers, one at the top and one at the bottom of each page, indicated how much time a participant had left for the current round. The round was automatically skipped to the next round, so the next page, if the time limit was reached and a participant could not go back to the previous round. In the conditions with the option to save, an extra question was added in rounds one to four. This question served as the saving option and was placed after the two matrices of each round: it was the third item of the round that participants had to deal with while the timer was still counting. In this item, subjects could precisely indicate how many seconds they wanted to save for the last round using a slider ranging from 0 to 40 or 150 (depending on the assigned time budget). The saved time would then be subtracted from the time limit of the subsequent round and added to the last round. If, for instance, a subject decided to save five seconds at the end of round one, these five seconds would be subtracted from his or her time limit in round two. Depending on being in the time-rich or time-poor group, the subject would then have either 145 seconds or 35 seconds to complete round two. Participants were told in the instructions that questions further in the assessment were more difficult and that in the last round each correct question would be worth three points, so three tickets, instead of one: in this way, the incentive for saving was created. As a result, the maximum amount of points that could be scored was 16: ten points for the first ten matrices and six points for the last two matrices. Furthermore, there was an interest rate of 2 on the saved time, similar to the time scarcity experiments of Shah et. al (2012). For example, if a time-poor subject indicated at the end of round two to save ten seconds, his time limit for round three would be 40 - 10 = 30 seconds; 10 * 2 = 20 seconds were then added to the time limit of round six. In appendix A, the instructions, matrices, and questions of the experiment are presented.

Statistical Analysis

To test the effect of time scarcity on the likelihood that the saving option is used (*H1*), a chi-squared analysis was conducted. The categorical variables time budget (time-rich vs. time-poor) and any savings were used in this analysis. Afterwards, several Mann-Whitney U tests were performed to test the remaining hypotheses since for each hypothesis two classes were compared to each other (either time-rich vs. time-poor or saving option vs. no saving option). First of all, test scores between the two saving option groups was compared to analyse the effect of the saving option on performance. This analysis was conducted twice: for the time-rich groups (*H2a*) and the time-poor groups (*H2b*). To determine whether the relative amount of time saved depended on time budget (*H3*), the two classes that were compared were time-rich and time-poor. By performing this test, the impact of time scarcity on relative time saved was examined. Similarly, to test the effect of time scarcity on score efficiency per minute (*H4*), the time-rich and time-poor were compared to each other in the Mann-Whitney-U test while score efficiency per minute was the dependent variable.

Results

The 2 x 2 between-subjects design of the experiment allowed for several comparisons between two groups: time-rich vs. time-poor and no saving option vs. saving option. To determine whether to apply parametric or non-parametric tests for the data analyses, several assumptions were tested. First of all, the dependent variables performance, relative time saved, and efficiency per minute were measured in a ratio scale, which is sufficient for parametric tests. Secondly, the independent observation assumption was met. All subjects took the experiment only once so the data was independent. Thirdly, the assumption of equality of variances must hold to apply parametric tests. Levene's tests were performed to test this assumption. Variances of performance were equal for the time-poor and time-rich groups ($p = .739$), between the two time-poor groups ($p = .206$), and time-rich groups ($p = .850$). In contrast, the equal variances assumption did not hold for the variables relative time saved ($p = .004$) and efficiency per minute ($p = .035$). Therefore, analyses regarding relative time saved and score efficiency per minute were conducted with non-parametric tests. Lastly, Swilk tests were performed to test whether the measured variables were normally distributed. The results of the Swilk test on performance for the time-rich with saving option condition showed that this distribution did not meet the normality assumption ($p = .033$). As a result, for the analyses with respect to performance, no parametric tests were conducted either. To conclude, non-parametric tests were conducted on the variables with interval scale as either the normality assumption or the equal variances assumption was violated, even though the independence assumption held. As a result, the non-parametric Mann-Whitney-U test was conducted for hypotheses 2a, 2b, 3, and 4. Table 1 shows the number of subjects per condition. The relevant sample sizes were used in each performed Mann-Whitney-U analysis. Since hypothesis 1 included variables with two classes (option to save vs. no option to save; any savings vs. no savings at all) which were compared to each other, a chi-squared test was applicable.

Usage of option to save

The usage of the saving option was analysed by creating the dummy variable any savings. Participants who saved time in at least one round (1) were distinguished from those who did not use the saving option at all (0). Then, the time-poor condition which had the option to save was compared to the time-rich condition with the option to save. The results of the analysis showed that time scarcity had no effect on whether a subject made use of the saving option at least once or not at all. Based on a chi-squared analysis, there was no significant difference between the time-poor and time-rich groups in regard to neglecting the possibility to save X^2 (1, N = 83) = 0.2529, $p = .615$. In fact, the two groups showed similar behaviour in having saved time at least in one round (see table A1 in appendix B). The first hypothesis *Time-poor people are more likely to neglect the possibility to save* was therefore not confirmed.

Performance option to save vs. no option to save

Time-rich conditions

The two time-rich groups were compared to measure the impact of the saving option on people who do not experience time scarcity. A Mann-Whitney-U test of option to save on performance was performed. Participants who did have the saving option performed significantly better (median = 12) than participants who did not have the saving option (median = 10), U = 656, p = .030, r = .24 (see appendix B for Mann-Whitney-U tests results in more detail). Hypothesis 2a *Time-rich people have an overall higher performance on a task when they have the option to save compared to when they are not allowed to save* was thereby confirmed. Figure 3 shows that the option to save leads to a higher test score. Appendix B provides more visualisations of the data including comparisons of means and standard deviations.

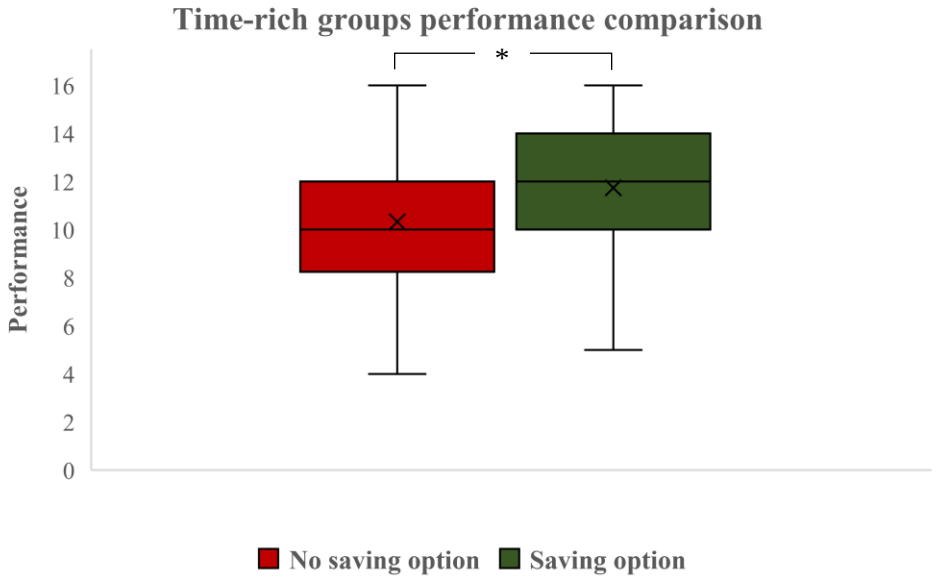

*Figure 3: Test performance comparison for the time-rich groups. The group with the saving option performed better than the group without the option. Means are indicated with 'X'. * p < .05; ** p < .01; *** p < .001.*

Time-poor conditions

A second Mann-Whitney-U test of option to save on performance was performed to measure the effect of the saving option on people experiencing time scarcity. For these time-poor groups, there was no significant difference in performance on the test. Time-poor participants with no saving option scored similar (median = 7) to those with the same time budget but with the saving option (median = 7), U = 858, p = .690, r = .04. Figure 4 presents this equal performance on the test for the poor groups. The result confirms hypothesis 2b, which implies that *For time-poor people, having the option to save does*

not influence overall performance on a task. In addition, test scores were higher for time-rich participants (median = 11) than for time-poor (median = 7), U = 1309, p < .001, r = .55 as can be seen in figure 5, though, this was not a remarkable finding considering the different time budgets.

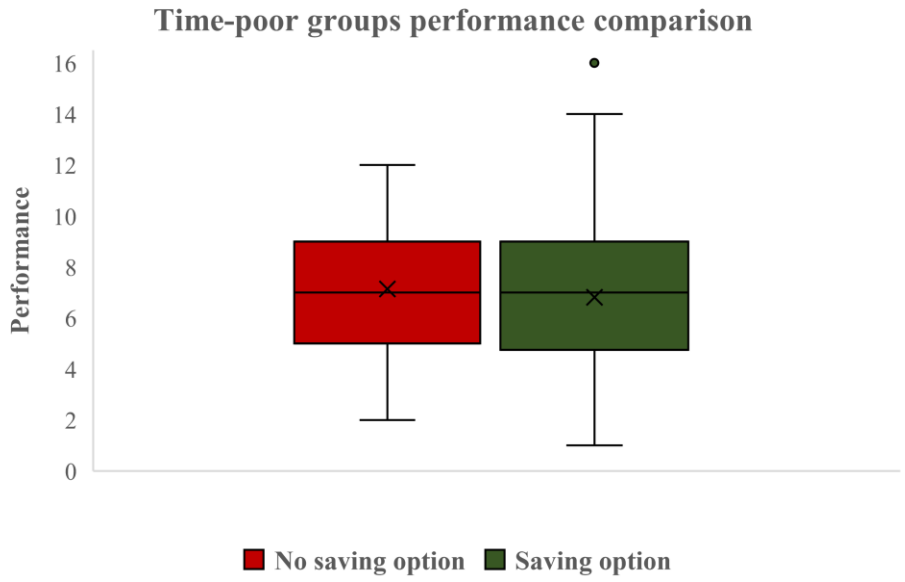

Figure 4: Test performance comparison for the time-poor groups. The groups perform similarly. Means are indicated with 'X'.

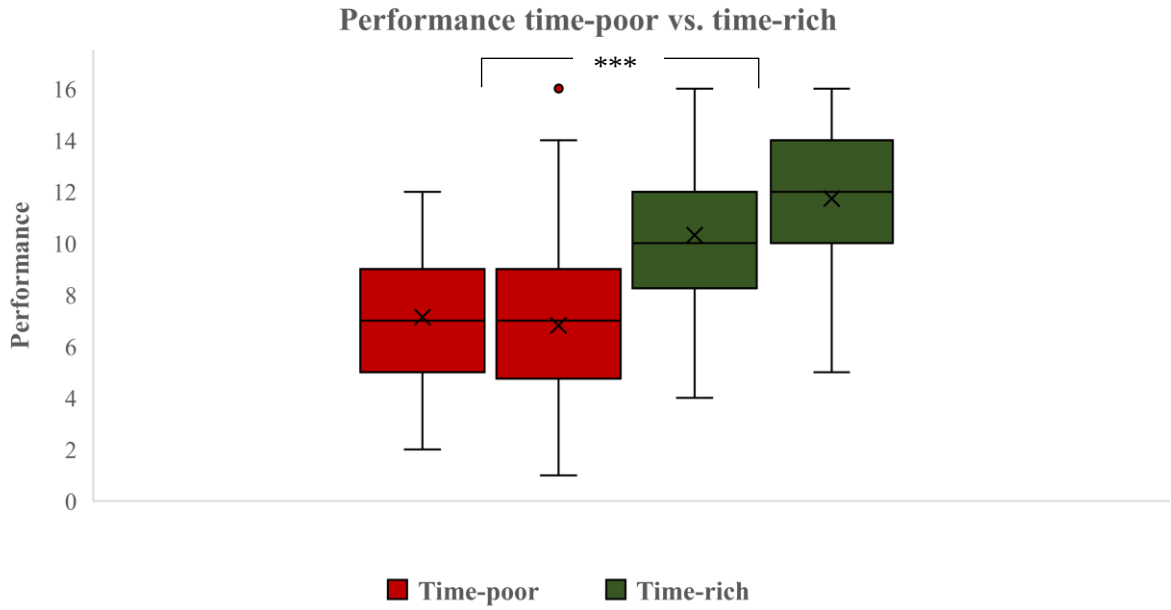

*Figure 5: Test performance time-poor vs time-rich. The time-rich scored significantly higher. Means are indicated with 'X'. * p < .05; ** p < .01; *** p < .001.*

Relative savings time-poor vs. time-rich

In order to compare saving behaviour between the time-rich and time-poor conditions, relative saving scores were calculated. Absolute comparison between the two groups would be unfair because time-rich people were able to save more time than time-poor people. For the time-poor subjects, the relative time saved was determined by dividing their total savings by 160, as they could save 40 seconds per round in four rounds. The relative time saved of time-rich participants was obtained by dividing their total savings by 600, as they could save 150 seconds per round in four rounds. Then, a Mann-Whitney U test of time budget on the rate of relative time saved was performed to compare the time-rich and time-poor conditions with saving option. Interestingly, time-rich participants significantly saved relatively more time (median = 0.21) than did time-poor participants (median = 0.08), $U = 523.5$, $p < .001$, $r = .37$ confirming the third hypothesis that *Time-poor people relatively save less than people who do not experience time scarcity.* The higher relative saving rate for time-rich participants is shown in Figure 6.

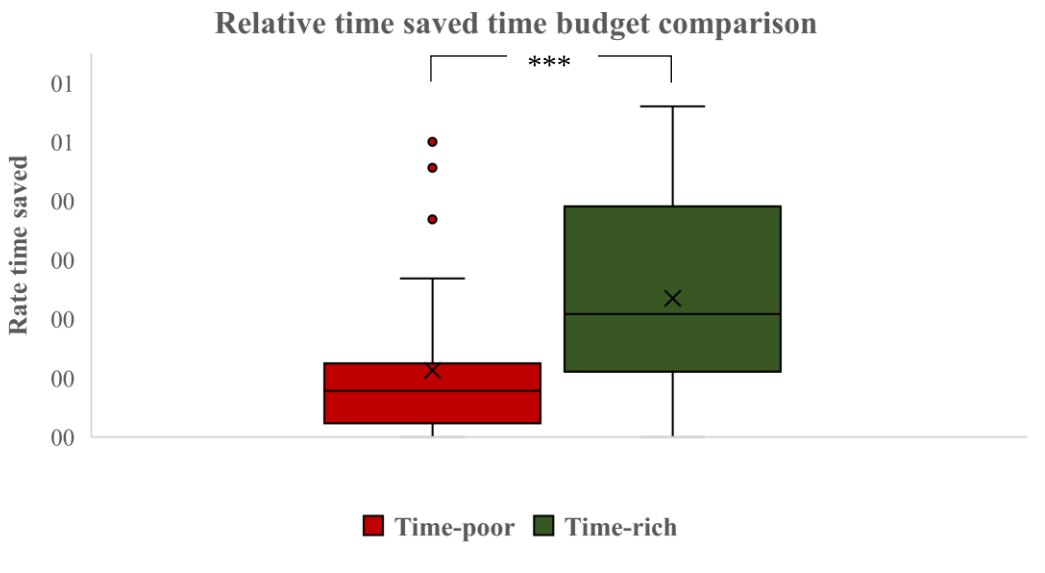

*Figure 6: Relative time saved per condition for the groups who had the option to save. The time-poor group saved relatively less than the time-rich group. Means are indicated with 'X'. * p < .05; ** p < .01; *** p < .001.*

Score efficiency

A Mann-Whitney-U test was performed on the time-poor and time-rich groups considering the score efficiency per minute, the latter variable calculated by taking a subject's score and dividing it by the time spent on the test. All observations were taken into account regardless the option to save. Time-poor participants had a significant higher efficiency rate per minute (median = 1.94) than time-rich participants (median = 1.63), $U = 2783.5$, $p = 0.009$, $r = .20$. In other words, the time-poor needed less time to solve the same number of matrices compared to the time-rich, as presented in Figure 7.

Hypothesis 4 *Time-poor people relatively save less than people who do not experience time scarcity* was thereby confirmed.

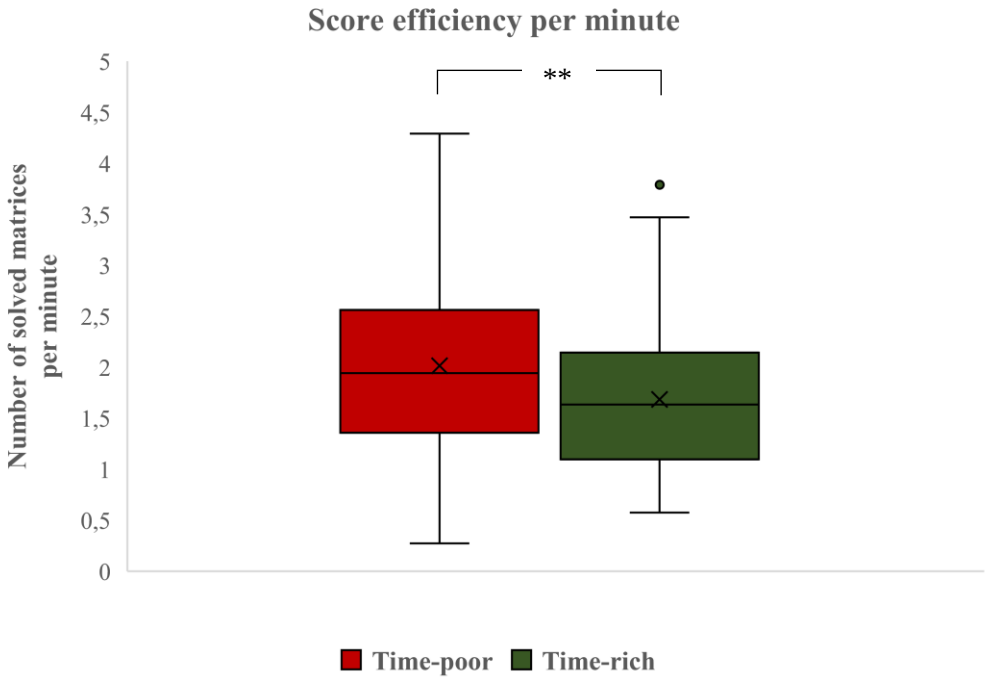

*Figure 7: Score efficiency per minute considering time budget. Time-poor participants had a higher score efficiency per minute. Means are indicated with 'X'. * $p < .05$; ** $p < .01$; *** $p < .001$.*

Discussion

This paper attempted to study the impact of time scarcity on saving behaviour. Cognitive capacity was manipulated and tested to examine this particular relationship. An online experiment was set up to acquire the necessary data. By assessing participants with Raven's Progressive Matrices test and including a saving component, the relevant variables could be measured and analysed. To start, the correlation between the usage of the option to save and time scarcity was calculated. Next, test scores between both time-rich and time-poor conditions were analysed to test the impact of the saving option on task performance. Afterwards, an analysis on the relative amount of time saved and time scarcity was conducted. Lastly, the potential increased efficiency on a task when experiencing scarcity was studied. Our results show that time scarcity influences behaviour and decision-making related to saving to a considerable extent.

First, contrary to the first hypothesis, time-poor people did not neglect the possibility to save more than did participants who had plenty of time to complete the test (*H1*). The time-poor were not as visually

tunnelled to the main task so that they completely ignored other clues as suggested by Tomm and Zhao (2016) and Tomm and Zhao (2017). Dividing the test into rounds with time budgets could be an explanation for this contradicting result. In contrast to the assessed Raven test by Tomm and Zhao (2017), participants of this experiment experienced time scarcity per round instead of overall. If the matrices of a round were found to be easy so that there was time left, a participant had no incentive to rush to the next round. Since the difficulty of the test increased, the first rounds could have been found to be relatively easy. Consequently, the saving option could have been considered without time pressure, so without excessive cognitive load. The easier the main task, the less attentional prioritisation so the less negligence for other objects in a context (Simons & Chabris, 1999).

Second, being able to save did not affect the score on the Raven test for people who were experiencing time scarcity. The time-poor participants were not capable of using the saving method to increase their performance. In contrast, individuals who had plenty of time to complete the task used the possibility to save effectively as they had a higher performance when they were able to save. These results are in line with hypotheses 2a and 2b. It confirms the theory described by Mullainathan and Shafir (2014) that people experiencing scarcity are not able to deal with tools which would increase the chance to reach their goals, while those without scarcity issues prove the effectiveness of these tools. Time-rich people did have an overall higher performance on the task when they had the option to save compared to when they were not allowed to save (*H2a*). Similarly, it was expected that having the option to save would make no difference for time-poor people as they experienced increased cognitive load caused by the Raven test. According to previous studies, a decrease in cognitive capacity results in enhanced focus on the main task but negligence of other helpful cues, resulting in unimproved task performance (Shah et. al, 2012; Tomm & Zhao, 2016; Tomm & Zhao, 2017). The results of this research indeed suggest that for time-poor people, having the option to save leads to similar overall task performance (*H2b*). The saving option was not used by time-poor participants to an extent that it increased their test score. In addition, an analysis between all time-poor and time-rich participants showed that people experiencing time scarcity have worse performance on a cognitive task. In the end, the observed difference of the effect of the saving option between the time-poor and the time-rich indicates that scarcity does reduce bandwidth and therefore cognitive capacity.

The third hypothesis concerned the amount of saving. Consistent with the theory, time-poor people relatively saved less than those who obtained a large time budget (*H3*). Although the time-poor had a smaller time budget to save from, saving a few seconds would have increased their relative saving rate considerably. Nevertheless, time scarcity led to relatively low saving amounts. This result confirms the scarcity mindset which implies that poor people are focussed on short-term goals and needs (Lurtz, 2019, Mullainathan & Shafir, 2014; Sawady & Tescher, 2008). The low relative amount of saving is also in line with findings of Shah et. al (2012). Instead of lower saving amounts, they demonstrated

increased borrowing of time due to scarcity. Because borrowing and saving rely on similar drivers such as self-control (Angeletos et. al, 2001; Heidhues & Köszegi, 2010; Jamal et. al, 2016; Karlan et. al, 2014; Nyhus, 2002; Schilbach, 2019), the consistent results make sense. Time-poor participants saved less time for the last round of the test: scarcity induced the preference to focus on solving the matrices in current rounds, even though the last round had the most impact on their final test score.

Finally, as expected, time scarcity increased score efficiency during the test (*H4*). Although people experiencing time scarcity had less time to solve the matrices, not surprisingly resulting in a lower absolute score, their accuracy was higher relative to the time budget they got: compared to time-rich people, the time-poor solved more matrices per spent minute. Tomm and Zhao (2017) observed similar behaviour during their experiments with the Raven test. In addition, the shooting game experiment of Shah et. al (2012) demonstrated a higher accuracy under scarcity either. Similar to these studies, both instructions and the incentives of this experiment were designed to highlight solving the matrices as the main assignment of the task. Scarcity leads to an even greater emphasis on the main task and those who were experiencing time scarcity were more focussed on solving each individual matrix within the time limit. The narrowed attention that comes with tunnelling had in this case a positive impact, namely increased efficiency.

Limitations

Several limitations of this study are acknowledged. The conducted experiment had a few potential biases and issues that could have negatively impacted the results. Firstly, participants were able to complete the experiment on any electronic device that had a web browser. Mobile phone users were asked in the instructions to put their phone on the 'do not disturb' feature as phones regularly get notifications. Any distractions during the Raven test can greatly impact the results of the test. However, no data was obtained on whether participants indeed put their phone on the notification free mode. Therefore, chances for distraction during the experiment were higher for phone users, thereby negatively impacting their performance on the Raven test. Nevertheless, subjects could complete the experiment in their own environment. There was no guarantee that every subject made the assessment in an environment without distraction. Hence, the main impact on test performance due to distraction was cancelled out due to randomisation.

Second of all, participants had the possibility to quit the experiment at any time. A drop out was counted when a participant proceeded to the second page of the experiment, so after reading the introduction note (see appendix A). Those who just opened the experiment link but did not go to the instructions of the assessment were not taken into account. The used software Qualtrics showed that 104 people opted

out after starting the experiment. This is an attrition rate of 37% considering the total recruitment number of 279, which is quite a high percentage. To identify the possible effects of the attrition, dropout rates were further analysed. The randomiser element built in the experiment assured equal distribution among the four conditions and was implemented so that people who quit did not influence the process of equalising the sizes of the groups. As a result, the number of dropouts among the conditions were varying and are presented in table 2. The two conditions with saving option appeared to have a higher dropout rate than the conditions without the saving option. Similarly, the time-poor groups had a higher dropout rate compared to the time-rich groups, meaning that the conditions which were relatively harder had higher dropout rates. However, the different dropout rates between the conditions are not statistically significant when performing a binomial test on the numbers ($p = .101$). Therefore, the attrition bias is not critical.

Table 2: Number of dropouts among the four conditions

	Saving	*No saving*	*Total*
Time-poor	32	27	59
Time-rich	27	18	45
Total	59	45	104

Furthermore, the act of saving during the test required some time as participants had to use a slider to indicate how much time they wanted to save. These few seconds could have been crucial for those in the time-poor condition as they only had 40 seconds per round, while the issue for subjects not in time scarcity was relatively less influential. Consequently, test performance for the time-poor with saving option group could have been slightly higher in case they did not have to play with the slider, resulting in lower significant differences between the time-poor and time-rich and between the time-poor without saving option and the time-poor with saving option. However, in real life, the act of saving anything often requires some extra effort or time. Whether the usage of the slider was truly taking exceptionally more time cannot be concluded as no related measurements were made.

Lastly, the 12-item version of Raven's Progressive Matrices test was used. All studies related to scarcity which applied the Raven test to assess cognitive capacity used the full version (Mani et. al, 2013; Tomm & Zhao, 2017). Due to its length, it would have been nearly impossible to reach the same sample size for this study considering the time and resources available for recruitment. In addition, in the experiments of Mani et. al (2013) and Tomm and Zhao (2017), participants were given a time budget to complete the whole Raven test instead of time budgets per few matrices. As a result, subjects were able to spend less time on the first matrices, which were relatively easy, so there would be more time for the others: an effective approach since the difficulty of the matrices in a Raven test increases.

Participants in the current study did not have this privilege. Combined with the usage of the 12-item version, the Raven test in this experiment could have been too difficult: the test is not designed to split up the questions into rounds. Participants got either 40 or 150 seconds to solve two matrices, which would be doable for the first rounds. However, as the difficulty increased per round, matrices in later rounds would have been too hard to solve given the time budget. Therefore, the extent of the cognitive load experienced by the participants might have been different compared to previous studies like Mani et. al (2013) and Tomm and Zhao (2017). Nevertheless, the goal of the Raven test, impairing cognitive capacity, was still reached as solving puzzles requires the activation of problem-solving skills.

Implications

Scarcity studies have demonstrated the negative impact of time scarcity on behaviour such as borrowing (Lurtz, 2019; Shah et. al, 2012) and cognitive functioning (Tomm & Zhao, 2017). In addition, Karlan et. al (2016) and Lurtz (2019) found a negative relationship between financial scarcity and savings. The findings of this study are consistent with previous literature regarding the negative consequences of time scarcity, but in addition, this paper has related scarcity of time to saving behaviour. From this study it can be concluded that additional cognitive load that time scarcity induces limits saving behaviour: affection of cognitive functioning directly links time scarcity to negative behaviour such as failing to save. Furthermore, the current study shows that when there is a tool available specifically to enhance achievement, performance based on cognitive capacity does not increase under time scarcity. Hence, the negative relationship between scarcity of time and saving due to reduced bandwidth implies that experiencing scarcity is not merely the result of low supply levels of that particular resource but rather an effect of the scarcity mindset. While similar conclusions regarding scarcity and borrowing behaviour by Lurtz (2019) were based on normative data and Shah et. al (2012) used a trivia game to cognitively load their participants, this paper has used Raven's Progressive Matrices test which is more reliable to test and manipulate one's cognitive capacity. However, no visual attentional prioritisation of the main task was found by this study as the saving option was not more neglected under scarcity. As this contradicts conclusions from other scarcity papers (Tomm & Zhao, 2016; Tomm & Zhao, 2017), it implies that visual attention depends on the task and context, and further research should focus on when exactly people start to prioritise.

The saving option tool which was implemented in this experiment proved to be effective for those who had time in abundance. Therefore, a possible solution for the scarcity problem could be creating slack, as slack can serve as a sort of reset for the bandwidth (Daminger et. al, 2015; Lurtz, 2019; Monahan & Cotteleer, 2016; Mullainathan & Shafir, 2014). A higher saving rate could then be one of the positive consequences. The scarcity phenomenon with its consequences is interesting for governments as well,

as Econsult solutions (2018) and UK Essays (2018) suggested that low personal saving rates negatively impact the state of a country.

On the other hand, the consequences of scarcity are not all negative. People experiencing scarcity are trade-off thinkers who are more efficient in meeting present needs (Sawady & Tescher, 2008; Mullainathan & Shafir, 2014; Shah et. al, 2015). A positive effect of time scarcity is the increased focus for tasks which are perceived as important. In the current study, time-poor subjects had a higher score efficiency per minute in terms of correct matrices than time-rich subjects, despite a worse overall task performance. Combining enhanced efficiency due to scarcity with improved saving behaviour would make people experiencing scarcity outperform those in permanent abundance of time. Therefore, saving options should be constructed in such a way that saving is seen as the better trade-off in the moment. If institutions seek to increase saving rates in an attempt to prevent poverty traps, short-term benefits should be created or more highlighted as salience of future costs and benefits play an important role in decision-making related to saving (Akerlof, 1991).

Future research

The current paper has established that the scarcity problem is also present in the relationship between time scarcity and saving behaviour. However, the effects of the proposed solutions for the scarcity problem should be studied in more detail. Organisational slack is proven to be effective for innovation in health care (Kerfoot, 2006) and can help "to trigger innovation and to support the exploitation of environmental opportunities, as well as to smooth organizational performance (Bourgeois, 1981, p. 38-39)". Future research should now find effective ways on how to create slack in the context of time scarcity and saving behaviour. By temporarily putting people who experience scarcity in a less time-poor situation, more space to examine saving decisions is created and an escape of the scarcity mindset could be realised. If such methods exist, companies and governments could be more convinced to implement the slack solution in their policies to deal with the scarcity problem.

Likewise, as the negative consequences of scarcity seem consistent throughout the literature, future research should focus on tackling the problem in other ways. Karlan et. al (2016) found that nudging poor people with the proper kind of reminders helps with committing people to save if they recently opened a savings account. Nevertheless, savings amounts did not go up significantly. Since people experiencing time scarcity seems to be able to enhance their focus on the task they perceive as important, this paper suggests running follow-up experiments in which will be tested whether constantly reminding an individual of instant benefits of saving increases saving rates.

In addition, it is interesting to study whether there is a difference of effect between objective and subjective time scarcity. Lurtz (2019) found that objective time scarcity increases saving for retirement, while results on subjective time scarcity were not correlative. Similarly, Ordonez, Benson, and Pittarello (2015) argue that time pressure (subjective time scarcity) and time constraint (objective time scarcity) are two different concepts that should be studied separately. The present study did not distinguish these terms, but solely focussed on objective time scarcity. Regarding this experiment, subjective time scarcity could be measured by self-assessment of participants to what extent they feel time pressure during the test.

Finally, the goal of scarcity research should be to tackle the scarcity-mindset. The poverty loop that can arise is dangerous and as it is a vicious circle, it should be captured at the earliest stage. This does not seem impossible. People experiencing scarcity do not have lack of attention or focus, it is just not always aimed at the right task. The extra marshmallow toddlers would earn in the marshmallow test was not important enough to focus on their assignment not to eat the marshmallow in the room. Instead, the desire to eat a candy was much stronger. What would have happened if the reward was salient and the child could clearly see the benefits of not eating that marshmallow, for example by putting the reward in a transparent box? When people prioritise their attention on acts that are crucial for high end results, there is no harm of scarcity. In case that is not possible, scarcity should either be used as a tool in certain situations where one can afford to have the focus on one single task or prevented entirely.

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Appendices

Appendix A: Experiment (Qualtrics content)

Introduction note + consent

Welcome and thank you for participating in my experiment.

This experiment consists of a test with several questions. Each correct question is worth 1 ticket which gives you a chance for a price. Within a few weeks, I will randomly choose two tickets. The prices are:

- 1x gift card of your choice (€30)
- 1x gift card of your choice (€20)

The gift card can be of any webshop or any Dutch store.

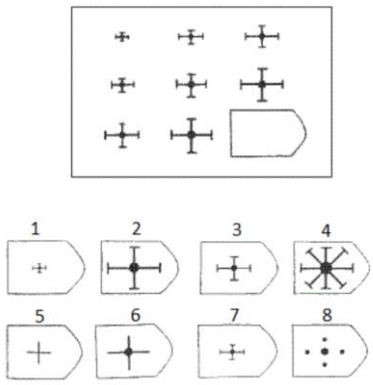
If you get more questions correct, your chance for the price is higher.

If you click next, you agree to participate in the experiment. Please be aware that you are free to withdraw at any point throughout the duration of the experiment. Data will only be used for research purposes and results will be published on group level. For further questions, you can contact the researcher via the email address given at the end of the experiment.

Instructions time-poor no saving option condition

The test consists of **12 questions**. Each question is a 3x3 matrix of figures. They have a logic order both horizontally and vertically. The bottom right figure is empty. The goal is to find the correct figure based on the other figures. You can choose out of 8 possible answers: it is a multiple-choice test.

EXAMPLE:



The answer is 2, as the shape of the symbol stays the same and increases in size when looking at both the horizontal and vertical sequence.

The 12 questions are divided into **6 rounds: 2 questions per round**. For each round, you have **40 seconds** to answer the questions. If time is up, you automatically go to the next round. You cannot go back. Note: The difficulty of the questions gradually increases during the test.

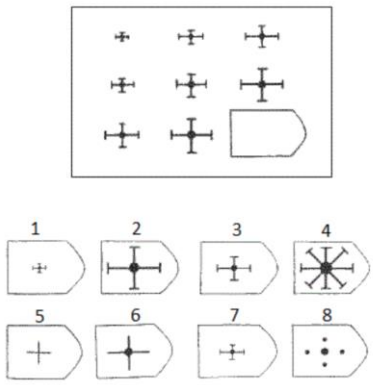
Remember that each correct question will give you 1 ticket for the price. **In the last round you will get 3 tickets per correct question.**

Now, there will be a practice round. **You CANNOT earn tickets here.**

Instructions time poor saving option condition

The test consists of **12 questions**. Each question is a 3x3 matrix of figures. They have a logic order both horizontally and vertically. The bottom right figure is empty. The goal is to find the correct figure based on the other figures. You can choose out of 8 possible answers: it is a multiple-choice test.

EXAMPLE:



The answer is 2, as the shape of the symbol stays the same and increases in size when looking at both the horizontal and vertical sequence.

The 12 questions are divided into **6 rounds: 2 questions per round**. For each round, you have **40 seconds** to answer the questions. If time is up, you automatically go to the next round. You cannot go back. Note: The difficulty of the questions gradually increases during the test.

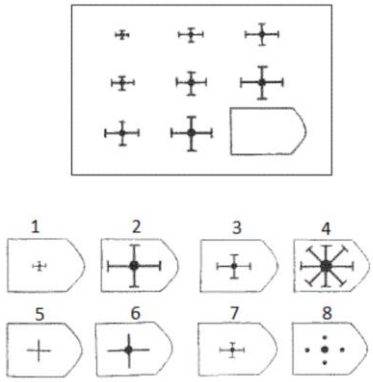
In addition, in rounds 1-4 you have the option to save time. You can indicate how much time you want to save in the next round. This time will be subtracted from the next round, and added to the **last round**. Your saved time will be **doubled**. *EXAMPLE: If you indicate in round 2 that you want to save 10 seconds in the next round, the time to complete round 3 is 30 seconds (40 - 10). The time to complete the last round will be 60 seconds (40 + 2*10).*

Remember that each correct question will give you 1 ticket for the price. In the last round you will get 3 tickets per correct question.

Now, there will be a practice round. **You CANNOT earn tickets here.**

Instructions time-rich no saving option condition
The test consists of **12 questions**. Each question is a 3x3 matrix of figures. They have a logic order both horizontally and vertically. The bottom right figure is empty. The goal is to find the correct figure based on the other figures. You can choose out of 8 possible answers: it is a multiple-choice test.

EXAMPLE:



The answer is 2, as the shape of the symbol stays the same and increases in size when looking at both the horizontal and vertical sequence.

The 12 questions are divided into **6 rounds: 2 questions per round**. For each round, you have **2 minutes and 30 seconds (150 seconds)** to answer the questions. If time is up, you automatically go to the next round. You cannot go back. Note: The difficulty of the questions gradually increases during the test.

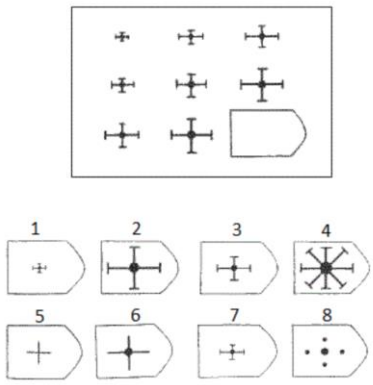
Remember that each correct question will give you 1 ticket for the price. **In the last round you will get 3 tickets per correct question.**

Now, there will be a practice round. **You CANNOT earn tickets here.**

Instructions time-rich saving option condition

The test consists of **12 questions**. Each question is a 3x3 matrix of figures. They have a logic order both horizontally and vertically. The bottom right figure is empty. The goal is to find the correct figure based on the other figures. You can choose out of 8 possible answers: it is a multiple-choice test.

EXAMPLE:



The answer is 2, as the shape of the symbol stays the same and increases in size when looking at both the horizontal and vertical sequence.

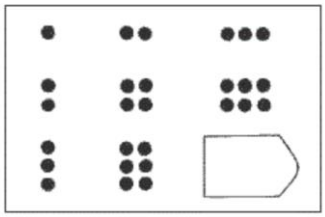
The 12 questions are divided into **6 rounds: 2 questions per round**. For each round, you have **2 minutes and 30 seconds (150 seconds)** to answer the questions. If time is up, you automatically go to the next round. You cannot go back. Note: The difficulty of the questions gradually increases during the test.

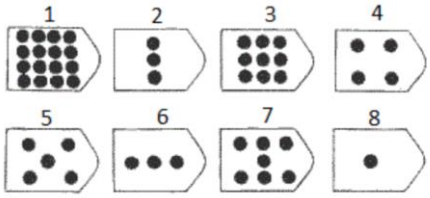
In addition, in rounds 1-4 you have the option to save time. You can indicate how much time you want to save in the next round. This time will be subtracted from the next round, and added to the last round. Your saved time will be **doubled**. *EXAMPLE: If you indicate in round 2 that you want to save 10 seconds in the next round, the time to complete round 3 is 140 seconds (150 - 10). The time to complete the last round will be 170 seconds (150 + 2*10).*

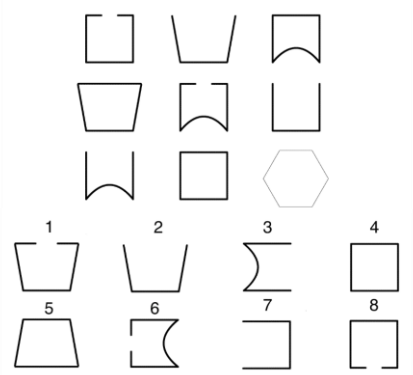
Remember that each correct question will give you 1 ticket for the price. **In the last round you will get 3 tickets per correct question.**

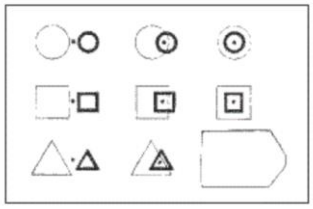
Now, there will be a practice round. **You CANNOT earn tickets here.**

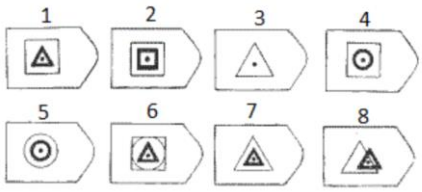
Matrices

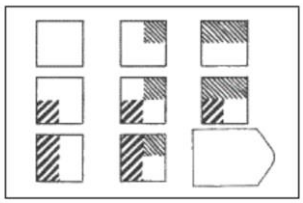


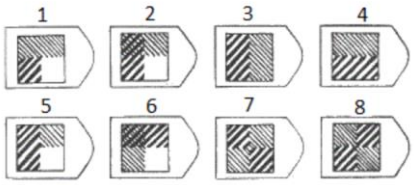








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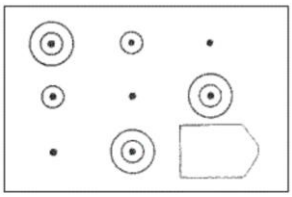

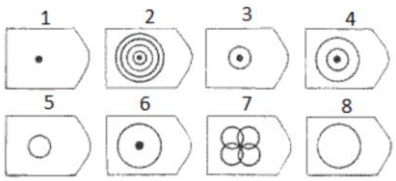
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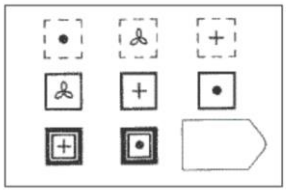

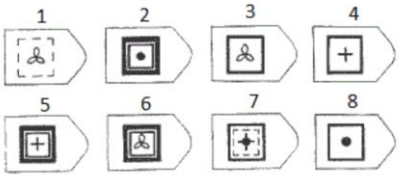
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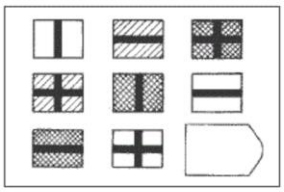

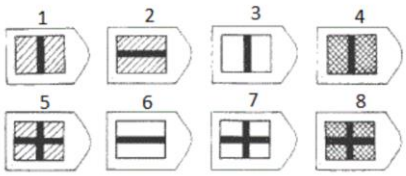
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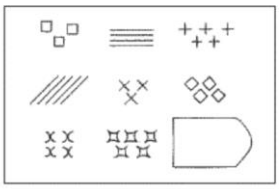

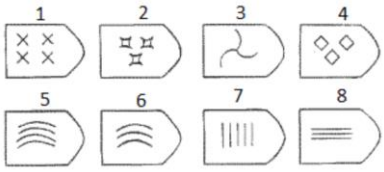
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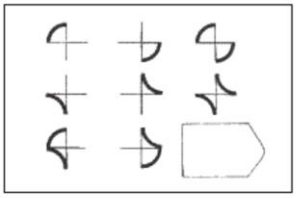

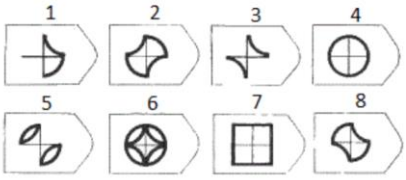
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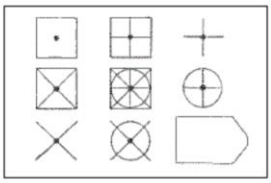
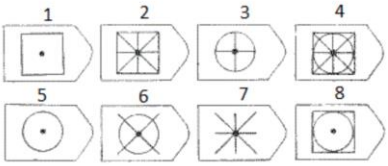
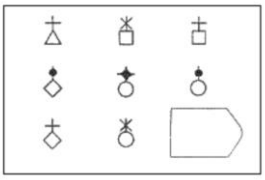
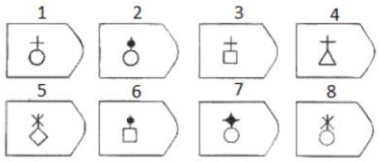
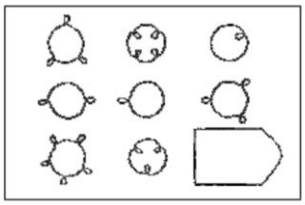
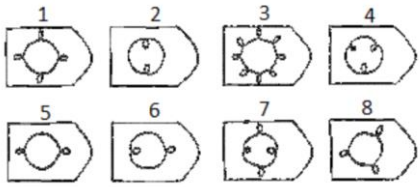






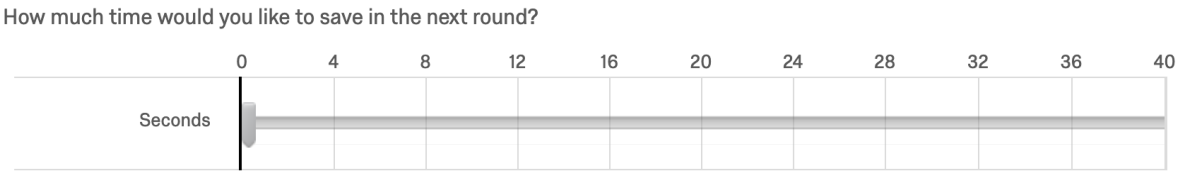




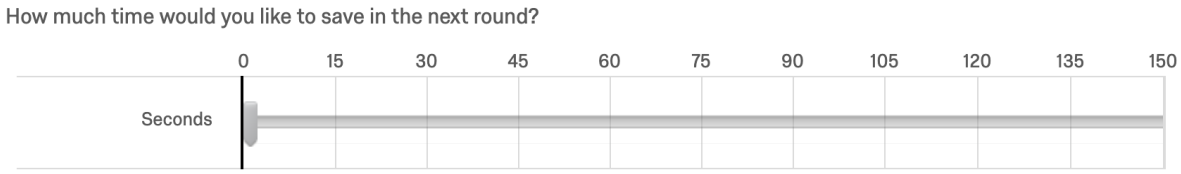


Saving questions

Saving question for the time-poor:



Saving question for the time-rich:



Debriefing

Thank you for your time and participation! Your response has been recorded. If you would like to be updated on this research or would like to receive your test score, please feel free to contact me: joel.oei@student.eur.nl

Appendix B: Results: supplementary tables and figures

* significant at alfa = 5%

** significant at alfa = 1%

*** significant at alfa = 0.1%

Relationship any savings and time budget

Table A1: Chi-squared test any savings per time budget

	Condition		
Any saving	*Poor save*	*Rich save*	*Total*
No saving at all	9	7	16
Saved at least one round	33	34	67
Total	42	41	83
Pearson chi²	=	0.2529	
p-value	=	0.615	

Relationship saving option and performance time-rich and time-poor

Mann-Whitney-U test:

Table A2: Mann-Whitney-U test on relation saving option and performance for time-rich conditions

Condition	*Observations*	*Rank sum*	*Expected*
Rich no save	44	1646	1892
Rich save	41	2009	1763
Combined	85	3655	3655
z	=	-2.175*	
Prob > z	=	0.030	

Table A3: Mann-Whitney-U test on relation saving option and performance for time-poor conditions

Condition	*Observations*	*Rank sum*	*Expected*
Poor no save	43	1894	1849
Poor Save	42	1761	1806
Combined	85	3655	3655
z	=	0.398	
Prob > z	=	0.6904	

Table A4: Mann-Whitney-U test performance time-rich vs. time-poor

Condition	*Observation*	*Rank Sum*	*Expected*
Time-rich	85	9571	7267.5
Time-poor	85	4964	7267.5
Combined	170	14535	14535
z	=	7.207***	
Prob > z	<	0.001	

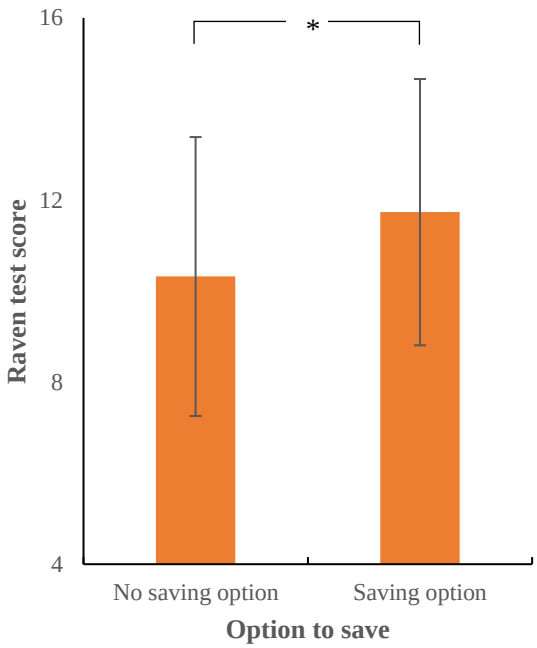


Figure A1: Test performance comparison for the time-rich groups. The group with the saving option performed better than the group without the option (p = .030). Error bars represent ± 1 SD.

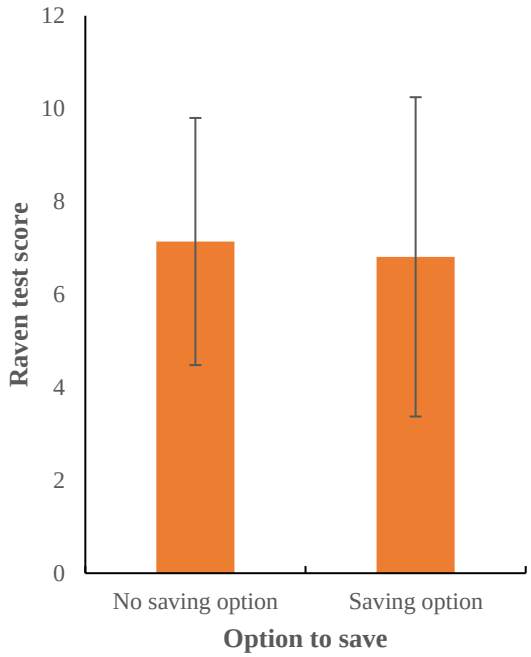


Figure A2: Test performance comparison for the time-poor groups. The groups perform similar (p=.690). Error bars represent ± 1 SD.

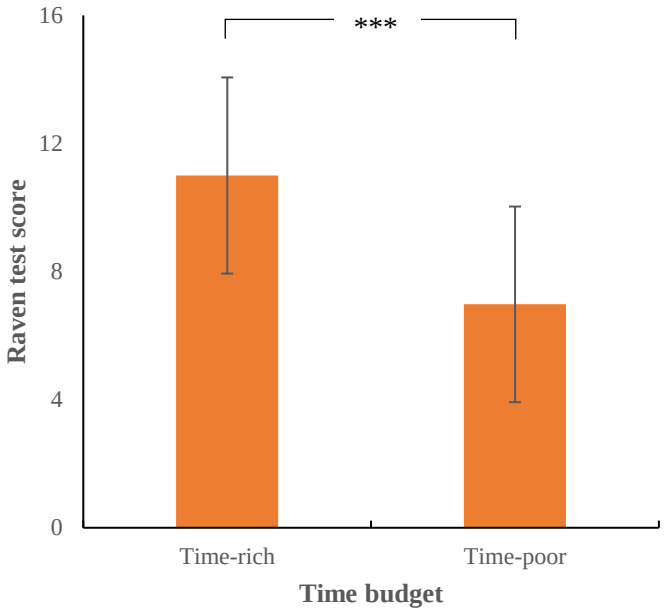


Table A3: Test performance comparison time-rich vs. time-poor. The time-rich group scored higher than the time-poor group ($p < .001$). Error bars represent ± 1 SD.

Relationship relative time saved and time budget

Table A5: Mann-Whitney-U test on relative time saved and time budget

Condition	*Observations*	*Rank sum*	*Expected*
Rich save	41	2093	1722
Poor save	42	1393	1764
Combined	83	3486	3486
z	=	3.382***	
Prob > z	<	0.001	

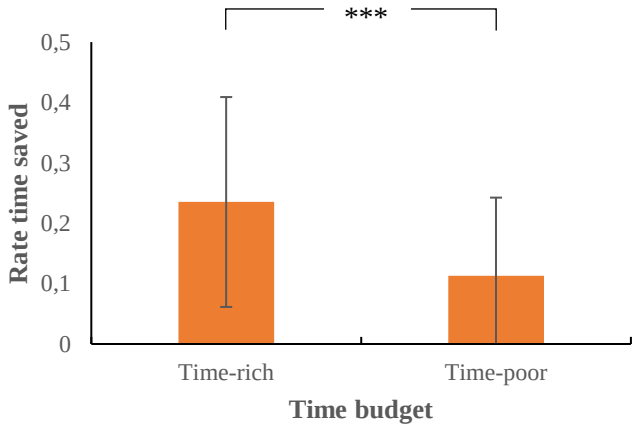


Figure A4: Relative time saved per condition for the groups who had the option to save. The time-poor group saved relatively less than the time-rich group ($p < .001$). Error bars represent ± 1 SD.

Relationship efficiency per minute and time budget

Table A6: Mann-Whitney-U test on score efficiency and time budget

Group	*Observations*	*Rank sum*	*Expected*
Time-rich	85	6431	7267.5
Time-poor	85	8104	7267.5
Combined	170	14535	14535
z	=	-2.607**	
Prob > z	=	0.009	

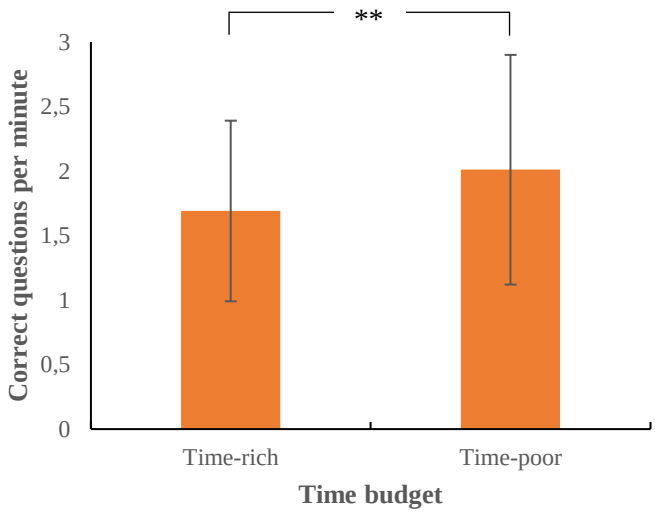


Figure A5: Score efficiency per minute considering time budget. Time-poor participants had a higher score efficiency per minute (p = .009). Error bars represent ± 1 SD.