

HOW DOES RESOURCE SCARCITY PERCEPTION AFFECT ECONOMIC
DECISION-MAKING? AN INVESTIGATION OF THE COGNITIVE AND
BEHAVIORAL CONSEQUENCES OF RESOURCE SCARCITY PERCEPTION

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ABSTRACT

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When the poor go through financial difficulties, a scarcity mindset becomes activated (e.g., they psychologically experience the consequences of scarcity). This psychological aspect has a direct impact on their economic decision-making as well. In this thesis, we investigated how resource scarcity perception affects economic decision-making, specifically people's time-discounting preferences, via the potential cognitive mechanisms (e.g., cognitive load, self-control, and thinking style) that it causes. We used Bayesian causal models, in the form of directed acyclic graphs (DAGs), to cast light on the cognitive effects of resource scarcity perception on economic decision-making. To this end, we analyzed the data of previous studies with the bnlearn package to explore possible equivalent DAGs. We also examined the findings and the available causal models from the previous literature to build DAGs. We proposed a causal model describing the relationships between resource scarcity perception and economic decision-making by employing abstraction methods in Bayesian Networks. Specifically, our causal model suggests that resource scarcity perception negatively affects people's self-control and leads them to have an intuitive mindset. The model also suggests that low (vs. high) SES people exhibit greater time-discounting preference (e.g., they tend to choose the immediate, proximal rewards over the larger, distal ones). As the last step, we causally tested this model in a preregistered experiment; however, the results indicated that our resource scarcity manipulation did not work as we intended. The results suggest that testing causal effects of resource scarcity is more difficult than initially assumed.

Keywords: Resource Scarcity Perception, Economic Decision-making, Causal Bayesian Networks, Time-discounting

ÖZ

KAYNAK KİTLİĞİ ALGISI EKONOMİK DAVRANIŞI NASIL ETKİLEMEKTEDİR? KAYNAK KİTLİĞİ ALGISININ BİLİŞSEL VE DAVRANIŞSAL SONUÇLARININ İNCELENMESİ

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Fakir insanlar maddi sorunlarla karşılaştıklarında, kıtlık düşünce yapısı aktif hale gelir. Yani fakir insanlar kıtlığın sonuçlarını psikolojik olarak deneyimlerler. Kaynak kıtlığının bu psikolojik tarafı ekonomik davranış üzerinde doğrudan bir etkiye sahiptir. Biz bu tezde kaynak kıtlığı algısının sebep olduğu potansiyel bilişsel mekanizmalar (örneğin bilişsel yük, öz-kontrol ve düşünme tarzları) üzerinden ekonomik davranışı, bilhassa süre indirimi tercihlerini, nasıl etkilediğini inceledik. Ekonomik davranış üzerindeki kaynak kıtlığı algısının bilişsel etkilerine ışık tutabilmek için Yönlü Düz Ağaçlar (YDA) biçiminde Bayesci nedensel modeller kullandık. Bu bakımdan, muhtemel muadil YDA'ları keşfetmek için bnlearn paketiyle önceki çalışmaların verilerini analiz ettik. Ayrıca YDA'lar inşa etmek için literatürdeki bulguları ve mevcut nedensel modelleri inceledik. Bayes ağlarında soyutlama yöntemlerini kullanarak kaynak kıtlığı algısı ve ekonomik davranış arasındaki ilişkileri betimleyen bir nedensel model ileri sürdük. Bilhassa nedensel modelimiz kaynak kıtlığı algısının insanların öz-kontrolünü negatif yönde etkilediğini ve onları sezgisel bir düşünce yapısına sevk ettiğini ileri sürer. Bu model ayrıca düşük (vs. yüksek) sosyoekonomik arka planlı insanların daha yüksek süre indirimi tercihi göstereceğini işaret eder (örneğin, bu insanlar küçük ve kısa süreli ödülleri, büyük ve uzun süreli ödüllere seçme eğilimi göstereceklerdir). Son adım olarak, ön kayıtlı bir deneyde nedensel olarak bu modeli test ettik; ancak bulduğumuz sonuçlar kaynak kıtlığı manipülasyonumuzun istediğimiz gibi çalışmadığını gösterdi. Sonuçlar kaynak kıtlığının nedensel etkilerini test etmenin ilk adımda varsayıldığından daha zor olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Kaynak Kıtlığı Algısı, Ekonomik Karar Alma, Nedensel Bayes Ağları, Süre İndirimi

DEDICATION

to my dear family for their neverending support for my
pursuit in Exploration...

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LIST OF ABBREVIATIONS

SES	Socio-economic Status
BN	Bayesian Network
DAG	Directed Acyclic Graph
CI	Conditional Independence
CRT	Cognitive Reflection Test
WEIRD	Western, Educated, Industrialized, Rich, and Democratic

CHAPTER 1

INTRODUCTION

1.1. Purpose of the Thesis

This thesis focuses on the impact of resource scarcity perception and socioeconomic status (SES) on cognition and decision-making. Whenever the poor face any financial trouble that is nearly impossible to overcome, the immediate result is that their cognitive resources are taxed by cognitive load, causing distraction in their executive functions (Mani et al. 2013, Haushofer & Fehr, 2014). Previous research shows that they perform poorly in certain cognitive tasks, such as Raven's Test or cognitive control tasks, as compared to those who are free from resource scarcity perception (Mani et al. 2013, Shah et al., 2012). This also has ramifications on their decision-making and economic behavior. The more intensely the poor feel resource scarcity, the more likely their actions will produce harmful consequences (Fehr & Haushofer, 2014; Mani et al. 2013; Hall et al., 2013; Vohs, 2013; Rea & Sheehy-Skeffington, 2017; Shah et al., 2012; Zwane 2012). In this thesis, we aim to use Bayesian causal models and experimental design to shed light on the underlying cognitive mechanisms of the effect of resource scarcity perception on economic decision-making.

We particularly delve into the psychological aspects of resource scarcity and its behavioral consequences. We investigate the effects of feeling resource scarcity interacting with socio-economic status on self-control, thinking style, and time-discounting. The thesis aims to reveal if resource scarcity mindset will make people less able to control themselves, especially for low SES participants, which in turn will lead them to rely on intuitive thinking style. People with low SES in a resource scarcity mindset will also be expected to choose the immediate, smaller rewards over the distal, larger ones (e.g., their time-discounting will be greater).

Thus, in the thesis, we hypothesize that;

- 1) Resource scarcity prime increases financial concerns among those who have lower (vs. higher) SES compared to the control condition.
- 2) Resource scarcity prime will change time-discounting preferences among those who have lower (vs. higher) SES compared to the control condition. More specifically, we expect that those with lower SES will choose the immediate, smaller reward over the distal, larger one when they are reminded of resource scarcity.
- 3) Resource scarcity prime will decrease self-reported self-control abilities among those who have lower (vs. higher) SES compared to the control condition.
- 4) Resource scarcity prime will increase self-reported intuitive thinking tendencies among those who have lower (vs. higher) SES compared to the control condition.

We also explore whether decreased self-control and intuitive thinking tendencies moderate the effect of resource scarcity on time-discounting preferences.

The thesis also proposes a systematic way of forming causal models that can be useful for future psychological and behavioral research. Our approach consists of four steps. First of all, we search the literature for possible causal relations. A thorough literature review and incorporation of the domain knowledge are essential for this part. Secondly, we assess the statistical strength of the existing relations in the literature and try to discover new relations by mining the data of previous studies by using Bayesian network structure learning algorithms (see, Chapter 4). Thirdly, the theoretical or conceptual models in the literature might be too complex for experimental testing. We use abstraction methods for directed acyclic graphs proposed (Yet and Marsh, 2014) to simplify the structure of these models in a consistent way (see, Chapter 5). Lastly, we use experimental design to test the true causality of the resulting models from these processes.

1.2. Significance of the Study

This study benefits from multiple, aligned theories coming from behavioral economics, decision science, and psychology. In our opinion, this rich theoretical background crossing various fields will possibly provide insightful perspectives to the literature investigating the relations between the scarcity mindset and economic decision-making. Additionally, the study puts forward a causal model with clearly

presented assumptions that directly fill the considerable gap in the literature about how resource scarcity perception affects economic decision-making, specifically time-discounting preference.

The study also makes methodological contributions. Our effort of systematizing to build causal models from the published evidence and modify and simplify the model for experiments presents a research algorithm for psychological and behavioral sciences aiming to explore and establish causal relations.

Lastly, the study investigates the psychological consequences of poverty and bad economic behaviors based on the causal model that is derived from our proposed approach. Hence, if the proposed causal relations in the model (see Chapter 5) are established, the research will give the opportunity to develop psychologically driven solutions to the effects of poverty. The practical output of the research will be to create a microeconomic policy impact by which welfare programs fighting against poverty might be inspired.

1.3. Outline of the Thesis

In the remainder of this thesis, Chapter 2 reviews the previous literature for causal and associational relations in this domain. A detailed description of the scarcity mindset and its psychological and behavioral consequences are mentioned. The findings of the studies in the literature about the relationships between resource scarcity perception and self-control, thinking style and time-discounting are described. This chapter also gives details of our general methodological strategy to show how we proceed in the following parts of the thesis. Chapter 3 provides the basic concepts and methods of causality and Bayesian networks to give a background of how the thesis benefited from causal inference. Chapter 4 shows how we analyzed the data from previous studies, using Bayesian network structure learning algorithms. Chapter 5 describes step by step how we abstracted a previous model in the literature to a simpler one for experimental testing. It also introduces the abstraction methods that we used in this part of the thesis. Chapter 6 consists of the experimental design of the study, its methods, and the result of the experiment. In the experiment, the effects of the interaction of resource scarcity perception and SES (low vs. high) on self-control, intuitive thinking style, time-discounting and financial concern were tested. The quantitative results of the experiment were reported and interpreted. Chapter 7 discusses the conclusions of the study, its limitations and how it might steer future work.

CHAPTER 2

LITERATURE REVIEW

“By scarcity, we mean having less than you feel you need” (Mullainathan & Shafir, 2013)

Scarcity can cause both internal disruption and the necessary concentration on what requires serious attention. It puts too much psychological (internal) emphasis on the need that has to be taken care of. In that case, it narrows down the attention to one specific problem because of which everything else might be left out (Mullainathan & Shafir, 2013). However, a healthy dose of scarcity can positively impact cognition in the form of a psychological resource that provides the necessary focus on the problems (Mullainathan & Shafir, 2013). So, having the feeling of deprivation will make someone experience what is called *tunneling* (Mullainathan & Shafir, 2013). The context in which one finds themselves determines the psychological effect of tunneling. Tunneling directs all the existing attention toward the problem that causes a narrowing of the attention. When someone has the means to deal with the problem faced, then tunneling boosts solving problems regarding attention and executive control. However, if the problem faced seems insurmountable, all the mental capacity gets focused on this particular problem. As a result, one might end up being stuck dealing with this problem at the expense of consuming all their mental resources (Mullainathan & Shafir, 2013).

Those who have a resource scarcity perception will go through the negative effect of excessive focus. As a result, above mentioned cognitive setbacks will occur, and these will have behavioral ramifications—namely, non-adaptive behavioral output; such as overborrowing; choosing immediate, smaller rewards over distal, larger ones; risk-taking vis-a-vis potential loss; engaging with bad health-related behaviors. (Shah et al., 2012; Zwane 2012; Mani et al. 2013; Hall et al., 2013; Vohs, 2013; Fehr & Haushofer, 2014; Rea & Sheehy-Skeffington, 2017).

Poverty puts the poor in a position that is very challenging in every aspect. First, their mental energy gets consumed since the problem faced seems to be insurmountable, and it creates massive attention towards, say, particular financial problems. Besides, life has other facets, and these facets require attention as well. The poor are left cognitively and materially resourceless in showing the necessary attention to them. Thus, the general description of consequences of resource scarcity felt by the poor is this: 1) Resource scarcity perception creates a significant focus on particular material problems, 2) this focus comes at the expense of neglecting other urgent matters, 3) since the resources that the poor have are limited and the problems that they face seem unsolvable, resource scarcity perception puts a great amount of cognitive load on the poor people's mind, 4) the experienced cognitive load impairs the cognitive function and changing the thinking style to the intuitive one (vs. deliberative one) by leaving the poor unguarded while making decisions and acting accordingly (Adamkovič & Martončík, 2017).

In this chapter, we will introduce the various relationships from the literature between resource scarcity perception and its psychological and behavioral consequences. Section 2.1. specifically focuses on the cognitive consequences of resource scarcity (e.g., on cognitive ability, self-control, and thinking style), whereas Section 2.2. investigates its consequences on economic decision-making (e.g., on time-discounting). Section 2.3 mentions rival theoretical perspectives in the literature. Section 2.4. introduces the conceptual model of poverty perpetuation proposed by Adamkovič (2020). Lastly, Section 2.5. provides an overview of our approach.

2.1. Cognitive Consequences of Resource Scarcity

2.1.1. Cognitive Ability

Shah et al. (2012) show that resource scarcity makes the poor focus too much on the present problem (e.g., they see nothing but the present problem). As a result, they end up being more fatigued than those free from the resource scarcity perception. In another experiment of the study, the result of the increased focus appears that the poor overborrow. In a nutshell, the experiments in Shah et al. (2012) establish that scarcity makes the poor focus too much on the material problems that they faced, thus they ended up being mentally too exhausted. To overcome the immediate problems, the poor overborrow and neglect the other vital matters that have to be cared for (Shah et al., 2012).

In Mani et al. (2013), how cognitive load caused by resource scarcity impairs mental capacity has been experimentally studied. In the laboratory setting, the experimental group has been induced feelings of financial difficulties in the form of car accident

expenditures exceeding their budgets. After priming resource scarcity feelings, the participants were asked to complete two tasks that measure cognitive ability: 1- Raven's Progressive Matrices measuring fluid intelligence, and 2- a spatial compatibility task measuring executive control. The result of this study showed that those who felt resource scarcity did worse on these tasks than the poor in the easy condition and the rich in the easy and hard conditions. The feelings of resource scarcity curbed the participants' cognitive resources. What has to be successfully done in these tasks is related to information processing and strategic decision-making. In Mani et al. (2013), since the poor in the difficult condition experienced greater cognitive load, they ended up having an impaired cognitive function and their cognitive abilities were negatively affected by it. In the following quasi-experimental study, Mani et al. (2013) showed that farmers' cognitive performance changed in pre or post-harvest time. The same farmers in the pre-harvest time did worse in these similar tasks than in the post-harvest time. Thus, Mani et al. (2013) established the relationship between resource scarcity and cognitive abilities in both a laboratory setting and a real environment.

Haushofer and Fehr (2014) also described how poverty impairs cognitive function by causing stress and negative affective states. The other consequences of experiencing cognitive load caused by resource scarcity perception appear in having limited attention since it gets narrowed down to the problems faced. The psychological consequences of resource scarcity also trigger habitual behavior (Haushofer & Fehr, 2014).

The stigmatization of poverty also comes with various cognitive impairments as well. The indirect end of being poor is to be stigmatized in the way that the poor are perceived to be lazy, unmotivated, and deficient in character. All this getting blamed by others is the source of cognitive distancing that the poor have. Thus, being stigmatized leads the poor to cognitive distancing and decreases their cognitive performance (Hall et al., 2013). On the contrary, self-affirmation reversed this effect to some extent. When people articulated their proud moments about themselves, it boosted their cognitive performance. They did better in fluid intelligence and cognitive control tasks than the ones in the control group (Hall et al., 2013). They were also more open to beneficial social programs. Those self-affirmed showed particular interest in the cues of those social programs (Hall et al., 2013).

The studies mentioned above relatively establish that poverty has a direct impact on cognition. It taxes mental bandwidth, leaving the poor temporarily with less intelligence and self-control capacity. These temporary decreases in cognitive performance have an impact on decision-making and economic behavior since intelligence enables one to process information, make inferences and develop strategies, whereas self-control makes sure that instant urges are kept tamed if impulsive and that the strategies developed with deliberation are followed. Thus, any declination on these fronts will change the pattern of decisions and behaviors.

2.1.2. Self-Control

A body of studies (Hoffman et al. 2012; Shah et al. 2012; Mani et al. 2013; Vohs, 2013, Fehr & Haushofer, 2014) indicates that people show weakened self-control when feeling poor (e.g., being exposed to resource scarcity).

Vohs (2013) mainly dwells on the poor's declined mental capacity by discussing how this deteriorates self-control capacity. Having limited material means obliges the poor to suppress plenty of urges and desires. As a result, the poor are constantly tested by financial dilemmas. As the limited-resource model of self-control (Baumeister et al., 1994; Hofmann et al., 2012; Vohs, 2013) puts it, being tested by all the complicated financial choices will exhaust the poor's mental power by leaving them unguarded against appearing other choices requiring mental vigilance. The resource model claims that self-control is exhausted by the choices that one makes and is something depletable. Thus, when the choices test someone hard and if they answer to it with willpower, from this theory, a person shows weak self-control in the next step requiring willpower. Thereof, a person's self-control "success" depends on their self-control resources that can be depletable in the previous choices. Therefore, this is expected to have a direct effect on economic behavior (Vohs, 2013; Fehr & Haushofer, 2014).

There is also a rival theory to the limited-resource model, which is called the process model of self-control. From this perspective, showing self-controlled behavior at Time 1 reduces the likelihood of engaging in self-control at Time 2 (Inzlicht & Schmeichel, 2012; Inzlicht et al., 2014; Inzlicht & Berkman, 2015). This first claim is apparently in line with the limited resource model of self-control. However, the process model of self-control differs from the former perspective in saying that failure in self-control is because of a motivational shift. Someone engaging in self-control at Time 1 shows weak self-control since their attention shifts toward other cues, such as immediate needs. In the second step, their motivation is not to preserve self-controlled behaviors; instead, they are motivated to satisfy the delayed needs. (Inzlicht & Schmeichel, 2012; Inzlicht et al., 2014; Inzlicht & Berkman, 2015)

Even though two of these theoretical perspectives help us understand what cognitively happens in the minds of the poor and explain the relevant behaviors that the poor exhibit (Adamkovič & Martončík, 2017; Lindler et al., 2017;), the limited resource model of self-control is more illustrative of why poverty creates a vicious circle that is hard to step out since: 1) it postulates that mental capacity is something depletable and further explains its effects on attention and working memory (Adamkovič & Martončík, 2017), 2) poverty seems not to be a result of shifting motivation, instead, it seems to be a result of the cognitive load caused by many dilemmas, choices. Besides, this cognitive load is one of the main factors that leave the poor unguarded by consuming their mental resources. (Adamkovič & Martončík, 2017), 3) The process

model of self-control does not fully explain why someone 'shifts' their motivation to the cues and necessities of immediate needs at Time 2 after engaging in self-control at Time 1. On the contrary, in the limited model of self-control, the psychological mechanism seems more precise. Since there are not any necessary mental resources left, a person tested by difficult choices shows lesser ability in controlling themselves at a later time.

2.1.3. Thinking Styles

The dual-process model of the mind posits two different types of thinking styles. Type 1 or intuitive thinking style is fast, cognitively effortless, automatized, and evolutionarily ancient (Evans, 2003; Kahneman, 2011; Evans & Stanovich, 2013). From this perspective, the solutions to specific problems are embedded in our cognitive systems, and they come to light if something triggers them. On the contrary, Type 2 or deliberative thinking style requires a great deal of mental and physical energy. It is generally slow, planned, serial, and to some extent rule-based (Evans, 2003; Kahneman, 2011; Evans & Stanovich, 2013).

Humans are not entirely rational in the sense that they calculate the expected utility and consequences of their preferences or actions. In Porcelli and Delgado (2009), it was shown that acute stress affected the participants' financial decision-making. Being subjected to acute stress via the cold pressor task increased their responsiveness to the reflection effect (i.e., people show greater preference for risky options if a potential loss is present, whereas they become conservative in their preferences in the face of potential gain). In line with the dual process of mind, it can be suggested that acute stress reinforces people's impulsive behavior by changing their thinking style. Since people will be more intuitive after feeling stressed, they will act with the reflection effect by taking more risks in the face of potential loss and do the exact opposite in the face of potential gain when they have to make financial decisions, whose consequences require particular pondering.

Masicampo and Baumeister (2015) claimed that sugar intake reduced the dependence on intuition when making decisions. The research showed that the tendency to make heuristic-type of decisions increased after the participants were asked to complete self-control tasks. This result indicates that prior self-control efforts exhausted their cognitive resources and led them to act intuitively. The research also put forward how self-control efforts depleted the participants' physical resources. When the participants drank lemonade with sugar, they were not affected by prior self-control efforts (Masicampo & Baumeister, 2015). Sugar intaking reinvigorated their mental and physical resources, thus allowing them to escape from the consequences of prior effortful decisions.

Stress also affects decision-making by switching thinking style (Starcke & Brand, 2012) since resource scarcity perception would cause stress as well by making people intuitive in their thinking style. Simonovic et al. (2016) show that participants' blood pressure was higher, and their Iowa Gambling Task performance and Cognitive Reflection Test results were poorer after stress manipulation. In this research, stressed participants tended to show riskier behavior vis-a-vis potential loss and showed a conservative attitude vis-a-vis potential gain. They exhibited also lesser analytical skills (e.g., reliance on reflective thought processes) since their CRT scores decreased as a result of feeling stressed (Simonovic et al., 2016).

In the case of resource scarcity perception, three possible manifestations of intuitive decision-making might occur in the form of 1) choosing immediate rewards over the distal ones, 2) not being able to consider the consequences of the actions taken, 3) depending on heuristics arising from cognitive biases (Evans, 2010). Therefore, resource scarcity perception makes people choose immediate rewards since choosing the immediate gains would satisfy the immediate needs. Thus, when they choose what is immediate, they are likely to pay no attention to the consequences of their decisions. Since they are too focused on the results of material scarcity and put too much thought into how it feels like at that time, their cognitive window revolves around what is present at the moment. Lastly, resource scarcity leads people to rely on cognitive biases; thus, people become more dependent on heuristics that are default cognitive tools.

2.2. Behavioral Consequences of Feeling Poor

2.2.1. Time-discounting

Increased time-discounting means the devaluation of distal, greater rewards as compared to immediate, smaller ones. In the relevant literature, other terms, such as intertemporal choice, temporal discounting, delay discounting, and delay of gratification are used as approximate substitutes for it. This section was devoted to exposing the findings showing the relation between the psychological consequences of resource scarcity and time-discounting.

In Liu et al. (2012), the psychological dimensions of feeling poor were investigated. In the first two experiments, participants were exposed to poverty pictures in the form of implicit and explicit cues. In the third experiment, they tried to inject a temporary perception of poverty and affluence with a lucky draw game. Those who were exposed to poverty cues showed a lesser delay of gratification. Thus, poverty cues led people to choose in favor of short-term options. They also came up with what they call the poverty cue hypothesis against the life-history theory, which simply considers the

objective economic background of people when they make intertemporal decisions. The poverty cue hypothesis claims that people with low SES should be aware of their economic conditions to show greater time-discounting (Liu et al., 2012).

Lerner et al. (2013) defined a phenomenon, which they named myopic misery (e.g., an urge to satisfy immediate needs). In a monetary choice, experiencing sadness triggered impatience and caused a myopic misery on the urge to take the immediate monetary reward. Thus, those with myopic misery showed greater intertemporal discounts. In Experiments 1 and 2, Lerner et al. (2013) investigated how sadness would affect participants' intertemporal choices and they also looked for the effect of disgust to explore which negative emotion other than sadness would have the same result on time-discounting. They made participants watch sad and disgusting videos and write essays relevant to these emotional states before asking them to make intertemporal choices. Those in the sadness condition were more impatient in the intertemporal task while those in the disgust condition did not. In Experiment 3, they investigated if sadness created a general increase in impatience or was it just related to choices that provided immediate rewards. Sadness created present bias with respect to immediate rewards. Furthermore, they could not find any evidence regarding sadness increases general impatience.

Mishra and Lalumiere (2016) treated delay discounting as related to the generality deviance. Namely, certain impulsive and risky behaviors are expected to be observed jointly. In their study, delay discounting was associated with high trait impulsivity, low trait self-control, risk avoidance vis-a-vis potential financial gain, risk-taking tendency in the face of potential monetary loss, paying less attention to healthy behaviors, gambling, antisocial and criminal behaviors. They found that delay discounting was indeed related to variables of the generality deviance (Mishra & Lalumiere, 2016).

Hoel et al. (2016) investigated whether self-control depletion would affect the preferences for time-discounting. In the experimental condition, they used the incongruent Stroop task, expecting that those in the experimental group would exert self-control via it. They found that those who exerted self-control preferred immediate reward as compared to those in the control group. Since the found effects were small, they split the participants based on their SES and they found that those with lower SES were more impatient and preferred immediate reward to a greater extent. They also claimed that the limited resource model of self-control failed at explaining their findings since relatively wealthy participants exerting self-control were not as much affected as expected. They claimed that the participants with lower SES showed weak self-control since their motivation shifted towards satisfying immediate needs after exerting self-control. Thus, they highlighted that the process model of self-control might be more explanatory in terms of the disparity seen between the time-discounting preference of the participants with lower SES and higher SES (Hoel et al., 2016).

Carvalho et al. (2016) investigated whether having saving accounts would have an impact on financial risk-taking and delay discounting. 1286 households were assigned to either the control group or the experimental group, in which people were offered formal saving accounts. The experiments took place in Nepal, where most of the general population does not have access to saving accounts. After a year, the participants' risk and time-discounting preferences were measured. The result showed that those in the experimental group took more risk in the lottery-choice task, and they were also more likely to delay taking immediate reward even though this was not totally conclusive. The result simply indicates that having any measure of financial security makes people confidently take risks in the face of potential gain and delay immediate gratification, whose result might have financial effects.

Brown et al. (2015) focused on the empirical determinants of time-discounting. The Croatian retirees' rights have been cut during the period of the war in Yugoslavia from 1990 to 1995. The Constitutional Court later decided that the government had to compensate for these unconstitutional cuts. In 2005, the Croatian retirees were offered two options, whether they take a more immediate, small stream of payment or they take a delayed, but a larger stream of payment. Seventy-one percent of the retirees chose the first option. Brown et al. (2015) found that younger, healthy people were likely to take the delayed payment. Those with higher income also preferred the delayed option. Having children and a stronger bequest motive also affected people's preferences. They chose a later, larger stream of payment (Brown et al., 2015). However, those who expected higher inflation and those who did not believe that the government would pay what they promised chose the immediate stream of payment (Brown et al., 2015). Thus, the study reveals the possible alternative variables that influenced time-discounting. The income status, liquidity constraints, longevity expectations, bequest motives and the perceptions of economic and political risks all have an impact on whether people would delay immediate rewards.

Time-discounting preference can be treated as a problem of self-control. Those who have depleted self-control will be more likely to show greater time-discounting (Amaya, 2020). The thinking style will also interact with time-discounting preferences. Depending on intuition can cause one to focus on satisfying immediate needs, not to think of consequences, and to depend on cognitive biases (Evans, 2010). Thus, a person can be choosing the immediate, smaller rewards over the larger ones since they intuitively approach this dilemma. They try to satisfy the urging needs and do not think about the consequences of their decision and can act with a habitual behavior arising from cognitive biases (Evans, 2010; Haushofer and Fehr, 2014). Moreover, what triggers this chain of relations is that one subjectively becomes aware of their resource scarcity.

2.3. Critical Notes and Additional Theoretical Alternatives Derived from the Literature

One critical note about the relationship between resource scarcity perception and impaired cognition comes from the recent studies of Sheehy-Skeffington and Rea (2017) and Sheehy-Skeffington (2020). They determined additional factors apart from the perception of resource scarcity. The other socio-ecological cues, as they call them, are environmental instability and low subjective social status. These three socio-ecological factors (e.g., resource scarcity perception, environmental instability, and low subjective social status) might be providing the poor with the necessary regulatory shift vis-a-vis material scarcity (Sheehy-Skeffington & Rea, 2017). Thus, with this regulatory shift toward the immediate needs that have to be taken care of, the poor behave in a way that makes sense of and is 'rational' from a short-term perspective since this is what makes them adapt to the circumstances they experience (Sheehy-Skeffington & Rea, 2017; Sheehy-Skeffington, 2020).

Other aligning interpretations suggest that the poor efficiently allocate their cognitive resources. One theoretical basis for this argument comes from construal level theory, which sees decisions resulting from information-processing differences related to psychological states (Liberman & Trope, 2010). This theoretical perspective posits that the mind tends to process information at any time by considering the psychological distance from the self at this moment. Psychologically distant information becomes related to the future, hypothetical, socially distant people, and physically distant places, whereas psychologically proximal information is related to the present, actual, socially near people, and here. Decisions of distal context align with abstract, goal-oriented thinking, whereas the proximal context decisions are related to concrete, implementation-oriented thinking (Liberman & Trope, 2010). Thus, whenever a person focuses on proximal information, their decision-making processes change. In this case, their decision-making is directed by concrete thinking. Those who experience the socioecological cues relating to resource scarcity perception, environmental instability, and low subjective social status will focus on the proximal information. Thereof, the results of their decision-making will be the efforts to solve what has to be immediately dealt with. Their mind tends to process information about what is actual, here, and socially nearby.

The life-history theory also aligns with this sort of interpretation. From the perspective of the life-history theory, organisms gain their energy from the environment in which they live, and they allocate this energy to the matters of survival and reproduction. (Gangestad & Kaplan, 2015) They will try to gain the necessary energy and strategically allocate it to increase fitness in their ecological niche. In most cases, allocating the energy the organism has is about trade-offs. The way the organism spends its energy budget determines its likely adaptation to the environment

(Gangestad & Kaplan, 2015). Thus, we can use this theory in the case of the poor as well. The poor have limited resources and have to spend them in their social and ecological niche. Thus, they better spend this *smartly* so as to adapt to the conditions that they go through. This trade-off leads them to a present-oriented perspective. Hence, the shift towards the present, what is actual, here, and socially near makes sense with these theories because the way the poor behave can be adaptive and, to some extent, rational in the case of poverty.

Having said that, in the scope of this thesis, we investigated whether the scarcity mindset impairs cognitive functions with the result of making the poor act in a way that is harmful in the long term.

2.4. The Conceptual Model of Poverty Perpetuation Proposed by Adamkovič (2020)

Adamkovič (2020) developed a comprehensive theoretical model (see Figure 2.1) explaining the relationship between poverty and economic decision-making. Even though the model is vast, it can be simplified as follows: subjective aspect of poverty triggers cognitive load that can be separated into negative affect and stress. Cognitive load impairs the executive functions consisting of attention, working memory, and self-control. Moreover, cognitive load also changes the thinking style to intuitive (vs. deliberative). This whole process affects the poor’s economic decision-making in terms of time-discounting preferences and risk preference (e.g., the poor choose the immediate reward over the distant but more beneficial ones. They also tend to risk less in case of a potential gain and risk more in the context of the possible loss).

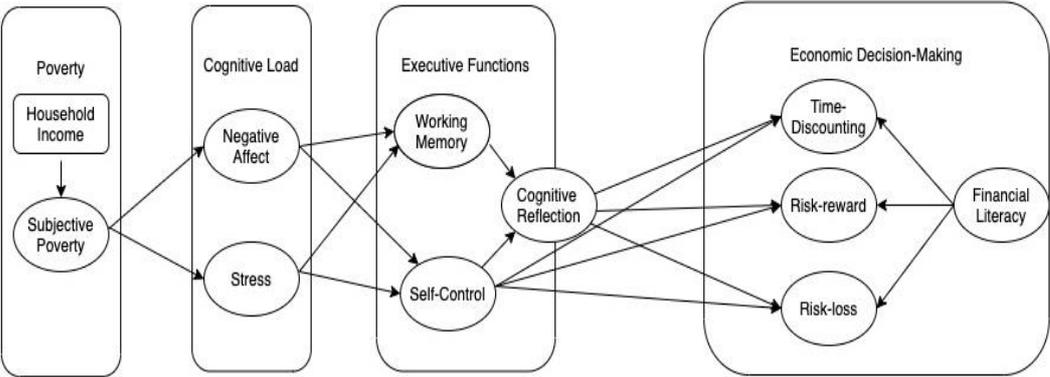


Figure 2. 1 The Conceptual Model of Poverty

Adamkovič (2020) tested the model in Figure 2.1 with three studies using Structural Equation Modelling (SEM). They also benefited from Confirmatory Factor Analysis (CFA) to explore the factor structures of the measurements for the variables in the model. The fitness of the models proposed in three studies was assessed with chi-

square tests. In their three studies, chi-square tests suggested that their model deviated from the data, even though they did various changes in the measurement models and added covariances between variables and even excluded some variables from the model (see Section 4.1 in Chapter 4)

2.5. An Overview of Our Approach

We thought that the limitations of the studies of Adamkovič (2020) lied in the structure of the model and the experiments' designs. To this end, we followed two steps. First, we looked at which relationships were solid in the studies of Adamkovič (2020): we used a data analytical perspective by mining the data of the studies in Adamkovič (2020) to discover likely Bayesian Networks (BNs) with the bnlearn package (see Chapter 4). This R package provides graphical structures of Bayesian Networks when its *learning* algorithms work on certain data. From the data of the three studies in Adamkovič (2020), we attained various Bayesian Network structures that indicated possible causal relations between the variables (see Chapter 4). Even though the attained BN structures showed partial relations, this procedure gave insightful results to propose alternative simpler BN models.

Secondly, we also benefited from the abstraction operations in BNs proposed by Yet and Marsh, (2014). This approach provides a way of abstracting the BNs in a systematic manner. With this approach, we abstracted the conceptual model proposed by Adamkovic (2020) to provide a simpler causal model. Thus, depending on the relevant findings in the literature and what we found in analyzing the data of Adamkovič (2020) with the bnlearn package, we applied the abstraction operations in Yet and Marsh (2014) to the model in Figure 2.1 and abstracted it (see Figure 2.2 and Chapter 5).

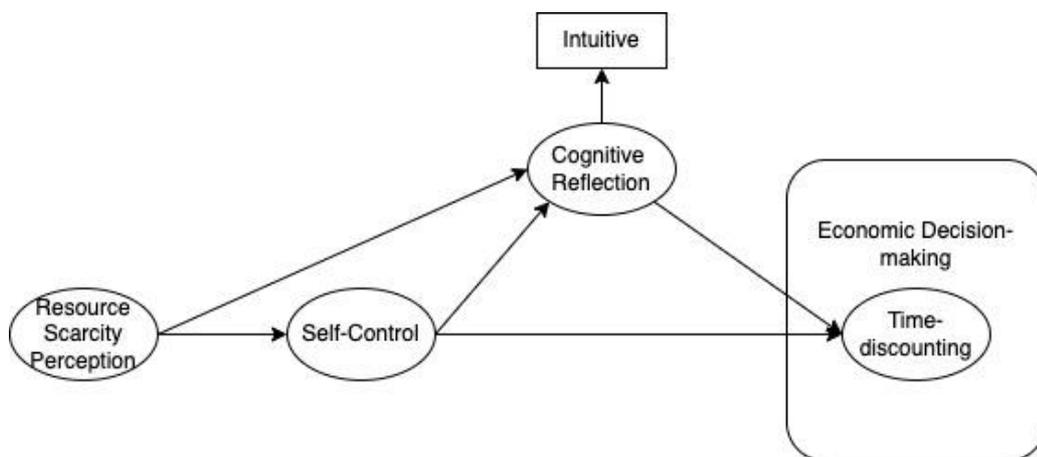


Figure 2. 2 Abstracted Causal Model Showing the Relationship Between Resource Scarcity and Time-discounting

The abstracted causal model¹ in Figure 2.2 describes that resource scarcity affects time-discounting preference (e.g., choosing the immediate and smaller reward now over the distal and larger reward in the future) of low SES people (vs. high SES participants). It also explains resource scarcity perception leads people to weak self-control and intuitive thinking style (low SES vs. high SES). Moreover, both weakened self-control and intuitive thinking style, at least in part, moderate the effect of resource scarcity on time-discounting preference (e.g., choosing the immediate and smaller reward now over the distal and larger reward in the future).

¹ Chapter 5 describes step by step how this model has been gained with the abstraction operations proposed by Yet and Marsh (2014)

CHAPTER 3

CAUSAL DISCOVERY AND CAUSAL BAYESIAN NETWORKS

3.1. Causality

Sciences essentially aim to understand the causal relations in nature. However, causal relations cannot be identified purely based on empirical data as “correlation does not imply causation”. In order to determine the causal relations from empirical data, we need to make some causal assumptions about the observations we make. As philosopher Nancy Cartwright puts it, "no causes in, no causes out" (Cartwright, 2003). In some sciences where randomized controlled trials are feasible, relatively fewer and simpler assumptions are needed for identifying causal relations. However, in other domains where randomized controlled trials are impossible or unethical, more comprehensive models and assumptions are required to make causal inferences from observational data.

When two events are related to each other, the relation can be due to statistical dependence (correlation) or causal dependence (causation). Statistical dependence can be identified purely from data, and it can be used for making predictions based on observations. However, statistical dependence cannot be used for predicting the outcome of interventions. For this, causal dependence between the events needs to be understood. Data alone is not sufficient for this task.

When a causal dependence is present, statistical dependence will often be present. However, statistical dependence can also be present if there is no causal dependence. For example, barometer measurements predict weather conditions due to statistical dependence between barometer values and weather conditions. However, this is not due to a causal relationship between the barometer readings and weather since intervening and changing the barometer values will not lead to rain. However, there is a causal dependence between air pressure and rain, and between air pressure and barometer values. If one can intervene and decrease the air pressure, it will change both the barometer readings and the probability of rain. In other words, there is a

correlation between barometer and rain as the air pressure causes both, but this correlation does not imply causation between barometer and rain (see Figure 3.1).

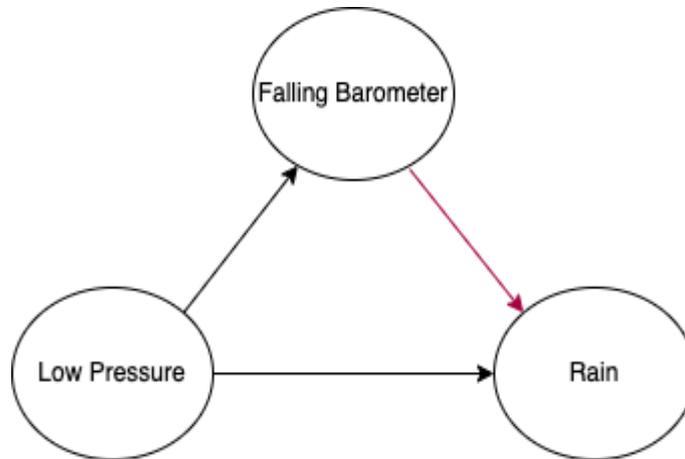


Figure 3. 1 The arrows going from Low Pressure to Falling Barometer and Rain show causality, whereas the arrow going from Falling Barometer to Rain does not. Thus, the arrow between Falling Barometer and Rain should not exist

3.2. Causal Bayesian Networks

Bayesian Networks (BNs) are graphical models that encode conditional independence assumptions for a set of variables and represent their joint probability distribution. BNs represent the mutual dependencies of the graphical model in a factorized manner (Pearl, 2011).

When two nodes X and Y are directly connected in a BN, such as $X \rightarrow Y$, X is called the parent node and Y is called the child node. A conditional probability distribution $P(Y / X)$ is defined for every node in a BN conditioned on its parents. If the variable has no parents, its marginal distribution $P(X)$ is defined.

The first step in building a BN model is to define its structure, which encodes the dependence and independence assumptions between its variables (see Section 3.3). The structure can be learned from data or built from experts' knowledge. The arcs in the BN structure may represent causal relationships but BNs are not necessarily causal. BN structures that are learned purely from data are non-causal as causal relations cannot be identified from the data alone. Once a BN structure is built, assumptions encoded by this structure can be verified based on expert knowledge or its performance can be assessed with data. The second step in building a BN model is parameter estimation, where the conditional probability distributions for each node are defined either based on data or expert knowledge.

BNs, both causal and non-causal, can be used to predict the result of observations. Identifying correlations in the data is sufficient for this. If a BN structure is causal,

interventional and counterfactual inferences can also be made from the model (Pearl, 2011; Pearl et al., 2016; Dablander, 2020). The conditional inference regarding an observation and an intervention is mathematically denoted as $P(X / Y)$ and $P(X / do(X))$ respectively. The former, $P(X / Y)$, denotes the statistical question of the probability of X given we observe Y . The latter, $P(X / do(Y))$, denotes the causal question of the probability of X given we intervene on Y .

3.3. Conditional Independence Assertions in a BN

The graphical structure of a BN is a DAG that encodes conditional independence assumptions on the variables in the BN. This section introduces some terminology and gives an overview of the conditional independence assumptions imposed by DAGs.

DAGs are directed graphs, meaning that each edge of a DAG has a direction pointing from one node to the other. For example, Figures 3.2 and 3.3 respectively show undirected and directed graphs.

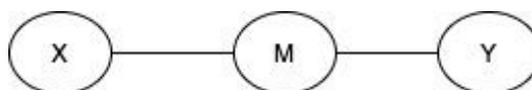


Figure 3. 2 A simple graphic showing no specific relationships

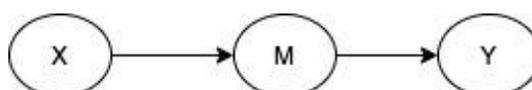


Figure 3. 3 A DAG with specific relationships between its variables

A path is a sequence of nodes in a graph in which each consecutive node in the sequence is connected by an edge. A directed path is a path that follows the edge directions. For example, $X \rightarrow M \rightarrow Y$ is a directed path from X to Y (see Figure 3.3).

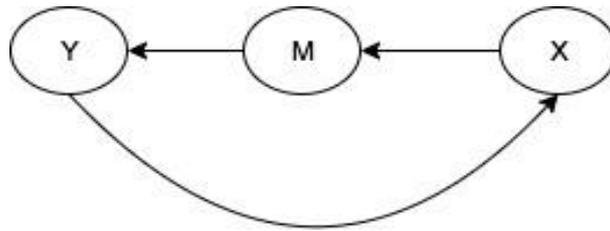


Figure 3. 4 A cyclic graph, where X is the initial and outcome variable

DAGs are also acyclic graphs, meaning that a directed path starting from a node cannot end with the same node. For example, Figure 3.4 shows a cyclic graph, in which the directed path, $X \rightarrow M \rightarrow Y \rightarrow X$, is a cycle. Therefore, the graph in Figure 3.4 is not a DAG and cannot be a BN structure.

If two nodes X and Y in a BN are independent due to the DAG structure, this is denoted by $X \perp\!\!\!\perp Y$. Similarly, X and Y are independent given conditioning on a third node M , this is denoted by $X \perp\!\!\!\perp Y / M$. Conditional independence assumptions imposed by a DAG structure can be summarized in terms of three types of relations between node triplets; i.e. the chain, fork and collider relations. All DAGs can be decomposed into chains, forks and colliders. Therefore, understanding the independence assumptions in these three types of relations is sufficient to understand all independence assumptions imposed by DAGs. In the remainder of this section, we review those independence assumptions.

3.4.2.1. Chain

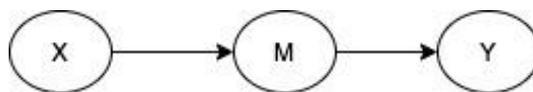


Figure 3. 5 A chain, where the path goes from X to Y through M

Figure 3.5 shows the basic example of the chain, in which X and Y are dependent, and X and Y are conditionally independent, given the value of M ($X \perp\!\!\!\perp Y / M$) (Pearl et al., 2016). In a causal BN, this model can be interpreted as M mediating the effect of X on Y .

For example, in the chain of $Fire \rightarrow Smoke \rightarrow Alarm$, fire causes smoke and smoke triggers alarm. Thus, fire and alarm are dependent. Observing the alarm will inform

you about the fire. However, once you know the value of smoke, observing a fire or alarm does not provide more information about each other.

3.4.2.2. Fork

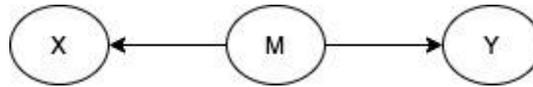


Figure 3. 6 A fork, where the path goes from M to X and Y

Figure 3.6 shows a fork, in which X and Y are dependent. They are conditionally independent, given M ($X \perp\!\!\!\perp Y / M$) (Pearl et al., 2016). In a causal BN, this can be interpreted as M being the common cause of the other two variables, X and Z . X and Y are correlated due to M but they are not causally related.

For example, assuming the DAG $Yellow\ Fingers \leftarrow Smoking \rightarrow Lung\ Cancer$, smoking causes both yellow-colored fingers and lung cancer, thus making them statistically related. Once we know the value of smoking, observing yellow fingers does not tell anything more about lung cancer.

3.4.2.3. Collider

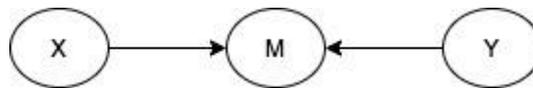


Figure 3. 7 A collider, where the path goes from X and Y to M

The independence assertion of a collider is different from the fork and chain structures. Figure 3.7 shows an example of a collider in which X and Y are parents of M . In this structure, X and Y are independent $X \perp\!\!\!\perp Y$. They become conditionally dependent, given M is observed (Pearl et al., 2016).

For example, consider the DAG $Talent \rightarrow Celebrity \leftarrow Attractiveness$. The talent and attractiveness of a celebrity are independent. Some people are famous due to their beauty, others are famous due to their talent. Once you condition on being a celebrity, talent and beauty become dependent. If a famous person is not talented, their fame is probably due to their beauty.

3.4.3. D-separation Rules

D-separation rules formalize conditional independence in any DAG. When two variables are *d*-separated in a DAG, they are independent in all probability distributions that can be represented on that DAG. When two variables are not *d*-separated, they are called *d*-connected (Pearl et al., 2016; Dablander, 2020). Chain, fork and collider relations discussed above have summarized *d*-separation rules. *D*-separation generalizes these rules for DAGs of any size and structure (see Appendix A).

Two nodes *X* and *Y* are *d*-separated by a set of nodes *Z* if the rules below are true for all of the paths between *X* and *Y*:

- along the path between *X* and *Y*, there is a chain $X \rightarrow \dots \rightarrow W \rightarrow \dots \rightarrow Y$ or a fork $X \leftarrow \dots \leftarrow W \rightarrow \dots \rightarrow Y$, where *W* is conditioned on ($W \in Z$)
- along the path between *X* and *Y*, there is a collider $X \rightarrow \dots \rightarrow W \leftarrow \dots \leftarrow Y$, and *W* or the descendants of *W* are not conditioned on ($W \notin Z$)

3.4.4. Confounding Bias

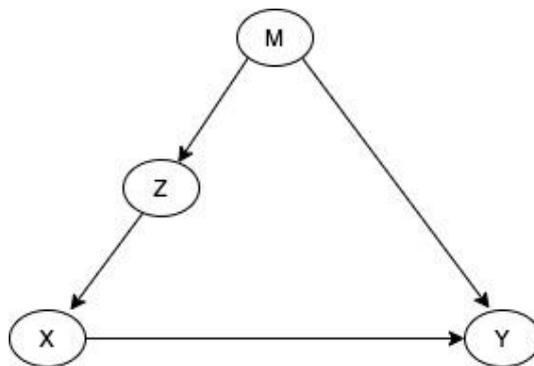


Figure 3. 8 A graph, showing the causal path from *X* to *Y*. The variables *Z* and *M* are the confounders to the causal path from *X* to *Y*.

When we aim to estimate the causal relation between *X* and *Y*, the causal relation between them will be confounded if there is also a common parent or ancestor of *X* and *Y*, such as *M* as shown in Figure 3.8. In other words, when a confounder is present, the results of observing and intervening *X* on *Y* will be different, i.e., $P(Y | X) \neq P(Y | do(X))$. This is because, when *X* is observed, it will be dependent on *Y* both through

the direct causal link and through the fork structure via M . In order to estimate causal relations, we need to include and address the confounders in the causal model (Pearl, 2011; Pearl et al., 2016; Dablander, 2020). This can be done by back-door or front-door adjustment.

3.4.4.1. Back-door Adjustment

Back-door adjustment can be used to estimate the causal relation between two variables from observational data even when there is confounding. Back-door adjustment simply means blocking all the back-door paths by conditioning on them. For example, assuming that Figure 3.8 is a causal model, in order to estimate the causal relation between X and Y , we need to block the backdoor paths by either conditioning on Z and M (see Figure 3.8) (Pearl, 2011; Pearl et al., 2016; Dablander, 2020).

More generally, variables in the set of T satisfy the backdoor criterion concerning X and Y if

- 1) T blocks all the backdoor paths from X to Y
- 2) T does not have any descendants of X .

3.4.4.2. Front-door Adjustments

We can also estimate causal effects using front-door adjustment. For example, in order to estimate the causal effect of X on Y in the causal model shown in Figure 3.9, the necessary conditions for front-door adjustment are:

- 1) M should mediate the effect of X on Y ,
- 2) There should not be any unblocked backdoor path from X to M ,
- 3) X should block all the backdoor paths from M to Y (Pearl, 2011; Pearl et al., 2016; Dablander, 2020).

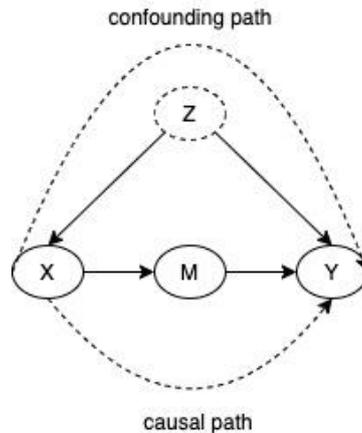


Figure 3. 9 A graph, showing the causal path from X to Y through M. The variable Z is unobservable and creates a confounding path.

In this case, the causal effect of X on Y can be identified through then the effect of X on M , and the effect of M on Y (Pearl, 2011; Pearl et al., 2016; Dablander, 2020 for a detailed description of this approach).

3.5. Overview of our approach for building BNs

In this study, we build causal BNs regarding decision making under the feelings of scarcity based on the literature, and then we assess the strength of certain relations in these BNs by using experiments. There are two main challenges to our approach.

The first challenge is to combine the information collected from domain experts, previous publications and data to build a causal BN structure. We primarily use domain knowledge and published evidence to define the structure of the BN. Data are used to learn the strength of these relations in this structure. Data-driven structure learning algorithms are also available for BNs. These algorithms cannot identify causal structure purely from data but they can be useful to provide insight and conduct sensitivity analysis regarding the expert elicited BN structures by identifying the conditional independencies in the data.

The second challenge is to match the structure of the BN for the same level of detail as the planned experiments. The BN structure built from expert and published knowledge can be more detailed and complex compared to the experiments. In this case, abstracting or refining the BN is necessary, and we use systematic approaches that are available for this task (Yet and Marsh, 2014).

In the remainder of this thesis, Chapter 4 will describe the use of data-driven structure learning algorithms to gain insight related to the scarcity decision-making problem,

and Chapter 5 will use abstraction techniques to modify the causal structure of the problem to match the level of detail of the experiments that are conducted for this problem. Chapter 6 will present the results of those experiments.

CHAPTER 4

DATA-DRIVEN APPROACH TO EXPLORE ALTERNATIVE CAUSAL STRUCTURES

In this chapter, we use data-driven BN structure learning algorithms to gain insights into the dependency structure of the problem being studied. Note that data are not enough to discover causal relationships on their own (see Chapter 3). The relationships identified in the BN structures that are learned from data indicate statistical dependencies that may or may not be due to causality as BN models with different causal structures can be statistically equivalent. Yet, BN structures learned purely from data can be helpful for having perspectives regarding statistical dependencies and they can aid the discovery of potential causal relationships.

Adamkovič and Martončík (2017) proposed a conceptual model of the possible relationships between resource scarcity perception and its effects on economic decision-making. Adamkovič (2020) came up with a revised model (see Figure 4.1) and assessed it with data collected by experiments. Adamkovič (2020) could not find statistically significant relations between the variables in the model. In this chapter, we use BN structure learning algorithms to learn BN models from this dataset (Adamkovič, 2020). We examine the structure of these BN models to gain insight into the conditional independencies in the dataset. We used the `bnlearn` package, which is implemented in R, for this task (Scutari, 2010).

4.1. The Conceptual Model of Adamkovič (2020)

Adamkovič (2020) tested the likely cognitive mechanism behind the behavioral consequences of resource scarcity perception. Their hypothesized model represents the link between socio-economic standing and economic decision-making. In sum, subjective feelings of poverty cause cognitive load via negative affect and stress. Cognitive load impairs people's executive functions, such as working memory, self-control and cognitive reflection. This cognitive path directly impacts economic decision-making (e.g., specific changes are observed in people's time discounting and risk-taking (risk-reward and risk-loss) preferences). Lastly, financial literacy also

affects people’s time-discounting, risk-reward and risk-loss preferences (see Figure 4.1).

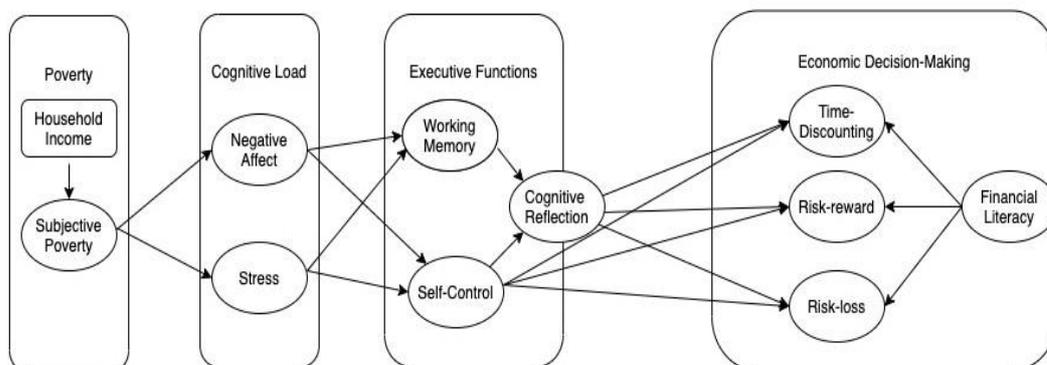


Figure 4. 1 The Theoretical Model of Poverty Perpetuation, Adamkovič (2020)

They tested the model in Figure 4.1 with three empirical studies using Structural Equation Modelling (SEM). They used Confirmatory Factor Analysis (CFA) to explore the alternative factor structures of the measurements for the variables in the model. They estimated the fitness of the proposed model and its modified versions by using means-adjusted and variance-adjusted weighted least squares for all the variables in the model except the one representing household income. The fitness of each model was evaluated with chi-square tests. In their first empirical study (Study 1) an exploratory analysis was done to propose theoretically suitable adjustments to the measurement models of the variables and evaluate the model’s fitness. Their second study (Study 2) examined the fitness of the model and its modified versions using chi-square tests. Their third study (Study 3) checked if the model would be replicated with slight changes. They conducted sensitivity analyses on the same structural model with different measurement construction approaches to see if they would have any impact on the estimations of the model as well (Adamkovič, 2020).

Table 4.1 summarizes the materials used in these three studies. The data regarding these materials are available². The results of Adamkovič (2020) can be summarized as follows. In Study 1, they improved the performance of their initial model by making some modifications to measurements in CFA, adding a covariance between negative affect and stress and excluding financial literacy. However, their model did not adequately fit the data in the chi-square tests. In Study 2, they changed the measurements of working memory and financial literacy (see Table 4.1), added a

² <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.00171/full#supplementary-material>

covariance between negative affect and financial literacy, and excluded financial literacy. However, their results in CFA were similar to those from Study 1. In Study 3, they made further modifications to the measurements, yet the model still did not show an adequate fit.

Table 4. 1 The table showing all the variables and materials of Adamkovič (2020)'s studies

	Variables	Measurements
Poverty	Household Income	For all the studies, they used revised OECD modification scale (Hagenaars et al., 1994)
	Subjective Poverty	For Studies 1 and 2, they used 1) The MacArthur scale of subjective social status (Adler&Stewart, 2007; Giatti, Camelo, Rodrigues, & Baretto, 2012). 2) a 5-item wealth satisfaction scale consisting of 6 items. 3) 9- point self-perception of poverty/wealth. For Study 3, they used a wealth satisfaction measurement consisting of 3 items and a 10-point response scale.
Cognitive Load	Negative Affect	For Studies 1 and 2, they used PANAS (Watson, Clark, & Tellegen, 1998)
	Stress	For all the studies, they used the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983)
Executive Functions	Working Memory	For Study 1, they used a 3-steps digit operation span test. there was a slight change in the measurement for Studies 2 and 3 (Adamkovic, 2020)
	Self-control	For all the studies, they used the Brief self-control scale (Tangney, Baumeister, & Boone, 2004)
	Cognitive Reflection	For all the studies, they used an extended version of the cognitive reflection test (Frederick, 2005; Oldrati, Patricelli, Colombo, & Antonietti, 2016)
Economic Decision-Making	Time-discounting	For all the studies, they used the staircase model of time-discounting (Falk, Becker, Dohmen, Huffman, and Sunde, 2016). 27 item monetary choice questionnaire (Kirby, Petry, & Bickel, 1999; Kaplan, Amlung, Reed, Jarmolowicz, McKechar, & Lemley, 2016) was used as an additional measure.
	Risk-reward	For Studies 1 and 2, they used the staircase model of risk preferences (Falk et al., 2016)
	Risk-loss	For Studies 1 and 2, the staircase model of risk preferences (Falk et al., 2016)
	Financial Literacy	For Study 1 they used a six-questions measurement (consisting of three basic and three advanced) (Lusardi, 2008). In Studies 2 and 3, two advanced questions were added.

4.2 Data Preprocessing

The complexity of a BN, i.e. the number of parameters that need to be defined for the model, depends on the combinations of the values of nodes that are directly connected to each other. As the number of parents of a variable, and the possible values those variables can take, increase, the number of parameters becomes subject to the combinatorial explosion. In the dataset, most variables had a scale of 5 or 10 points. Considering the limited sample size and the complexity of the BN, we discretized these variables into a smaller number of values. Continuous variables in the dataset were also discretized. Table 4.2 shows the discretized data used for learning the BNs³.

Table 4. 2 The table showing all the measurements used in Adamkovič (2020) and how we discretized their dataset

Variables	Measurements	Discretization of the Scales
Subjective Poverty	The MacArthur 10-point scale of subjective social status	Discretized into three categories: Low SES, Medium SES, and High SES
	5-point Wealth Satisfaction Scale	Discretized into two categories: Low Wealth Satisfaction and High Satisfaction
	9-point Self-perception of Poverty/Wealth Scale	Discretized into three categories: Poor, Middle, and Rich
	10-point Wealth Satisfaction Scale	Discretized into three categories: Low Wealth Satisfaction, Neutral, and High Wealth Satisfaction
Negative Affect	The PANAS with a 5-point scale	Discretized into two categories: Low Negative Affect and High Negative Affect
Working Memory	A digit span task with either giving correct or wrong answer	Discretized into two categories: Low Working Memory and High Working Memory
Self-control	The Brief Self-control 5-point scale	Discretized into two categories: Weak Self-control and High Self-control
Cognitive Reflection	Cognitive Reflection test with giving either correct or wrong answer	Discretized into two categories: Weak Cognitive Reflection and High Cognitive Reflection
Time-discounting	1) The staircase model of a time-discounting 32-point scale 2) a monetary 4-choice questionnaire	Discretized into two categories: Low Time-discounting and High Time-discounting
Risk-reward	The staircase model of risk preference 32-point scale	Discretized into two categories: Low Risk Taking and High Risk Taking
Risk-loss	The staircase model of risk preference 32-point scale	Discretized into two categories: Low Risk Taking and High Risk Taking
Financial Literacy	Questions revealing either financial literacy or illiteracy	Discretized into two categories: Weak Financial Literacy and High Financial Literacy

³ Our R codes for how we discretized the dataset of all three studies of Adamkovič (2020) were shared in our OSF link (see <https://osf.io/4s6th/>).

4.3 Overview of BN Structure Learning Algorithms

After discretizing and preprocessing the dataset, we learned BN models from this data by using BN structure learning algorithms. Structure learning algorithms can be categorized as score-based and constraint-based algorithms. Score-based algorithms assign a network score for each candidate network and try to find the structure with the maximum score by putting, erasing, and reversing the arcs (Nagarajan et al., 2013). Examples of score-based algorithms include Greedy search algorithms, genetic algorithms and simulated annealing. The Hill-climbing algorithm is a greedy score-based algorithm that makes the structure change with the highest increase in the score in each iteration⁴.

Algorithm 1.1, the principles of the Hill-Climb algorithm:

- “1. Choose a network structure G over V , usually (but not necessarily) empty.
2. Compute the score of G , denoted as $ScoreG = Score(G)$.
3. Set $maxscore = ScoreG$.
4. Repeat the following steps as long as $maxscore$ increases:
 - a. for every possible arc addition, deletion or reversal not resulting in a cyclic network:
 - i. compute the score of the modified network G^* , $ScoreG^* = Score(G^*)$:
 - ii. if $ScoreG^* > ScoreG$, set $G = G^*$ and $ScoreG = ScoreG^*$.
 - b. update $maxscore$ with the new value of $ScoreG$.
5. Return the directed acyclic graph G .” (Nagarajan et al., 2013)

Incorporating prior knowledge about the BN structure can improve the performance of structure learning algorithms. A simple approach for this is to define a whitelist and blacklist that respectively defines the existence and non-existence of different arcs for the algorithm. A structure learning algorithm never includes the arcs from the blacklist in the learned BN structure, and it always includes the arcs from the whitelist. For exploratory purposes, we used whitelisting and blacklisting in our further analyses (see Sections 4.4.1, 4.5.1, and 4.6.1).

4.4. BNs Learned from the Data of Study 1

Firstly, we used the Hill-Climb algorithm without incorporating any prior knowledge. Figure 4.2 shows the BN model learned by the algorithm. It gave a mixed result in the sense that some relationships in this BN are aligned with those reported in the literature, whereas others were unexpected considering the previous literature. For example, there is an arc going from Negative Affect to Self-control, which is aligned

⁴ See Chapters 17 and 18 of Koller and Friedman (2009) for a more comprehensive review of BN parameter and structure learning approaches and their limitations.

with the findings of the literature (Hofmann et al., 2012, Vohs, 2013). Another expected relationship is the arc going from Working Memory to Cognitive Reflection (Adamkovič & Martončík, 2017).

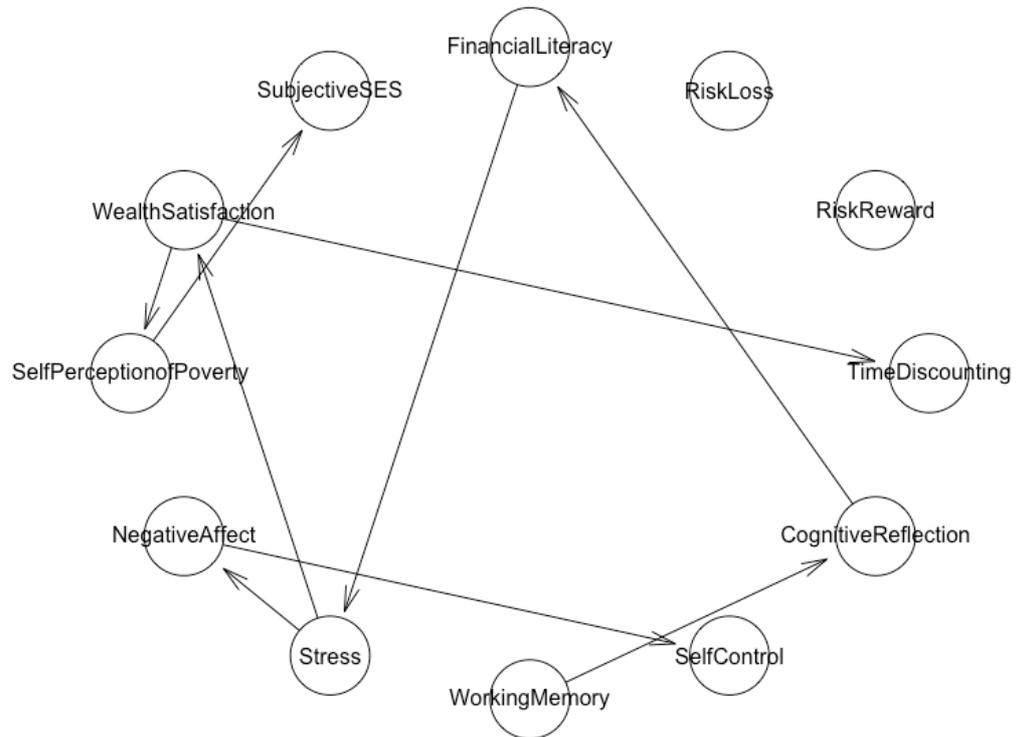


Figure 4. 2 The network that the Hill-Climb algorithm implemented on the data of Study 1 gave

Some relations in Figure 4.2 conflict with previous studies. For example, the arc from Financial Literacy to Stress and the arc from Stress to Wealth Satisfaction are unexpected considering the previous literature. On the contrary, the arc would have been expected to go from Wealth Satisfaction to Stress since those who are not satisfied with their economic situations would be more likely to get stressed in the face of economic hardship. Note that such misdirected arcs are expected from structure learning algorithms as these algorithms cannot learn causal relationships from data. The other relationships from this BN are summarized in Figure 4.3.

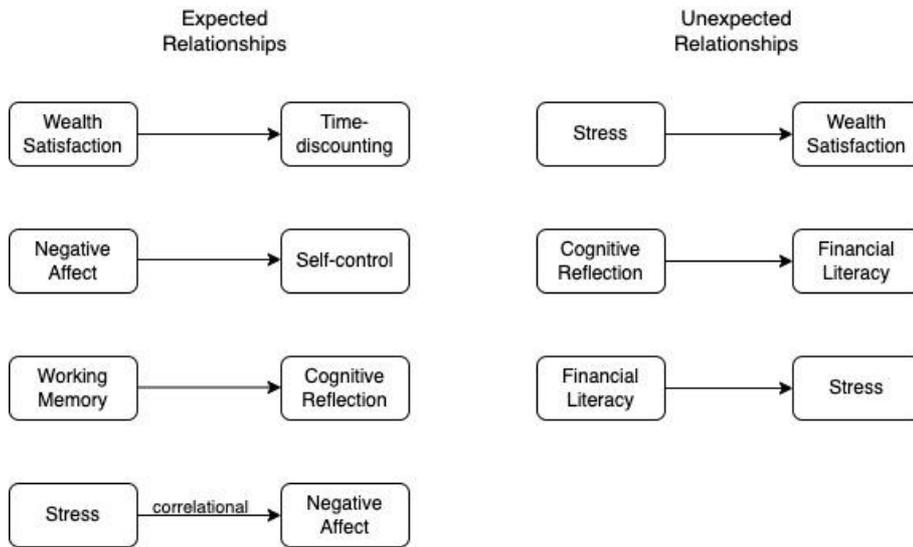


Figure 4. 3 The summarized relations in Figure 4.2

4.4.1. Study 1: BNs Learned with Prior Structural Knowledge

We used the blacklist and whitelist shown in Figure 4.4 to incorporate the prior knowledge about the arcs that should be and not be in the BN model. The BN model learned by the Hill-Climbing algorithm according to this list is shown in Figure 4.5. Note that, all of these arcs are aligned with the findings from the previous literature.

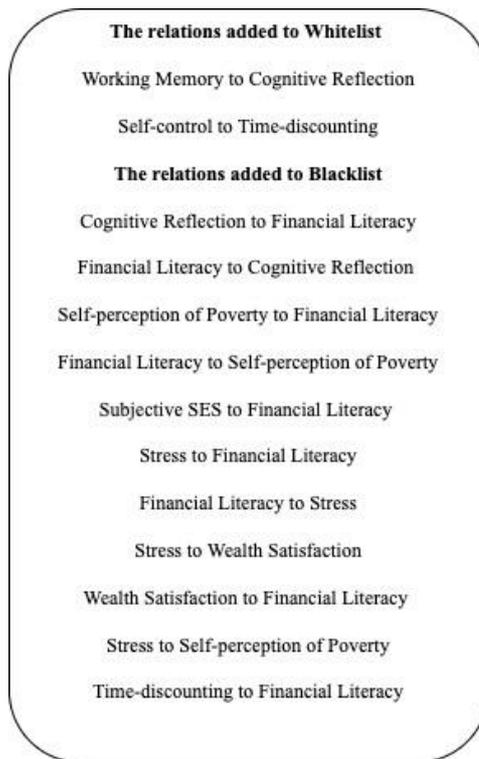


Figure 4. 4 The list showing the relations added to Whitelist.and Blacklist

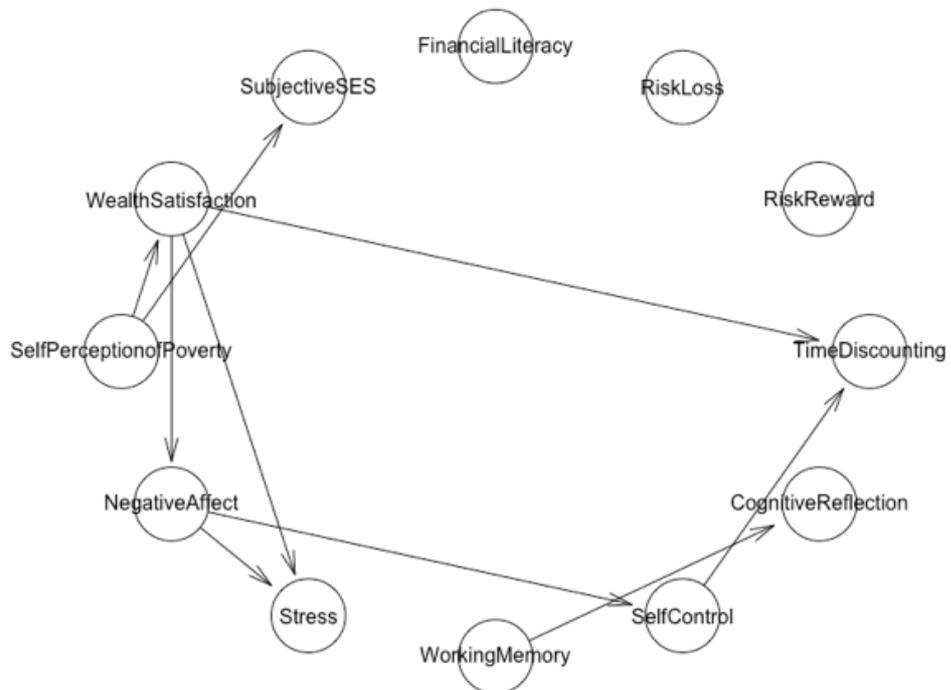


Figure 4. 5 The network gained after using white-listing and black-listing

4.5. BNs Learned from the Data of Study 2

The dataset from Study 2 was also analyzed with the Hill-Climbing algorithm without incorporating any prior knowledge. Note that, there were some differences between the networks learned with the data of Study 1 and Study 2. In Figure 4.6, there is an arc from Stress to Cognitive Reflection and to Time-discounting. These arrows are aligned with the previous literature, and they were not present in Figure 4.2. Several relationships in this model were not aligned with the previous literature including the relationship between Cognitive Reflection and Working Memory, and, Cognitive Reflection and Financial Literacy. Figure 4.7 summarizes all relationships in this model according to their compatibility with the previous literature.

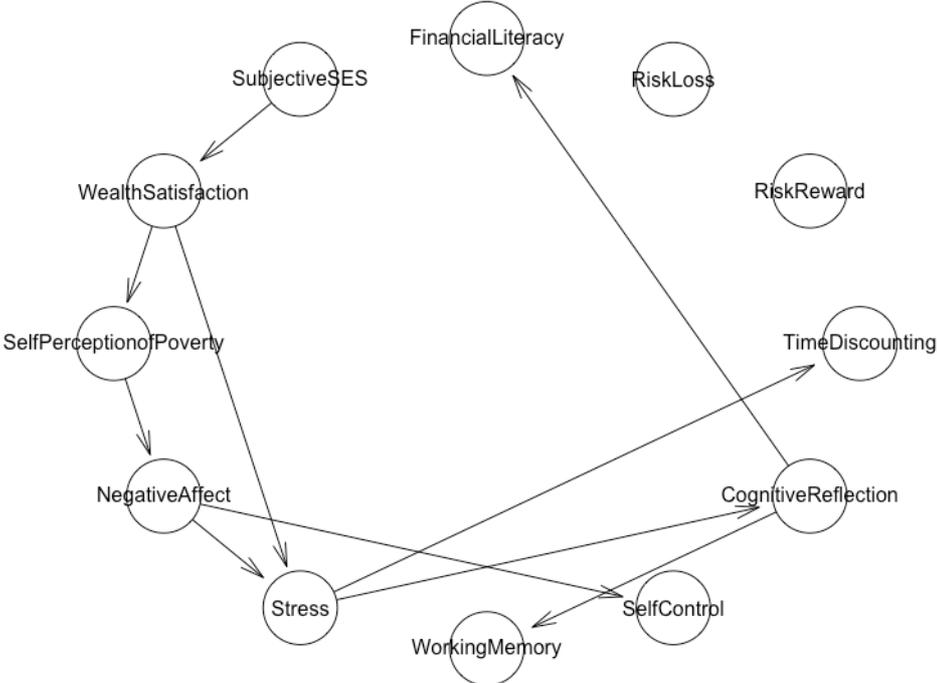


Figure 4. 6 The network that the Hill-Climb algorithm implemented on the data of Study 4.4 gave

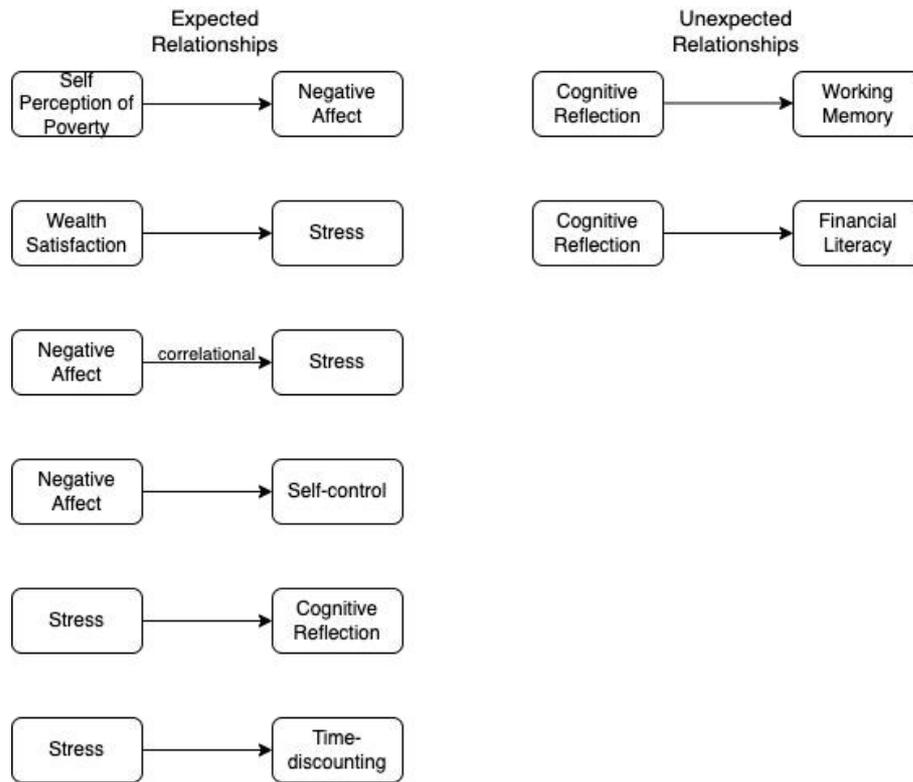


Figure 4. 7 The table showing the summarized relations in Figure 4.6

4.5.1. Study 2: BNs Learned with Prior Structural Knowledge

We used the blacklist and whitelist shown in Figure 4.8 to incorporate the prior knowledge about the arcs that should be and not be in the BN model. The BN model learned by the Hill-Climbing algorithm according to this list is shown in Figure 4.9. Note that, all of these arcs are aligned with the findings from the previous literature.

- The relations added to Whitelist**
- Working Memory to Cognitive Reflection
 - Self-control to Time-discounting
- The relations added to Blacklist**
- Cognitive Reflection to Financial Literacy
 - Financial Literacy to Cognitive Reflection
 - Self-perception of Poverty to Financial Literacy
 - Financial Literacy to Self-perception of Poverty
 - Subjective SES to Financial Literacy
 - Stress to Financial Literacy
 - Financial Literacy to Stress
 - Stress to Wealth Satisfaction
 - Wealth Satisfaction to Financial Literacy
 - Stress to Self-perception of Poverty
 - Time-discounting to Financial Literacy

Figure 4. 8 The list showing the relations added to Whitelist and Blacklist

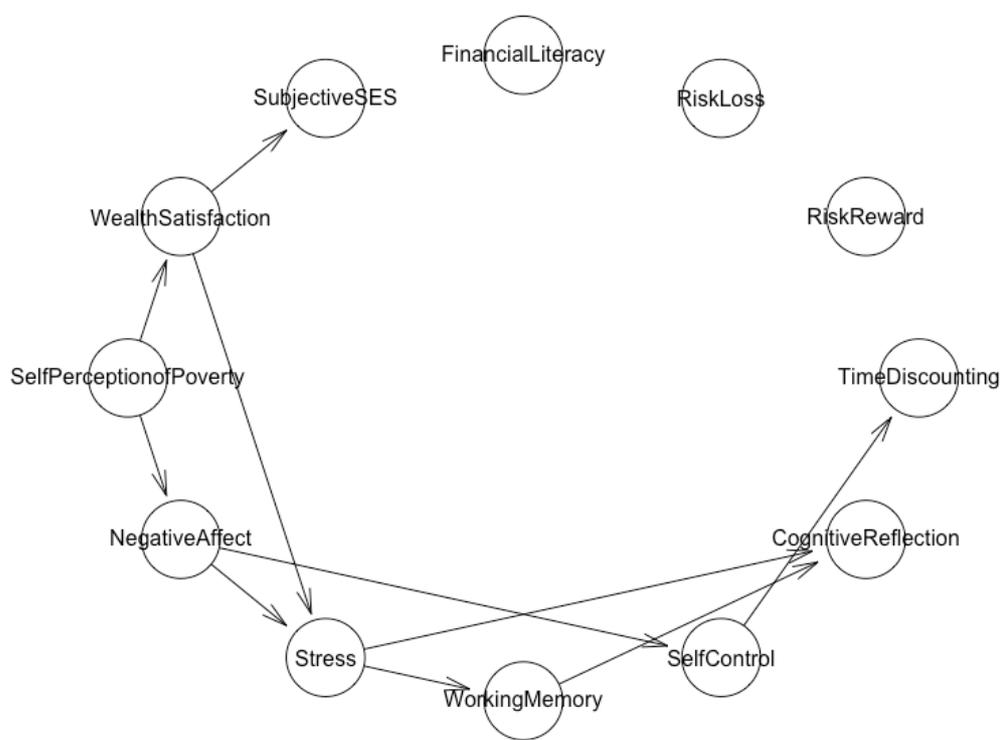


Figure 4. 9 The network gained after using white-listing and black-listing

4.6. BNs Learned from the Data of Study 3

The dataset from Study 3 was also analyzed with the Hill-Climbing algorithm without incorporating any prior knowledge. The model in Figure 4.10 gave more consistent relations compared to the ones in Figures 4.2 and 4.5 given the literature. There is a clear path from Wealth Satisfaction to Self-control and Cognitive Reflection through Stress. Though the direction is wrong, the arc going from Financial Literacy and Time-discounting 2 indicated a relationship between these variables.

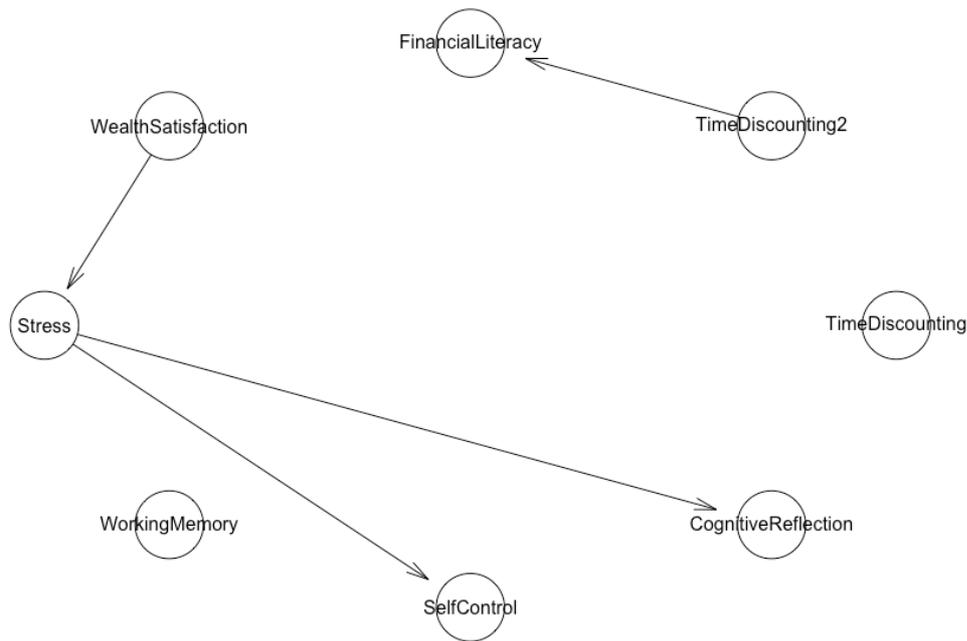


Figure 4. 10 The network that the Hill-Climb algorithm implemented on the data of Study 1 gave

4.6.1. Study 3 BN Learned with Prior Structural Knowledge

We used the blacklist and whitelist shown in Figure 4.11 to incorporate the prior knowledge about the arcs that should be and not be in the BN model. The BN model learned by the Hill-Climbing algorithm according to this list is shown in Figure 4.12. Note that, all of these arcs are aligned with the findings from the previous literature.

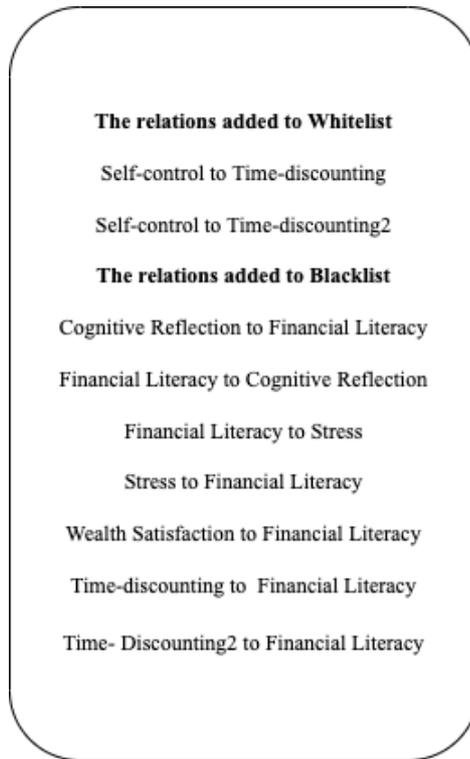


Figure 4. 11 The list showing the relations added to Whitelist.and Blacklist

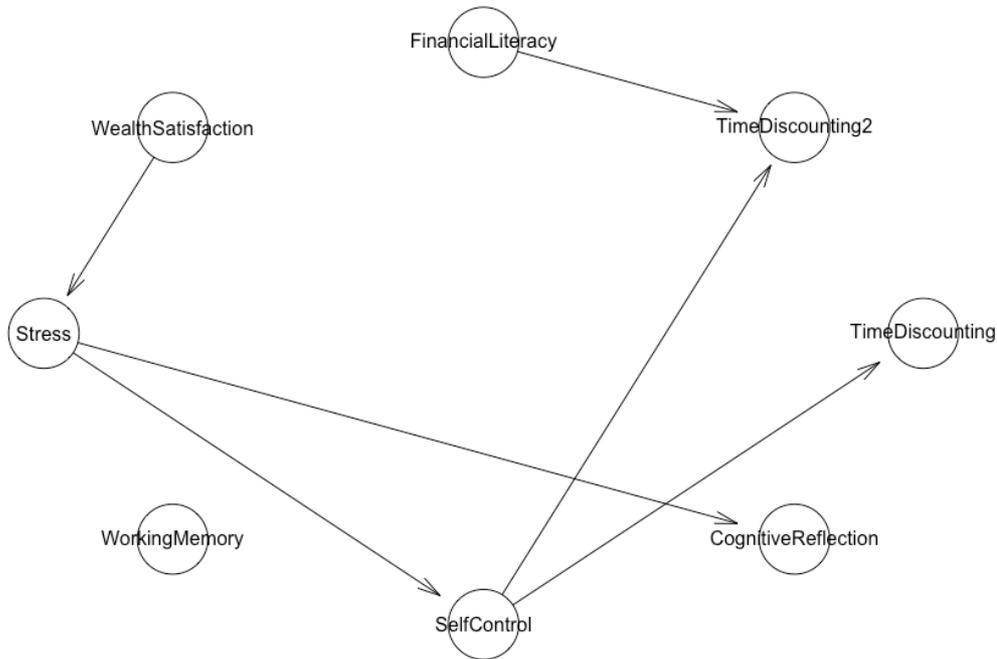


Figure 4. 12 The network that the Hill-Climb algorithm implemented on the data of Study 2 gave

In Figure 4.12 the relationships between Wealth Satisfaction and Stress, Stress and Self-control, and Stress and Cognitive Reflection were aligned with the previous literature. However, we also observed expected other relationships (e.g., the relationships between Self-control and Time-discounting; between Self-control and Time-discounting²; between Financial Literacy and Time-discounting²).

4.7. Discussion

In summary, there were some theoretical contradictions in the network of Study 1 when any prior knowledge was not given to the structure learning algorithm. After informing the structure learning algorithm about them, a more theoretically consistent network has been given by the Hill-Climbing learning algorithm. We made similar arrangements for Study 2. After incorporating the prior knowledge, the structure learning algorithm gave a more aligned structure with the literature. Our analysis for Study 3 included similar processes and the gained structure gave a relatively insightful network as well.

CHAPTER 5

ABSTRACTING EXISTING BAYESIAN NETWORKS TO SIMPLE CAUSALLY INDICATIVE ONES

In this study, we conduct a psychology experiment based on a conceptual causal model of the current understanding of the relevant domain (see Chapter 1). Our approach is to elicit the causal relations from domain experts and scientific literature, and then to learn the strength of these relations from data. In order for this to happen, the level of detail in the knowledge-based BN structure should match the data. A BN can contain some additional latent variables that are not available in the data, which can be dealt with the algorithms that employ latent variables. However, the observable variables in the BN and variables available in the data need to match. Yet, this is not always the case. Usually, some pre-processing of the BN structure is required before the experimental step.

When a BN structure is modified to match the data, modifications are often done in an ad-hoc way without following any systematic procedure. Yet and Marsh (2014) proposed a systematic approach to abstract complex BN structures by using four operations: 1- node removal, 2- node merging, 3- state-space collapsing, 4- edge removal. Their approach can identify the compatibility of the abstracted BN to the original BN in terms of the conditional independence assumptions it encodes (Yet & Marsh, 2014). This approach shows how the initial and abstracted BN structures are related to each other, and which additional conditional independence are introduced after using each abstraction operation.

In this chapter, we use these BN abstraction operations to match the knowledge-based BN with the data. Section 5.1 describes each of these abstraction operations and Section 5.2 illustrates their use for the resource scarcity-time-discounting model.

5.1. BN Abstraction Operations

The abstraction operations are applied to a knowledge-based BN structure that aims to incorporate all important relations about the domain of the problem in question. Each abstraction operation makes a particular simplification in the BN structure. These

abstraction operations are divided into two categories. The first category is the compatible abstractions which do not introduce any new conditional independence (CI) assertions on the BN structure that it is applied to. The second category is the incompatible abstractions which introduces additional CI assertions. Node removal and node merging are compatible abstractions, whereas state-space abstraction and edge removal are incompatible abstractions. The details of these operations are described as follows.

5.1.1. Node Removal

Nodes without any children or descendants are called *barren nodes*. Removing an unobserved barren node does not introduce any new CI conditions to the BN (Yet & Marsh, 2014). When a node has children, we can use the *arc reversal* operations to turn it into a barren node without introducing additional CI conditions. For example, in order to reverse the arc between M and Z without introducing any CIs (see Figure 5.1 (a)); we, 1) add an arc from each parent of M to Z, 2) add an arc from each parent of Z to M, 3) reverse the arc (see Figure 5.1 (b)). This operation makes M a barren node and we can remove it from the BN without introducing any CIs (see Figure 5.1 (c)). In general, any node in a BN can be made a barren node by a series of arc reversal operations, and then be removed without introducing CIs (Yet & Marsh, 2014). As a result, node removal is a compatible abstraction that can always be done without introducing new CIs.

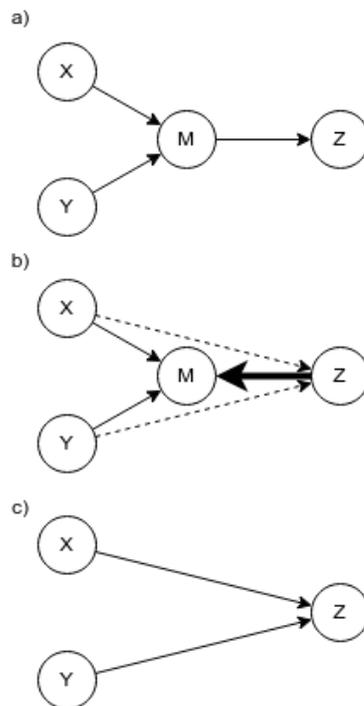


Figure 5. 1 Figure 5.1. (a) M with a single child node (b) M removed and the number of edges is the same

5.1.2. Node Merging

Node merging combines two nodes into a single node. It assumes the two nodes that are merged will be observed or unobserved at the same time. In order to merge two nodes, we add an edge between them (see Figure 5.2), and then use the arc reversal operation to reverse this edge. Node merging is also a compatible abstraction since it does not bring new CI conditions to the BN (Yet & Marsh, 2014).

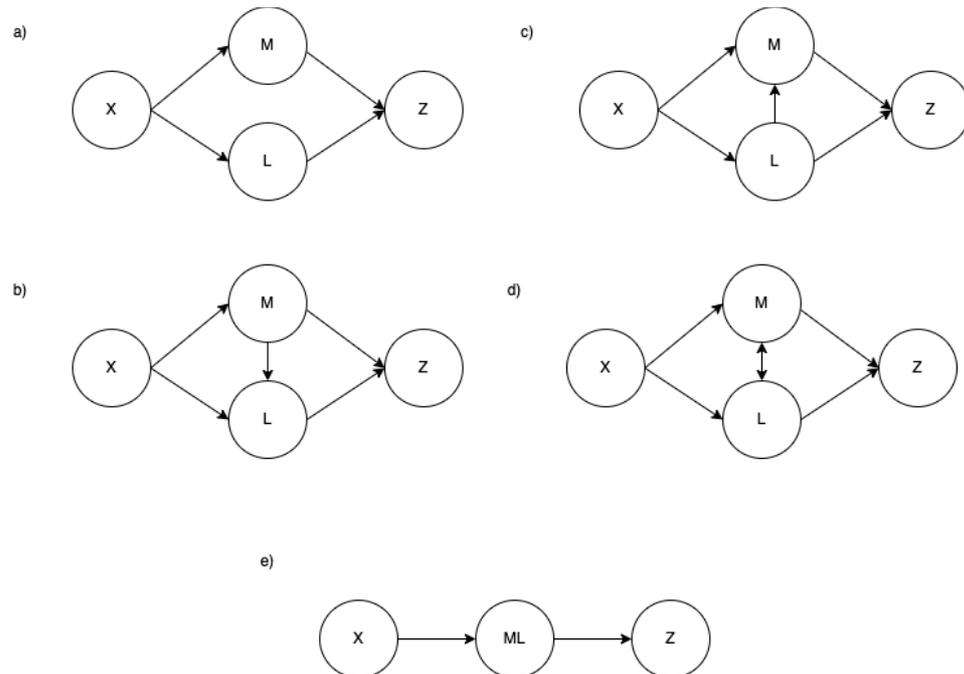


Figure 5. 2 (a) Initial BN (b) an arrow added from M to L (c) an arrow added from L to M (d) a bilateral arrow added between M and L (e) M and L are combined

5.1.3. State-space Abstraction

Each discrete node in a BN has multiple possible states. State-space abstraction combines multiple states to simplify the state-space (Yet & Marsh, 2014). For example, the state-space of a variable with five states, such as “Certainly Agree”, “Mostly Agree”, “Undecided”, “Mostly Disagree”, and “Certainly Disagree”, can be simplified to three states by combining “Certainly Agree” and “Mostly Agree” as “Agree”; “Certainly Disagree” and “Mostly Disagree” as “Disagree”. This operation is an incompatible abstraction that can introduce new CIs (Yet & Marsh, 2014).

5.1.4. Edge removal

Edge removal operation deletes an existing arrow from the BN structure. Deleting an arrow always introduces new CIs that does not exist in the original BN structure (Yet & Marsh, 2014).

5.2. Abstracting Resource Scarcity Model for Experiments

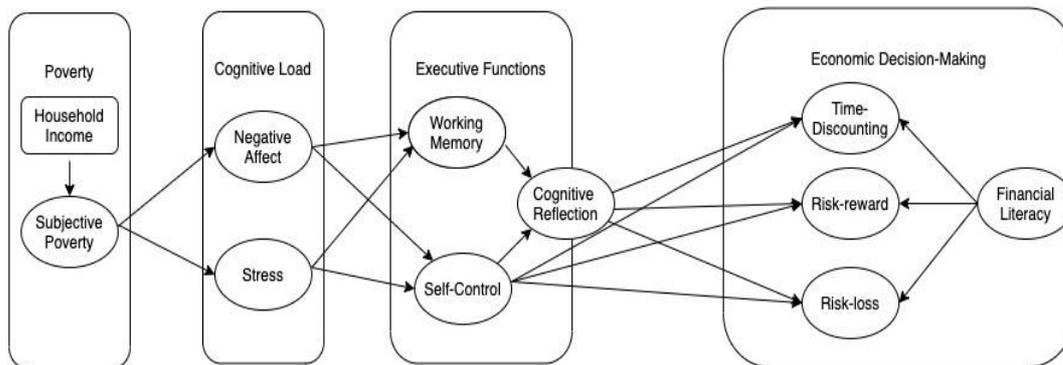


Figure 5. 3 The Theoretical Model of Poverty Perpetuation, Adamkovič (2020)

We applied the BN abstraction operations on the resource scarcity model of Adamkovič (2020) to match the level of detail of this model with the planned experiment (see Figure 5.3).

The relations shown in the model were obtained from the previous relevant studies. The model describes the causal relations regarding how low household income creates a subjective perception of poverty. Subjective perception of poverty creates a cognitive burden that negatively affects economic decision-making through executive functions including working memory, self-control and thinking style (see Chapters 2 and 4).

Our aim is to examine the effect of resource scarcity perception on economic decision-making. In the remainder of this coming section, we describe and explain step by step how we abstracted the conceptual model in Figure 5.3 to match the variables and level of granularity in our experiment and obtained our abstracted causal model in Figure 5.14.

5.2.1. Step 1: Abstracting Outcome Nodes

The initial conceptual model shown (see Figure 5.3) has three variables that represent different aspects of economic decision-making (e.g., risk-reward, risk-loss, time-discounting). We focus on only keeping time-discounting preferences to measure how

people economically made economic decisions under the scarcity mindset due to two reasons. Firstly, the relationship between resource scarcity perception and self-control has been relatively strong (see Section 2.1.2). Since the preference of time-discounting can be translated as the degree of delay of gratification one shows, the effect of lesser self-control as a result of resource scarcity perception on time-discounting is kept in the model. Secondly, we aimed to keep the experiment simple and more focused by having just one outcome variable. Therefore, we used node removal operations on the variables of Risk-loss (see Figure 5.4), Risk-reward (see Figure 5.5), Financial Literacy (see Figure 5.6) as we focus only on Time-discounting.

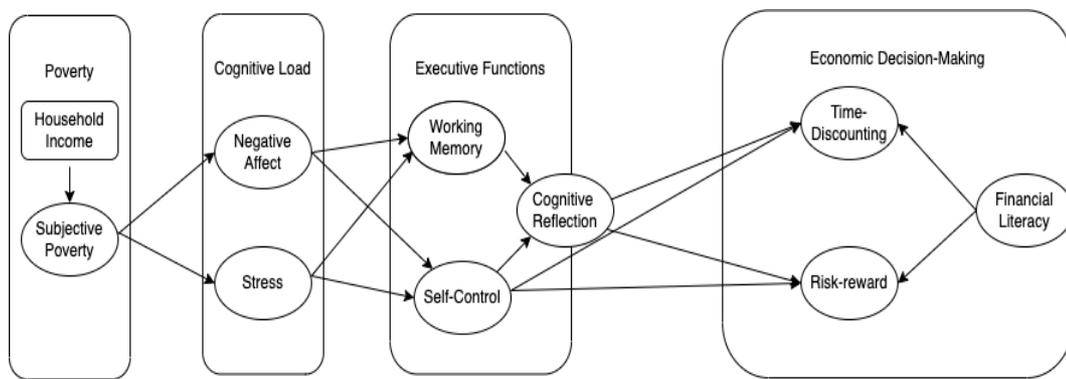


Figure 5. 4 The node removal operation of Risk-loss

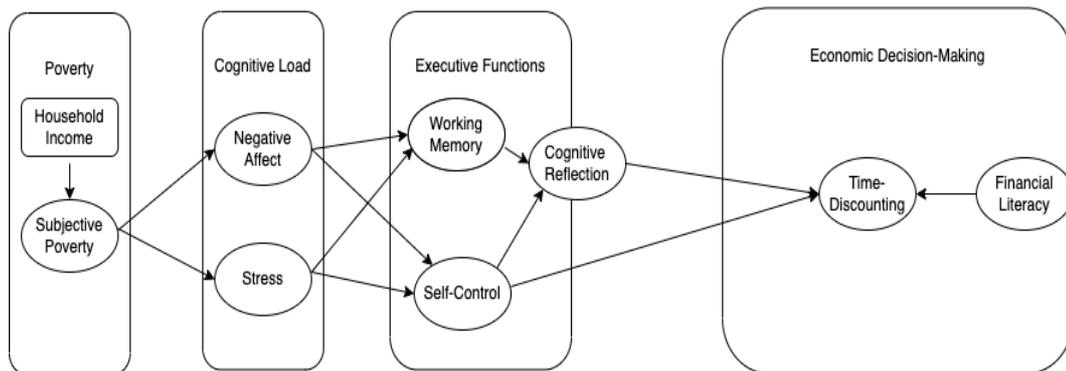


Figure 5. 5 The node removal operation of Risk-reward

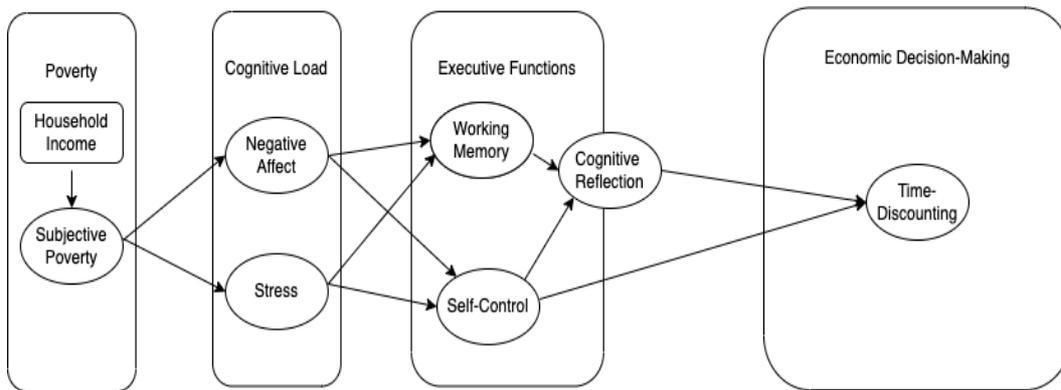


Figure 5. 6 The node removal operation of Financial Literacy

5.2.2. Step 2: Abstracting Executive Functions

We also collected data on the preserved various variables in our abstracted model that exhibited resource scarcity perception's psychological aspect (consequences). Among executive functions, we measured self-control and cognitive reflection in our experiments as self-control and Cognitive Reflection are associated (see Sections 2.1.2 and 2.1.3), and Cognitive Reflection has a direct impact on Time-discounting (see Section 2.2.1). We removed Working Memory (see Figure 5.7) for the reasons of simplicity.

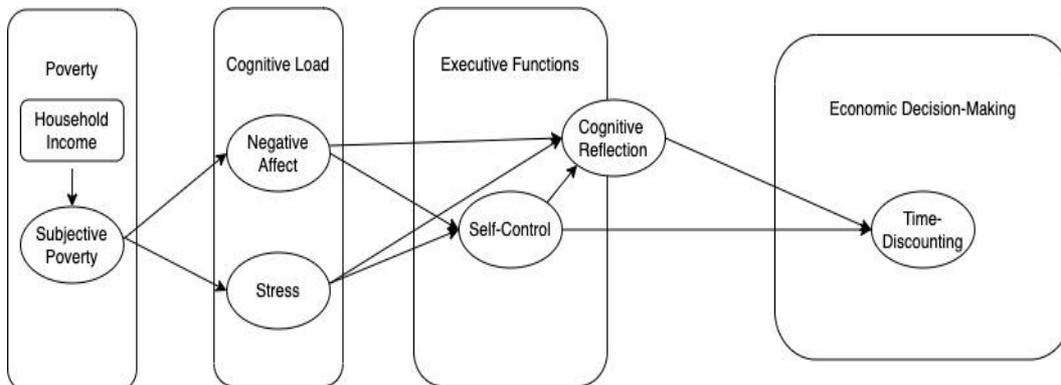


Figure 5. 7 The node removal operation of Working Memory

5.2.3. Step 3: Abstracting Cognitive Loading

Experiencing resource scarcity taxes cognitive resources, as discussed in Chapter 2. Mental exhaustion created by cognitive load can be experienced in the form of negative emotional states and stress (see Figure 5.8), (Adamkovič & Martončík, 2017). We merged negative load and stress into a single variable called cognitive load (see Figure 5.9).

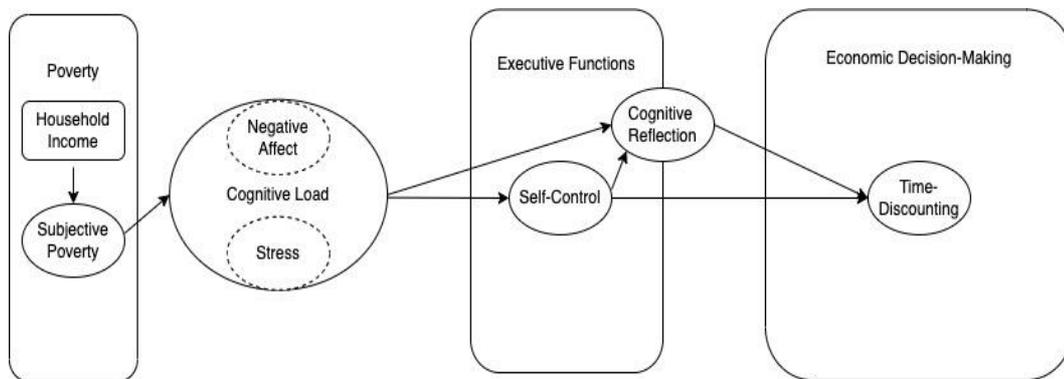


Figure 5. 8 Stress and Negative Affect merged

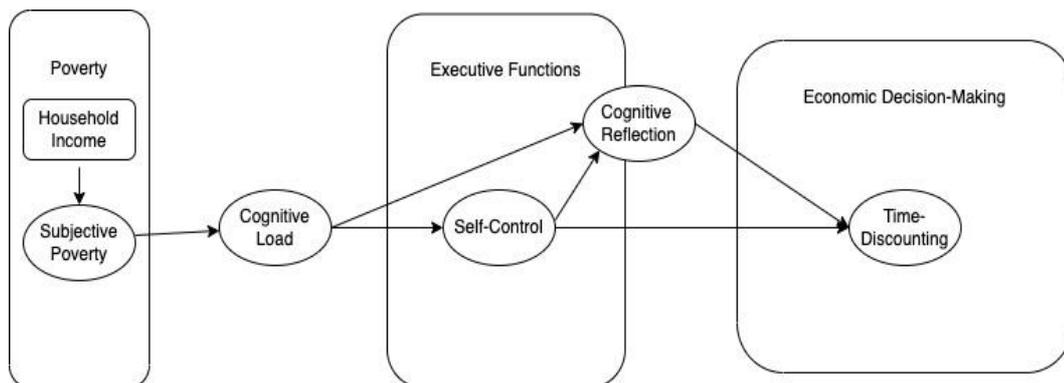


Figure 5. 9 Cognitive Load merged variable

5.2.4. Step 4: Removing Objective Poverty and Changing the Name of Subjective Poverty

One of our main research questions investigates the effect of resource scarcity perception on economic decision-making; we changed the name of the variable Subjective Poverty to Resource Scarcity Perception (see Figure 5.11). Concerning that, in the experimental part, we used a manipulation technique that created the feeling of resource scarcity (see Figure 5.10) (see Chapter 6), and we removed the household income from the model (see Figure 5.10).

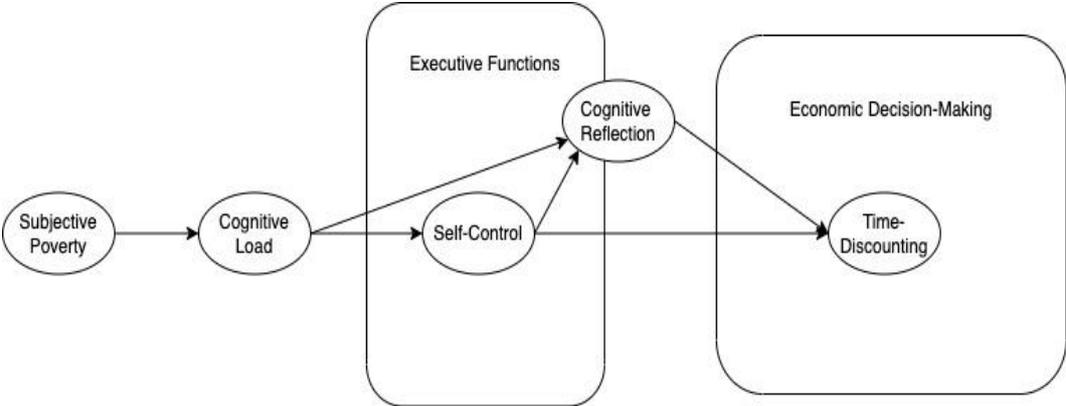


Figure 5. 10 Objective aspect of poverty has been excluded

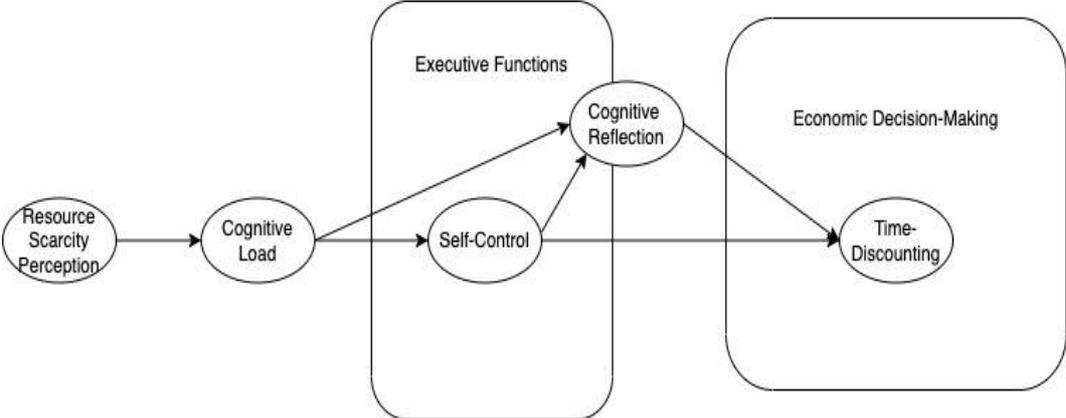


Figure 5. 11 Resource scarcity was added

5.2.5. Step 5: Representing for Cognitive Reflection

When people think analytically, they are likely to perform high cognitive reflection, whereas depending on intuitive thinking style is an indicator of low cognitive reflection (see Figure 5.12). Thus, the degree of high or low cognitive reflection can be specified with the working measurements (Pacini & Epstein, 1999, Frederick, 2005) of deliberative and intuitive thinking styles. Therefore, we added intuitive thinking style as a variable to measure the latent cognitive reflection variable (see Figure 5.13).

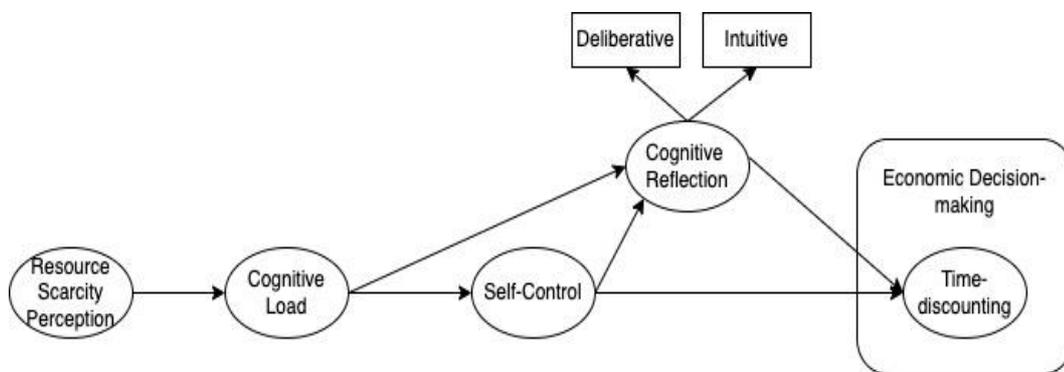


Figure 5. 12 Cognitive reflection (intuitive versus deliberative)

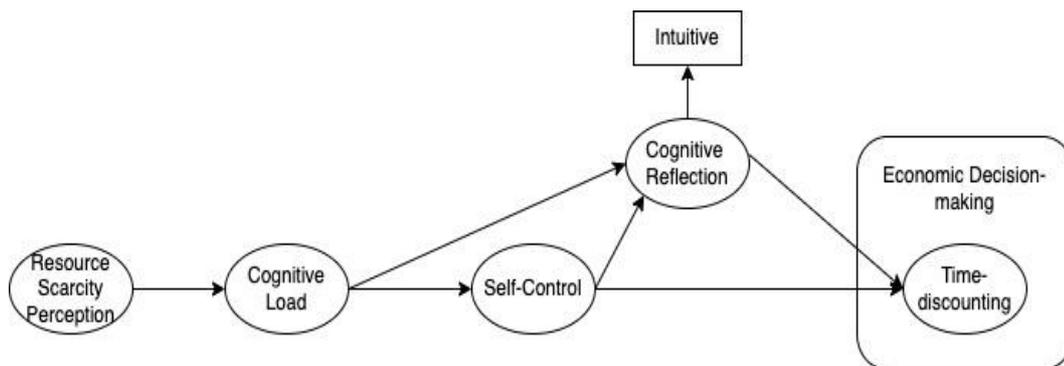


Figure 5. 13 Cognitive reflection measured with intuitive thinking style

5.2.6. Step 6: Last corrections: Cognitive Load, Self-control, and Time-discounting

Negative affect and stress merged might not constitute a variable identical to cognitive load. Cognitive load can be correlated with negative affect and stress; however,

claiming that we can specify cognitive load if we measure negative affect and stress could be regarded as a misleading theoretical perspective. Thus, to overcome this theoretical debate, we removed cognitive load as a variable from our model (Figure 5.14). We do not collect any data directly related to this part of the model in the experiments. Since various empirical studies (see Section 2.1.2) put forward that resource scarcity perception leads the poor to weak self-control, we keep self-control in the model. The last part of the model shows the direct effect of the decline in self-control and the change in thinking style on economic decision-making. To represent this, we kept time-discounting preference as the final output of this model.

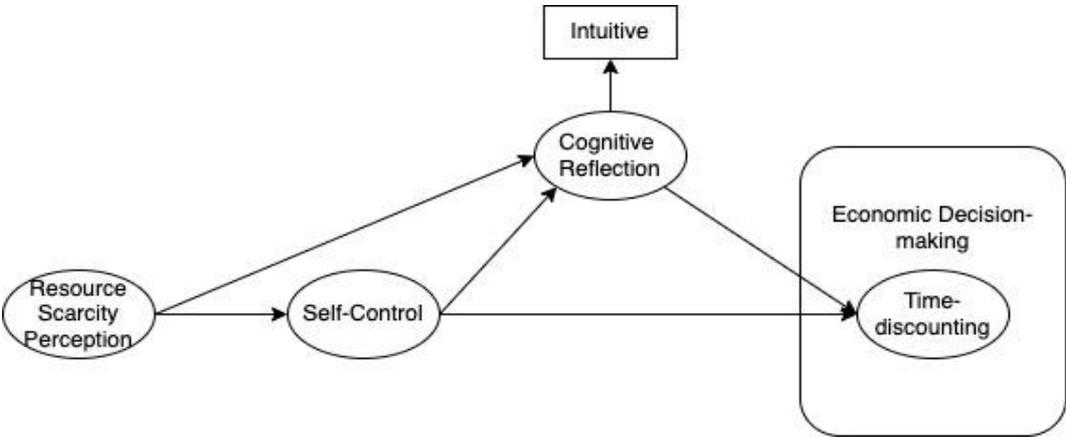


Figure 5. 14 Cognitive load removed: the last version to be tested

5.3. Final Model for Experiments

By using the abstraction operations, we built a conceptual model that describes the underlying theory of our experiments and matches the level of granularity of the data that will be collected from the experiments. The abstraction operations show how the causal assumptions and CIs of the final model are kept intact compared to the initial, more detailed, conceptual model. Having a causal model that is systematically built by this approach clarifies the underlying assumptions of our experiments and their links with the previous literature. In the following section, we present the methodology and results of our experiments which are based on this causal model (see Figure 5.14).

CHAPTER 6

STUDY

In Chapter 4, we used data-driven structure learning algorithms to gain insights related to economic decision-making under scarcity. We tried to explore the possible effects of resource scarcity perception on economic decision-making through cognitive load and executive functions. Moreover, in Chapter 5, we used the abstraction methods proposed by Yet and Marsh (2014) to modify the causal structure of the problem of resource scarcity perception and economic decision-making. With these steps, we proposed a causal model describing the relationship between resource scarcity perception and time-discounting through a cognitive mechanism (e.g., through self-control and intuitive thinking style) (see Figure 5.14). This chapter was devoted to a behavioral experiment to establish the relations proposed in our model.

6.1. Methods

The preregistration documents, materials, and data can be found at <https://osf.io/4s6th/>.

6.2. Overview

There were two conditions to which the participants were randomly assigned. For the experimental condition, the scarcity recall task was used (Roux et al., 2015) to activate the feeling of resource scarcity. In this task, participants were asked to cite their five memories, in which they experienced resource scarcity and write two of them in detail. Those in the control group were asked to cite their daily past five activities and write two of them in detail. To analyze if the participants' socio-economic background when interacted with resource scarcity perception has any effects on self-control, intuitive thinking style and time-discounting, we used The MacArthur Subjective Social Status Scale (Adler & Stewart, 2007). The following step was to present the Brief Self-Control Scale (Tangney, 2004) to observe any decrease in self-control after introducing resource scarcity prime. Additionally, Faith in Intuition (Pacini & Epstein,

1999) measurement was used to check whether the transition to intuitive thinking style has happened. The time-discounting pattern (e.g., choosing the immediate reward over the distal one) was evaluated with a modified model of time-discounting measurement, asking the participants whether they would want 50 Turkish liras within two weeks after the research, or they could determine a specific amount subtracted from 50 liras and take it doubled two months later (Adamkovič, 2020). Financial Concerns Questionnaire (Lee & Zietsch, 2011) was also directed to the participants since we looked at whether participants' financial concerns differ as a function of the condition that they were assigned to for manipulation check purposes. The two last steps were that we asked the questions revealing the participants' socioeconomic background, and we used a digital scale called the affective slider (Betella & Verschure, 2016) to specify the participants' pleasure and arousal.

6.3. Participants

Since there is no meta-analysis on the interaction effect of SES and resource scarcity on time-discounting in the literature, the required number of participants was determined based on the small-to-moderate effect size generally observed in social psychology (Richard et al., 2003). Accordingly, we planned for a powerful test ($1-\beta = 0.95$) to identify small-to-moderate effects of manipulations ($f = .15$) in a 2 by 2 ANOVA model and standard Type I error rate ($\alpha = 0.05$). Using G*Power 3.1.9.2 (Faul et al., 2009), we estimated our target sample size to include at least 580 complete submissions.

As preregistered, we limited the data collection period of targeted 580 submissions to a week. However, since the targeted sample size was not achieved within the planned period, we continued collecting data for the following three days. After the additional three days, the data collection was stopped, and the analyses were run based on this sample size. We commenced collecting the data on the 30th of November and ended it on the 9th of December. 1355 people opened the link we distributed. However, 776 of them had not given answers to our main DV and attention checks (see Section 6.4), that's why they were excluded from the analyses as preregistered, leaving our sample size consisting of 579 participants.

The sample characteristics are described in Table 6.1. Since answering the demographic questions about Age, Gender, SES, Religion and Ideology was not forced, some participants ($N = 11$) did not give information about their demographics. The mean of the participants' age was 28.9. The youngest participant was 18 years old, whereas the oldest was 78 years old ($SD = 9.81$). 74.6 percent of the participants were Female ($N = 424$), whereas 24.3 percent Male ($N = 138$). Furthermore, 1.1 percent of them identified themselves as Other ($N = 6$). Forty three percent of the participants had an undergraduate degree ($N = 244$), and 33.1 percent of them held a high school

degree. The participants with graduate-level education (N = 105) were 18.4 percent, whereas those with below high school education (N = 5) were 0.9 percent.

Table 6. 1 The sample's characteristics

	Age	SES	Religion	Ideology
N	568	568	568	568
Missing	11	11	11	11
Mean	28.9	5.28	2.79	3.12
Median	25.0	5.00	2.00	3.00
Standard deviation	9.81	1.71	1.71	1.07
Minimum	18	1	1	1
Maximum	78	10	7	7

Table 6. 2 Gender Distribution

Levels	Counts	% of Total	Cumulative %
Other	6	1.1 %	1.1 %
Male	138	24.3 %	25.4 %
Woman	424	74.6 %	100.0 %

Table 6. 3 Education

Levels	Counts	% of Total	Cumulative %
Doctorate	15	2.6 %	2.6 %
Bachelors	244	43.0 %	45.6 %
High School	188	33.1 %	78.7 %
Secondary School	4	0.7 %	79.4 %
Master	90	15.8 %	95.2 %
Associate Degree	26	4.6 %	99.8 %
Elementary School	1	0.2 %	100.0 %

6.4. Materials and Procedures

The recruitment of the participants has been done in three ways. We used the MINT Lab's (the Moral Intuitions Lab; www.moralintuitionslab.com) online panel, where more than 3000 people are members and participate in the studies when informed with e-mails. We also made announcements about the study on Twitter and Facebook groups. Lastly, the psychology students at Kadir Has and Bařkent Universities were invited to take part in the study in return for extra credits for their courses.

We used Qualtrics to design the survey for the study and to circulate it. The survey consisted of the materials reported in the Materials section. The participants were randomly assigned to either the experimental or the control group via Qualtrics. The approximate time of the survey was between 10 to 20 minutes.

6.4.1. The Scarcity Recall Task

In order to prime the feelings of resource scarcity, the episodic scarcity task (Roux et al., 2015) was used. Participants were asked to cite five episodes in which they felt that they "did not have enough of something" or "resources were scarce." After citing these episodes, they were asked to describe two of them in detail.

6.4.2. Brief Self-Control Scale or Trait Self-Control Scale

Any decrease in self-control by resource scarcity was assessed with the Brief Self-Control Scale (Tangney, 2004) adapted into Turkish by Nebioglu et al. (2012), which includes 13 statements (e.g., I am good at resisting temptation, People would say that I have iron self-discipline). The statements on the scale were rated from 1 (not at all like me) to 5 (very much like me). The reliability score of the measurement (Cronbach's α) in our study was .81.

6.4.3. Faith in Intuition scale

The intuitive thinking style expected to be observed was assessed with the Faith in Intuition scale (Pacini & Epstein, 1999) adapted into Turkish by Türk and Artar (2014), which includes ten items (e.g., I hardly ever go wrong when I listen to my deepest gut feelings to find an answer). The items on the scale were rated from 1 (absolutely disagree) to 5 (totally agree). The reliability score of the measurement (Cronbach's α) in our study was .88.

6.4.4. The Measurement for Time-discounting Preference

We used a real financial reward as an incentive and gave it after the lottery among the participants. We made minor changes to the time-discounting measurement used by Adamkovič (2020: Study 3). They asked the participants whether they would prefer taking 6 euros now, 8 euros in 10 days, 10 euros in 20 days, and 12 euros in a month. In our study, we assessed the participants' time-discounting preference with whether they wanted 50 Turkish liras now or wanted the amount that they extracted from 50 Turkish liras and preferred to take it doubled after a month. This award was paid to five randomly selected participants as a lottery draw. The award was distributed according to the choices made by the participant (see Charness et al., 2016; Cubitt et al., 1998 for the validity of this random lottery incentivizing method).

6.4.5. Financial Concerns Questionnaire

To check if scarcity was primed as intended, we used Financial Concerns Questionnaire (Lee & Zietsch, 2011) adapted into Turkish by Yilmaz et al. (2021), which includes 14 statements (e.g., I worry about the rising cost of food). The statements on the scale were rated from 1 (absolutely disagree) to 5 (absolutely agree). The reliability score of the measurement (Cronbach's α) in our study was .82.

6.4.6. Socioeconomic Status

The MacArthur Subjective Social Status Scale (Adler & Stewart, 2007), also known as the ladder question, was used to measure the subjective socioeconomic status (SES) of the participants. In the ladder question, the participants positioned themselves on a ladder between 1 and 10 by comparing themselves with the economic levels of the people in the country they live in. This scale was a simple and reliable method frequently used in different cultures to measure perceived socio-economic levels (e.g., Giatti et al., 2012).

6.4.7. Demographic Form

Standard questions revealing demographic background were asked to the participants. Participants were asked to state their gender, age, single item political orientation question, socioeconomic and educational level.

6.4.8. The Affective Slider

We used a digital scale called the affective slider (Betella & Verschure, 2016) to reveal the participants' pleasure and arousal. Participants self-assessed their pleasure (sad-happy) and arousal (sleepy and wide-awake) degrees by moving the slider either to left or right.

6.5. Control Measures and Data Exclusion

To control if the participants showed full attention in the experiment, we added additional attentional questions (e.g., please mark 2 as your answer to show that you have carefully read this question) to the measurements. Those who gave wrong answers to the attentional questions were excluded from the analyses.

Those who also did not answer the dependent variable were excluded from the analyses.

6.6. Planned Analysis

6.6.1. Confirmatory Analysis

We proceeded with two-way ANOVAs as our confirmatory analyses. To test H1, a 2 (manipulation: scarcity vs. control) x 2 (SES: low vs. high) between-subjects ANOVA

on financial concerns was run for manipulation check purposes. To test our main hypothesis (H2), a 2 (manipulation: scarcity vs. control) x 2 (SES: low vs. high) between-subjects ANOVA on time-discounting preferences was run. To test H3, a 2 (manipulation: scarcity vs. control) x 2 (SES: low vs. high) between-subjects ANOVA on self-control was run. To test H4, a 2 (manipulation: scarcity vs. control) x 2 (SES: low vs. high) between-subjects ANOVA on intuitive thinking was run.

6.6.2. Exploratory Analysis

We also explored if decreased self-control and intuitive thinking style moderated the effect of resource scarcity on time-discounting preferences by conducting a regression analysis.

6.7. Results

Before reporting our results, some clarification is needed. As mentioned, we have used the MacArthur Scale of Subjective Social Status to measure participants' SES background. The participants were presented with a ladder with ten rungs representing where they stand in society. At the top of the ladder, people who are best off are located. In contrast, the bottom of the ladder represents the worst-off people.

In our confirmatory and exploratory tests, to examine the interaction of one's SES and their feeling of resource scarcity on the dependent variables (e.g., time-discounting, financial concern, self-control, and intuitive thinking style), we split the answers given to the MacArthur Scale of Subjective Social Status by its median ($M = 5$) and defined the score below-median as low SES (e.g., below 6) and the score above-median as high SES (e.g., above 5) as preregistered. We did our analyses with this distinction in subjective SES.

Table 6. 4 Descriptive statistics of the variables

	Resource Scarcity Perception	SES	Self- control	Intuitive Thinking Style	Time- discounting	Financial Concern
N	579	568	579	579	579	570
Missing	0	11	0	0	0	9
Mean	0.427	5.28	2.71	3.26	15.4	2.09
Median	0	5.00	2.69	3.27	1.00	2.00
Standard deviation	0.495	1.71	0.606	0.746	20.4	0.655
Minimum	0	1	1.08	1.09	0.00	1.00
Maximum	1	10	4.62	5.00	50.0	4.43

6.6.1. Confirmatory Analyses

6.6.1.1. The effect of resource scarcity perception and its interaction with SES on Financial Concern

To test H1 (see Chapter 1), a 2 x 2 ANOVA was run to analyze the effect of resource scarcity perception (experimental condition vs. control condition) and SES (low vs. high) on financial concern. In contrast to our preregistered hypothesis, the result did not provide a significant interaction between the effect of resource scarcity perception and SES on financial concern, $F(1, 564) = 1.45, p = .230, \eta_p^2 < .002$. Simple main effects analysis yielded a significance of the effects of resource scarcity perception on financial concern, $F(1, 564) = 4.62, p = .032, \eta_p^2 = .007$. However, those in the resource scarcity condition ($M = 3.87, SD = 0.672, 95\% CI [3.88, 4.02]$) had a significantly lower financial concern scores compared to the ones in the control group ($M = 3.95, SD = 0.641, 95\% CI [3.79; 3.96]$), $t(564) = 0.110, p < .032, d = .184$, indicating that our manipulation did not activate scarcity concerns as intended. Main effects of SES had a significant effect on financial concern, $F(1, 564) = 111.79, p < .001, \eta_p^2 = .164$. As predicted, low SES participants ($M = 4.16, SD = 0.569, 95\% CI [4.09; 4.22]$) had a significantly higher financial concern scores compared to high SES participants ($M = 3.63, SD = 0.637, 95\% CI [3.55; 3.71]$), $t(564) = 0.541, p < .001, d = .903$.

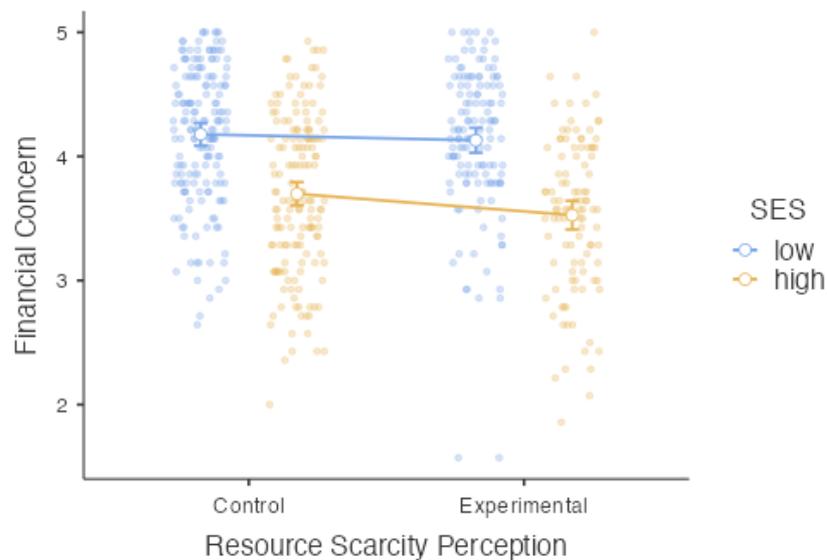


Figure 6. 1 The effects of Resource Scarcity Perception and SES on Financial Concern. 1 indicates low financial concern, whereas 5 represents high financial concern

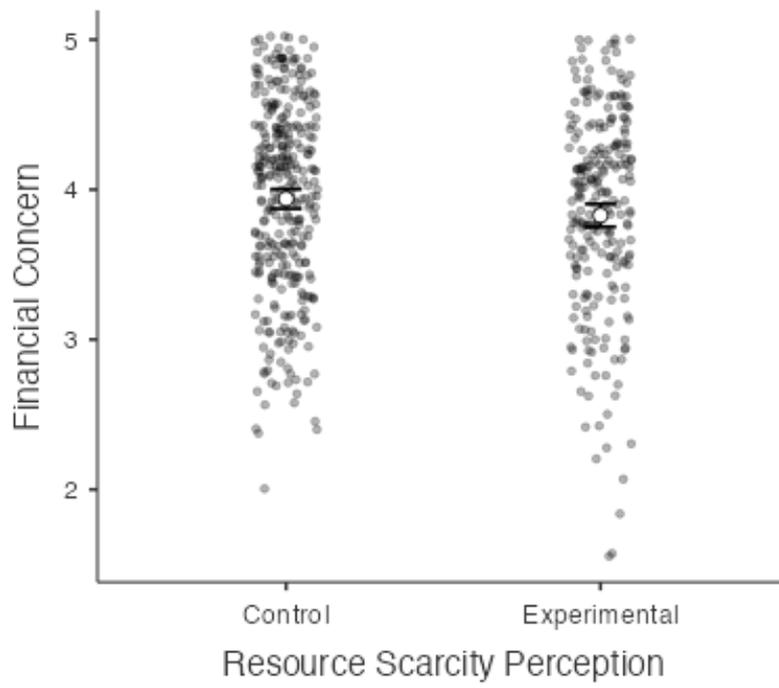


Figure 6. 2 The effects of Resource Scarcity Perception on Financial Concern

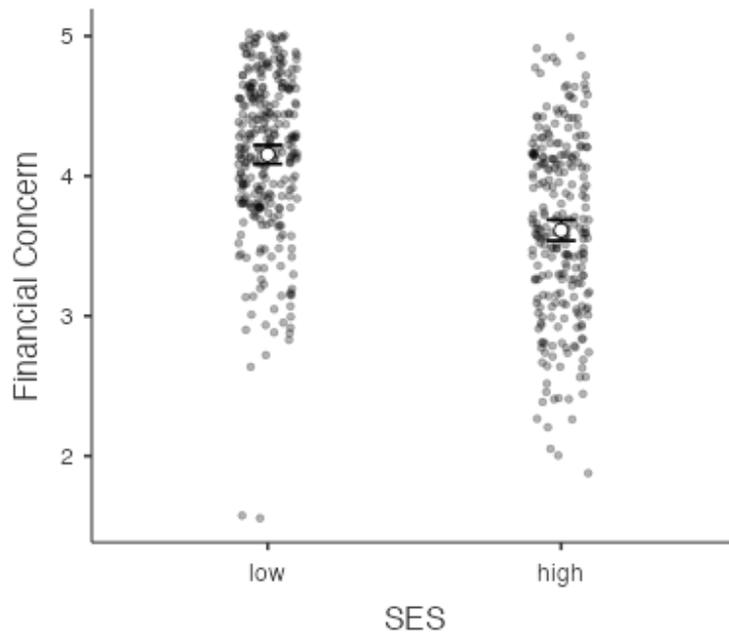


Figure 6. 3 The effects of SES on Financial Concern

6.6.1.2. The effect of resource scarcity perception and its interaction with SES on Time-discounting

To test H2 (see Chapter 1), a 2 x 2 ANOVA was run to analyze the effect of resource scarcity perception (experimental condition vs. control condition) and SES (low vs. high) on time-discounting. The result did not provide a significant interaction between the effects of resource scarcity perception and SES on time-discounting, $F(1, 564) = 0.0792, p = 0.392, \eta_p^2 < .001$. Simple main effects analysis did not yield a significance of the effects of resource scarcity perception on time-discounting, $F(1, 564) = 0.792, p = .374, \eta_p^2 < .001$ (e.g., the experimental group ($M = 16.3, SD = 20.9, 95\% CI [13.7; 18.9]$) did not have higher time-discounting score compared to the control group ($M = 14.8, SD = 20.1, 95\% CI [12.6; 16.9]$)). Main effects of SES did not have a significant effect on time-discounting as well, $F(1, 564) = 0.551, p = .458, \eta_p^2 < .001$ (e.g., the participants with low SES ($M = 16.0, SD = 20.9, 95\% CI [13.6; 18.3]$) did not have higher time-discounting score compared to the ones with high SES ($M = 14.8, SD = 20.0, 95\% CI [12.4; 17.2]$)).

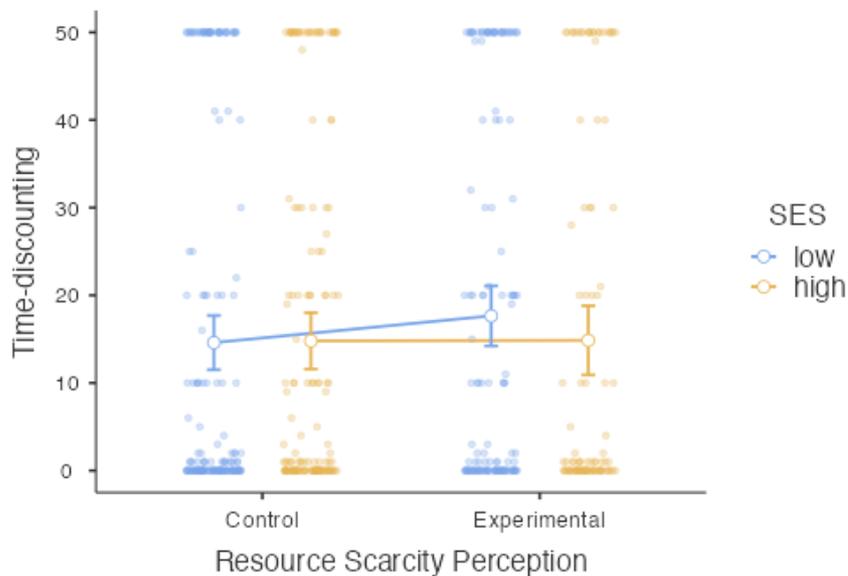


Figure 6. 4 The effects of Resource Scarcity Perception and SES on Time-discounting. 50 indicates low time-discounting, whereas 10 represents high time-discounting

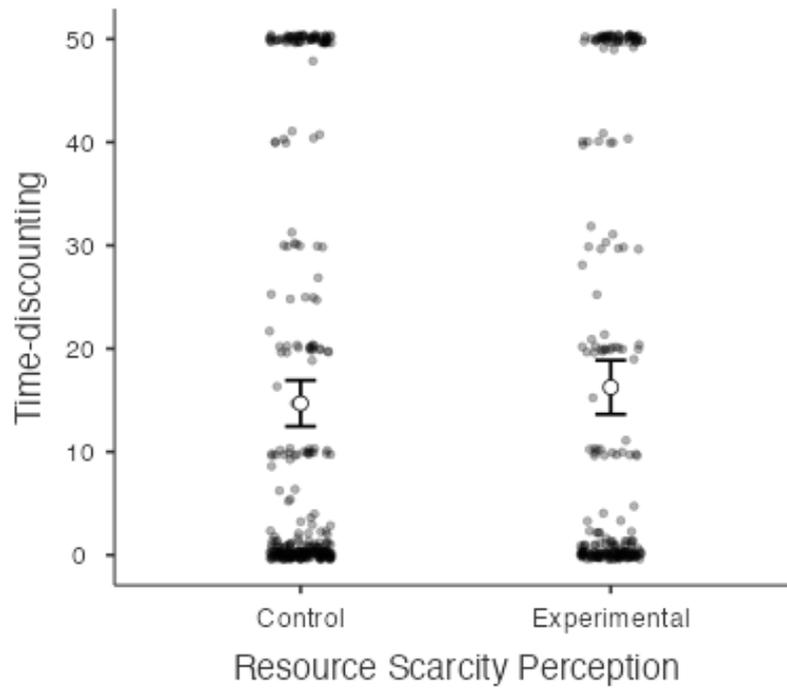


Figure 6. 5 The effects of Resource Scarcity Perception on Time-discounting

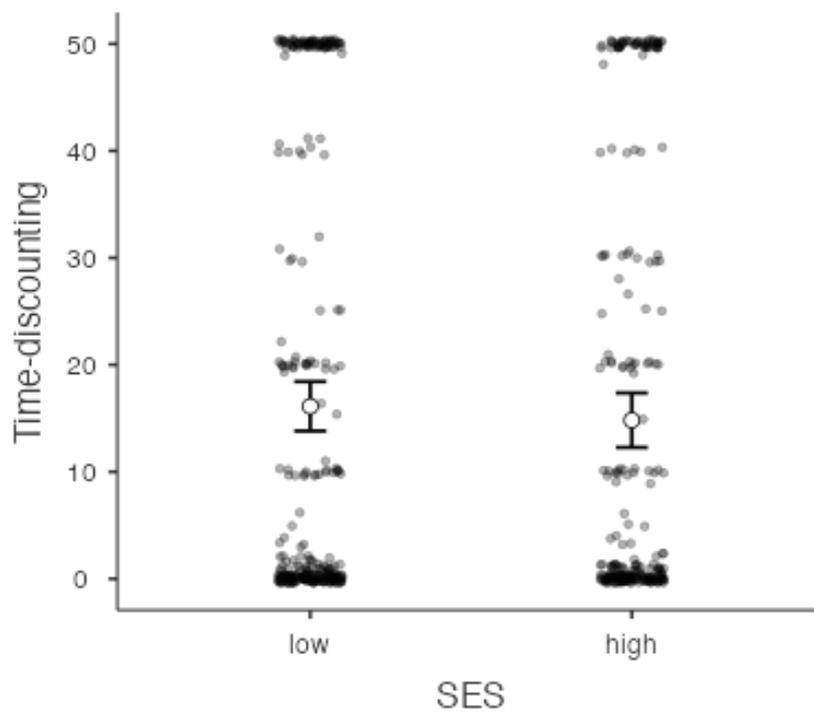


Figure 6. 6 The effects of SES on Time-discounting

6.6.1.3. The effect of resource scarcity perception and its interaction with SES on Self-control

To test H3 (see Chapter 1), a 2 x 2 ANOVA was run to analyze the effect of resource scarcity perception (experimental condition vs. control condition) and SES (low vs. high) on self-control. The result did not provide a significant interaction between the effects of resource scarcity perception and SES on self-control, $F(1, 564) = 2.385, p = .123, \eta_p^2 = .004$. Simple main effects analysis yielded a significance of the effects of resource scarcity perception on self-control, $F(1, 564) = 2.424, p = .010, \eta_p^2 < .012$. Those in the resource scarcity condition ($M = 3.37, SD = 0.594, 95\%CI [3.29; 3.44]$) had a significantly higher self-control scores compared to the ones in the control group ($M = 3.23, SD = 0.610, 95\%CI [3.17; 3.30]$), $t(564) = -0.133, p < .010, d = -.221$, in contrast to our initial expectation. Main effects of SES did not have a significant effect on self-control, $F(1, 564) = 0.310, p = .578, \eta_p^2 < .001$.

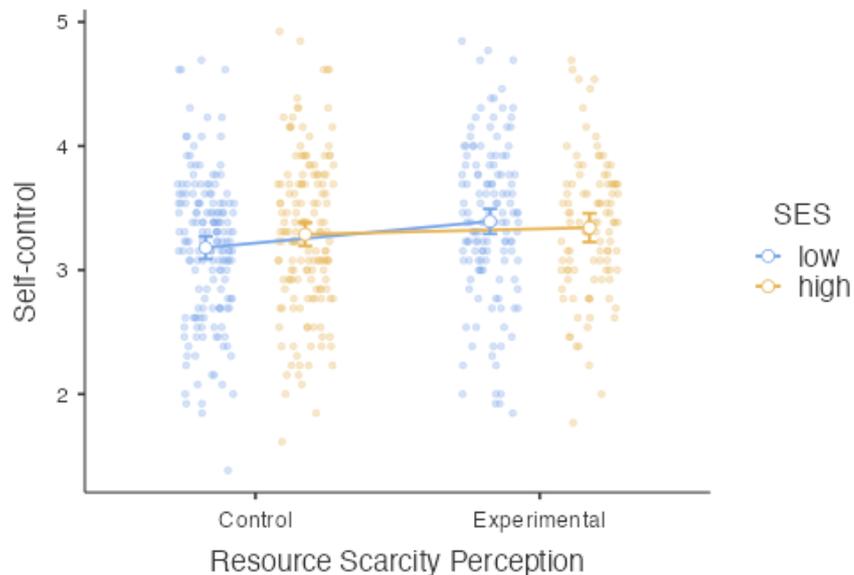


Figure 6. 7 The effects of Resource Scarcity Perception and SES on Self-control. 5 indicates high self-control, whereas 1 represents weak self-control

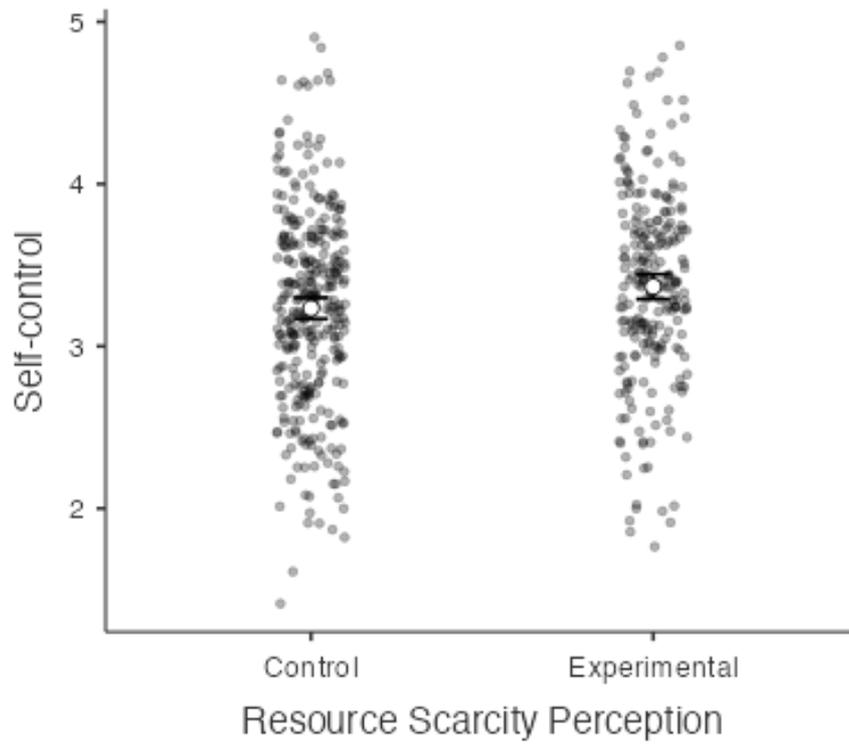


Figure 6. 8 The effects of Resource Scarcity Perception on Self-control

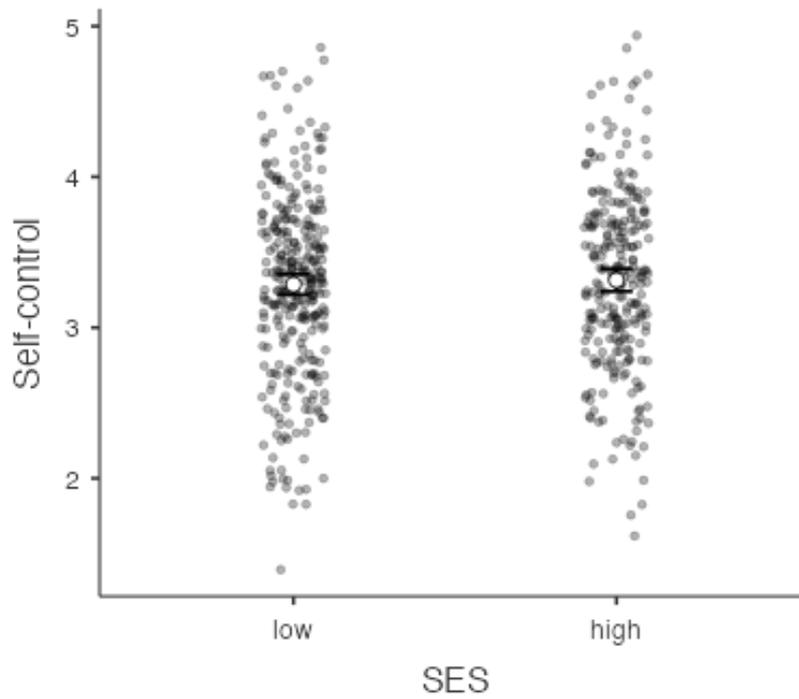


Figure 6. 9 The effects of SES on Self-control

6.6.1.4. The effect of resource scarcity perception and its interaction with SES on Thinking Style

To test H4 (see Chapter 1), a 2 x 2 ANOVA was run to analyze the effect of resource scarcity perception (experimental condition vs. control condition) and SES (low vs. high) on intuitive thinking style. The result did not provide a significant interaction between the effects of resource scarcity perception and SES on intuitive thinking style, $F(1, 564) = 0.0456, p = .831, \eta_p^2 < .001$. Simple main effects analysis did not yield a significance of the effects of resource scarcity perception on intuitive thinking style, $F(1, 564) = 1.8184, p = .178, \eta_p^2 = .003$. Main effects of SES had a significant effect on intuitive thinking style, $F(1, 564) = 4.0380, p = .045, \eta_p^2 = .007$. Those with low SES ($M = 3.20, SD = 0.782, 95\%CI [3.11; 3.29]$) had a significantly lower intuitive thinking style scores compared to the ones with high SES ($M = 3.33, SD = 0.702; 95\%CI [3.24; 3.38]$), $t(564) = -0.128, p = .045, d = -.178.$, in contrast to our initial expectation.

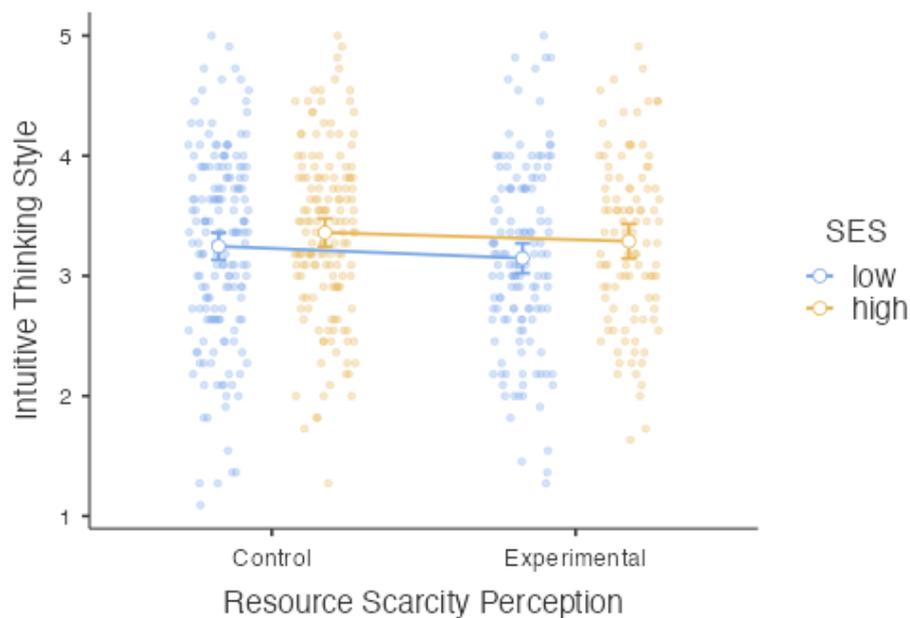


Figure 6. 10 The effects of Resource Scarcity Perception and SES on Intuitive Thinking Style. 1 indicates low intuitive thinking style, whereas 5 represents high thinking style

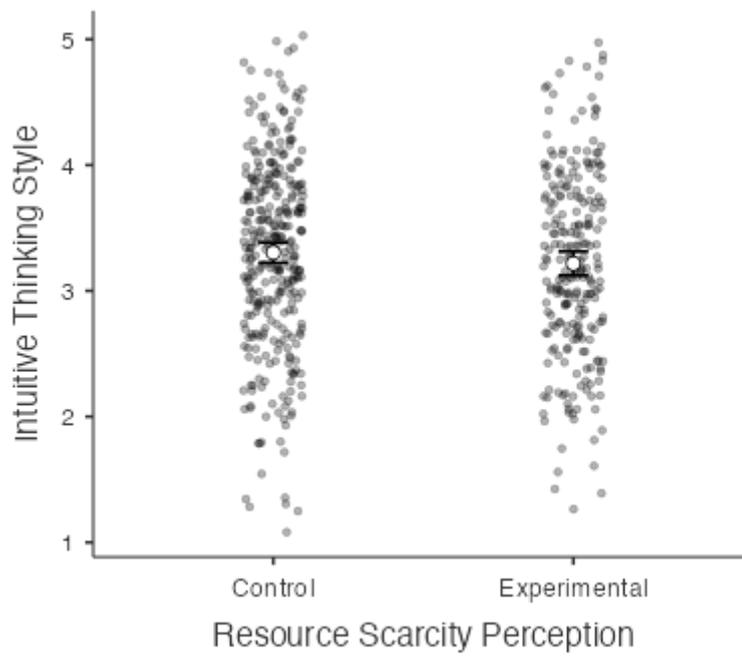


Figure 6. 11 The effects of Resource Scarcity Perception on Intuitive Thinking Style

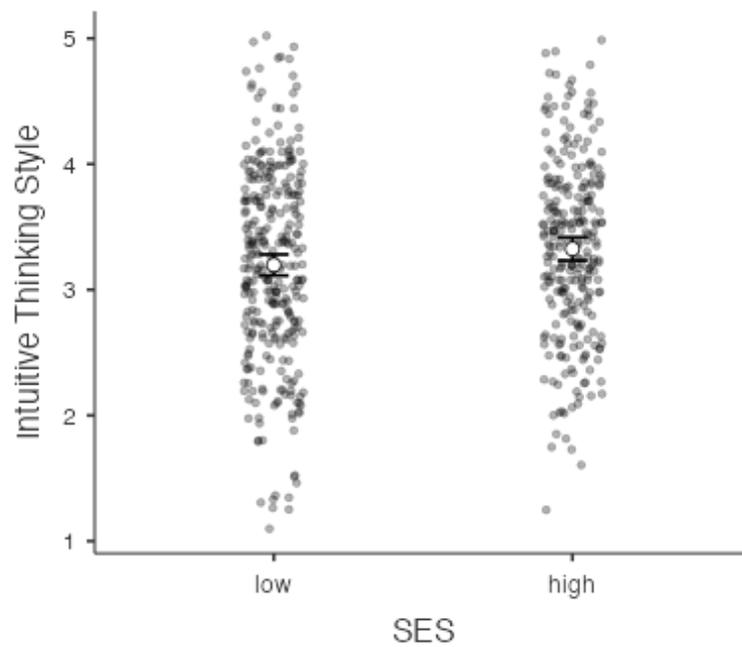


Figure 6. 12 The effects of SES on Intuitive Thinking Style

6.6.2. The moderating effect of self-control and intuitive thinking style on time-discounting

As an exploratory analysis, we looked at the moderating role of self-control and intuitive thinking style on time-discounting by conducting a multiple regression analysis. In Model 1 (see Table 6.7), resource scarcity perception did not have a significant effect on time-discounting ($B = .07$, $SE = 1.72$, $p = .364$, 95%CI [-0.08; 0.24]). In Model 2 (see Table 6.8), self-control and intuitive thinking style were added to the analysis to explore if they had a predictive effect on time-discounting preference. The results showed that neither self-control ($B = -.03$, $SE = 1.41$, $p = .359$, 95%CI [-0.04; 0.12]) nor thinking style ($B = -0.00$, $SE = 1.14$, $p = .973$, 95%CI [-0.08; 0.08]) interacting with resource scarcity perception had a significant effect on time-discounting.

Table 6. 5 Hierarchical Regression, Model 1, the interaction between Resource Scarcity Perception and Time-discounting

Predictor	Estimate	SE	95% Confidence Interval		t	p	Stand. Estimate	95% Confidence Interval	
			Lower	Upper				Lower	Upper
Intercept ^a	14.76	1.12	12.56	16.97	13.153	<.001			
Resource Scarcity Perception:									
1 – 0	1.56	1.72	-1.81	4.94	0.909	0.364	0.0764	-0.0887	0.241

^a Represents reference level

Table 6. 6 Hierarchical Regression, Model 2, the interaction between Resource Scarcity Perception and Time-discounting with the moderating role of Self-control and Intuitive Thinking Style

Predictor	Estimate	SE	95% Confidence Interval		t	p	Stand. Estimate	95% Confidence Interval	
			Lower	Upper				Lower	Upper
Intercept ^a	10.6927	6.05	-1.20	22.58	1.7662	0.078			
Resource Scarcity Perception:									
1 – 0	1.3871	1.73	-2.02	4.79	0.8005	0.424	0.06784	0.0986	0.2343
Self-control	1.2981	1.41	-1.48	4.07	0.9189	0.359	0.03849	0.0438	0.1208
Intuitive Thinking Style	-0.0391	1.14	-2.28	2.21	0.0342	0.973	-0.00143	0.0834	0.0805

^a Represents reference level

CHAPTER 7

DISCUSSION AND CONCLUSION

7.1. An Overview of the Findings

In this study, we investigated the relationship between resource scarcity perception and time-discounting. We proposed a causal model describing that resource scarcity perception when interacting with SES (low vs. high) negatively affects people's time-discounting preference via a cognitive mechanism (e.g., self-control and intuitive thinking style). That is to say, we expected to find an effect between resource scarcity perception and self-control (e.g., feelings of resource scarcity would lead people to decrease their self-control), as well as we expected another effect between resource scarcity perception and intuitive thinking style (e.g., the feelings of resource scarcity would direct people into an intuitive thinking style). Finally, we suggested that this cognitive mechanism from resource scarcity perception to self-control and intuitive thinking style would have an impact on people's time-discounting preferences (e.g., people would choose the smaller, proximal rewards over the larger, distal ones), especially for low SES participants.

In other words, we hypothesized that resource scarcity perception would lead people to have greater time-discounting among those who have low (vs. high) SES compared to the control condition (Hypothesis 2). Our results did not support Hypothesis 2. We also did not find any main effect of resource scarcity perception on time-discounting (e.g., resource scarcity perception did not affect the participants' time-discounting preference). SES was also not associated with the participants' time-discounting preferences. In contrast to our initial expectation, the results indicated that our resource scarcity perception manipulation failed at increasing the financial concerns among people with low SES (Hypothesis 1) whereas lower SES was related to a higher financial concern, as expected. Interestingly, it turns out to be that the resource scarcity perception manipulation significantly decreased the financial concerns, the exact opposite of what we intended. Though theoretically contradictory, those in the resource scarcity perception manipulation group reported *lower* financial concerns compared to the ones in the control group, indicating that our manipulation failed.

As proposed in our model, we also investigated if resource scarcity perception interacting with SES (low vs. high) led people to weak self-control (Hypothesis 3).

The interaction effects of resource scarcity and SES on self-control were not significant. However, our results suggested that resource scarcity perception had an effect on self-control. Theoretically, the resource scarcity perception would be suggested to lead people to deploy their self-control abilities as we hypothesized, but, in contrast to our initial expectation, those in the resource scarcity condition showed *higher* self-control than the ones in the control group. Lastly, we investigated if the interaction of resource scarcity perception and SES led people to have an intuitive mindset. The interaction effects of resource scarcity perception and SES on intuitive thinking style were not statistically significant. However, SES alone was significantly associated with the tendency to think intuitively. However, again in contrast to our preregistered hypotheses, higher SES participants relied more on an intuitive thinking style than the ones with lower SES. Various explanations can be suggested for this result. Since positive feelings (e.g., the feelings of safety) might increase the usage of heuristics due to the cognitive ease (Kahneman, 2011), higher SES participants might tend to depend on intuition and heuristics. Another explanation might be that higher SES participants generally have stable jobs and living conditions. Since their lives are not challenging compared to those with lower SES, they might be more likely to depend on intuitive thinking style, which in turn will lead them to have accurate decisions (Raoelison et al., 2020).

We also conducted regression analyses to explore if self-control and intuitive thinking style moderated the effects of resource scarcity perception on time-discounting. Our regression analysis also suggested the failure of the moderation effect of self-control and intuitive thinking style on time-discounting.

7.2. Limitations and Future Work

Psychological research is in a so-called replication crisis (Ioannidis, 2005; Yong, 2012). One possible remedy to overcome the replication crisis is to strengthen the culture of open science in psychological and behavioral research (Nosek et al., 2018; Nosek et al., 2019). Namely, researchers should make available their sources, materials, data, and methodology. However, in our study, we had to use the materials that were developed before the open science movement. Thus, while conducting our study we were aware that their reliability might have been in question. This problem was especially present in our manipulation technique. With respect to this, our results are in fact in line with the recent failure of resource scarcity perception priming techniques (O'Donnell et al., 2021; Isler et al., 2022). Current failure in activating resource scarcity perception reveals that the manipulation techniques developed in the past are not adequate to activate relevant psychological mechanisms related to resource scarcity (e.g., a scarcity mindset; O'Donnell et al., 2021; Isler et al., 2022).

Other possible limitations might appear due to the gender distribution of our participants. 74.6 percent of the participants were female (N = 424), whereas only 24.3

percent were male ($N = 138$) (see Section 6.2 in Chapter 6). To measure people's SES, we also used the MacArthur Subjective Social Status Scale (Adler & Stewart, 2007), which measures the subjective SES. However, objective measurements of SES might provide more consistent results.

In addition, psychological research is generally conducted in WEIRD societies (e.g., Western, Educated, Industrialized, Rich, and Democratic), thus other 85% of the world's population remains out of its scope (Henrich et al., 2010). To our knowledge, the effects of resource scarcity perception on time-discounting preferences have not been hitherto investigated in a non-WEIRD sample, especially in a Turkish sample, although various studies (Saribay et al., 2021; Isler et al., 2022) used resource scarcity manipulation in a Turkish sample. However, since the resource scarcity manipulation technique as a short video clip used by Saribay et al. (2021) did fit for our experimental design due to the pandemic conditions and short-time period of a master's thesis, we preferred using the previously well-established tool to experimentally activate resource scarcity concerns in online experiments (Roux et al., 2015). Hence, one of the reasons for the contradictory findings might be that we had to use a technique that was normally designed for western countries. Future studies should attempt to develop novel and local techniques to activate relevant concerns. More specifically, economic games creating a real-like scarcity experience might be an alternative manipulation technique that future research might focus on developing. Another effort should be put into developing the materials that are adapted to the characteristics of the Turkish sample. Future research might also test our hypotheses in a gender-balanced study since our study was not. To measure SES, a measurement of objective SES might be beneficial in future work. Additionally, to establish the effects of self-control and intuitive thinking style, future work might directly test the relationships between these variables. Future research might also extend the scope of relations in our proposed model. For example, we did not investigate the effects of resource scarcity perception on the other variables of economic decision-making (e.g., risk-taking preferences in the case of potential loss and gain). We also did not include negative affect, stress, and working memory in our model. The effects of resource scarcity and other moderator variables on people's risk-taking preferences can be investigated as well.

The other problem might be related to our experimental design. Our causal model described a cognitive mechanism from resource scarcity to time-discounting via self-control and intuitive thinking style. Thus, our model suggested causal relationships between self-control and time-discounting, as well as between intuitive thinking style and time-discounting. In order to establish true causality among these relationships, we had to manipulate self-control and intuitive thinking style in different experiments and observe their effects on time-discounting. Since this research was a master's thesis and included a great deal of methodological content, we had limited time and space for the experimental part. In fact, we did not experimentally test the effects of self-control and intuitive thinking style on time-discounting. Instead, we were able to test the potential moderating role of self-control and intuitive thinking style on time-discounting, which was not enough to give an idea about the potential causality between these variables.

7.3. Conclusion

We integrated the domain knowledge, findings and data of previous publications in the literature to build a causal BN structure. We used domain knowledge and published evidence to specify our BN structure. To this end, we benefited from the data of the studies of Adamkovič (2020) (see Chapter 4). We employed data-driven structure learning algorithms of the `bnlearn` package implemented in R over the data from Adamkovič (2020). Even though, these algorithms were not definitive for determining causal structures purely from data; however, they were useful to provide insight and conduct sensitivity analysis about the expert elicited BN structures by identifying the conditional independencies in the data. We also matched the structure of the BN for the same level of detail as our planned experiment. The BN structures gained from the knowledge of experts and published findings can be more detailed and complex compared to the ones that are suitable for experimental testing. We used systematic approaches that were available for this task (Yet and Marsh, 2014) to abstract and refine the BN (see Chapter 5).

Analyzing the data of previous research and treating the relations that they bear as Bayesian Networks provided insights as to figuring out which one of these relations might be possibly causal. This mere data-driven approach is theoretically blind and is not sufficient alone to establish causal relations. Prior knowledge of the domain always has to be incorporated into the process of forming Bayesian structures. Prior domain knowledge and abstraction operations in Yet and Marsh (2014), combined with the first step, give a structural way of forming causal models that are suitable for experimental testing.

Overall, in this study, we attempted to integrate two different approaches in the field of cognitive science (causal Bayesian Networks and behavioral experimentation). First, we tried to detect possible causal relationships by using Bayesian Network learning algorithms on a previously collected dataset (see Chapter 4) and benefited from abstraction operations in Bayesian Networks (see Chapter 5). Then, we tested the resulting model through a behavioral experiment (see Chapter 6). Although the method we used was a promising approach since it combines complementary approaches from two different disciplines, the ineffectiveness of the manipulation we used prevented us from making an accurate test of the model. Although we conducted a preregistered experiment with high statistical power and used a manipulation method that has been known to have an effect in the past, as the current findings and two recent studies have shown (O'Donnell et al., 2021; Isler et al., 2022), experimentally activating resource scarcity is much more difficult than previously assumed. Therefore, future studies should develop generic manipulation methods that are much more powerful and can be used easily in different cultures to activate these and similar psychological mechanisms, and experimentally test the models here.

REFERENCES

- Adamkovič, M. (2020). Consequences of Poverty on Economic Decision-Making: Assessing the Verisimilitude of the Cognitive Mechanism. *Frontiers in Psychology, 11*. <https://doi.org/10.3389/fpsyg.2020.00171>
- Adamkovič, M., & Martončík, M. (2017, October 11). A review of consequences of poverty on economic decision-making: A hypothesized model of a cognitive mechanism. *Frontiers in Psychology*. Frontiers Media S.A. <https://doi.org/10.3389/fpsyg.2017.01784>
- Agnew R, Matthews SK, Bucher J, Welcher AN, Keyes C. Socioeconomic Status, Economic Problems, and Delinquency. *Youth Soc.* 2008 Dec 1;40(2):159–81.
- Alós-Ferrer, C., & Hügelschäfer, S. (2012). Faith in intuition and behavioral biases. *Journal of Economic Behavior & Organization, 84(1)*, 182–192. doi:10.1016/j.jebo.2012.08.004
- Amaya, S. (2020). The science of self-control. John Templeton Foundation. <https://www.templeton.org/wp-content/uploads/2020/08/JTF-Self-Control-Final.pdf>
- Amir, O., Ariely, D., Cooke, A., Dunning, D., Epley, N., Gneezy, U., ... Silva, J. (2005). Psychology, behavioral economics, and public policy. *Marketing Letters, 16(3–4)*, 443–454. <https://doi.org/10.1007/s11002-005-5904-2>
- Banerjee AV, Duflo E. The Economic Lives of the Poor. *J Econ Perspect.* 2007 Mar;21(1):141–68.
- Banerjee, A. V., & Duflo, E. (2011). The Economic Lives of the Poor. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.942062>

- Barefoot, J. C., Peterson, B. L., Dahlstrom, W. G., Siegler, I. C., Anderson, N. B. and Williams, R. B., Jr. (1991) 'Hostility patterns and health implications: correlates of Cook-Medley hostility scale scores in a national survey', *Health Psychology*, 10, pp. 18–24
- Barkow JH, Cosmides L, Tooby J. *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. Oxford University Press; 1995. p. 679)
- Barrett, C. B., Carter, M., Chavas, J.-P., & Carter, M. R. (2019). Poverty and Cognitive Function. In *The Economics of Poverty Traps* (pp. 57–124). University of Chicago Press. <https://doi.org/10.7208/chicago/9780226574448.003.0002>
- Barrett, C. B., Garg, T., & McBride, L. (2016). Well-being dynamics and poverty traps. *Annual Review of Resource Economics*, 8(1), 303–327. <https://doi.org/10.1146/annurev-resource-100815-095235>
- Basile, A. G., and Toplak, M. E. (2015). Four converging measures of temporal discounting and their relationships with intelligence, executive functions, thinking dispositions, and behavioral outcomes. *Front. Psychol.* 6:728.doi: 10.3389/fpsyg.2015.00728
- Bertrand, M., Mullainathan, S., & Shafir, E. (2004). A behavioral-economics view of poverty. In *American Economic Review* (Vol. 94, pp. 419–423). <https://doi.org/10.1257/0002828041302019>
- Bertrand, M., Mullainathan, S., & Shafir, E. (2006). Behavioral economics and marketing in aid of decision making among the poor. *Journal of Public Policy and Marketing*. American Marketing Association. <https://doi.org/10.1509/jppm.25.1.8>
- Betella, A., & Verschure, P. F. M. J. (2016). The affective slider: A digital self-assessment scale for the measurement of human emotions. *PLoS ONE*, 11(2). <https://doi.org/10.1371/journal.pone.0148037>
- Brienza Justin P., Grossmann Igor. Social class and wise reasoning about interpersonal conflicts across regions, persons and situations. *Proc R Soc B Biol Sci.* 2017 Dec 20;284(1869):20171870.

- Bronfenbrenner U, Evans GW. Developmental Science in the 21st Century: Emergig Questions, Theoretical Models, Research Designs and Empirical Findings. *Soc Dev.* 2000;9(1):115–25.
- Brown, J. R., Ivković, Z., and Weisbenner, S. (2015). Empirical determinants of intertemporal choice. *J. Financ. Econ.* 116, 473–486. doi: 10.1016/j.jfineco.2015.04.004
- Carvalho, L. S., Meier, S., & Wang, S. W. (2016). Poverty and economic decision-making: Evidence from changes in financial resources at payday. *American Economic Review*, 106(2), 260–284. <https://doi.org/10.1257/aer.20140481>
- Carvalho, L. S., Prina, S., and Sydnor, J. (2016b). The effect of saving on risk attitudes and intertemporal choices. *J. Dev. Econ.* 120, 41–52. doi: 10.1016/j.jdeveco.2016.01.001
- Cartwright, N. (2003). Nature’s Capacities and Their Measurement. In *Nature’s Capacities and Their Measurement*. <https://doi.org/10.1093/0198235070.001.0001>
- Charness, G., Gneezy, U., & Halladay, B. (2016). Experimental methods: Pay one or pay all. *Journal of Economic Behavior and Organization*, 131, 141–150. <https://doi.org/10.1016/j.jebo.2016.08.010>
- Cubitt, R.P., Starmer, C. & Sugden, R. On the Validity of the Random Lottery Incentive System. *Experimental Economics* 1, 115-131 (1998). <https://doi.org/10.1023/A:1026435508449>
- Cui, J.-F., Wang, Y., Shi, H.-S., Liu, L.-L., Chen, X.-J., and Chen, Y.-H. (2015). Effects of working memory load on uncertain decision-making: evidence from the Iowa Gambling Task. *Front. Psychol.* 6:162. doi: 10.3389/fpsyg.2015.00162
- Dablender, F. (2020). An introduction to causal inference. PsyArXiv Preprint. (doi:10.31234/osf.io/b3fkw)
- Dalton, P. S., Ghosal, S., & Mani, A. (2016). Poverty and Aspirations Failure. *Economic Journal*, 126(590), 165–188. <https://doi.org/10.1111/eoj.12210>

- Datta, S., & Mullainathan, S. (2014). Behavioral design: A new approach to development policy. *Review of Income and Wealth*, 60(1), 7–35. <https://doi.org/10.1111/roiw.12093>
- De Ridder, D. T. D., Lensvelt-Mulders, G., Finkenauer, C., Stok, F. M., and Baumeister, R. F. (2012). Taking stock of self-control. *Pers. Soc. Psychol. Rev.* 16, 76–99. doi: 10.1177/1088868311418749
- Dewall C. N., Baumeister R. F., Gailliot M. T., Maner J. K. (2008). Depletion makes the heart grow less helpful: helping as a function of self-regulatory energy and genetic relatedness. *Pers. Soc. Psychol. Bull.* 34 1653–1662. 10.1177/0146167208323981
- Ellis BJ, Bianchi J, Griskevicius V, Frankenhuis WE. Beyond Risk and Protective Factors: An Adaptation-Based Approach to Resilience. *Perspect Psychol Sci.* 2017 Jul 1;12(4):561–87.
- Ellis BJ, Figueredo AJ, Brumbach BH, Schlomer GL. Fundamental Dimensions of Environmental Risk. *Hum Nat.* 2009 Jun 1;20(2):204–68.
- Evans, J. S. B. T. (2010). Intuition and reasoning: a dual-process perspective. *Psychol. Inq.* 21, 313–326. doi: 10.1080/1047840x.2010.521057
- Evans, J. S. B. T., & Curtis-Holmes, J. (2005). Rapid responding increases belief bias: Evidence for the dualprocess theory of reasoning. *Thinking & Reasoning*, 11(4), 382–389.
- Evans, J. St. B. T. (2003). In two minds: dual-process accounts of reasoning. *Trends in Cognitive Sciences*, 7(10), 454–459.
- Evans, J. St. B. T., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, 8(3), 223–241.
- Fields, S. A., Lange, K., Ramos, A., Thamotharan, S., and Rassa, F. (2014). The relationship between stress and delay discounting. *Behav. Pharmacol.* 25, 434–444. doi: 10.1097/fbp.0000000000000044

- Frankenhuis WE, Bijlstra G. Does Exposure to Hostile Environments Predict Enhanced Emotion Detection? *Collabra Psychol.* 2018 May 31;4(1):18
- Frederick, S. (2005). Cognitive reflection and decision making. *J. Econ. Perspect.* 19,25–42. doi: 10.1257/089533005775196732
- Frederick, Shane, George Loewenstein, and Ted O'Donoghue. 2002. "Time Discounting and Time Preference: A Critical Review." *Journal of Economic Literature*, 40 (2): 351-401. DOI: 10.1257/002205102320161311
- Fujita K. On Conceptualizing Self-Control as More Than the Effortful Inhibition of Impulses. *Personal Soc Psychol Rev.* 2011 Nov 1;15(4):352–66.
- Giudice, M., Gangestad, S., & Kaplan, H. (2015, November 18). Life History Theory and Evolutionary Psychology. Retrieved January 22, 2021, from <https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119125563.evpsych102>
- Grossmann I, Varnum MEW. Divergent life histories and other ecological adaptations: Examples of social class differences in attention, cognition, and attunement to others. *Behav Brain Sci.* 2017;40:e329.
- Hafenbrädl, S., Waeger, D., Marewski, J. N., and Gigerenzer, G. (2016). Applied decision making with fast-and-frugal heuristics. *J. Appl. Res. Mem. Cogn.* 5,215–231. doi: 10.1016/j.jarmac.2016.04.011
- Hall, C. C., Zhao, J., & Shafir, E. (2014). Self-Affirmation Among the Poor: Cognitive and Behavioral Implications. *Psychological Science*, 25(2), 619–625. <https://doi.org/10.1177/0956797613510949>
- Haushofer, J., & Fehr, E. (2014). On the psychology of poverty. *Science*. American Association for the Advancement of Science. <https://doi.org/10.1126/science.1232491>
- Haushofer, J., & Shapiro, J. (2013). Household Response to Income Changes: Evidence from an Unconditional Cash Transfer Program in Kenya. *Working Paper*, 1–57. Retrieved from https://www.princeton.edu/~joha/publications/Haushofer_Shapiro_UCT_2013.pdf

- Haushofer, J., Cornelisse, S., Seinstra, M., Fehr, E., Joëls, M., and Kalenscher, T. (2013). No effects of psychosocial stress on intertemporal choice. *PLOS ONE* 8:e78597. doi: 10.1371/journal.pone.0078597
- Heberle, A. E., & Carter, A. S. (2015). Cognitive aspects of young children's experience of economic disadvantage. *Psychological Bulletin*, 141(4), 723–746. <https://doi.org/10.1037/bul0000010>
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, Vol. 33. <https://doi.org/10.1017/S0140525X0999152X>
- Hoel, J. B., Schwab, B., and Hoddinott, J. (2016). Self-control exertion and the expression of time preference: experimental results from Ethiopia. *J. Econ. Psychol.* 52, 136–146. doi: 10.1016/j.joep.2015.11.005
- Hofmann, W., Vohs, K. D., & Baumeister, R. F. (2012). What People Desire, Feel Conflicted About, and Try to Resist in Everyday Life. *Psychological Science*, 23(6), 582–588. <https://doi.org/10.1177/0956797612437426>
- Hume, D. (2019). A Treatise of Human Nature. In *Hume's Ethical Writings*. <https://doi.org/10.2307/j.ctvpj759p.7>
- Hume, D. (2014). Enquiries Concerning Human Understanding and Concerning the Principles of Morals. In *David Hume: Enquiries Concerning Human Understanding and Concerning the Principles of Morals (Third Edition)*. <https://doi.org/10.1093/oseo/instance.00046349>
- Ifcher, J., and Zarghamee, H. (2011). Happiness and time preference: the effect of positive affect in a random-assignment experiment. *Am. Econ. Rev.* 101,3109–3129. doi: 10.1257/aer.101.7.3109
- Inzlicht M, Schmeichel BJ. What Is Ego Depletion? Toward a Mechanistic Revision of the Resource Model of Self-Control. *Perspect Psychol Sci.* 2012 Sep 1;7(5):450–63.
- Ioannidis, J. P. A. (2005). Why most published research findings are false. *PLoS Med*, 2, e124.
- Isler, O., Yilmaz O., & Dulleck, U. (2022). Does scarcity impede cognitive function? A comparison of resource scarcity manipulations. <https://doi.org/10.17605/OSF.IO/8TGZ7>

- Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar, Straus & Giroux.
- Kaplan, B. A., Amlung, M., Reed, D. D., Jarmolowicz, D. P., McKerchar, T. L., & Lemley, S. M. (2016). Automating Scoring of Delay Discounting for the 21- and 27-Item Monetary Choice Questionnaires. *Behavior Analyst*, *39*(2), 293–304. <https://doi.org/10.1007/s40614-016-0070-9>
- Kidd C, Palmeri H, Aslin RN. Rational snacking: Young children’s decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*. 2013 Jan 1;126(1):109–14 Mischel W. Processes in Delay of Gratification. In: Berkowitz L, editor. *Advances in Experimental Social Psychology* [Internet]. Academic Press; 1974 p.249–92. <http://www.sciencedirect.com/science/article/pii/S0065260108600398>
- Kidd, C., Palmeri, H., and Aslin, R. N. (2013). Rational snacking: young children’s decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition* 126, 109–114. doi: 10.1016/j.cognition.2012.08.004
- Koller, D. and Friedman, N. (2009). *Probabilistic Graphical Models: Principles and Techniques*
MIT Press
- Kopetz C, Orehek E. When the End Justifies the Means: Self-Defeating Behaviors as “Rational” and “Successful” Self-Regulation. *Curr Dir Psychol Sci*. 2015 Oct 1;24(5):386–91.
- Kurzban R, Duckworth A, Kable JW, Myers J. An opportunity cost model of subjective effort and task performance. *Behav Brain Sci*. 2013 Dec;36(6):661–79.
- Lee, A. J., & Zietsch, B. P. (2011). Experimental evidence that women’s mate preferences are directly influenced by cues of pathogen prevalence and resource scarcity. *Biology Letters*, *7*(6), 892–895. <https://doi.org/10.1098/rsbl.2011.045>
- Lehrer, J. (2010). The truth wears off: Is there something wrong with the scientific method? *The New Yorker*, December 13.
- Lerner, J. S., Li, Y., and Weber, E. U. (2013). The financial costs of sadness. *Psychol.Sci.* *24*, 72–79. doi: 10.1177/0956797612450302

- Liu, L., Feng, T., Suo, T., Lee, K., and Li, H. (2012). Adapting to the destitute situations: poverty cues lead to short-term choice. *PLOS ONE* 7:e33950.doi: 10.1371/journal.pone.0033950
- Mani, A., Mullainathan, S., Shafir, E., & Zhao, J. (2013). Poverty impedes cognitive function. *Science*, 341(6149),976–980.<https://doi.org/10.1126/science.1238041>
- Margatiris, D. (2003). Learning Bayesian Network Model Structure from Data. Ph.D. thesis, School of Computer Science, Carnegie-Mellon University, Pittsburgh, PA. Available as Technical Report CMU-CS-03-153
- Masicampo, E. J., and Baumeister, R. F. (2008). Toward a physiology of dual-process reasoning and judgment: lemonade, willpower, and expensive rule-based analysis. *Psychol. Sci.* 19, 255–260. doi: 10.1111/j.1467-9280.2008.02077.x
- Michaelson, L., de la Vega, A., Chatham, C. H., and Munakata, Y. (2013). Delaying gratification depends on social trust. *Front. Psychol.* 4:355. doi: 10.3389/fpsyg.2013.00355
- Mishra, S., and Lalumière, M. L. (2016). Associations between delay discounting and risk-related behaviors, traits, attitudes, and outcomes. *J. Behav. Decis. Mak.*30, 769–781. doi: 10.1002/bdm.2000
- Mullainathan, S., & Shafir, E. (2014). *Scarcity: Why having too little means so much*. New York: Picador, Henry Holt and Company.
- Nagarajan, R., Scutari, M., & Lèbre, S. (2013). Bayesian Networks in R. In *Bayesian Networks in R*. <https://doi.org/10.1007/978-1-4614-6446-4>
- Nebioglu, M., Konuk, N., Akbaba, S. & Eroglu, Y. (2012). The Investigation of Validity and Reliability of the Turkish Version of the Brief Self-Control Scale. *Klinik Psikofarmakoloji Bülteni-Bulletin of Clinical Psychopharmacology*, 22(4), 340-351. DOI: 10
- Nelson, L. D., & Morrison, E. L. (2005). The symptoms of resource scarcity: Judgments of food and finances influence preferences for potential partners. *Psychological Science*, 16(2), 167-173.
- Nosek, B. A., Ebersole, C. R., DeHaven, A. C., & Mellor, D. T. (2018). The preregistration revolution. *Proceedings of the National Academy of Sciences of the United States of America*, 115(11). <https://doi.org/10.1073/pnas.1708274114>

- Nosek, B. A., Beck, E. D., Campbell, L., Flake, J. K., Hardwicke, T. E., Mellor, D. T., ... Vazire, S. (2019). Preregistration Is Hard, And Worthwhile. *Trends in Cognitive Sciences*, Vol. 23. <https://doi.org/10.1016/j.tics.2019.07.009>
- O'Donnell, M., Dev, A. S., Antonoplis, S., Baum, S. M., Benedetti, A. H., Brown, N. D., ... Nelson, L. D. (2021). Empirical audit and review and an assessment of evidentiary value in research on the psychological consequences of scarcity. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 118. <https://doi.org/10.1073/pnas.2103313118>
- Pacini, R., & Epstein, S. (1999). The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *Journal of Personality and Social Psychology*, 76(6), 972–987.
- Pearl, J. (2011). Causality: Models, reasoning, and inference, second edition. In *Causality: Models, Reasoning, and Inference, Second Edition*. <https://doi.org/10.1017/CBO9780511803161>
- Pearl, J., Glymour, M., and Jewell, N. Causal Inference in Statistics: a Primer. Wiley, 2016.
- Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015). Everyday consequences of analytic thinking. *Current Directions in Psychological Science*, 24, 425–432. doi:10.1177/0963721415604610
- Pepper GV, Nettle D. The behavioural constellation of deprivation: Causes and consequences. *Behav Brain Sci*. 2017 ed;40.
- Pepper, G. V., & Nettle, D. (2017). The behavioural constellation of deprivation: Causes and consequences. *Behavioral and Brain Sciences*, 40. <https://doi.org/10.1017/S0140525X1600234X>
- Piff, P. K., Kraus, M. W., C.t., S., Cheng, B. H. and Keltner, D. (2010) ‘Having less, giving more: the influence of social class on prosocial behavior’, *Journal of Personality and Social Psychology*, 99(5), pp. 771–84
- Pocheptsova, A., Amir, O., Dhar, R., and Baumeister, R. F. (2009). Deciding without resources: resource depletion and choice in context. *J. Mark. Res.* 46, 344–355. doi: 10.1509/jmkr.46.3.344

- Porcelli, A. J., and Delgado, M. R. (2009). Acute stress modulates risk taking in financial decision making. *Psychol. Sci.* 20, 278–283. doi: 10.1111/j.1467-9280.2009.02288.x
- Raoelison, M. T. S., Thompson, V. A., & De Neys, W. (2020). The smart intuitor: Cognitive capacity predicts intuitive rather than deliberate thinking. *Cognition*, 204. <https://doi.org/10.1016/j.cognition.2020.104381>
- Richard, F. D., Bond Jr, C. F., & Stokes-Zoota, J. J. 2003. “One hundred years of social psychology quantitatively described”, *Review of General Psychology*, 7(4), 331-363.
- Rode C, Cosmides L, Hell W, Tooby J. When and why do people avoid unknown probabilities in decisions under uncertainty? Testing some predictions from optimal foraging theory. *Cognition*. 1999 Oct 26;72(3):269–304.
- Roux, C., Goldsmith, K., & Bonezzi, A. (2015). On the psychology of scarcity: When reminders of resource scarcity promote selfish (and generous) behavior. *Journal of Consumer Research*, 42(4). <https://doi.org/10.1093/jcr/ucv048>
- Saribay, S. A., Tureček, P., Paluch, R., & Kleisner, K. (2021). Differential effects of resource scarcity and pathogen prevalence on heterosexual women’s facial masculinity preferences. *Evolutionary Human Sciences*, 3. <https://doi.org/10.1017/ehs.2021.42>
- Scutari, M. (2010). Learning Bayesian networks with the bnlearn R Package. *Journal of Statistical Software*, 35(3). <https://doi.org/10.18637/jss.v035.i03>
- Shah, A. (2001). Water Scarcity Induced Migration: Can Watershed Projects Help? *Economic and Political Weekly*, 36(35), 1–7.
- Shah, A. K., Mullainathan, S., & Shafir, E. (2012). Some consequences of having too little. *Science*, 338(6107), 682–685. <https://doi.org/10.1126/science.1222426>
- Shah, A. K., Shafir, E., & Mullainathan, S. (2015). Scarcity Frames Value. *Psychological Science*, 26(4), 402–412. <https://doi.org/10.1177/0956797614563958>
- Shah, A. K., Zhao, J., Mullainathan, S., & Shafir, E. (2018). Money in the mental lives of the poor. *Social Cognition*, 36(1), 4–19. <https://doi.org/10.1521/soco.2018.36.1.4>

- Shamosh, N. A., and Gray, J. R. (2008). Delay discounting and intelligence: a meta-analysis. *Intelligence* 36, 289–305. doi: 10.1016/j.intell.2007.09.004
- Shamosh, N. A., DeYoung, C. G., Green, A. E., Reis, D. L., Johnson, M. R., Conway, A. R. A., et al. (2008). Individual differences in delay discounting: relation to intelligence, working memory, and anterior prefrontal cortex. *Psychol. Sci.* 19,904–911. doi: 10.1111/j.1467-9280.2008.02175.x
- Sheehy-Skeffington, J., & Rea, J. (2017). How poverty affects people’s decision-making processes. *Www.Jrf.Org.Uk*, (February), 1–73. Retrieved from <https://www.jrf.org.uk/report/how-poverty-affects-peoples-decision-making-processes>
- Simonovic, B., Stuppel, E. J. N., Gale, M., and Sheffield, D. (2016). Stress and risky decision making: cognitive reflection, emotional learning or both. *J. Behav. Decis. Mak.* 30, 658–665. doi: 10.1002/bdm.1980
- Starcke, K., and Brand, M. (2012). Decision making under stress: a selective review. *Neurosci. Biobehav. Rev.* 36, 1228–1248. doi: 10.1016/j.neubiorev.2012.02.003
- Steinberg, L., Graham, S., O’Brien, L., Woolard, J., Cauffman, E., and Banich, M. (2009). Age differences in future orientation and delay discounting. *Child Dev.* 80, 28–44. doi: 10.1111/j.1467-8624.2008.01244.x
- Travers, E., Rolison, J. J., and Feeney, A. (2016). The time course of conflict on the cognitive reflection test. *Cognition* 150, 109–118. doi: 10.1016/j.cognition.2016.01.015
- Türk, E. G., & Artar, M. (2014). Adaptation of the rational experiential inventory: Study of reliability and validity. *Ankara University Journal of Faculty of Educational Sciences*, 47(1), 1–18.
- Vohs, K. D. (2013). The poor’s poor mental power. *Science*, Vol. 341, pp.969–970. <https://doi.org/10.1126/science.1244172>
- Waegeman, A., Declerck, C. H., Boone, C., Van Hecke, W., and Parizel, P. M. (2014). Individual differences in self-control in a time discounting task: an fMRI study. *J. Neurosci. Psychol. Econ.* 7, 65–79. doi: 10.1037/npe0000018

- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037/0022-1070>.
- Wicherts, J. M., & Zand Scholten, A. (2013). Comment on “Poverty impedes cognitive function.” *Science*. <https://doi.org/10.1126/science.1246680>
- Wittmann, M., and Paulus, M. P. (2009). Intertemporal choice: neuronal and psychological determinants of economic decisions. *J. Neurosci. Psychol. Econ.* 2, 71–74. doi: 10.1037/a0017695
- Yet, B., & Marsh, D. W. R. (2014). Compatible and incompatible abstractions in Bayesian networks. *Knowledge-Based Systems*, 62, 84–97. <https://doi.org/10.1016/j.knosys.2014.02.020>
- Yilmaz, O., Harma, M., & Doğruyol, B. (2021). Validation of Morality as Cooperation Questionnaire in Turkey, and Its Relation to Prosociality, Ideology, and Resource Scarcity. *European Journal of Psychological Assessment*, 37(2), 149–160. <https://doi.org/10.1027/1015-5759/a000627>
- Yong, E. (2012). Bad copy: In the wake of high-profile controversies, psychologists are facing up to problems with replication. *Nature*, 485, 298-300
- Young ES, Griskevicius V, Simpson JA, Waters TEA, Mittal C. Can an unpredictable childhood environment enhance working memory? Testing the sensitized-specialization hypothesis. *J Pers Soc Psychol*. 2018;114(6):891 908.
- Yu, R. (2016). Stress potentiates decision biases: a stress induced deliberation to intuition(SIDI) model. *Neurobiol. Stress* 3, 83–95. doi: 10.1016/j.ynstr.2015.12.006
- Zucker, G. S., & Weiner, B. (1993). Conservatism and perceptions of poverty: An attributional analysis. *Journal of Applied Social Psychology*, 23, 925-943.
- Zwane, A. P. (2012, November 2). Implications of scarcity. *Science*. American Association for the Advancement of Science. <https://doi.org/10.1126/science.1230292>

APPENDICES

Appendix A: D-Separation Rules

Below we show three examples regarding d-separation rules:

1)

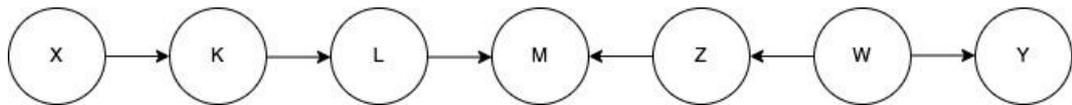


Figure 8.1. a graph that contains chain, fork, and collider simultaneously.

For X and Y to be d -connected, there should not be any blocked path between them. X - K - L - M is a chain and unblocked in the graph below, therefore X and M d -connected. Similarly, the path between M - Z - W - Y is unblocked. Hence M and Y are claimed to be d -connected.

However, since M is an unobserved collider between X and Y , the path between them is blocked, and X and Y are d -separated unless conditioned on M (See Figure 8.1) (Pearl et al., 2016; <http://bayes.cs.ucla.edu/BOOK-2K/d-sep.html>).

2)

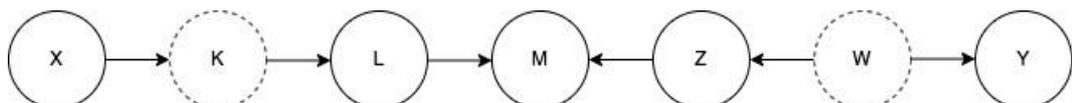


Figure 8.2. a graph that contains chain, fork, and collider simultaneously. Its variables, K and W , have been conditioned on.

In Figure 8.2, we condition on K and W . Conditioning on K blocks the chain between X and L , hence X becomes d -separated from L and M . Similarly, conditioning on W blocks the fork between Z and Y , hence Y becomes d -separated from Z and M (Pearl et al., 2016; <http://bayes.cs.ucla.edu/BOOK-2K/d-sep.html>).

3)

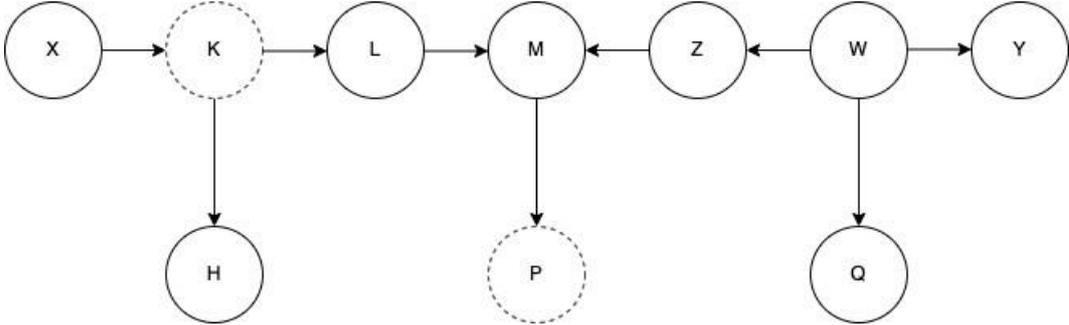


Figure 8.3. a graph, showing the d -connectedness of the variables L and Y when the child node of the collider M has been conditioned on.

In Figure 8.3., the path between L and Y becomes unblocked when P is observed, making L and Y d -connected, since the variable P is a descendant of the collider M (see Section 3.4.2.2) (Pearl et al., 2016; <http://bayes.cs.ucla.edu/BOOK-2K/d-sep.html>).

Appendix B: Learning Algorithms

Study 1 (Chapter 4, Section 4.1.3.1 and Chapter 4, Section 4.1.3.2)

Bayesian network learned via Score-based methods

learning algorithm:	Hill-Climbing
score:	BIC (disc.)
penalization coefficient:	3.018935
tests used in the learning procedure:	187
optimized:	TRUE

Bayesian network learned via Score-based methods

learning algorithm:	Hill-Climbing
score:	BIC (disc.)
penalization coefficient:	3.018935
tests used in the learning procedure:	148
optimized:	TRUE

Study 2 (Chapter 4, Section 4.1.4.1 and Chapter 4, Section 4.1.4.2)

Bayesian network learned via Score-based methods

learning algorithm:	Hill-Climbing
score:	BIC (disc.)

penalization coefficient: 3.092074
tests used in the learning procedure: 176
optimized: TRUE

Bayesian network learned via Score-based methods

learning algorithm: Hill-Climbing
score: BIC (disc.)
penalization coefficient: 3.092074
tests used in the learning procedure: 157
optimized: TRUE

Study 3 (Chapter 4, Section 4.1.5.1)

Bayesian network learned via Score-based methods

learning algorithm: Hill-Climbing
score: BIC (disc.)
penalization coefficient: 2.740319
tests used in the learning procedure: 56
optimized: TRUE

Appendix C: Scarcity Recall

Manipulation Group

From time to time, people may experience periods in their lives where they cannot reach the basic resources they need.

For example, you may not have had enough money to have a meal out. You may not have bought a new coat to keep you warmer in cold weather. It might have happened that the water, electricity, etc., were cut off by distribution companies since you could not pay your bills. You may not have gone out to socialize at the end of the month. You may have paid your credit card debt by taking a cash advance from your other credit cards.

We now ask you to reflect on similar situations you have experienced in the past. Would you please write below four different past experiences you felt like resource scarcity in the first box below? In the second box, would you please describe two of them in detail; you can even talk about what these memories made you feel while describing them in the boxes.

İnsanlar yaşamlarında zaman zaman ihtiyaç duydukları temel kaynaklara ulaşamadıkları dönemler yaşayabilmektedirler.

Örneğin, dışarıda bir öğün yemek için yeterli paranız olmamış olabilir. Soğuk havalarda sizi daha sıcak tutacak yeni bir mont alamamış olabilirsiniz. Su, elektrik vs. faturalarınızı ödeyemediğinizden bunların kullanımını kesmiş olabilirler. Ay sonunda sosyalleşmek için dışarıya çıkamamış olabilirsiniz. Kredi kartı ekstrelerinizi diğer kartlarınızdan nakit avans çekerek ödemiş olabilirsiniz.

Şimdi sizden geçmişte yaşadığınız benzer durumlar üzerine düşünmenizi istiyoruz. Lütfen, aşağıda yer alan ilk kutucuğa geçmişte kaynak kıtlığı çektiğiniz dört farklı anınızı yazınız. İkinci kutucuğa ise bunlardan ikisini detaylı betimleyiniz; hatta bu anıları kutucuklara betimlerken bunların size neler hissettirdiğinden de bahsedebilirsiniz.

Control Group

In this section, we will ask you to describe a few of the things you did last week.

For example, you may have stayed at home and watched TV series or read a book. You may have had to overcome a particular problem at work. You may have socialized with a friend at a cafe or stayed at home to spend time with family members. You may have gone to the cinema to see a newly released movie or to the theater to see the play.

Whatever you've done in the last week, we want you to specify four of them and think about them without worrying about them being simple.

Would you please write in the first box below the four events we just asked you to think about. In the second box, we would kindly ask you to write two of them in detail.

Bu kısımda geçen hafta yaptıklarınızdan birkaçını anlatmanızı isteyeceğiz.

Örneğin, evde kalıp dizi izlemiş veya kitap okumuş olabilirsiniz. İş yerinde belirli bir sorunu aşmak zorunda kalmış olabilirsiniz. Kafede bir arkadaşınızla sosyalleşmiş veya evde kalarak aile fertlerinizle vakit geçirmiş olabilirsiniz. Yeni çıkan bir filmi izlemek için sinemaya veya oyunu görmek için tiyatroya gitmiş olabilirsiniz.

Basit olacak kaygısı taşımadan son bir hafta içinde her ne yaptıysanız bunların dördünü seçip üzerine düşünmenizi istiyoruz. Lütfen, aşağıda yer alan ilk kutucuğa az önce sizden üzerlerine düşünmenizi istediğimiz dört olayı yazınız. İkinci kutucuğa ise bunlardan ikisini detaylı yazmanızı rica ediyoruz.

Appendix D: Brief Self-Control Scale

Using the scale provided, please indicate how much each of the following statements reflects how you typically are.

Response format:

1 2 3 4 5

Absolutely Disagree

Absolutely Agree

- 1) I am good at resisting temptation. 1—2—3—4—5
- 2) I have a hard time breaking bad habits. 1—2—3—4—5
- 3) I am lazy. 1—2—3—4—5
- 4) I say inappropriate things. 1—2—3—4—5
- 5) I do certain things that are bad for me, if they are fun. 1—2—3—4—5
- 6) I refuse things that are bad for me. 1—2—3—4—5
- 7) I wish I had more self-discipline. 1—2—3—4—5
- 8) People would say that I have iron self-discipline. 1—2—3—4—5
- 9) Pleasure and fun sometimes keep me from getting work done. 1—2—3—4—5
- 10) I have trouble concentrating. 1—2—3—4—5
- 11) I am able to work effectively toward long-term goals. 1—2—3—4—5
- 12) Sometimes I can't stop myself from doing something, even if I know it is wrong. 1—2—3—4—5
- 13) I often act without thinking through all the alternatives. 1—2—3—4—5

Size verilen ölçeği kullanarak, aşağıdaki ifadelerin size ne kadar yansıttığını belirtiniz.

Yanıt Formatı:

1 2 3 4 5

Kesinlikle Katılıyorum
Katılmıyorum

Kesinlikle

- 1) İnsanların beni kötülüğe yönlendirmesine karşı koymada başarılıyım. 1—2—
—3—4—5
- 2) Kötü alışkanlıklarımı terk etmekte zorlanırım. 1—2—3—4—5
- 3) Tembel biriyim. 1—2—3—4—5
- 4) Uygun olmayan şeyler söylerim. 1—2—3—4—5
- 5) Eğlenceli olmaları durumunda benim için kötü olan bazı şeyleri yaparım. 1—
2—3—4—5
- 6) Benim için kötü olan şeyleri reddederim. 1—2—3—4—5
- 7) Daha fazla öz-disipline sahip olmayı isterdim. 1—2—3—4—5
- 8) İnsanlar güçlü bir öz-disipline sahip olduğumu ifade ederler. 1—2—3—
4—5
- 9) Zevkli ve eğlenceli şeyler yapacağım işten beni alıkoyar. 1—2—3—4—
—5
- 10) Konsantrasyon sorunum var. 1—2—3—4—5
- 11) Uzun vadeli amaçlarıma ulaşmak için verimli biçimde çalışabilirim. 1—2—
—3—4—5
- 12) Bazen yanlış olduğunu bilsem de bazı şeyleri yapmaktan kendimi alamam. 1—
2—3—4—5
- 14) Sıklıkla bütün seçenekler üzerinde düşünmeden hareket ederim. 1—2—3—
—4—5

Appendix E: Faith in Intuition

Response format:

1 2 3 4 5

Absolutely Disagree

Absolutely Agree

- 1) Using my gut feelings usually works well for me in figuring out problems in my life. 1—2—3—4—5
- 2) Intuition can be a very useful way to solve problems. 1—2—3—4—5
- 3) I hardly ever go wrong when I listen to my deepest gut feelings to find an answer. 1—2—3—4—5
- 4) I believe in trusting my hunches. 1—2—3—4—5
- 5) I often go by my instincts when deciding on a course of action. 1—2—3—4—5
- 6) I like to rely on my intuitive impressions. 1—2—3—4—5
- 7) I don't like situations in which I have to rely on intuition. 1—2—3—4—5
- 8) I don't have a very good sense of intuition. 1—2—3—4—5
- 9) I don't think it is a good idea to rely on one's intuition for important decisions. 1—2—3—4—5
- 10) I trust my initial feelings about people. 1—2—3—4—5
- 11) I tend to use my heart as a guide for my actions. 1—2—3—4—5

Size verilen ölçeği kullanarak, aşağıdaki ne kadar katıldığınızı belirtiniz.

Yanıt Formatı:

1 2 3 4 5

Kesinlikle Katılıyorum
Katılmıyorum

Kesinlikle

- 1) Yaşamımdaki sorunları çözmeye sezgilerimi kullanmak genellikle işime yarar. 1—
—2—3—4—5
- 2) Sezgi, sorunları çözmeye çok yararlı bir yol olabilir. 1—2—3—4—5
- 3) Bir yanıt bulmak için en derin sezgilerimi dinlediğimde çok nadir yanılırım. 1—
—2—3—4—5
- 4) Önsezilerime güvenmem gerektiğine inanırım. 1—2—3—4—5
- 5) Bir eylemin yönüne karar verirken sıklıkla içgüdülerim doğrultusunda karar
veririm. 1—2—3—4—5
- 6) Sezgisel izlenimlerime güvenmeyi severim. 1—2—3—4—5
- 7) Sezgilerime güvenmek zorunda kaldığım durumlardan hoşlanmam. 1—2—
3—4—5
- 8) Çok iyi bir sezgi duygusuna sahip değilimdir. 1—2—3—4—5
- 9) Önemli kararlar için kişinin sezgilerine güvenmesinin iyi bir fikir olduğunu
sanmıyorum. 1—2—3—4—5
- 10) İnsanlar hakkındaki ilk duygularıma güvenirim. 1—2—3—4—5
- 11) Kalbimi, eylemlerime yön gösterici olarak kullanma eğilimindeyim. 1—2—
—3—4—5

Appendix E: The Measurement for Time-discounting Preference

In the explanation text at the beginning of the research, we stated that we would give a second gift card to 10 different people among the participants, ranging from 50 TL to 100 TL. The amount of the prize that you can win from the second promised gift card will be determined by your answer to this question. Now please answer the question by paying attention to the explanation below.

You can choose to receive the 50 TL gift card that will be given to you within two weeks after the research. Alternatively, you can select an amount from this 50 TL gift card yourself and receive this amount within two weeks after the research and double the remaining amount two months later.

If you want to receive the second gift card within two weeks after the research, you will have a gift card worth 50 TL. However, if you take an amount that you set yourself now and get the rest two months later, you will receive twice the remaining amount two months later. Therefore, you can get a gift card worth at least 50 TL or at most 100 TL depending on your choice.

For example;

Within two weeks after the research, you can take 50 TL and the remaining 0 TL doubled and receive 0 TL two months later, that is, a total of 50 TL gift cards in total.

Within two weeks after the research, you can take 40 TL and the remaining 10 TL doubled and receive 20 TL two months later, that is, 60 TL gift cards in total.

Within two weeks after the research, you can take 30 TL and the remaining 20 TL doubled and receive 40 TL two months later, that is, a total of 70 TL gift cards in total.

Within two weeks after the research, you can take 20 TL and the remaining 30 TL doubled and receive 60 TL two months later, that is, a total of 80 TL gift cards in total.

Within two weeks after the research, you can take 10 TL and the remaining 40 TL doubled and receive 80 TL two months later, that is, a total of 90 TL gift cards.

Within two weeks after the research, you can take 0 TL and the remaining 50 TL doubled and receive 100 TL two months later, that is, a total of 100 TL gift cards.

Would you please pay attention to the explanation above and indicate the amount you prefer to receive now from 50 TL?

Araştırmanın başında yer alan açıklama metninde, katılımcılar arasından 10 farklı kişiye 50 TL'den 100 TL'ye kadar değişebilecek ikinci bir hediye çeki daha vereceğimizi belirtmiştik. İkinci hediye çekilişinden kazanabileceğiniz ödül miktarı bu soruya vereceğiniz yanıtta göre belirlenecektir. Şimdi lütfen aşağıdaki açıklamaya dikkat ederek soruyu yanıtlayınız.

Size vereceğimiz 50 TL'lik hediye çekini araştırmadan iki hafta sonra almayı tercih edebilirsiniz. Alternatif olarak bu 50 TL'lik hediye çeki içinden kendiniz bir miktar belirleyerek bu miktarı araştırmadan iki hafta sonra alıp kalan miktarın ise iki katını iki ay sonra alabilirsiniz. Eğer ikinci hediye çekini araştırmadan iki hafta sonra almak isterseniz 50 TL değerinde hediye çeki alabileceksiniz. Fakat, kendi belirlediğiniz bir miktarı şimdi alıp, kalanını iki ay sonra almak isterseniz kalan miktarın iki katını alabileceksiniz. Dolayısıyla yapacağınız tercihe göre en az 50 TL veya en çok 100 TL değerinde hediye çeki alabilirsiniz.

Örneğin:

Araştırmadan iki hafta sonra 50 TL alıp kalan 0 TL'nin iki katını 0 TL'yi iki ay sonra, yani toplamda 50 TL'lik hediye çeki alabilirsiniz.

Araştırmadan iki hafta sonra 40 TL alıp kalan 10 TL'nin iki katını 20 TL'yi iki ay sonra, yani toplamda 60 TL'lik hediye çeki alabilirsiniz.

Araştırmadan iki hafta sonra 30 TL alıp kalan 20 TL'nin iki katını 40 TL'yi iki ay sonra, yani toplamda 70 TL'lik hediye çeki alabilirsiniz.

Araştırmadan iki hafta sonra 20 TL alıp kalan 30 TL'nin iki katını 60 TL'yi iki ay sonra, yani toplamda 80 TL'lik hediye çeki alabilirsiniz.

Araştırmadan iki hafta sonra 10 TL alıp kalan 40 TL'nin iki katını 80 TL'yi iki ay sonra, yani toplamda 90 TL'lik hediye çeki alabilirsiniz.

Araştırmadan iki hafta sonra 0 TL alıp kalan 50 TL'nin iki katını 100 TL'yi iki ay sonra, yani toplamda 100 TL'lik hediye çeki alabilirsiniz.

Lütfen yukarıdaki açıklamaya dikkat ederek şimdi kaç TL almayı tercih ettiğinizi belirtini

Appendix G: Financial Concerns Questionnaire

Please circle your agreement with the following statements.

1 2 3 4 5

Strongly Disagree

Strongly Agree

1) I generate enough income to afford luxuries after purchasing necessities. 1——
2——3——4——5

2) I have enough money saved to support myself should I suddenly lose my source of
income. 1——2——3——4——5

3) Despite the rising cost of property, I am confident one day I will own a house. 1—
—2——3——4——5

4) I only generate enough income to afford the bare necessities (e.g. food, bills, fees).
1——2——3——4——5

5) The cost of fuel worries me. 1——2——3——4——5

6) Lending a large amount of money to a friend would be no financial burden on me.
1——2——3——4——5

7) I can afford to make unnecessary impulse buys. 1——2——3——4——5

8) If I suddenly lost my source of income, I would worry that I couldn't maintain my
current lifestyle.

1——2——3——4——5

9) I make a budget to ensure I don't over-spend. 1——2——3——4——5

10) I am sometimes required to spend money I do not have. 1——2——3——4—
—5

11) I worry that I will never afford a home due to the rising price of residential estates. 1—2—3—4—5

12) I generate enough income to support the costs of a functioning household (e.g. groceries, bills, upkeep). 1—2—3—4—5

13) Money is important for basic needs. 1—2—3—4—5

14) I worry about my future financial stability. 1—2—3—4—5

Size verilen ölçeği kullanarak, aşağıdaki ifadelerin size ne kadar yansıttığını belirtiniz.

Yanıt Formatı:

1 2 3 4 5

Kesinlikle Katılmıyorum

Kesinlikle Katılıyorum

1) *Oldukça lüks bir hayat yaşayacak kadar gelirim vardır. 1—2—3—4—5*

2) *Gelirimi tamamen kaybetmem durumunda darda kalmamı önleyecek kadar birikmiş param vardır. 1—2—3—4—5*

3) *Son model bir araba alabilecek kadar zengin olacağıma eminim. 1—2—3—4—5*

4) *İleride lüks bir müstakil evde yaşayacak kadar gelirim olacağını düşünüyorum. 1—2—3—4—5*

5) *Artan benzin fiyatları beni hiç endişelendirmiyor. 1—2—3—4—5*

6) *İhtiyacı olan bir arkadaşına 1000 TL vermek bana yük olmaz. 1—2—3—4—5*

7) *İhtiyacım olmayan keyfi harcamalar yapmaya yetecek kadar gelirim var. 1—2—3—4—5*

8) Birden tüm gelirimı kaybetsem bile, şimdiki hayat standardımı koruyabilirim. 1—
—2—3—4—5

9) İleride yaşanabilecek olumsuzlukları düşünüp aşırı harcamalar yapmaktan kaçınırım. 1—2—3—4—5

10) Bazen almak isteyip, yeteri kadar param olmadığı için alamadığım şeyler olur. 1—2—3—4—5

11) Emlak fiyatları ne kadar artarsa artsın, bir gün ev sahibi olabileceğimi düşünüyorum. 1—2—3—4—5

12) İleride hem kendi evimi geçindirecek, hem de ailemin masraflarını karşılayacak kadar gelirim olacağını düşünüyorum. 1—2—3—4—5

13) Para, nasıl bir hayat yaşayacağımızı pek etkilemez. 1—2—3—4—5

14) Sürekliliği olan bir gelire sahip olmam pek de önemli değildir. 1—2—3—
—4—5

Appendix H: Demographic Form

1- Yaşı (sayıyla ifade ediniz)

2- Cinsiyet

Kadın/Erkek/Diğer

3- En son tamamlanan eğitim seviyesi

İlkokul, ortaokul, lise, ön lisans, lisans, yüksek lisans, doktora

4- Aşağıdaki merdivenin Türkiye'deki insanların ekonomik açıdan bulunduğu seviyeyi temsil ettiğini düşünün. Merdivenin tepesindekiler (10) her şeyin en iyisine (örneğin; en çok paraya, en iyi eğitime ve en saygın mesleklere) sahip insanlardır. Merdivenin en altındakiler (1) ise en kötü koşullara (örneğin; en az paraya, en az eğitime ve en az saygın mesleklere) sahip insanlardır. Merdivende daha Yüksek bir konuma sahip olmanız en tepedeki insanlara daha yakın olduğunuz, daha aşağıda olmanız ise en alttaki insanlara daha yakın olduğunuz anlamına gelmektedir.



5- Kendinizi ne kadar dindar tanımlıyorsunuz?

Hiç dindar değil Çok Dindar
1 2 3 4 5 6 7

6- Kendinizi ne kadar solcu ya da sağcı tanımlıyorsunuz?

Sol Sağ
1 2 3 4 5 6 7

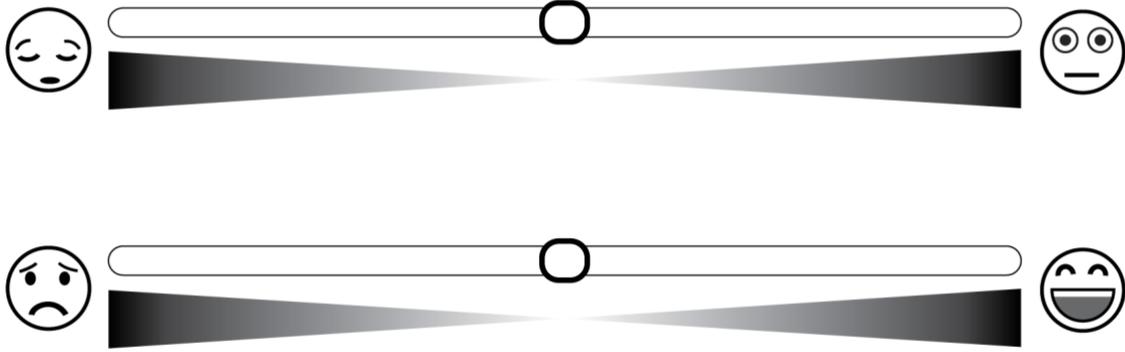
Appendix I: Affective Slider

Move the slider to rate your level of Arousal

Dikkat derecenizi lütfen aşağıdaki skala üzerinde belirtiniz.

Move the slider to rate your level of Pleasure

Memnuniyet derecenizi lütfen aşağıdaki skala üzerinde belirtiniz.



Appendix J: ANNOUNCEMENT

Bu araştırma Orta Doğu Teknik Üniversitesi'nden Doç. Dr. Barbaros Yet ve Kadir Has Üniversitesi'nden Doç. Dr. Onurcan Yılmaz'ın danışmanlığında, Yüksek Lisans öğrencisi Dođukan Demirciođlu'nun tezi kapsamında gerekleřtirilmektedir. Arařtırmanın amacı maddi yokluk hissinin ekonomik davranıř üzerindeki etkilerinin incelenmesidir.

Arařtırmaya katılım tamamen gönüllülük esasına dayalıdır. Size sunulan ankette kiřisel kimliđinizi belirleyebilecek herhangi bir soru bulunmamaktadır. Sorulara vereceđiniz yanıtlar anonim olarak tutulacak ve yalnızca bilimsel arařtırmalar için kullanılacaktır. Ankette size rahatsızlık verebilecek herhangi bir soru bulunmamaktadır. Fakat yine de herhangi bir nedenle devam etmek istemezseniz alıřmayı dilediđiniz ařamada yarıda bırakabilirsiniz.

Arařtırma yaklaşık 15 dakika sürmektedir. Katılımcılar arasından ekiliřle belirlenecek 5 farklı kiřiye 75 TL deđerinde Migros Hediye eki verilecektir. Buna ek olarak, arařtırma ierisindeki eřitli sorularda yer alan altı izili yönergelere uyarak alıřmayı tamamlayan 10 farklı kiřiye ekiliřle 100 TL'ye kadar ikinci bir Migros Hediye eki eki daha verilecektir.

Arařtırmaya katıldıđınız için řimdiden teřekkür ederiz. **Merak ettiđiniz sorular** olması durumunda daha detaylı bilgi edinmek için Dođukan Demirciođlu ile **dogukandmrcgl@gmail.com** adresinden iletiřime geebilirsiniz.

Arařtırmaya katılmak istiyorsanız lütfen ařađıdaki "Kabul ediyorum" seeneđini tıklayınız ve bir sonraki sayfaya geiniz. "Kabul ediyorum" seeneđini tıklayarak bu onam formunu okuduđunuzu, anladıđınızı ve arařtırmaya katılmayı kabul ettiđinizi belirtmiř olacaksınız.