Individual Rationality under Cognitive Limitations: The Effect of Sequential Elimination

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Abstract

I study individual consistency with preference maximization by examining two choice procedures: namely, the direct procedure, where people choose directly from the menu, and the sequential elimination procedure, where they sequentially eliminate alternatives until only one survives. I first show formally that, in a limited attention framework, the choices made by a decision maker who considers at least two available alternatives under sequential elimination are consistent with preference maximization, whereas this is not necessarily the case under the direct procedure. To test empirically whether sequential elimination facilitates consistency, I implement an experiment in which subjects are randomly assigned to a risky decision-making task involving one of the two procedures. I find evidence that sequential elimination leads to an economically meaningful improvement in individual consistency, especially for subjects with low cognitive ability. Next, I investigate the determinants of individual preference for sequential elimination and the impact of sequential elimination on risk preferences. Finally, I discuss the policy implications of the results.

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Keywords: revealed preference, economic rationality, choice procedures, sequential elimination, experiment.

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1 Introduction

Traditional economics stems from the premise that individuals act to maximize a rational preference relation. However, revealed preference analysis provides overwhelming evidence that individual choices are inconsistent with preference maximization (e.g., Choi et al., 2014; Carvalho, Meier and Wang, 2016). Behavioral economics has put forward cognitive limitations as an underlying factor in reconciling individual inconsistency with rational preference relations (e.g., Simon, 1957). In other words, people may suffer from inconsistent choices that are caused by cognitive limitations; this is a crucial issue that deserves attention from economists and policymakers. Strikingly, despite the wealth of research on individual inconsistency, few studies have sought to improve individual consistency under cognitive limitations.

This paper provides the first study on whether a simple *choice procedure* can improve individual consistency under cognitive limitations. To this end, I focus on a key consequence of cognitive limitations, *limited attention*, which implies that people may only consider a limited set of available alternatives (Eliaz and Spiegler, 2011; Masatlioglu, Nakajima and Ozbay, 2012; Dean, Kıbrıs and Masatlioglu, 2017; Lleras et al., 2017).[1] Following this strand of literature, I study a decision maker (DM) with a rational preference relation and limited attention. Importantly, I assume the minimum property of limited attention that the DM considers at least two alternatives when faced with a menu of multiple alternatives, based on the converging evidence from experiments (Krajbich and Rangel, 2011; Reutskaja et al., 2011) and the field (Honka, Hortaçsu and Vitorino, 2017; Barseghyan, Molinari and Thirkettle, 2021).

Since Simon (1955), the notion of choice procedures has been acknowledged for its fundamental role in shaping choice behavior (Simon, 1976; Salant, 2011). Drawing on this notion, I develop a formal framework of limited attention to examine the DM's choice consistency under two choice procedures. One is the *direct procedure*, where the DM chooses directly from the menu. Limited attention may cause choice inconsistency in this procedure due to the DM overlooking the best alternatives on the menu. This leads me to investigate *sequential elimination*, in which the DM eliminates alternatives sequentially until only one survives. It has been extensively studied in marketing, psychology—and more recently,—economics (e.g., Tversky, 1972; Masatlioglu and Nakajima, 2007; Manzini and Mariotti, 2007). Specifically, the investigation is motivated by incorporating two strands of empirical evidence: first, sequential decision-making can reduce choice overload (Besedeš et al., 2015); second, elimination-based decision-making can lead to more alternatives being considered (e.g., Sokolova and Krishna, 2016). Building on the established evidence, this paper presents the first research on the role of sequential elimination in improving individual consistency in a revealed preference setting.

[1] See also stochastic choice models of limited attention, e.g., Manzini and Mariotti (2014), Brady and Rehbeck (2016), Caplin, Dean and Leahy (2019), Cattaneo et al. (2020), and Dardanoni et al. (2020).

I show that the DM makes choices consistent with preference maximization under sequential elimination. An intuitive explanation for this result is that one of the best alternatives in a menu survives in every elimination, either by not being considered or by beating the other alternatives in the set of considered alternatives. In effect, sequential elimination decomposes a potentially complex (preference) maximization problem into an equivalent sequence of elimination subproblems, each of which is manageable to solve. Based on these results, I formulate the main hypothesis in this paper, which is that individuals make choices with a higher level of consistency under sequential elimination than under the direct procedure. One implication of limited attention is that it tends to occur among individuals with low cognitive ability. Hence, to add further validity to the framework, I put forward another key hypothesis—namely, that sequential elimination improves the consistency of individuals with low cognitive ability.

To test the hypotheses, I implement an experiment involving risky decision problems, each representing a list of portfolio options from a unique budget line. Each option rewards one of two amounts of money with equal probability. In the experiment, subjects are randomly assigned to one of the three choice procedure treatments: (1) *Direct Procedure*; (2) *Sequential Elimination*; and (3) *Free Procedure*, where subjects are allowed to select one of the first two procedures.[2] Cognitive ability is expressed as IQ scores obtained from the International Cognitive Ability Resource (ICAR) test (Condon and Revelle, 2014). Consistency is measured by the number of Generalized Axiom of Revealed Preference (GARP) violations; GARP is a necessary and sufficient condition for choices to be consistent with preference maximization (Afriat, 1967; Varian, 1982, 1983).[3] More GARP violations indicate a lower level of consistency. Accordingly, I test the hypotheses by examining the difference in GARP violations between the first two treatments. To further shed light on sequential elimination's impact on economic rationality, I also investigate their difference in first-order stochastic dominance (FOSD) violations. FOSD violations, while not implying GARP violations, are typically regarded as mistakes. GARP is the minimal criterion for economic rationality, and FOSD complements GARP in decision-making under risk. Lastly, the Free Procedure helps provide insights into individual preference for sequential elimination.

The main experimental results show that Sequential Elimination reduces GARP violations by almost 76% (with statistical significance approaching conventional levels) and FOSD violations by almost 63% (with statistical significance) compared to the Direct Procedure. Furthermore, I find that Sequential Elimination leads to a statistically significant and economically substantial (over 94%) reduction in the number of GARP violations by low-IQ subjects (i.e., those with below-or-equal-to-median IQ scores) compared to the Direct Procedure. There is no evidence

[2]Henceforth, where initially capitalized, the terms Sequential Elimination and Direct Procedure refer to the respective treatments in the experiment; otherwise, they refer to their respective general meanings.

[3]Section 3.1 discusses other consistency measures. See also Apesteguia and Ballester (2015) and Halevy, Persitz and Zrill (2018) for detailed discussion of consistency measures.

that Sequential Elimination affects the consistency of high-IQ subjects (i.e., those with above-median IQ scores). Nevertheless, the reduction in the number of FOSD violations committed by high-IQ subjects under Sequential Elimination relative to the Direct Procedure (almost 97%) is statistically significant. Most importantly, these results provide causal evidence supporting the hypotheses, thereby narrowing the gap in the literature on improving economic rationality.

I present three other experimental results that contribute to the literature on choice procedures. First, in the Free Procedure, subjects with lower cognitive ability are more likely to select Sequential Elimination than those with higher cognitive ability. This provides empirical evidence for the role of cognitive ability in determining individual preference for choice procedures in the context of decision-making under risk. Second, the experiment explores another choice procedure, choice revision, which has been shown to reduce choice inconsistency with a few normative axioms (e.g., FOSD), but not including GARP (MacCrimmon, 1968; Gaudeul and Crosetto, 2019; Benjamin, Fontana and Kimball, 2020; Breig and Feldman, 2020; Nielsen and Rehbeck, 2020). I find evidence that choice revision corresponds to fewer FOSD violations but not to fewer GARP violations, thus adding to the literature that examines choice revision. Third, the experiment reflects an overall negative relationship between cognitive ability and risk aversion, in line with the main findings of prior studies (Burks et al., 2009; Dohmen et al., 2010; Benjamin, Brown and Shapiro, 2013; Falk et al., 2018). Further analysis indicates that this relationship is significant under Sequential Elimination but not under the Direct Procedure. This result connects the literatures on choice procedures and risk preferences by suggesting the role of choice procedures in revealing risk preferences.

This paper gives rise to important policy implications. In particular, sequential elimination may boost individuals' economic rationality by mitigating the impact of limited attention. Arguably, this procedure is easy and low-cost to implement in a variety of real-world decision problems, e.g., bank loans or health insurance choices involving meaningful consequences. Moreover, it can be implemented with a reasonably high degree of flexibility. My analysis suggests that individuals with low cognitive ability tend to use sequential elimination when available. Thus, policymakers can offer sequential elimination as an optional procedure and support individuals in using their preferred procedures. Finally, and taken together, the present findings highlight the importance of choice procedures in welfare policies.

1.1 Related Literature

This paper contributes to the literature on limited attention (Eliaz and Spiegler, 2011; Masatlioglu, Nakajima and Ozbay, 2012; Dean, Kıbrıs and Masatlioglu, 2017; Lleras et al., 2017), which postulates that the DM directly chooses from a limited set of alternatives on a menu, known as the *consideration set*. Dardanoni et al. (2020) explicitly model consideration set sizes as a result of cognitive heterogeneity in a stochastic choice framework. I build on this literature by proposing the minimum property of limited attention, which finds firm support in evidence from economics and the cognitive sciences. For example, eye-tracking studies find that subjects attend to at least two alternatives most of the time (Krajbich and Rangel, 2011; Reutskaja et al., 2011). Field data also suggest that most individuals form consideration sets containing at least two alternatives (Honka, Hortaçsu and Vitorino, 2017; Barseghyan, Molinari and Thirkettle, 2021). Notably, Cowan (2001), drawing on a survey of studies from the cognitive sciences, suggests that the attention span of normal adult humans stretches beyond the processing of two alternatives. By exploiting the minimum property, I open up the possibility of improving rationality through a particular choice procedure, i.e., sequential elimination.

Sequential elimination originates from the marketing and psychology literatures, where it is postulated that individuals use it to simplify decision problems involving criteria, e.g., certain aspects of the alternatives (Tversky, 1972) or environmental cues (Gigerenzer and Todd, 1999; Todd and Gigerenzer, 2000). Recently, it has received growing attention in economics. Masatlioglu and Nakajima (2007) propose a model of choice by elimination where the DM eliminates all alternatives that are dominated by some other alternatives in the menu. Inconsistency may arise in this model when the DM chooses every alternative that is not comparable to any of the others on the menu. Further studies postulate that the DM may eliminate alternatives sequentially based on multiple acyclic relations (Manzini and Mariotti, 2007), a checklist of desirable properties (Mandler, Manzini and Mariotti, 2012), or a particular order of binary comparisons (Apesteguia and Ballester, 2013). A common implication of the existing models is that inconsistency originates from the assumption that individuals do not inherently possess one well-behaved preference relation. In contrast and importantly, this paper's central implication is that preference maximization is hindered by cognitive constraints, which can be alleviated by choice procedures.

Several experimental studies provide evidence that sheds light on the potential improvement by sequential elimination on decision-making. For example, Besedeš et al. (2015) show the impact of sequential decision-making in reducing choice overload. Specifically, they study a choice procedure known as the "sequential tournament", where subjects make choices from several rounds of smaller menus randomly separated from a larger one. The cited authors find that subjects are more likely to choose the option with the highest payment likelihood in the sequential tournament than when faced with many at once. Marketing and psychology studies consistently find that subjects consider more options when asked to eliminate than to choose in judgement tasks (Huber, Neale and Northcraft, 1987; Yaniv and Schul, 1997, 2000; Sokolova and Krishna, 2016). In addition, Sokolova and Krishna (2016) suggest that elimination can reduce the emergence of framing effects. The general idea of sequential elimination is widely recommended in practice, e.g., career decisions (Gati, Fassa and Houminer, 1995), managerial decision making (Stroh et al., 2003), patient counseling (Zikmund-Fisher, Angott and Ubel, 2011), and criminal identification (Pica and Pozzulo, 2017). The present paper contributes to this strand of literature by examining the effect of sequential elimination on economic rationality.

This paper is also part of the literature strand that investigates the determinants of economic rationality. For example, Harbaugh, Krause and Berry (2001) find that senior students are more consistent than junior students. List and Millimet (2008) find that individual consistency is facilitated by market experience. Burks et al. (2009) show a positive association between cognitive skills and consistency. Abaluck and Gruber (2011) find that elders tend to make inconsistent choices in the Medicare Part D program; moreover, if they had made consistent choices, they might have achieved a markedly higher level of welfare (about 27%). Choi et al. (2014) find that female, low-income, low-education, and older households have, on average, lower levels of economic rationality in a representative sample of over 2000 Dutch households. Dean and Martin (2016) find that households of retirement age are more consistent than younger households, using scanner data on a large set of representative households in Denver. However, Echenique, Imai and Saito (2021) find that younger people (i.e., aged 16-34) comply with rationality more than older people (i.e., aged 65+) based on the datasets from Choi et al. (2014), Carvalho, Meier and Wang (2016), and Carvalho and Silverman (2019). Kim et al. (2018) exploit a randomized controlled field experiment involving the introduction of an education program for female students in a Malawian secondary school. They find causal evidence of education's impact on improving economic rationality, which operates partially through enhancing cognitive ability. Banks, Carvalho and Perez-Arce (2019), on the other hand, find no evidence of education effects in a sample of people who have been affected by a policy on compulsory schooling in England. Despite growing interest in the literature, little is known about the effects of choice procedures on individual consistency. I fill this gap in the literature by proposing a simple theoretical framework, and, most importantly, by providing causal evidence from a randomized controlled experiment.

The rest of the paper proceeds as follows. Section 2 presents the framework with which I derive the hypothesis. Section 3 describes the details of the experimental design. Section 4 provides the experimental results. Finally, Section 5 discusses the implications of the results and concludes.

2 Framework

Let $x \in \mathbb{R}^k_+$ be an alternative representing a bundle of k goods. Consider a finite data set $D = \{c^i, M^i\}_{i=1}^n$, where M^i is a finite menu of distinct alternatives and a DM chooses c^i from M^i. Let $X = \cup_{i=1}^n M^i$ be the set of all available alternatives and $\mathcal{X}$ be the set of all nonempty subsets of X. Let $\succeq$ be a complete, transitive, and monotone preference relation over X.[4]

[4] A preference relation $\succeq$ is monotone if $x \geq y$ implies $x \succeq y$ and $x > y$ implies $x \succeq y$ but not $y \succeq x$.

In this paper, I assume that when faced with a menu M, the DM pays attention to a limited set of alternatives on the menu, $\gamma(M)$, known as the consideration set. Importantly, the DM's limited attention satisfies the *minimum property*, i.e., he pays attention to at least two alternatives when M comprises multiple alternatives. Formally, a *consideration set mapping* γ assigns to every $M \in \mathcal{X}$ a subset of M such that $|\gamma(M)| \geq \min\{|M|, 2\}$. A consideration set mapping is said to be a *full consideration* if for all $M \in \mathcal{X}$, $\gamma(M) = M$.

2.1 The Direct Procedure

I propose that under the direct procedure, the DM chooses an alternative that is preferred to all the others in his consideration set within a menu. The following definition is adapted from Masatlioglu, Nakajima and Ozbay (2012).

Definition 1. The data set $D = \{c^i, M^i\}_{i=1}^n$ is generated by the direct procedure if there exist a preference relation $\succeq$ and a consideration set mapping γ such that for all i, $c^i \in \{x \in \gamma(M^i) | x \succeq y \; \forall y \in \gamma(M^i)\}$. Further, D is generated by the direct procedure with full consideration if γ is a full consideration.

I examine choice consistency by GARP, a necessary and sufficient condition for a data set D to be rationalized by a preference relation. The number of GARP violations gives an exact measure of the deviation of the DM's choices from preference maximization. More GARP violations indicate a lower level of consistency with preference maximization. I formally introduce GARP in the present setting by adapting Cosaert and Demuynck (n.d.)'s axiom of revealed preference for finite choice sets. For any pair of choices c^i and c^j, I denote that $c^i R^* c^j$ if there exists $x \in M^i$ such that $x \geq c^j$. In words, for any pair of choices, the first is revealed preferred to the second if the first menu contains an alternative that is weakly greater than the second choice. I also denote that $c^i R c^j$ if there exists some sequence $i, h, g, ..., m, j$ such that $c^i R^* c^h, c^h R^* c^g, ..., c^m R^* c^j$. That is, R is the transitive closure of R^*.

Definition 2 (GARP)**.** The data set $D = \{c^i, M^i\}_{i=1}^n$ satisfies the *Generalized Axiom of Revealed Preference* if for any pair of choices c^i and c^j, $c^i R c^j$ implies there exists no $x \in M^j$ such that $x > c^i$.

Unless the DM considers every available alternative under the direct procedure, his choices do not necessarily satisfy GARP, as the following example shows. Consider two menus, $M^1 = \{x, y, z\}$ and $M^2 = \{u, v, w\}$ with $z > u$ and $w > x$. Suppose that the DM's preferences are described by $z \succeq w \succeq x \succeq u \succeq v \succeq y$ and his consideration sets are $\gamma(M^1) = \{x, y\}$ and $\gamma(M^2) = \{u, v\}$. Consequently, the DM's choices from M^1 and M^2 under the direct procedure are $c^1 = x$ and $c^2 = u$. We have that $c^1 R c^2$ but there exists $w \in M^2$ such that $w > c^1$, violating GARP.

How may GARP violations depend on the size of consideration sets under the direct procedure? Consider a different case where the DM has full consideration. In this case, his choices under the direct procedure are $\tilde{c}^1 = z$ and $\tilde{c}^2 = w$, satisfying GARP. The DM pays attention to more alternatives as compared to the previous case. Intuitively, the number of GARP violations (weakly) decreases in the expansion of consideration sets, because the DM would not make worse choices by attending to additional alternatives. In fact, it is equivalent for a data set to be generated by the direct procedure with full consideration and to be rationalized by standard preference maximization.

The following remark summarizes the above discussion, which will be useful later for the formulation of the hypothesis.

Remark 1. *Let $D = \{c^i, M^i\}_{i=1}^n$ and $\tilde{D} = \{\tilde{c}^i, M^i\}_{i=1}^n$ be two data sets, the following statements are true:*

(i) D does not necessarily satisfy GARP if D is generated by the direct procedure.

(ii) The number of GARP violations in D is weakly greater than that in $\tilde{D}$ if D ($\tilde{D}$, respectively) is generated by the direct procedure with a preference relation $\succeq$ and a consideration set mapping γ ($\tilde{\gamma}$, respectively) such that $\tilde{\gamma}(M^i) \supseteq \gamma(M^i)$ for all i.

(iii) D satisfies GARP if D is generated by the direct procedure with full consideration.

2.2 Sequential Elimination

Remark 1 implies that the DM may miss the best alternatives under the direct procedure by not giving the menu full consideration. This paper's proposal for addressing this problem is to study sequential elimination, in which the DM eliminates alternatives sequentially until only one survives, i.e., the choice.

To illustrate sequential elimination, consider again that the DM is confronted with M^1. Under this procedure, he goes through two rounds of elimination to select a alternative from M^1. In the first round, he eliminates $e_1^1 = y$, leaving the menu to be $M^1 \backslash \{y\} = \{x, z\}$. In the second round, the DM confronts $\{x, z\}$ as a "new" menu, from which he eliminates $e_2^1 = x$, leaving the menu to be $M^1 \backslash \{y, x\} = \{z\}$ representing his choice under sequential elimination.

Formally, $E = \{e^i, M^i\}_{i=1}^n$ is an *elimination* data set, where e^i is a sequence of alternatives $e^i = (e_1^i, ..., e_{|M^i|}^i) \in \prod_{r=1}^{|M^i|} \mathbb{R}_+^k$ such that $\bigcup_{r=1}^{|M^i|} \{e_r^i\} = M^i$. The sequence e^i fully describes an elimination behavior of the DM with the interpretation that when confronted with a non-singleton menu M^i, he eliminates $e_1^i, ..., e_{|M^i|-1}^i$ sequentially, and finally chooses $e_{|M^i|}^i$ from M^i. For all i and $r = 1, .., |M^i|$, let E_r^i denote the remaining menu before the jth round of elimination by $E_r^i = \bigcup_{s=r}^{|M^i|} \{e_s^i\}$. I propose the following model of sequential elimination with limited attention.

Definition 3. The data set $D = \{c^i, M^i\}_{i=1}^n$ is generated by sequential elimination if there exist a preference relation $\succeq$, a consideration set mapping γ, and an elimination data set $E = \{e^i, M^i\}_{i=1}^n$ such that for all i and $r = 1, ..., |M^i|$,

(i) $e^i_r \in \gamma(E^i_r)$.

(ii) $\{x \in \gamma(E^i_r) | x \succeq e^i_r, x \neq e^i_r\} \neq \emptyset$ if $|E^i_r| \geq 2$.

(iii) $c^i = e^i_{|M^i|}$.

Definition 3 (i) and (ii) state that the DM eliminates an alternative from the consideration set if he prefers another alternative in this set. In other words, despite limited attention, the DM compares at least two alternatives according to his preferences in every elimination. The last condition relates an elimination data set to a choice data set by imposing the final remaining alternative to be the choice.

The following proposition formally establishes the consistency of the choice behavior under sequential elimination. All proofs are in Appendix A.

Proposition 1. *Let D be a data set. D satisfies GARP if and only if D is generated by sequential elimination.*

Proposition 1 shows that the DM always makes choices consistent with preference maximization under sequential elimination. Thanks to the minimum property, one of the best alternatives survives in every elimination, according to one or other of the following two cases. One is that the DM does not consider this alternative, which remains on the menu. The other is that he considers this alternative, which beats all the others in the consideration set. Instead of confronting a taxing problem, the DM sequentially solves an equivalent sequence of elimination subproblems, each of which requires arguably lower cognitive costs.

Note that Remark 1 and Proposition 1 imply that it is impossible to distinguish whether a data set is generated by the direct procedure with full consideration or by sequential elimination with the same preference relation. This poses no problem here, given that this paper focuses precisely on individuals whose choices violate GARP under the direct procedure.

2.3 Testable Implications

In light of Remark 1 and Proposition 1, a preference maximizer with limited attention satisfying the minimum property would make consistent choices under sequential elimination but would not necessarily do so under the direct procedure, unless applying full consideration. I take the premise that a sufficiently large portion of the population can be described as preference maximizers with limited attention satisfying the minimum property. Although the proportion of the population applying full consideration is unclear, it may, to some degree, be inferred by taking into account cognitive ability. An individual's cognitive capacity (i.e., his total endowment of usable mental resources) could limit his attention to the alternatives (Kahneman, 1973). Thus, I argue that individuals with low cognitive ability may attend to fewer alternatives than those with high cognitive ability.

Taking these factors together, I reason that the population may behave in accordance with the implication of Remark 1 and Proposition 1, and more so in the case of those with low cognitive ability. In other words, I expect the following hypotheses to be true:

Hypothesis 1. *Individuals make choices with a higher level of consistency (i.e., fewer GARP violations) under sequential elimination than under the direct procedure.*

Hypothesis 2. *Individuals with low cognitive ability make choices with a higher level of consistency (i.e., fewer GARP violations) under sequential elimination than under the direct procedure.*

There exist two possibilities such that the hypotheses might not be true in a given sample. The first possibility is that the sample contains a sufficient number of individuals with a high enough level of cognitive ability to apply full consideration. As a result, these individuals may make consistent choices irrespective of the choice procedure, and the sequential elimination effect may not be significant. This possibility can be verified by observing that individual choices are highly consistent overall, particularly for those members of the sample with high cognitive ability. The second possibility is that a large fraction of the sample consists of individuals who are intrinsically inconsistent (e.g., Gilboa and Schmeidler, 1989; Ok, 2002; Gilboa et al., 2010). In this case, I expect to observe a low level of consistency in individual choices under both choice procedures.

3 Experimental Design

Figure 1 presents a global view of the experimental design. After starting the experiment, subjects are randomly assigned to one of the three treatments, Direct Procedure, Sequential Elimination, or Free Procedure. Subjects are first asked to make economic decisions under their assigned choice procedures. They are then asked to complete cognitive ability tests. Finally, they are requested to complete a survey on additional information, including individual attitudes towards consistency and demographics. The details of the experimental design are discussed below.

3.1 Main Design

3.1.1 Measuring Consistency

Individual choice consistency with preference maximization is measured based on twenty risky decision problems adapted from Kim et al. (2018). Each decision problem comprises eleven randomly ordered *options* from a budget line with a unique price and endowment combination.

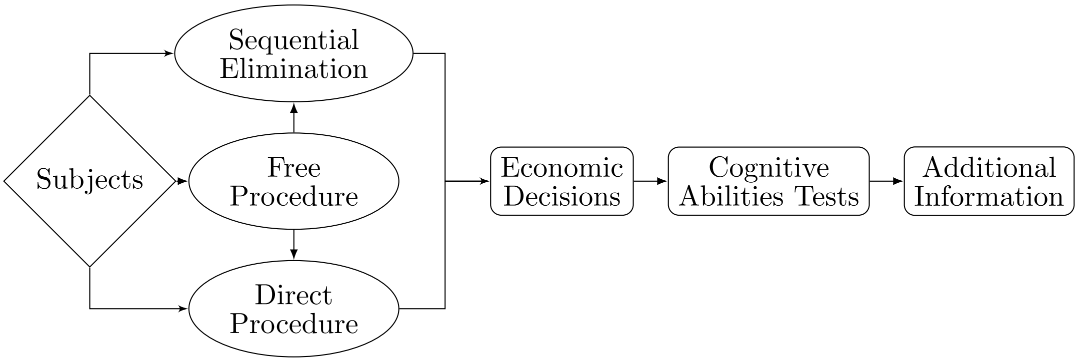


FIGURE 1. A GLOBAL VIEW OF THE EXPERIMENT

An *option* (x_1, x_2) rewards x_1 or x_2 tokens with equal probability. There is also one decision problem to check comprehension.[5] In addition, there is a choice revision design, the motivation and the details of which will be explained shortly in Section 3.2.1.

Consistency is measured as the number of GARP violations in choices.[6] GARP is the minimal criterion for economic rationality. The number of GARP violations indicates the degree to which choices can be rationalized by a preference relation, which does not need to be objectively optimal. As a complement to GARP violations, the number of first-order stochastic dominance (FOSD) violations in choices is also computed.[7] FOSD is proposed in decision theory as a fundamental criterion for rationality in decision-making under risk (Quiggin, 1990; Wakker, 1993) and has been widely applied in experiments as a measure of decision-making quality (Choi et al., 2014; Carvalho, Meier and Wang, 2016; Kim et al., 2018; Banks, Carvalho and Perez-Arce, 2019). By committing a FOSD violation, subjects forgo an option that yields better outcomes than their choices, with no additional risk. That is, a larger number of FOSD violations signals a lower level of economic rationality.

In robustness checks, consistency is additionally measured by the number of strong axiom of revealed preference (SARP) violations (Rose, 1958), the Houtman–Maks (HM) index (Houtman and Maks, 1985), and the critical cost efficiency index (CCEI, Afriat, 1972), as proposed by the literature. SARP differs from GARP by excluding indifference between alternatives in the preferences. The HM index finds the minimal removal of the observations such that the rest are consistent. The CCEI considers the minimal wealth change such that choices are consistent.[8] Similarly, more SARP violations, a higher HM index, or a higher CCEI indicate a lower level of consistency.

[5] The comprehension check problem comprises nine options: (11, 11), (22, 22), (33, 33), (44, 44), (55, 55), (66, 66), (77, 77), (88, 88), (99, 99). Subjects are identified as having failed the comprehension check if they did not choose (99, 99).

[6] See Appendix B for a graphical illustration of a GARP violation in this setting.

[7] FOSD violations are computed by assuming a symmetric preference for the two values of options. To be specific, subjects commit a FOSD violation if they choose an option (x_1, x_2) when there exists another option (y_1, y_2) in the same problem such that $y_2 > x_1$ and $y_1 > x_2$.

[8] CCEI assumes that choices are made from linear budget sets. It is not sensitive to the total number of GARP violations, which is the paper's main interest.

3.1.2 Experimental Treatments

In every decision problem, the left-hand side of the screen shows a vertical list of options, labeled "Options". Under the Direct Procedure, subjects are asked to click on their selected options sequentially and place them in a box labeled "Choice List" which appears on the right-hand side of the screen.[9] They are not allowed to move any option from the Choice List back to the Options list. Subjects are asked to choose an option from the Choice List box once it contains all their options. Under Sequential Elimination, subjects are asked to eliminate options sequentially and put them into a box labeled "Trash" on the right-hand side of the screen. Subjects can move any option from the Trash box back to the Options list by clicking on it. Subjects are asked to choose one option by leaving it as the only remaining option on the Options list. These designs minimize the differences in presentation and numbers of clicks between the Direct Procedure and Sequential Elimination. Thus, the difference in choice behavior between the two treatments enables precise testing of the hypothesis. In the Free Procedure, subjects are asked to select either one of the Direct Procedure and Sequential Elimination as their choice procedures. The Free Procedure treatment enables the investigation of individual preference for sequential elimination. Is there any demographic factor that might affect procedure preferences? More importantly, are those with lower cognitive ability—who are arguably prone to limited attention— more likely to adopt sequential elimination than those with a higher level?

3.1.3 Measuring Cognitive Ability

Cognitive ability is expressed as IQ scores derived from the ICAR test. Specifically, subjects are required to complete five matrix reasoning and five three-dimensional rotation questions, both of which are considered the primary measure of problem-solving and reasoning abilities (Nisbett et al., 2012). The number of correct answers (i.e., an integer between 0 and 10) provides the test score. The experiment also includes tests of selective attention and working memory capacity, which are related to the notion of limited attention.[10] Selective attention is measured by the Stroop test (Stroop, 1935), where subjects are presented with a word, say, GREEN, printed in the same or a different color, say, red, and asked to name the colors in which the words are printed. Working memory capacity is measured by the Sternberg test (Sternberg, 1966), where subjects see a sequence of numbers presented singly and are asked to remember them. After a

[9] See Appendix B for screenshots of all treatments and other designs of the experiment. Under the Direct Procedure, subjects are instructed to "examine" them by clicking on them. Under each treatment, subjects are given a trial problem; specifically, Free Procedure subjects are given a trial problem with the two procedures randomly ordered.

[10] See Appendix B for the details of the cognitive ability tests. The tests are implemented via the platform of Henninger et al. (2022). Selective attention refers to the differential processing of simultaneous information sources (Johnston and Dark, 1986). Working memory capacity refers to the capacity for "temporary storage and manipulation of the information" (Baddeley, 1992). Oberauer (2019) reviews the close relationship between working memory and attention.

few numbers have been shown, there is a brief pause, and a test number appears. Subjects are asked to answer whether the test number was included in the sequence previously shown. At the end of a trial, subjects are asked to recall the entire sequence of numbers previously shown.

3.2 Other Details of the Experimental Design

3.2.1 Choice Revision

It is important to know whether sequential elimination is more effective than other procedures. There is an emerging literature on the choice revision procedure, i.e., the procedure gives individuals a chance to revise choices (Gaudeul and Crosetto, 2019; Benjamin, Fontana and Kimball, 2020; Breig and Feldman, 2020; Nielsen and Rehbeck, 2020). They document cases of individual choices being revised to comply with axioms of normative decision theory, e.g., FOSD, but not with GARP. Based on this evidence, it is possible that people reduce their GARP violations by revising their choices, although the possibility appears to be unexplored. The present experiment includes a choice revision design with a view to exploring this hypothesis. More importantly, the comparison between the effects of choice revision and sequential elimination may aid interpretation of the latter.

Specifically, subjects are asked to make decisions for two identical blocks of decision problems, Blocks A and B, each containing the set of decision problems described in Section 3.1.1. Subjects are not informed of the identical nature of the two blocks until they enter Block B. The decision problems are ordered randomly within each block and independently between them. In a Block B problem, subjects may either alter the choice they made in the respective problem in Block A by clicking on a different option or keep their Block A choice by clicking on a button.[11] Subjects are informed that they will have to choose one block for payment (referred to as the *payment block*), from which one decision problem is randomly drawn for the payoff.[12] Thus, the two blocks are equally incentive-compatible. Subjects are labeled as having revised their choices if they alter their choices from Block A to Block B, and then choose Block B for payment.

3.2.2 Attitude towards Consistency

The literature points out that, in some individuals, inconsistency of choices is deliberate (e.g., Kahneman, 2003; DellaVigna, 2009). Consequently, this study accounts for the possible impact of individual attitudes towards consistency on choice consistency. Subjects are presented

[11]The literature has employed different choice revision designs. The one used in this study is similar to that used in Gaudeul and Crosetto (2019) and Yu, Zhang and Zuo (2021), where subjects are asked whether they want to revise their choices without further instructions. This design is, furthermore, comparable to sequential elimination in that it too is without normative axioms.

[12]Evidence from Agranov and Ortoleva (2017) suggests that individuals may deliberately make different choices when faced with repetitive problems. Requiring subjects to choose the payment block avoids this issue, as each problem is unique to subjects in terms of providing incentives.

with a scenario which includes the presence of the attraction effect (Huber, Payne and Puto, 1982); a common behavioral phenomenon which violates consistency with preference maximization (Tversky and Simonson, 1993). Subjects are asked to rate how at ease they are with the scenario on a scale of 0 (least at ease) to 10 (most at ease). This rating provides an indicator of individual attitudes towards consistency, i.e., the higher the rating, the less negative the attitude towards inconsistency.

3.3 Experimental Procedure

Subjects were recruited from the Prolific survey pool and the experiment was conducted online between May 31, 2020, and June 1, 2020, using the Qualtrics survey platform. They could withdraw from the experiment at any time with no need for justification. Their earned tokens were converted to money after the experiment. Each subject received £3 as a participation fee for completing the experiment. There was an additional payment of up to £14.6 depending on the economic decisions and the performance in cognitive ability tests. Subjects received their payoffs three days after the experiment via Prolific. The average completion time for the experiment was 42 minutes, and the average payout was £8.14.

The main analysis is based on a sample of 223 subjects (50.2% female) and 73-75 observations per treatment.[13] The sample subjects are plausibly younger and more educated than the population on average. The mean age is approximately 24, and 75% of the subjects are aged between 18 and 25. All subjects have completed at least secondary education. Specifically, 57% of the subjects are currently in undergraduate education, and 39% have completed at least undergraduate education. By design, demographics and cognitive ability are balanced across the Direct Procedure and Sequential Elimination. To examine the hypotheses, subjects are categorized into two groups based on cognitive ability: (1) low-IQ subjects, whose IQ scores are lower than or equal to the sample median; (2) high-IQ subjects, whose IQ scores are higher than the sample median.[14] Table 1 presents the breakdown of subjects by treatment and IQ. In the Free procedure, 32 (82%) of the low-IQ subjects and 17 (47.2%) of the high-IQ subjects choose Sequential Elimination.

[13] 253 (53.1% female) subjects were recruited. All subjects speak English as their first language and could complete the experiment only once. 30 subjects who failed the first block's comprehension check were filtered out. Appendix C gives the histograms of demographics and cognitive ability for the study sample and per treatment.

[14] The sample median IQ score is 4, the mean is about 4.74, and the standard deviation is about 2.47. In the sample, the IQ scores range from 0 to 10, with 3 and 6 being the first and third quantiles, respectively. Note that low-IQ (high-IQ, respectively) subjects identically match those with IQ scores lower than (higher than, respectively) the sample mean IQ score.

TABLE 1. BREAKDOWN OF OBSERVATIONS

Treatment / IQ Group	Direct Procedure	Sequential Elimination	Free Procedure
Low-IQ Subjects	34 (45.3%)	40 (54.8%)	39 (52%)
High-IQ Subjects	41 (54.7%)	33 (45.2%)	36 (48%)
Total	75 (100%)	73 (100%)	75 (100%)

4 Experimental Results

4.1 Main Results

This section examines the hypotheses by analyzing the observed differences between the Direct Procedure and Sequential Elimination. I present descriptive statistics and perform regression analysis to test for treatment effects. The negative binomial regression is used to estimate the sequential elimination effect on GARP and FOSD violations because of their count data nature (Cameron and Trivedi, 2013).[15]

I start by discussing the evidence for Hypothesis 1. Figure 2(a) shows that the average numbers of GARP violations under Sequential Elimination and the Direct Procedure are roughly 4.3 and 5.9, respectively. This indicates that Sequential Elimination leads to a reduction of about 27% in the number of GARP violations on average when compared with the Direct Procedure, in line with Hypothesis 1. In addition, Figure 3(a) depicts that the empirical cumulative distribution function (eCDF) of GARP violations under the Direct Procedure almost (first-order) stochastically dominates that under Sequential Elimination, except on the extreme right tails of the distributions. That is, subjects are likelier to commit more GARP violations under the Direct Procedure than under Sequential Elimination.

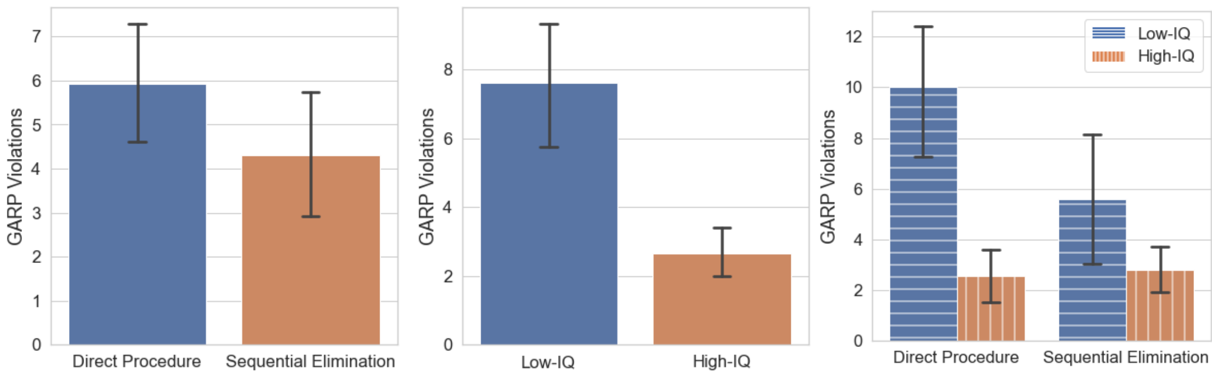
Table 2 presents the estimation results.[16] Column (1) indicates that Sequential Elimination reduces the number of GARP violations by nearly 4.5 as compared with the Direct Procedure ($p = 0.07$). Closely approaching the statistical significance, the impact of Sequential Elimination is economically meaningful: it improves consistency by almost 76% relative to the Direct Procedure. The same column shows a positive and statistically significant relationship between high-IQ and consistency ($p = 0.01$), in line with previous studies (e.g., Burks et al., 2009; Cappelen et al.,

[15]Nonlinear regressions are widely applied in economics for nonnegative integer data, e.g., R&D patents (Karkinsky and Riedel, 2012; Acemoglu, Moscona and Robinson, 2016), conflicts and wars (Glick and Taylor, 2010; Crost, Felter and Johnston, 2014), level-k reasoning (Camerer, Ho and Chong, 2004), and revealed preference analysis (Choi et al., 2014). Cameron and Trivedi (2013) recommend the Poisson, negative binomial, and zero-inflated negative binomial models for count data. Appendix E reports the model selection procedure. The negative binomial model is selected based on the Akaike information criterion, Bayesian information criterion, likelihood ratio test, and Vuong Test.

[16]Table 2 presents results from the negative binomial regressions, including an interaction between Sequential Elimination and High-IQ, in the form of average marginal effects. P-values of the Sequential Elimination effect (for low-IQ, high-IQ subjects, and overall) are computed based on the null hypothesis that the number of GARP (FOSD) violations under Sequential Elimination is larger than or equal to that under the Direct Procedure. The regressions are reported in the original form in Appendix E.

2020). Indeed, high-IQ subjects are very consistent, both overall (see Figure 2(b)), and per treatment (see Figure 2(c)). Taken together, these results suggest that the impact of sequential elimination in improving consistency operates mainly through its effect on low-IQ subjects, which leads to the following discussion on Hypothesis 2.

Figure 2(c) shows that the occurrence of GARP violations among low-IQ subjects is approximately 44.2% lower, on average, under Sequential Elimination than under the Direct Procedure (5.58 vs. 10 GARP violations, respectively), thus supporting Hypothesis 2. Furthermore, Figure 3(b) displays that the eCDF of GARP violations by low-IQ subjects under the Direct Procedure strongly (first-order) stochastically dominates that under Sequential Elimination, except on the extreme right tails of the distributions. Column (1) in Table 2 indicates that Sequential Elimination reduces by over 9.4 the number of GARP violations ($p = 0.04$) among low-IQ subjects as compared with the Direct Procedure.[17] This reduction is substantial (over 94%) relative to their average of 10 GARP violations under the Direct Procedure. The treatment effect on low-IQ subjects is more pronounced than the overall treatment effect, thus confirming that the former is the key driver of the latter. The results demonstrate the effect of sequential elimination on individuals with low cognitive ability, thus lending support to Hypothesis 2.



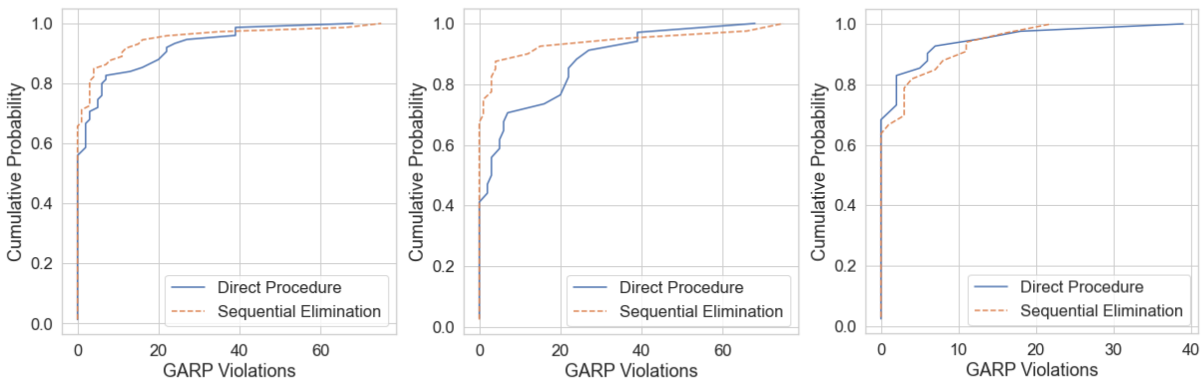
(a) BY TREATMENT (b) BY IQ (c) BY TREATMENT×IQ

FIGURE 2. GROUP-BY-GROUP MEANS OF GARP VIOLATIONS

Notes: Error bars indicate the standard error of means.

Besides consistency, Table 2 depicts the effect of sequential elimination on FOSD violations in Column (2). Overall, Sequential Elimination corresponds to a decrease in the number of FOSD violations by 0.5 ($p = 0.01$), approximately 63% of the average 0.8 FOSD violations under the Direct Procedure. There is no significant difference in FOSD violations between low-IQ and high-IQ subjects. In contrast to what was observed for GARP violations, no significant treatment effect on FOSD violations by low-IQ subjects can be seen. High-IQ subjects, on the other hand,

[17] For robustness checks, see Appendix D, which reports nonparametric tests of treatment effects, other specifications of the estimation, and estimations on other consistency measures. The robustness checks reveal comparable treatment effects on SARP violations, HM index, and CCEI for low-IQ subjects ($p = 0.04$, $p = 0.11$ and $p = 0.14$), although not all are significant at the conventional levels.



(a) ALL SUBJECTS (b) LOW-IQ SUBJECTS (c) HIGH-IQ SUBJECTS

FIGURE 3. GROUP-BY-GROUP EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTIONS OF GARP VIOLATIONS

show 0.9 (almost 97%, $p = 0.02$) fewer FOSD violations under Sequential Elimination than under the Direct Procedure (on average about 0.93 FOSD violations). This finding provides empirical support for the idea that individuals with high cognitive ability can benefit from sequential elimination in decision-making.

In conclusion, the experimental results provide causal evidence of the role played by sequential elimination in increasing economic rationality, as indicated by the improvement in individual consistency (especially among individuals with low cognitive ability) and the reduction in FOSD violations (especially among individuals with high cognitive ability).[18]

4.2 Other Factors of Economic Rationality

The literature has documented that demographics (i.e., age, education, and gender) have diverse effects on economic rationality, as reviewed in Section 1.1. A partial explanation for this lies in the differences in sample characteristics and choice settings between studies. The present sample of primarily young and educated subjects is arguably unique in comparison to those used in other studies. Thus, an examination of the effects of demographics on economic rationality in this sample may enhance our understanding of their impact.

I found some considerable results for the demographical variables. Table 2 shows that higher age is associated with higher economic rationality (i.e., fewer GARP and FOSD violations), in line with Dean and Martin (2016), but not with Choi et al. (2014) or Echenique, Imai and Saito (2021). The effect of age on economic rationality possibly varies by age group. On the one hand, normal aging can cause cognitive decline; although the evidence also suggests that this is not a

[18] Appendix D analyses individual behavior during the choice procedures, suggesting a tendency of subjects to examine options sequentially following presentation orders under the Direct Procedure, regardless of their cognitive ability. However, there is no robust evidence that subjects tend to eliminate options sequentially based on presentation orders under Sequential Elimination. Note that there is no significant difference in the presentation positions of choices between the two procedures. Accordingly, the economic rationality difference between the two procedures cannot be attributed to their different interactions with a potential presentation order effect on choices.

TABLE 2. DETERMINANTS OF ECONOMIC RATIONALITY

	GARP Violations (1)	FOSD Violations (2)
Sequential Elimination	-4.480*	-0.515**
	(3.045)	(0.215)
-Low-IQ Subjects	-9.409**	-0.226
	(5.246)	(0.233)
-High-IQ Subjects	0.799	-0.917**
	(1.302)	(0.434)
Age	-0.456*	-0.064***
	(0.253)	(0.024)
Female	0.885	0.170
	(2.138)	(0.177)
Education	-1.232	0.212
	(1.339)	(0.133)
High-IQ	-7.300**	0.145
	(2.900)	(0.211)
Selective Attention	-0.283	-0.030
	(0.373)	(0.031)
Working Memory	-0.357	-0.045
	(0.500)	(0.051)
Response Time (Minutes)	-0.491**	0.012
	(0.229)	(0.020)
Attitude towards Inconsistency	-0.840	0.021
	(0.511)	(0.033)
N	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

substantial problem for young people (Plassman et al., 1995; Aartsen et al., 2002; Rönnlund et al., 2005).[19] On the other hand, age may contribute to the accumulation of knowledge required for decision-making (Eberhardt, de Bruin and Strough, 2019). That is, the marginal returns of aging probably outweigh its marginal costs in the young population, thereby resulting in the positive association between age and economic rationality observed in the sample. The education and gender effects are not significant, in line with Banks, Carvalho and Perez-Arce (2019), and in contrast to Choi et al. (2014) and Kim et al. (2018). This suggests that, at high education levels, the marginal returns to education on consistency may be low, intuitively in line with the hypothesis that marginal returns to education diminish as education levels increase (Harris, 2007; Agüero and Beleche, 2013). Conclusions from other studies are based on measures of economic rationality, which may differ according to their research motivations. More research is needed

[19]Eberhardt, de Bruin and Strough (2019) find that older age is associated with with more experience-based knowledge, and fewer negative emotions surrounding financial decisions. Findings from the cognitive sciences also suggest that cognitive decline may begin after age 50 or later (Plassman et al., 1995; Aartsen et al., 2002; Rönnlund et al., 2005).

to evaluate the various implications of demographic factors on different measures of economic rationality.

Lastly, this section examines response times, an emerging topic in economics (e.g., Woodford, 2014; Fudenberg, Strack and Strzalecki, 2018; Baldassi et al., 2020), and recently as related to revealed preference analysis (Alós-Ferrer, Fehr and Netzer, 2021). Table 2 shows that longer response times are associated with fewer GARP violations ($p = 0.03$).[20] That is, slow decisions are more likely to reveal preferences consistent with preference maximization than fast decisions. This is in line with the well-known trade-off between slow decisions and higher accuracy (Fitts, 1966; Wickelgren, 1977). Importantly, the results contribute evidence to the vital role of response times in the revelation of individual preferences.

4.3 Individual Preference for Sequential Elimination

This section focuses on the Free Procedure treatment to analyze the determinants of individual preference for sequential elimination. Table 3 presents the results from probit and logit regressions, where the probability of choosing Sequential Elimination is regressed on demographics and cognitive ability.[21] A positive association is observed between the probability of choosing Sequential Elimination and education. Although further research is needed to determine the main channel of this association, it could indicate that sequential elimination presents a potential challenge to people with relatively low educational attainments. Importantly, over 82% of the low-IQ subjects choose Sequential Elimination, as shown in Appendix C. The probability of choosing Sequential Elimination decreases, *ceteris paribus*, as IQ ($p = 0.04$ in probit and $p = 0.03$ in logit), working memory ($p = 0.07$ in probit and $p = 0.05$ in logit), or selective attention ($p = 0.13$ in probit and $p = 0.17$ in logit) increase, although the last of these is not significant at the conventional levels. In other words, subjects with lower cognitive ability are more likely to use sequential elimination than those with higher cognitive ability.

In fact, the negative association between cognitive ability and the choice of Sequential Elimination is strong. Only 18% (seven) low-IQ subjects choose the Direct Procedure over Sequential Elimination. This plausible under-sampling of low-IQ subjects in the Direct Procedure hinders me from examining the effect of sequential elimination when the sample is restricted to Free Procedure subjects.

All in all, the evidence suggests that individuals with low cognitive ability—the central interest of this paper—may tend to use sequential elimination. This could be crucial for policy evaluation. However, due to the constraints of the present study, I here cannot validate sequential elimination's impact in the context where subjects freely determine the choice procedure. The

[20] Appendix E reports that subjects spend more time in Sequential Elimination than in the Direct Procedure, however, there is no strong evidence that the effects of response times depend on choice procedures.

[21] Table 3 presents results from the probit and logit regressions in the form of average marginal effects. The regressions are reported in their original form in Appendix E.

TABLE 3. DETERMINANTS OF PREFERENCE FOR SEQUENTIAL ELIMINATION

	Probability of Choosing Sequential Elimination	
	Probit (1)	Logistic (2)
Age	-0.004	-0.004
	(0.007)	(0.007)
Female	0.110	0.115
	(0.094)	(0.096)
Education	0.114***	0.111**
	(0.044)	(0.044)
IQ	-0.042**	-0.042**
	(0.020)	(0.020)
Selective Attention	-0.025	-0.024
	(0.016)	(0.018)
Working Memory	-0.038*	-0.038*
	(0.020)	(0.020)
Attitude towards Inconsistency	0.003	0.00339
	(0.019)	(0.021)
N	75	75

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

conclusion from this section is that there is a need for further investigation in this context.

4.4 Choice Revision

This section explores the effects of choice revision. In brief, the resulting evidence shows that choice revision has some potential to reduce FOSD violations as aligned with other studies, but not necessarily GARP violations. This result complements the existing research on choice revision by evaluating its effect in relatively complex decision-making tasks without explicitly presenting the normative axioms.

Table 4 shows the estimation of choice revision effect.[22] As shown in Column (1), there is no sound evidence to show that choice revision improves individual consistency overall, whether conditioned on IQ or treatment groups.[23] To some degree, this reveals the limited effect of choice revision in mitigating inconsistency. Column (2) indicates that choice revision corresponds to an overall reduction of 0.42 FOSD violations ($p = 0.04$), that is, approximately 61% fewer

[22]Table 4 presents results from the negative binomial regressions, where the triple interaction between Choice Revision, high-IQ, and Sequential Elimination is included. The results are reported in the form of average marginal effects. P-values of choice revision effect are computed based on the null hypothesis that the number of GARP (FOSD) violations of subjects who revise is larger than or equal to that of subjects who do not revise. This estimation is based on the sample of subjects who passed the comprehension check in the payment block. GARP violations in the table are calculated based on choices from the payment block. The complete table and the regression estimates appear in their original form in Appendix E.

[23]This is further corroborated by testing its sensitivity to other specifications, as reported in Appendix D.

than among non-revisers (on average, about 0.69 FOSD violations). The significance of this effect holds when restricted to the low-IQ subjects under Sequential Elimination ($p = 0.03$). Collectively, these results indicate that choice revision may complement sequential elimination to further improve economic rationality in low-IQ individuals by reducing their FOSD violations.

Benjamin, Fontana and Kimball (2020), Breig and Feldman (2020), and Nielsen and Rehbeck (2020) show choice revision to have a stronger effect in shifting choices towards normative axioms than observed in the present study. Those studies present the normative axioms in primarily binary choice tasks. In contrast, this study uses eleven-options choice tasks without presenting axioms. Considering the contrast, it is possible that choice revision's effect may hinge on the comprehensive design of the procedure and complexity of choice settings. This discussion sheds light on the further question of the robustness of choice revision effects across contexts.

TABLE 4. EFFECTS OF CHOICE REVISION ON ECONOMIC RATIONALITY

	GARP Violations (1)	FOSD Violations (2)
Choice Revision	-1.833	-0.42**
	(2.849)	(0.244)
-Low-IQ Subjects under the Direct Procedure	-4.665	-0.612
	(7.004)	(0.647)
-High-IQ Subjects under the Direct Procedure	-3.182	0.085
	(2.695)	(0.467)
-Low-IQ Subjects under Sequential Elimination	3.487	-0.610**
	(3.804)	(0.331)
-High-IQ Subjects under Sequential Elimination	-5.078	-0.207
	(6.182)	(0.251)
N	151	151

Notes: Control variables not shown in this table: Age, Female, Education, IQ, Selective Attention, Working Memory, and Attitude towards Inconsistency. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.5 Risk Preferences

This section presents the analysis of risk preferences based on the constant relative risk aversion (CRRA) utility indexes revealed from the subjects' choice data.[24] Before stating the results, it is worth mentioning that, although the literature tends to find a negative relationship between cognitive ability and risk aversion (Burks et al., 2009; Oechssler, Roider and Schmitz, 2009; Dohmen et al., 2010; Benjamin, Brown and Shapiro, 2013; Dohmen et al., 2018), this relationship cannot always be replicated and sometimes even becomes positive (Mather et al.,

[24]CRRA utility indexes are estimated using the code packages from Halevy, Persitz and Zrill (2018). Assuming the CRRA expected utility model, the estimation recovers parameters using nonlinear least squares. The eCDF of the estimated CRRA utility index in the experiment is given in Appendix C.

2012; Tymula et al., 2012; Andersson et al., 2016).[25] Specifically, Andersson et al. (2016) argue that the effect of cognitive ability on risk preferences may operate through the channel of decision-making mistakes. Recall the theoretical prediction that individuals may err due to limited attention under the Direct Procedure but not under Sequential Elimination. Also, the existing studies primarily derive their results from simple choice settings, i.e., most decisions comprise two or three options (e.g., Oechssler, Roider and Schmitz, 2009; Andersson et al., 2016). Thus, the following analysis contributes to the discussion by examining the relationships between cognitive ability and risk preferences under the two procedures in non-simple choice settings.

Table 5 presents the estimation results based on two specifications.[26] In Column (1), CRRA utility index is directly regressed on IQ and a complete set of explanatory variables. Coinciding with early reported findings, overall, there is a negative impact of IQ on CRRA utility index ($p = 0.09$). No other factor, including sequential elimination, appears to be associated significantly with risk aversion. Conjecturally, the sequential elimination effect may depend on cognitive ability, based on the previous results showing its heterogeneous effects on consistency.

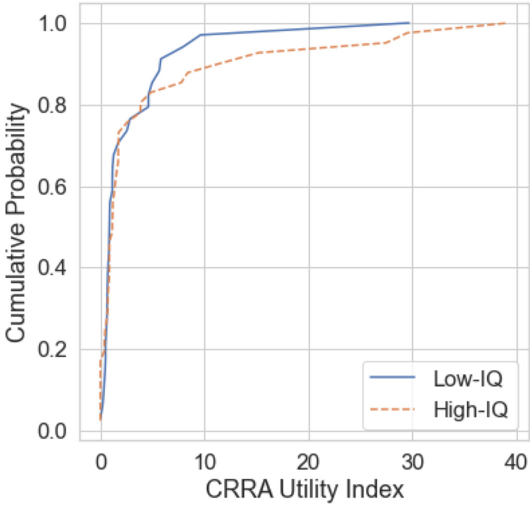
The estimation in Column (2) incorporates the interaction between IQ and Sequential Elimination. Verifying the conjecture, the association between IQ and CRRA utility index is significant ($p = 0.04$) under Sequential Elimination but not under the Direct Procedure. Further, this association is stronger under Sequential Elimination than overall. This is also confirmed by the distinction in eCDFs of CRRA utility index between the low-IQ and high-IQ subjects is sharpest under Sequential Elimination (Figure 4(b)), where that of the low-IQ subjects almost stochastically dominates that of the high-IQ subjects. Under the Direct Procedure (Figure 4(a)), in contrast, there is no evident distinction between the two groups in this respect.

These results may be driven by the present choice setting comprising eleven options. The choices made by low-IQ subjects under the Direct Procedure may not fully reveal their risk preferences, potentially as a result of mistakes caused by limited attention, as would be consonant with Andersson et al. (2016). In other words, the complexity of the choice task may be determinant in the revelation of risk aversion.

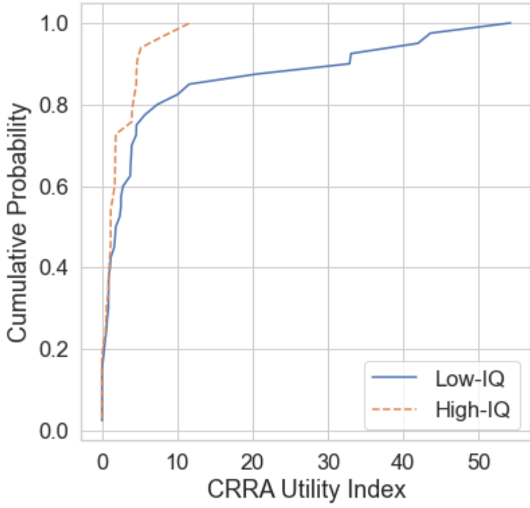
In short, the findings in this section complement the existing evidence for the negative relationship between cognitive ability and risk aversion. This relationship is confirmed under sequential elimination, where choice consistency is theoretically established and empirically supported by the previous results of this study. Crucially, these findings raise the question of whether the robustness of this relationship holds for complex choice settings.

[25] Dohmen et al. (2018) suggest that the nonsignificant relationships in Mather et al. (2012) and Tymula et al. (2012) may be due to small sample size and measurement error. Andersson et al. (2016) find a positive relationship in a multiple-price list (MPL) where there are more opportunities to err towards the risky option. They argue that choice errors cause an underestimation of risk aversion.

[26] Table 5 Column (2) reports the average marginal effects based on the linear regression, which includes an interaction term between IQ and Sequential Elimination in addition to the specification reported in Column (1). The complete table and the regression estimates appear in their original form in Appendix E.



(a) DIRECT PROCEDURE



(b) SEQUENTIAL ELIMINATION

FIGURE 4. GROUP-BY-GROUP EMPIRICAL CUMULATIVE DISTRIBUTIONS OF ESTIMATED CRRA UTILITY INDEXES

TABLE 5. DETERMINANTS OF RISK PREFERENCES

	CRRA Utility Index	
	(1)	(2)
IQ	-0.397*	-0.358
	(0.230)	(0.227)
-Under the Direct Procedure		0.071
		(0.320)
-Under Sequential Elimination		-0.799**
		(0.397)
Sequential Elimination	2.010	2.063
	(1.619)	(1.628)
N	148	148

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Control variables not shown in this table: Age, Female, Education, Selective Attention, Working Memory, Response Time, and Attitude towards Inconsistency.

5 Discussion

5.1 Policy Implications

Policymakers and institutions can implement sequential elimination in a wide range of contexts to mitigate the impact of limited attention and improve individual welfare. For example, field evidence indicates that individuals have difficulty in making decisions for retirement plans (Sethi-Iyengar et al., 2004; Thaler and Benartzi, 2004) and bank loans (Bertrand et al., 2010), which typically involve a large number of options. Public policy can promote sequential elimination at a relatively low cost, e.g., by providing it on a governmental website where people choose retirement plans or by regulating it to be installed on banking websites where consumers choose loan plans. More broadly, sequential elimination might be flexibly applied to numerous meaningful contexts across a person's life cycle—spanning from education, through career, to retirement decisions—where often the options are complex, and most people long for the "best" choice.

Upon improvement of individual consistency, sequential elimination may complement policymaking based on economic predictions drawn from the premise of rationality. In light of the present results on risk preferences, sequential elimination may help exploit information on individual preferences. Perhaps, this presents an alternative approach that could enhance policymaking based on revealed preferences by incorporating the emerging behavioral findings of human limitation (e.g., Bernheim and Rangel, 2007, 2009). Importantly, sequential elimination needs not be implemented in a paternalistic fashion. Individuals can be allowed to opt out of making decisions under sequential elimination at no cost. The Free Procedure's analysis suggests that individuals with limited attention are likely to use the procedure based on their preferences. The non-paternalistic approach of implementing sequential elimination inflicts little or no harm on individuals; thus, it is a desirable advantage in institutional design (Thaler and Sunstein, 2003).

In light of my theoretical framework, it is sufficient for individuals to consider only two alternatives in every elimination to achieve consistency. It may be efficient for less cognitively constrained individuals to eliminate more than one alternative at a time. In effect, the procedure works as long as each round of elimination remains within the individual's cognitive ability. Further study is required to evaluate variations in sequential elimination due to individual heterogeneity.

5.2 Concluding Remarks

This paper has shown that sequential elimination—a well-known choice procedure, especially in the cognitive sciences (Tversky, 1972; Todd and Gigerenzer, 2000)—improves individual consistency with preference maximization under cognitive limitations. This paper develops a formal framework to identify the role of sequential elimination in improving individual consistency. Causal evidence for a sequential elimination effect is obtained for subjects participating in a randomized controlled risky decision-making experiment. This effect is statistically significant and economically substantial for individuals with low cognitive ability. The existing literature on the gap between low cognitive ability and choice consistency is enriched by the identification of theoretical and empirical conditions under which this gap narrows. This paper may offer a new insight into the ways in which choice procedures can influence individual consistency with preference maximization, which poses one of the major challenges to neoclassical economics.

Finally, beyond decision-making under risk, it would be desirable to test the robustness of sequential elimination in different choice domains, such as consumer goods, intertemporal choice, and altruistic choice. Notably, field research into the effect of sequential elimination presents a promising line of research.

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Appendices

Appendix A Proof of Proposition 1

Let $D = \{c^i, M^i\}_{i=1}^n$ be a data set. Consider the following conditions:

[1] D satisfies GARP.

[2] D is rationalizable by sequential elimination.

[3] There exists a preference relation $\succeq$ over X such that for all i, $c^i \in \{x \in M^i | x \succeq y \ \forall y \in M^i\}$.

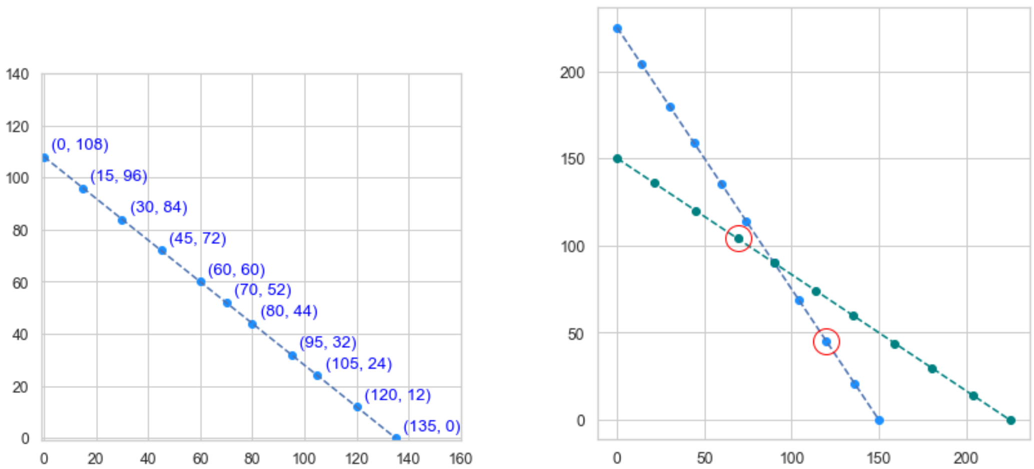
By a theorem of Cosaert and Demuynck (n.d.), we have that [1] if and only if [3]. Hence in the following proof, I show equivalently that [2] if and only if [3].

[3] implies [2]. Suppose that [3] is true. Define $\gamma(M) = M$ for all $M \in \mathcal{X}$. Given $D = \{c^i, M^i\}_{i=1}^n$, define $E = \{e^i, M^i\}_{i=1}^n$ such that for all i: if $|M^i| \geq 2$, then $e^i = (e^i_1, ..., e^i_{|M^i-1|}, c^i)$ with $\bigcup_{r=1}^{|M^i|}\{e^i_r\} = M^i$; if $|M^i| = 1$, then $e^i = (c^i)$. For all i and $r = 1, ..., |M^i|$, we have $e^i_r \in \gamma(E^i_r)$ (Definition 3 (i)); $c^i \in \{x \in \gamma(E^i_r) | x \succeq e^i_r, x \neq e^i_r\} \neq \emptyset$ if $|E^i_r| \geq 2$ (Definition 3 (ii)); and $c_i = e^i_{|M^i|}$ (Definition 3 (iii)). Thus, D is rationalizable by sequential elimination.

[2] implies [3]. Suppose that [2] is true. Let $\succeq$, γ, and $E = \{e^i, M^i\}_{i=1}^n$ be the preference relation, consideration set mapping, and elimination data set that satisfy the conditions in Definition 3. Suppose by contradiction that there exists some $j \in \{1, ..., n\}$ such that $c^j = e^j_{|M^j|} \notin \{x \in M^j | x \succeq y \ \forall y \in M^j\}$. Since $\succeq$ is complete and transitive, $\{x \in M^j | x \succeq y \ \forall y \in M^j\} \neq \emptyset$. Then there must exist some $r \in \{0, ..., |M^j - 1|\}$ such that $e^j_r \in \{x \in M^j | x \succeq y \ \forall y \in M^j\}$ and $\{x \in E^i_r | x \succeq e^i_r, x \neq e^i_r\} = \emptyset$. This implies $\{x \in \gamma(E^i_r) | x \succeq e^i_r, x \neq e^i_r\} = \emptyset$, which is a contradiction to Definition 3 (ii). Therefore, we have that for all i, $c^i \in \{x \in M^i | x \succeq y \ \forall y \in M^i\}$.

Appendix B Details of the Experimental Design

B.1 Illustrations of the Experimental Setting



(a) DECISION PROBLEM (b) GARP VIOLATION

FIGURE B.1. GRAPHICAL ILLUSTRATIONS OF A DECISION PROBLEM AND A GARP VIOLATION

Notes: As illustrated in Figure B.1(a), each budget line represents a menu of options in the experiment. The red circles indicate a pair of choices from these menus that violate GARP. In Figure B.1(b), the red circles indicate a pair of choices from these menus that violate GARP.

B.2 Instructions in the Experiment

B.2.1 Introduction

Welcome to our study on decision-making.

The study consists of three sections. In Section 1, you will make a series of economic decisions. In Section 2, you will participate in some cognitive tasks. In Section 3, you will be asked to imagine yourself in some hypothetical scenarios and answer a few questions related to those scenarios. Detailed instructions will be provided at the beginning of each section.

You will receive £3 as a participation fee for completing the study. You will also earn an additional payment of up to £14.6 depending partly on your decisions and partly on chance. You will be paid within 3 working days after completing the study.

Please pay careful attention to the instructions. During the study, we will speak in terms of experimental tokens instead of pounds. The sum of tokens you earn in the experiment will be converted to pounds at the following rate:

25 tokens= £1

Important: Once you have moved on to the next question, you cannot go back and change your choice. Do not close the web browser at any time!

B.2.2 Experimental Section 1

Section 1 consists of two blocks, Blocks A and B. Each block consists of 21 decision problems that share a common format. An example of the decision problem will be provided at the beginning of each block.

In each decision problem, you will be asked to choose **one** option out of multiple options. An option [X, Y] indicates that you will earn either X tokens or Y tokens with **the same** probability. For instance, the option [24, 32] indicates that you will earn 24 tokens with probability 50% and 32 tokens with probability 50%.

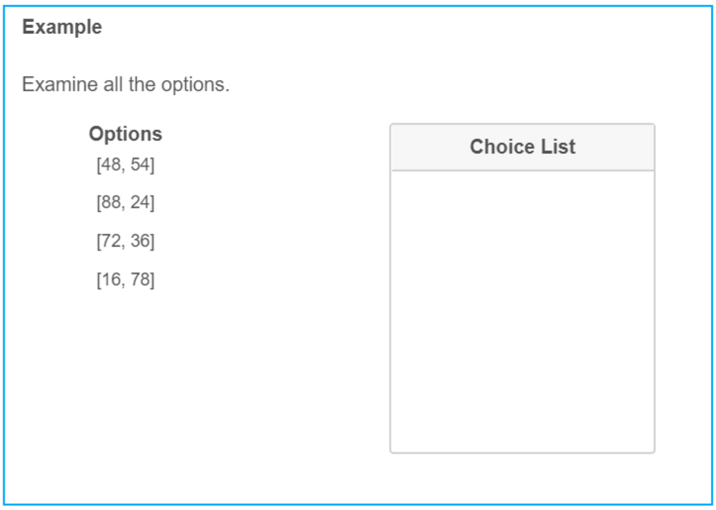
In each decision problem, you are encouraged to examine all options and should choose only one option that you prefer. There is no right and wrong answer to each decision problem. We are interested in studying your preferences.

We use the following method to determine your payment in Section 1: At the end of Section 1, you will be asked to make a choice between Blocks A and B for your payment. At the end of the experiment, one of the 21 problems from the block you choose will be drawn at random. Each problem has **the same** probability of being drawn. You will earn tokens according to your choice in this randomly drawn problem.

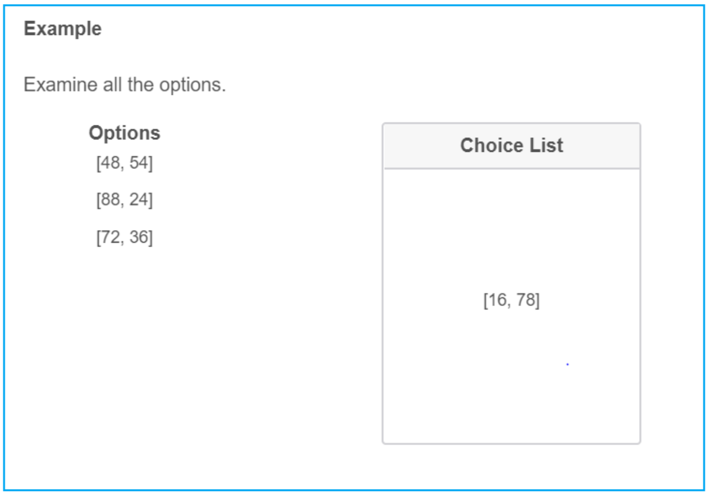
You will earn real money, depending on your decisions. Please make careful decisions.

The Direct Procedure (Block A)

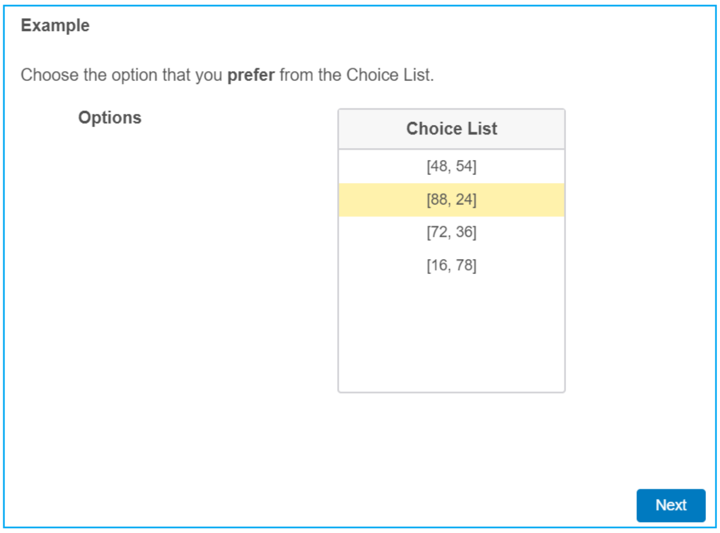
In this block, you will participate in 21 decision problems. You will make decisions by a procedure called "**sequential examination**". You will be asked to sequentially examine, one by one, options by clicking on them. Then you will be asked to choose only **one** option that you **prefer**. Below, you can see an example of sequential examination:



For instance, if you have examined the option [16, 78], you can click on it. It will then be moved to the "**Choice List**".



You should examine all the options by clicking on them. Then you can choose the option that you prefer from the "**Choice List**" by clicking on it. Your final choice will be highlighted in yellow. For instance, in the screen below, your choice is [88, 24].



You should click on "Next" to confirm your choice and proceed to the next problem.

Regarding payment, suppose that you choose [88, 24] by sequential examination. If you are paid according to this choice, you would receive 88 tokens with 50% probability and 24 tokens with 50% probability.

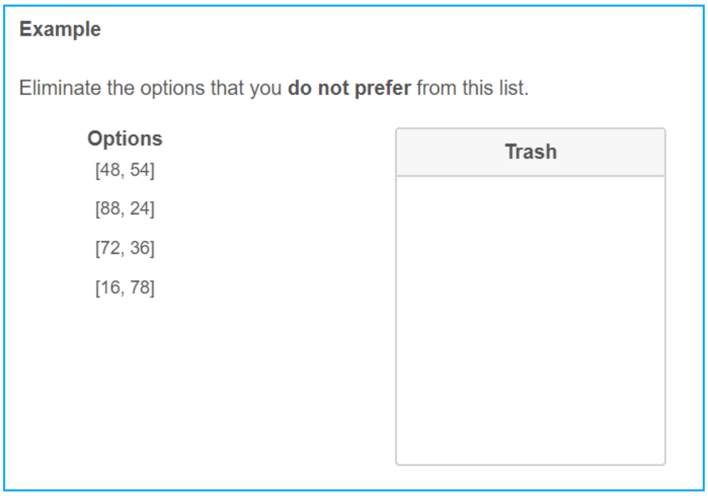
To familiarize you with the decision problems, you will have a practice problem. It will not affect your payment. Then you will be asked to complete all the problems.

Important: Once you have clicked on "**Next**", you cannot go back and change your choice.

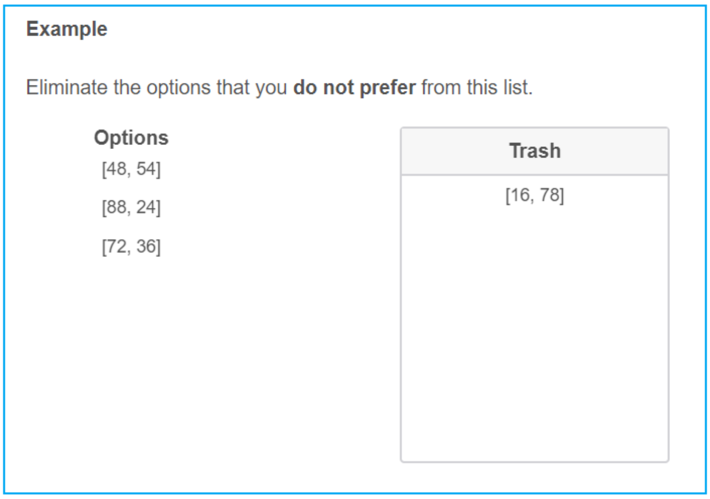
Sequential Elimination (Block A)

In this block, you will participate in 21 decision problems. You will make decisions by a procedure called "**sequential elimination**". You will be asked to sequentially eliminate, one by one, the options that you do not prefer by clicking on them, until only **one** option remains. The **last remaining option** is your **choice** in the decision problem.

Below, you can see an example of sequential elimination:



For instance, if you eliminate [16, 78] by clicking on it, it will be moved to the "**Trash**".

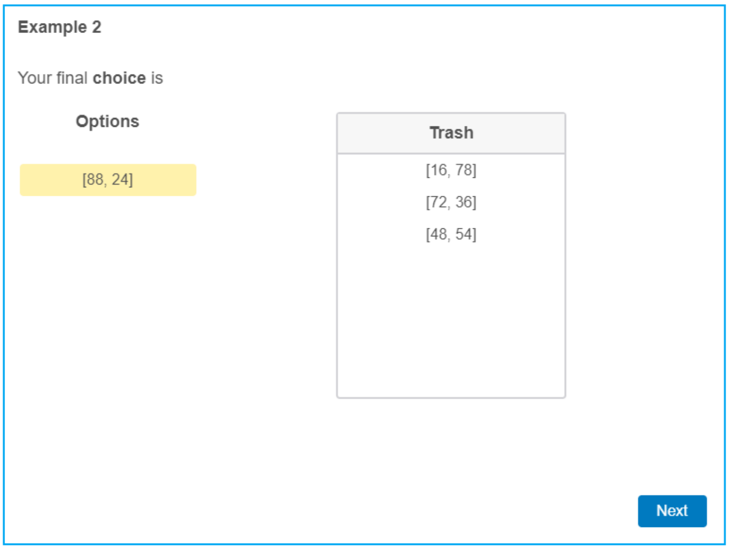


Note that you can **recover** the options in the Trash by clicking on them. For example, if you click on [16, 78] in the Trash, it will be moved back to the "Options".

Regarding your choice, you should eliminate options until only **one** option remains. For instance, in the screen below, supposed that you have eliminated [16, 78], [72, 36] and [48, 54]. As a result, the **last remaining** [88, 24] is your final **choice** in this problem. Your final choice is highlighted in yellow.

You should click on "Next" to confirm your choice and proceed to the next problem.

Regarding payment, suppose that you choose [88, 24] by sequential elimination. If you are paid according to this choice, you would receive 88 tokens with 50% probability and 24 tokens with 50% probability.



To familiarize you with the decision problems, you will have a practice problem. It will not affect your payment. Then you will be asked to complete all the problems.

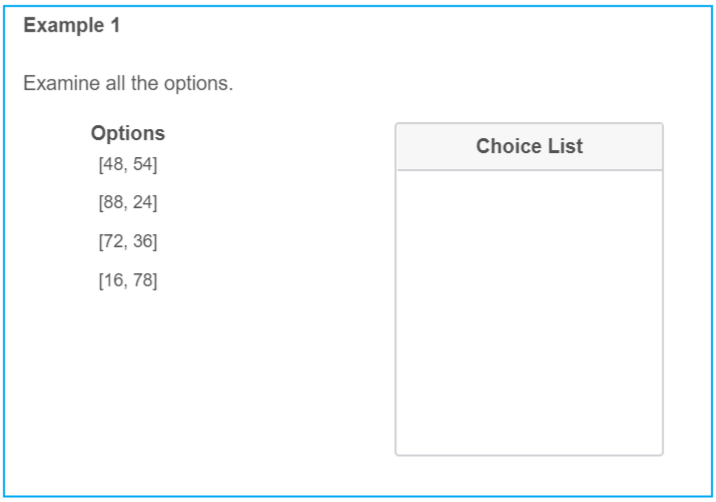
Important: Once you have clicked on "Next", you **cannot** go back and change your choice.

The Free Procedure (Block A)

First, you have to make a choice between two choice procedures: sequential examination and sequential elimination. The two procedures will be explained below with examples. Then you will participate in 21 decision problems using the procedure chosen by you.

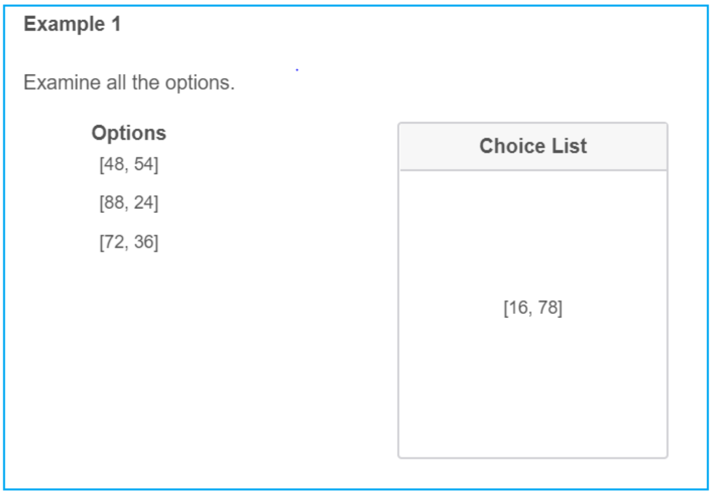
1) **Sequential Examination**: You will be asked to sequentially examine, one by one, options by clicking on them. Then you will be asked to choose only **one** option that you **prefer**.

Below, you can see an example of sequential examination:

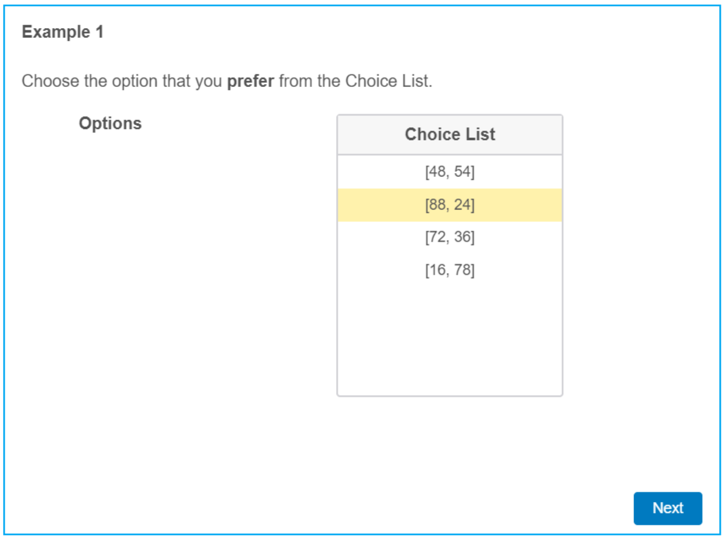


For instance, if you have examined the option [16, 78], you can click on it. It will then be moved to the "**Choice List**".

You should examine all the options by clicking on them. Then you can choose the option that you prefer in the "**Choice List**" by clicking on it. Your final choice will be highlighted in



yellow. For instance, in the screen below, your choice is [88, 24].

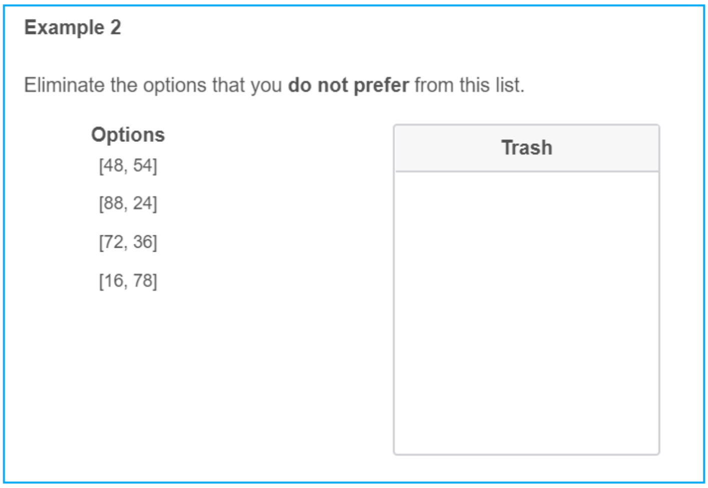


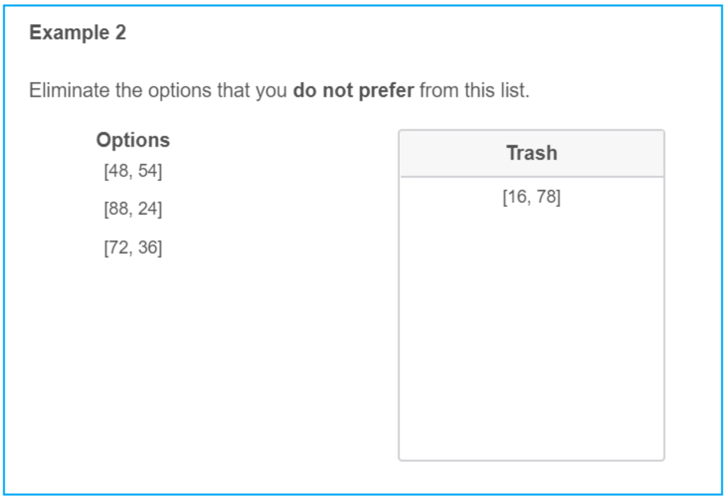
You should click on "Next" to confirm your choice and proceed to the next problem.

2) **Sequential Elimination**: You will be asked to sequentially eliminate, one by one, the options that you do **not prefer** by clicking on them, until only one option remains. The **last remaining option** is your **choice** in the decision problem.

Below, you can see an example of sequential elimination:

For instance, if you eliminate [16, 78] by clicking on it, it will be moved to the "**Trash**".

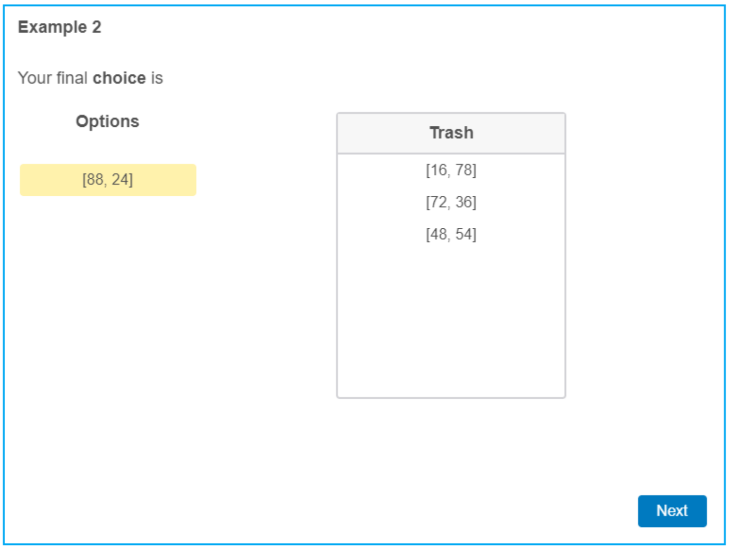




Note that you can **recover** the options in the Trash by clicking on them. For example, if you click on [16, 78] in the Trash, it will be moved back to the "Options".

Regarding your choice, you should eliminate options until only **one** option remains. For instance, in the screen below, supposed that you have eliminated [16, 78], [72, 36] and [48, 54]. As a result, the **last remaining** [88, 24] is your final choice in this problem. Your final **choice** is highlighted in yellow.

You should click on "Next" to confirm your choice and proceed to the next problem.



Regarding payment, suppose that you choose [88, 24] by sequential examination or sequential elimination. If you are paid according to this choice, you would receive 88 tokens with 50% probability and 24 tokens with 50% probability.

To familiarize you with the decision problems, you will have a practice problem for each procedure. It will not affect your payment. Then you will be asked to choose a procedure and complete all the problems.

Important: Once you have clicked on "Next", you **cannot** go back and change your choice.

The Free Procedure: Procedure Selection

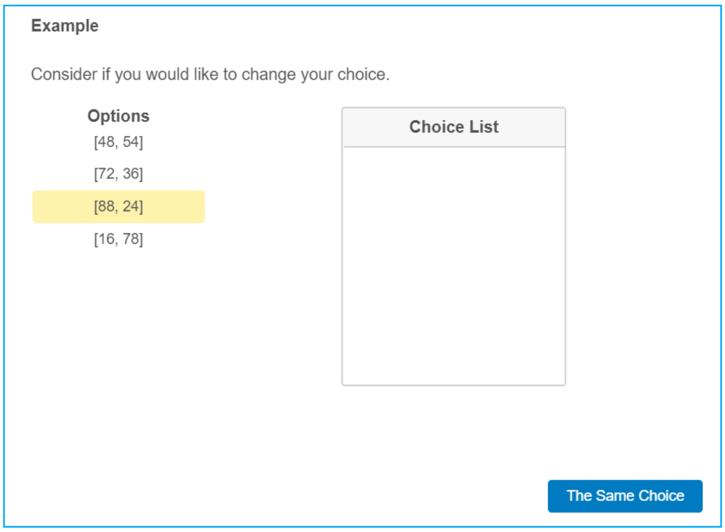
Please indicate which procedure that you would like to use in Section 1.

- The Direct Procedure
- Sequential Elimination

The Direct Procedure (Block B)

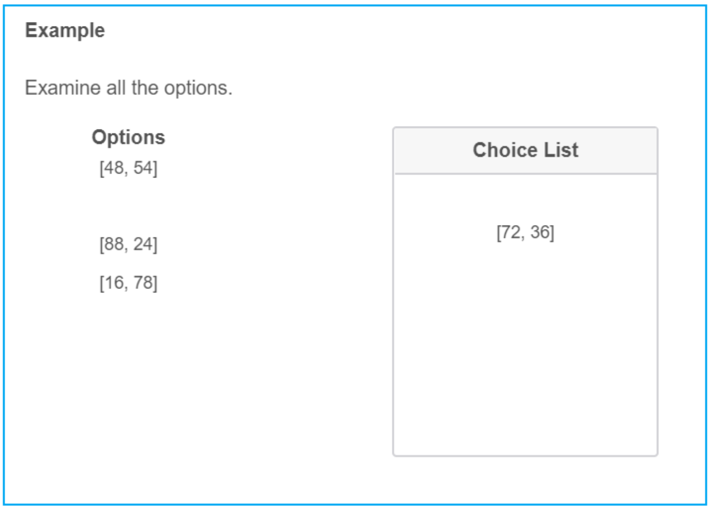
In this block, you will confront the **same** 21 decision problems as those in Block A. You will see your choice from the corresponding problem in Block A highlighted in yellow. You will be asked to consider if you would like to change you choice.

Below, you can see an example of Block B problem:



You can choose the same option as you chose in the corresponding problem in Block A by clicking on "The Same Choice". For instance, if you click on "The Same Choice" in this problem, your choice is [88, 24] and you will proceed to the next problem directly.

If you want to change your choice, you can click on **any** option on the list. Then you can start again the sequential examination. For instance, if you click on [72, 36], you will see the screen below.



Regarding payment, suppose that this time you choose [48, 54]. If you are paid according to this choice, you would receive 48 tokens with 50% probability and 54 tokens with 50% probability.

To familiarize you with the decision problems, you will have a practice problem. It will not affect your payment. Then you will be asked to complete all the problems.

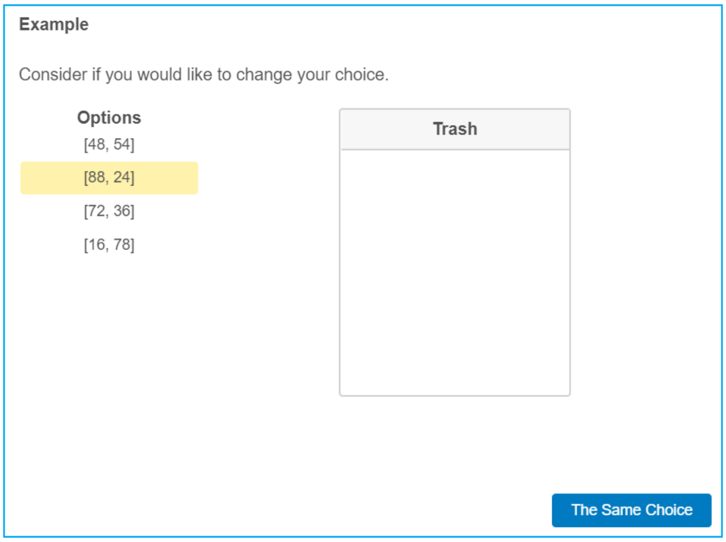
Remember that we will ask you to choose between Blocks A and B for payment at the end of Section 1.

Important: Once you have clicked on "Next", you **cannot** go back and change your choice.

Sequential Elimination (Block B)

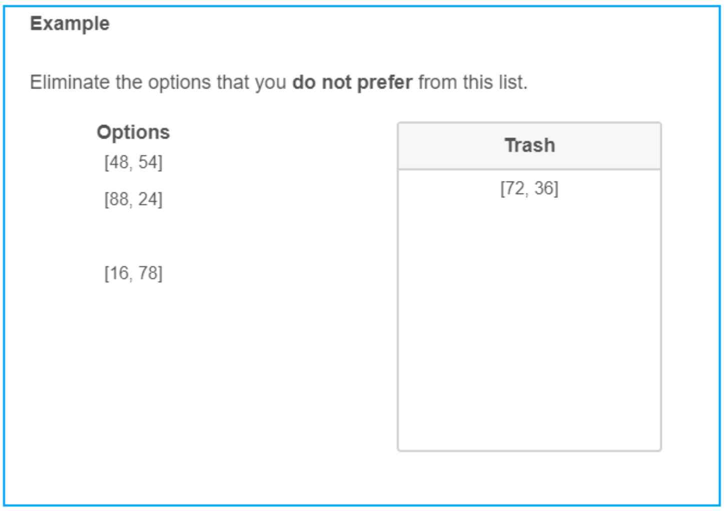
In this block, you will confront the **same** 21 decision problems as those in Block A. You will see your choice from the corresponding problem in Block A highlighted in yellow. You will be asked to consider if you would like to change you choice.

Below, you can see an example of Block B problem: You can choose the same option as you



chose in the corresponding problem in Block A by clicking on "The Same Choice". For instance, if you click on "The Same Choice" in this problem, your choice is [88, 24] and you will proceed to the next problem directly.

If you want to change your choice, you can click on **any** option on the list. Then you can start again the sequential elimination. For instance, if you click on [72, 36], you will see the screen below.



Regarding payment, suppose that this time you choose [48, 54]. If you are paid according to this choice, you would receive 48 tokens with 50% probability and 54 tokens with 50% probability.

To familiarize you with the decision problems, you will have a practice problem. It will not affect your payment. Then you will be asked to complete all the problems.

Remember that we will ask you to choose between Blocks A and B for payment at the end of Section 1.

Important: Once you have clicked on "Next", you **cannot** go back and change your choice.

Payment Block Selection

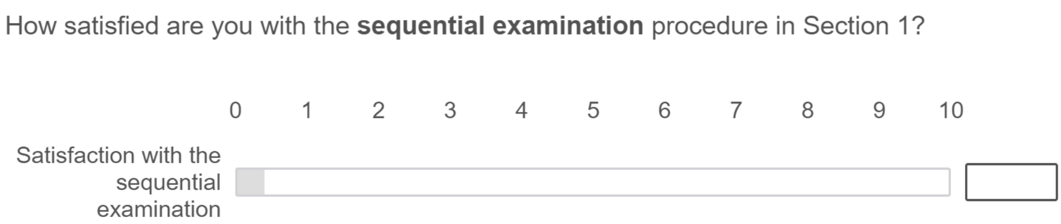
Please indicate that which block you would like to choose for your payment in Section 1.

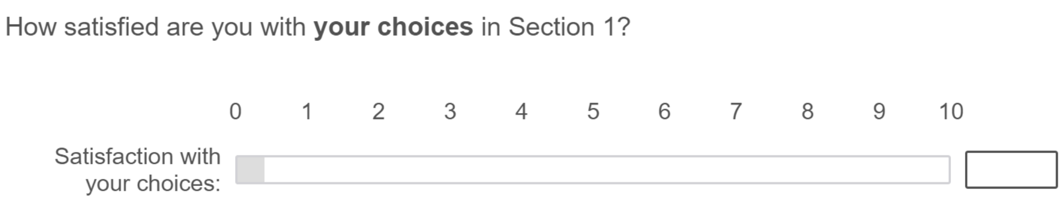
- Block A
- Block B

Individual Satisfaction (The Direct Procedure)

Now, we would like to understand how satisfied you are with the decisions you made in Section 1.

A rating of 0 means that you are not satisfied at all. A rating of 10 means that you cannot be more satisfied. Please select the number between 0 and 10 that best describes how you feel about the sequential examination procedure and your choices in Section 1.





Individual Satisfaction (Sequential Elimination)

Now, we would like to understand how satisfied you are with the decisions you made in Section 1.

A rating of 0 means that you are not satisfied at all. A rating of 10 means that you cannot be more satisfied. Please select the number between 0 and 10 that best describes how you feel about the sequential elimination procedure and your choices in Section 1.

How satisfied are you with the the **sequential elimination** procedure in Section 1?

0 1 2 3 4 5 6 7 8 9 10

Satisfaction with the sequential elimination

How satisfied are you with **your choices** in Section 1?

0 1 2 3 4 5 6 7 8 9 10

Satisfaction with your choices:

Screenshots of Treatments

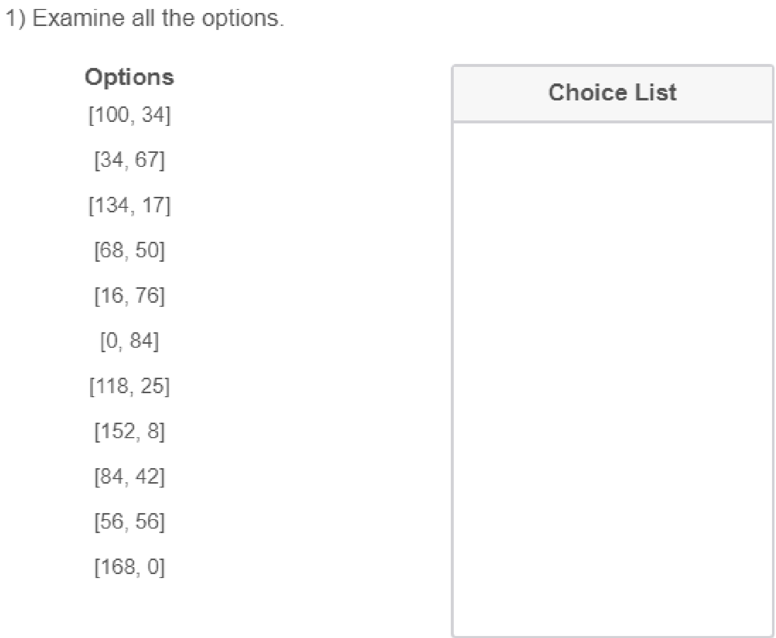


FIGURE B.2. THE DIRECT PROCEDURE, A SUBJECT ENTERS A DECISION PROBLEM

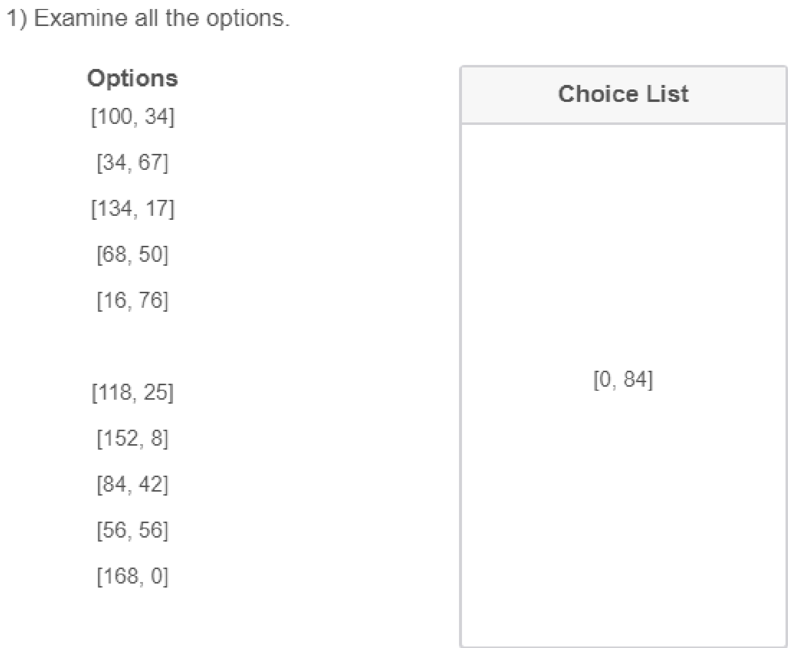


FIGURE B.3. THE DIRECT PROCEDURE, A SUBJECT CLICKS ON AN OPTION

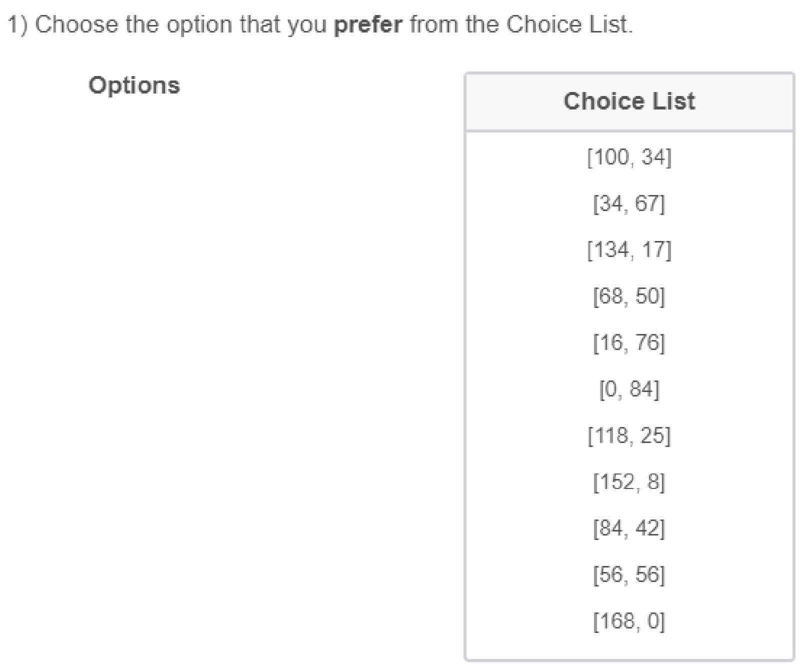


FIGURE B.4. THE DIRECT PROCEDURE, A SUBJECT HAS CLICKED ON ALL OPTIONS

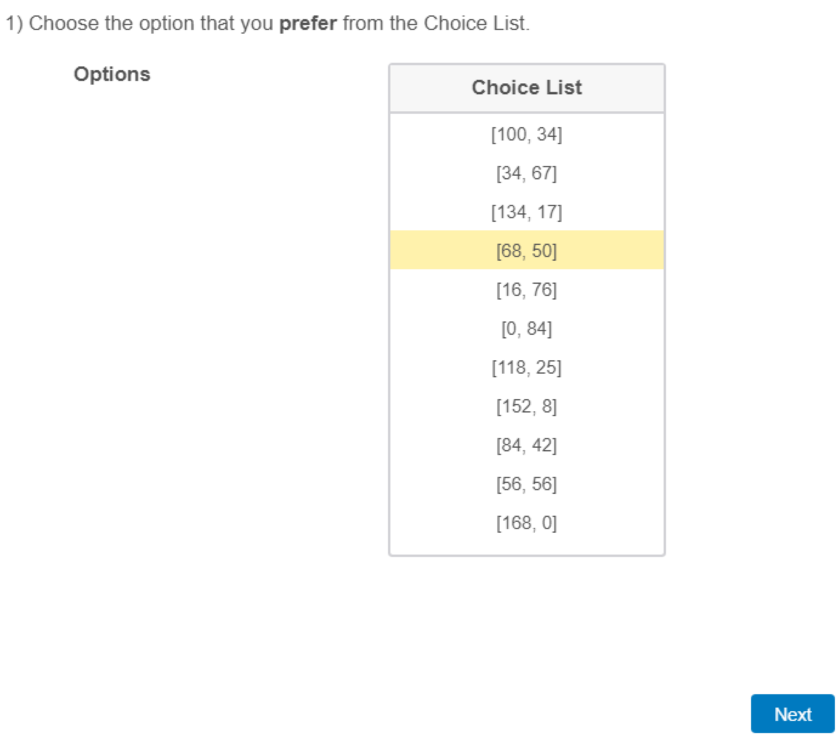


FIGURE B.5. THE DIRECT PROCEDURE, A SUBJECT CHOOSES AN OPTION IN THE CHOICE LIST

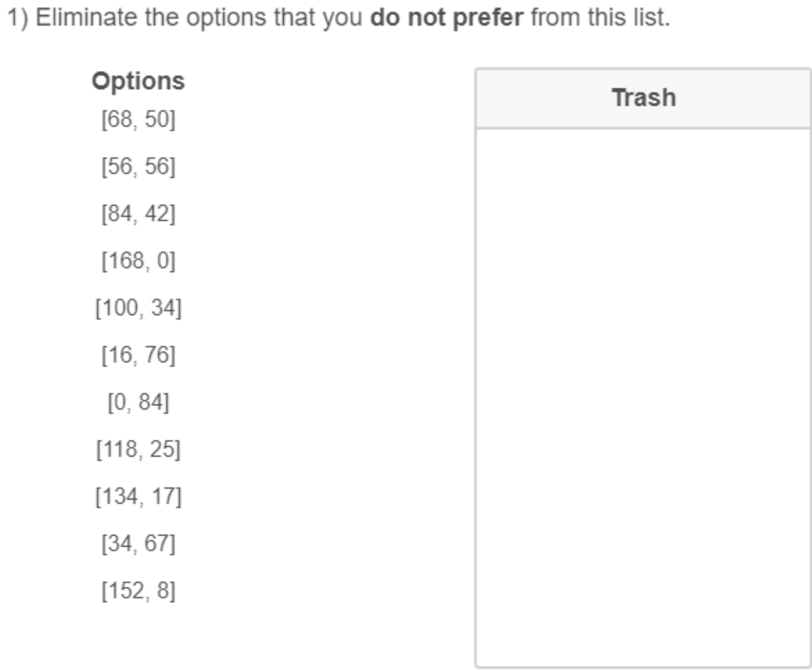


FIGURE B.6. SEQUENTIAL ELIMINATION, A SUBJECT ENTERS A DECISION PROBLEM

FIGURE B.7. SEQUENTIAL ELIMINATION, A SUBJECT ELIMINATES AN OPTION

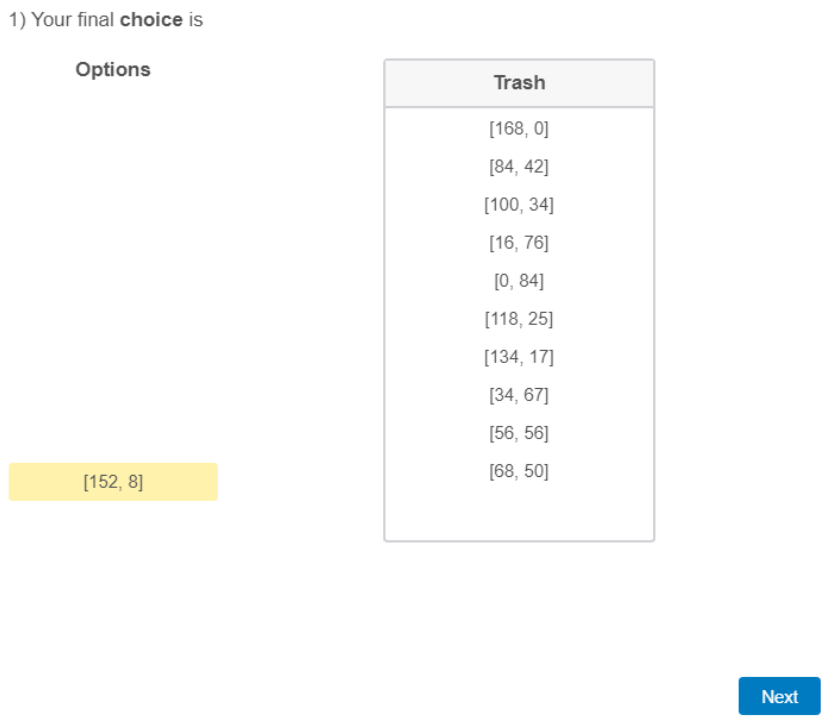


FIGURE B.8. SEQUENTIAL ELIMINATION, A SUBJECT HAS ELIMINATED ALL BUT ONE OPTIONS

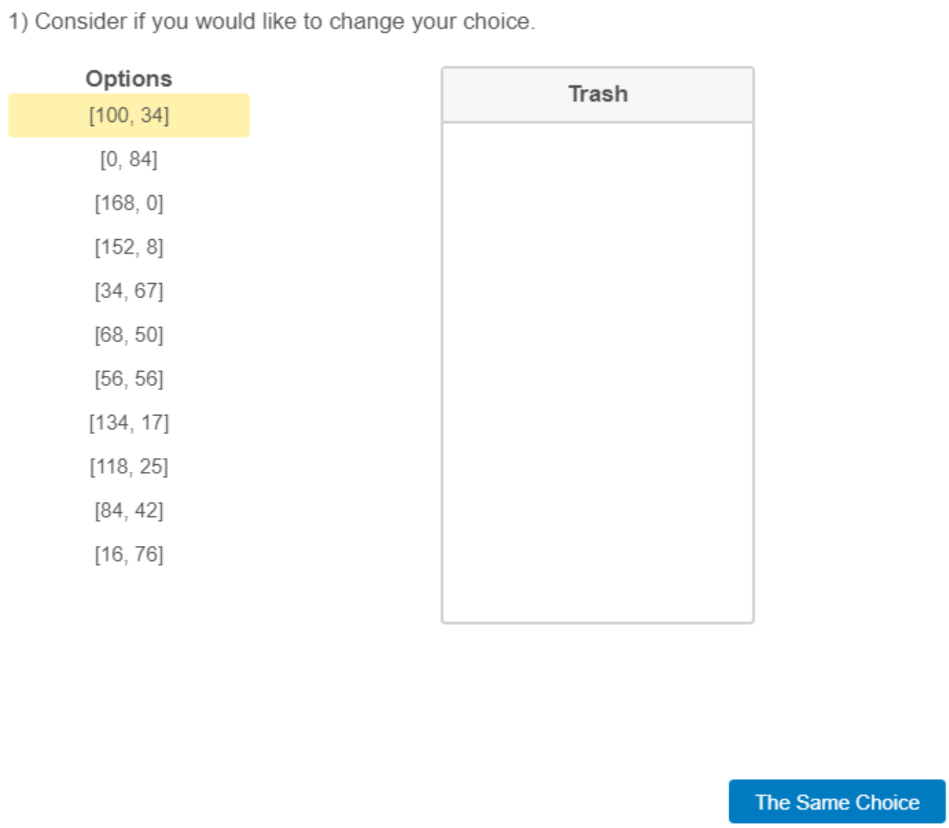


FIGURE B.9. CHOICE REVISION (BLOCK B), A SUBJECT ENTERS A DECISION PROBLEM

B.2.3 Experimental Section 2

This section has three cognitive tasks. Your payment in this section will depend on your performance in the three tasks. Each task has a different number of questions. At the end of the experiment, the computer will randomly draw three questions from all the tasks with equal probability. For each correct answer to the random three questions, you will receive 25 tokens.

Task 1 (ICAR)

In this task, you are asked to answer ten questions. Five of them are about matrix reasoning and the other five are about three-dimensional rotation. There is a right answer to each question. You can have at most twelve minutes in this task.

Please indicate which is the best answer to complete the figure below.

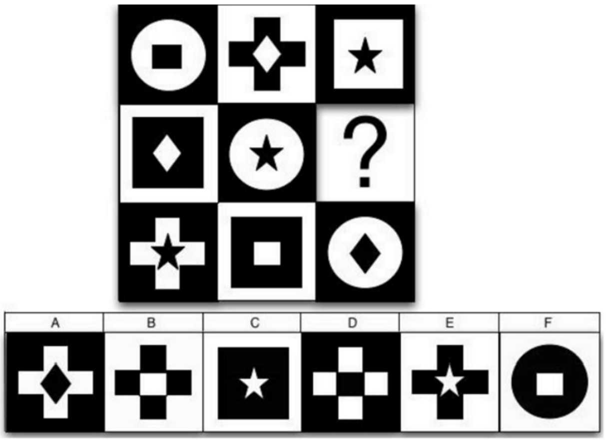


FIGURE B.10. ICAR, MATRIX REASONING PROBLEM

Please indicate which is the best answer to complete the figure below.

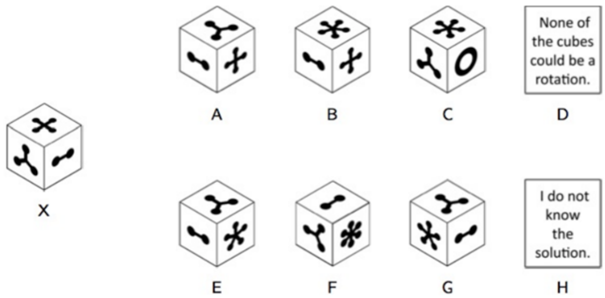


FIGURE B.11. ICAR, THREE-DIMENSIONAL ROTATION PROBLEM

Task 2 (Stroop Task)

This task measures your concentration. In each round, you are asked to **identify the color of the word shown on the screen**. The word itself is irrelevant — you can safely ignore it. To indicate the color of the word, please use the keys **r**, **g**, **b** and **o** for red, green, blue and orange, respectively. A plus sign will be shown before each word, please keep your eyes on the plus sign. You will have only two seconds in each round.

Task 3 (Sternberg Task)

This task measures your working memory. In each round, you are asked to memorize a sequence of digits. The length of this sequence can vary from four to eight digits. After the presentation, we will ask you to indicate whether a certain digit was included in the sequence. Please press **y** if you think that the digit was in the sequence. If not, please press **n**. If your decision is correct, you will see a green circle. Otherwise, you will see a red circle. Then we will ask you to type in

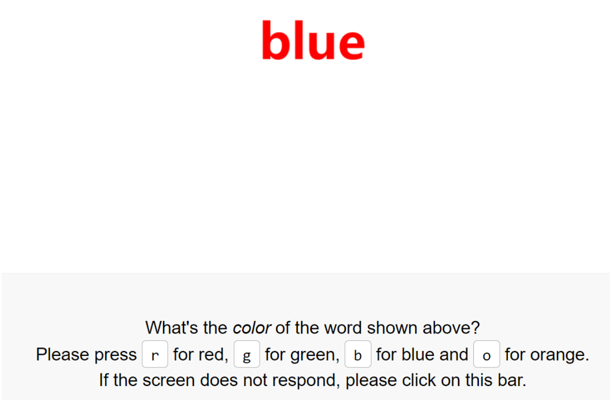


FIGURE B.12. STROOP TASK

the entire sequence.

FIGURE B.13. STERNBEG TASK, MEMORIZATION PHASE

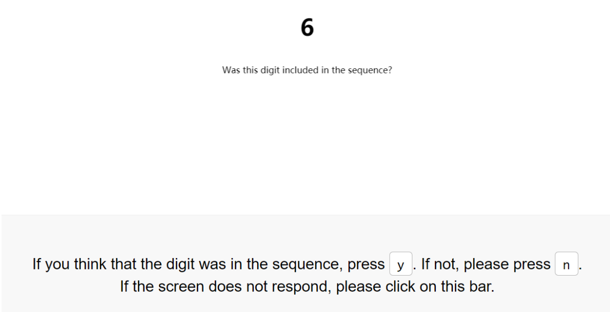


FIGURE B.14. STERNBEG TASK, RECALL PHASE

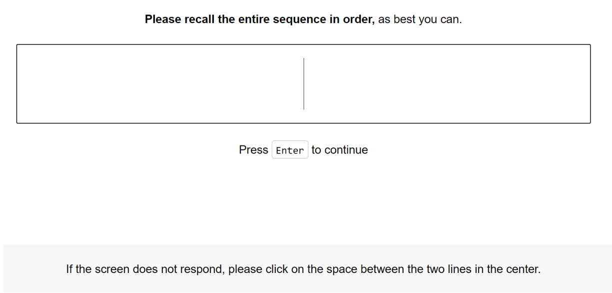


FIGURE B.15. STERNBEG TASK, RECALL PHASE

B.2.4 Experimental Section 3

In this section, you will also be asked to imagine yourself in three hypothetical scenarios and answer a few questions related to those scenarios. There are no right or wrong answers to those questions, simply answer based on your feeling.

Attitude towards Inconsistency

Imagine that you are at a cinema and wish to buy some popcorn. The cinema sells small tubs of popcorn for £3 and large ones for £7. Suppose that you choose the small one. Now consider a different situation. The cinema sells small tubs for £3, medium ones for £6.50 and large ones for £7. This time you choose the large one.

In the first case, you prefer the small size to the large. In the second case, your choice suggests the opposite. How at ease do you feel with your choices? Please rate how at ease you feel on the scale provided. A rating of 0 means that you are not at all at ease with one or more of your choices and would really like to make changes. A rating of 10 means that you could not be more at ease and have no wish to change anything.

Sunk Cost Fallacy

Imagine that you have spent £50 on a ticket for concert A and £100 on a ticket for concert B. You really prefer A to B, but you have discovered that the two concerts are to take place exactly at the same time on the same day. You cannot obtain a refund or sell the tickets. Which concert would you go to?

- Concert A
- Concert B

Non-Consequentialism

Imagine two trips you may make this summer. You plan Trip 1 by yourself. Someone plans Trip 2 for you. The plans for both trips are the same. You will visit the same places, take the same photos and enjoy the same foods. In other words, you will enjoy the same experiences on both trips. Which trip do you prefer to go to?

- Trip 1
- Trip 2
- I am indifferent between the two trips.

Appendix C Descriptive Statistics of the Sample

C.1 Demographics

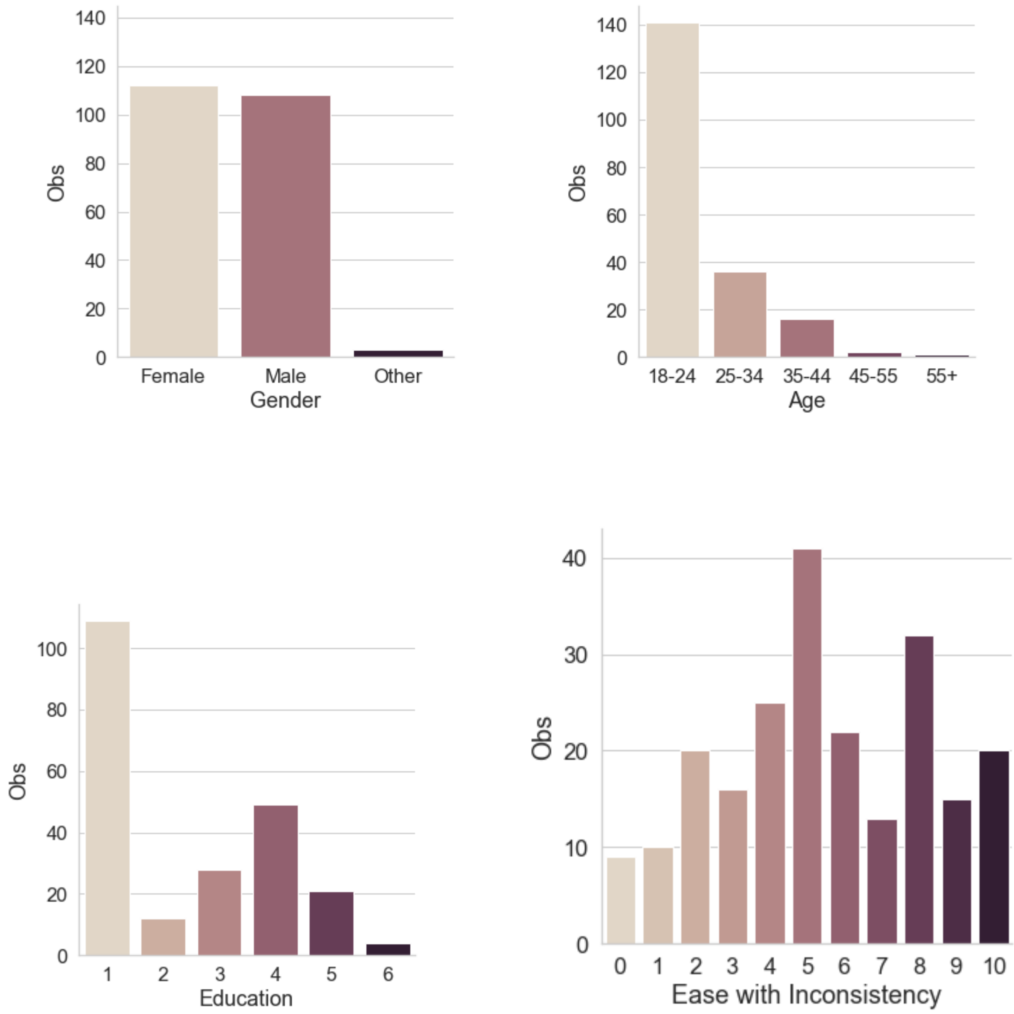


FIGURE C.1. HISTOGRAMS OF DEMOGRAPHICS

Notes: The variable *Education* takes a numeric value defined as follows: 0="No Qualifications", 1="High school diploma/A-levels" or "Secondary education (e.g., GED/GCSE)", 2="Technical/community college", 3="Undergraduate degree (BA/BSc/other)", 4="Graduate degree (MA/MSc/MPhil/other)", 5="Doctorate degree (PhD/other)".

C.2 Cognitive Ability

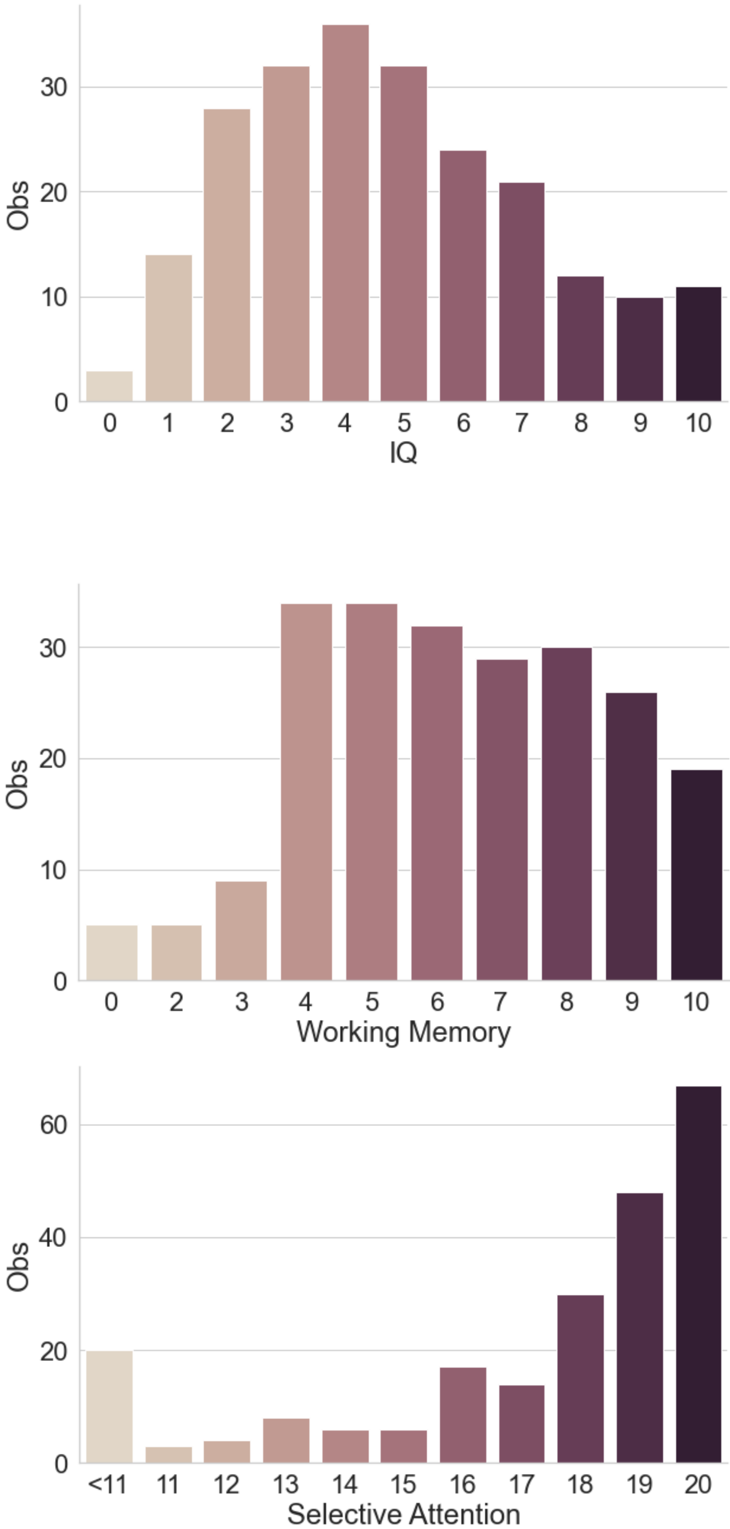


FIGURE C.2. HISTOGRAMS OF COGNITIVE ABILITY

C.3 Balance Checks

TABLE C.1. DESCRIPTIVE STATISTICS AND BALANCE

Variable	Direct Procedure	Sequential Elimination	Difference
Age (years)	23.147	24.712	1.566
	(5.082)	(8.259)	(1.124)
Female	0.520	0.507	-0.013
	(0.503)	(0.503)	(0.083)
Education (highest completed level)	1.973	2.000	0.027
	(1.150)	(1.190)	(0.192)
IQ	4.907	4.562	-0.345
	(2.291)	(2.560)	(0.399)
Selective Attention	17.173	16.616	-0.557
	(3.411)	(4.192)	(0.627)
Working Memory	6.213	6.096	-0.117
	(2.164)	(2.328)	(0.369)
Attitude towards Inconsistency	5.800	5.329	-0.471
	(2.899)	(2.911)	(0.478)
Observations	75	73	148

Notes: Standard errors in parentheses.

TABLE C.2. DETAILED BREAKDOWN OF OBSERVATIONS

Treatment / IQ Group	Direct Procedure	Sequential Elimination	Direct Procedure (Free)	Sequential Elimination (Free)
Low-IQ Subjects	34 (45.3%)	40 (54.8%)	7 (26.9%)	32 (65.3%)
High-IQ Subjects	41 (54.7%)	33 (45.2%)	19 (73.1%)	17 (34.7%)
Total	75 (100%)	73 (100%)	26 (100%)	49 (100%)

C.4 Economic Rationality

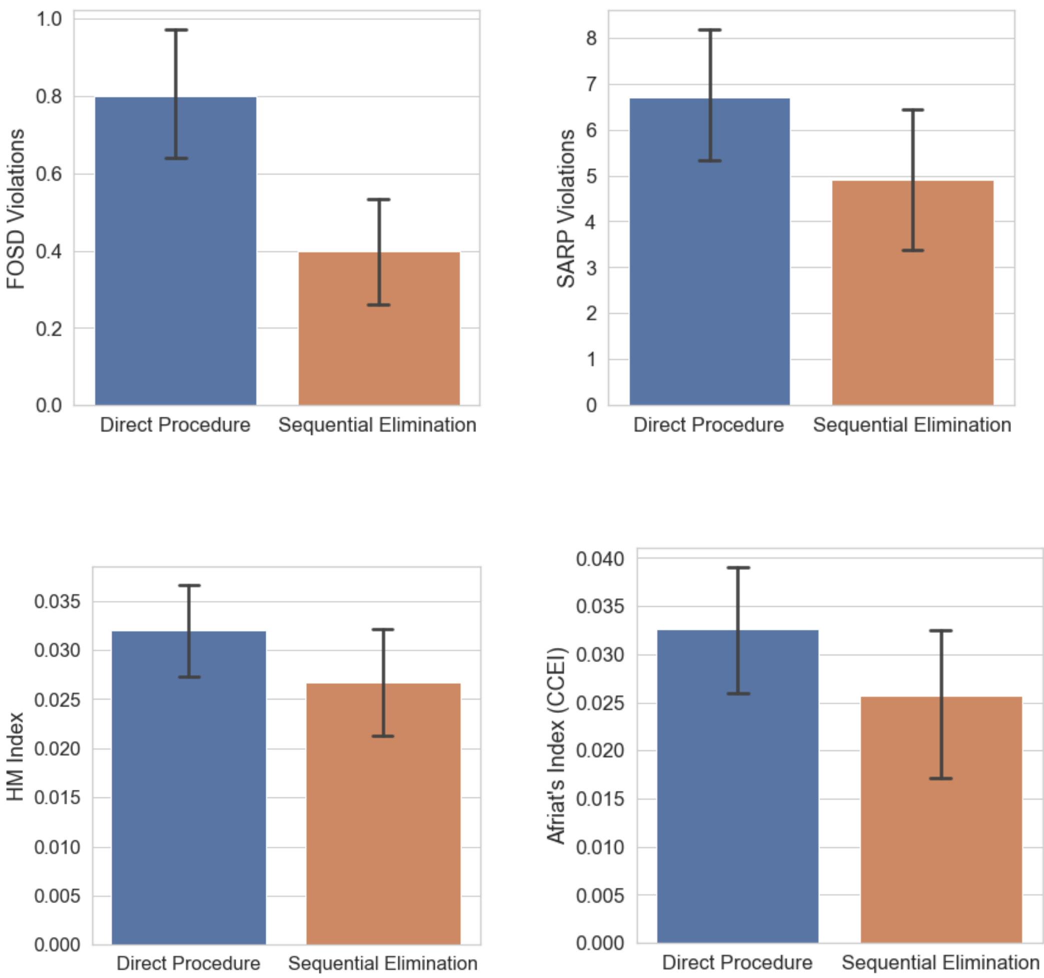


FIGURE C.3. GROUP-BY-GROUP MEANS OF ECONOMIC RATIONALITY MEASURES
Notes: Error bars indicate the standard error of means.

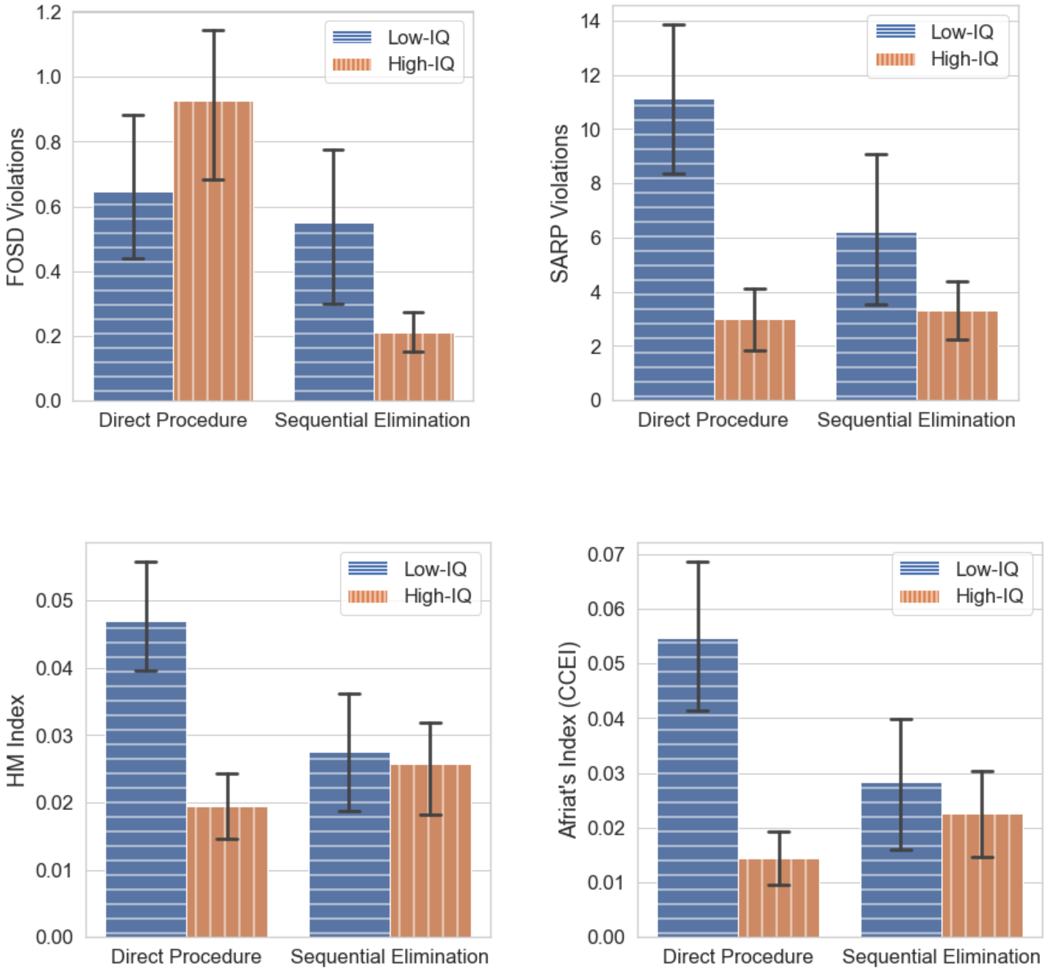


FIGURE C.3 (Continued). GROUP-BY-GROUP MEANS OF ECONOMIC RATIONALITY MEASURES

Notes: Error bars indicate the standard error of means.

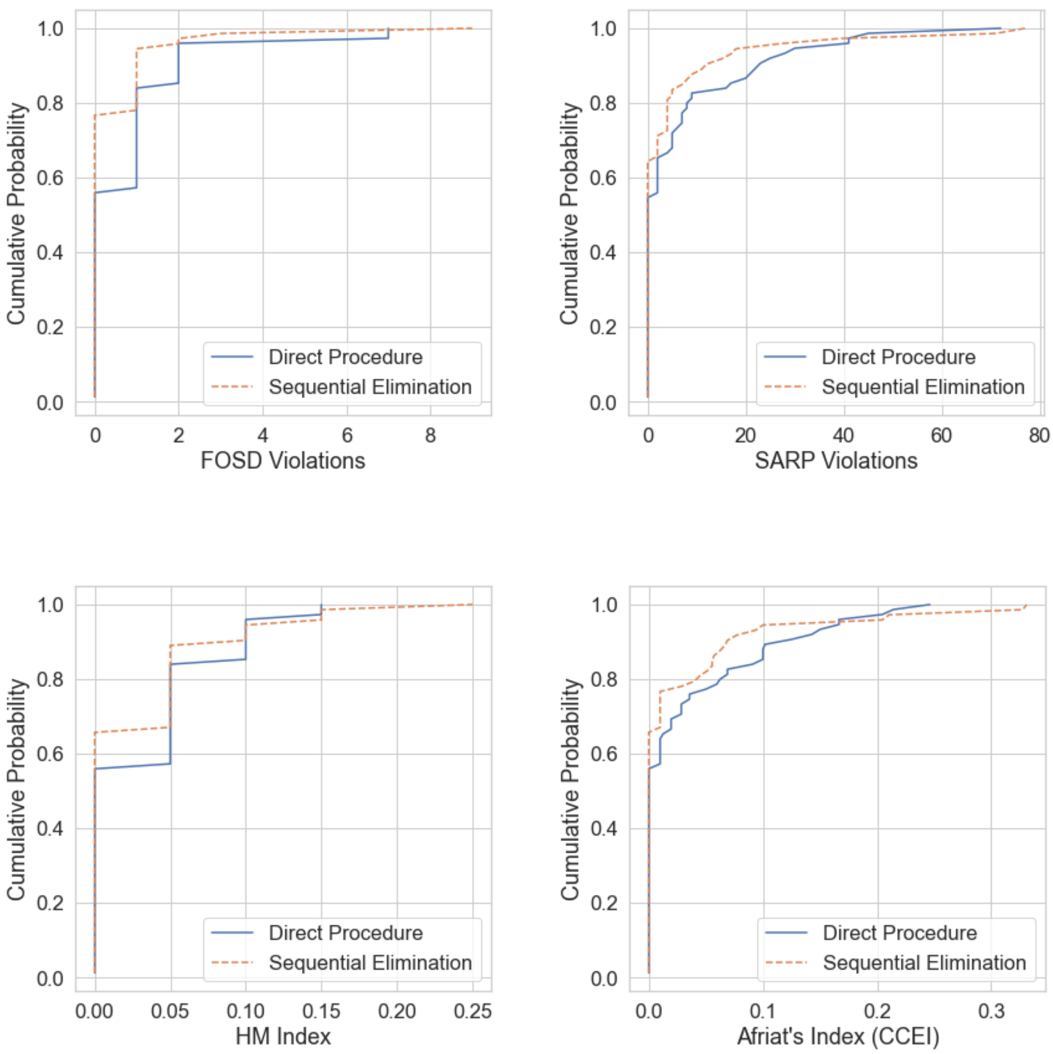


FIGURE C.4. GROUP-BY-GROUP EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTIONS OF ECONOMIC RATIONALITY MEASURES

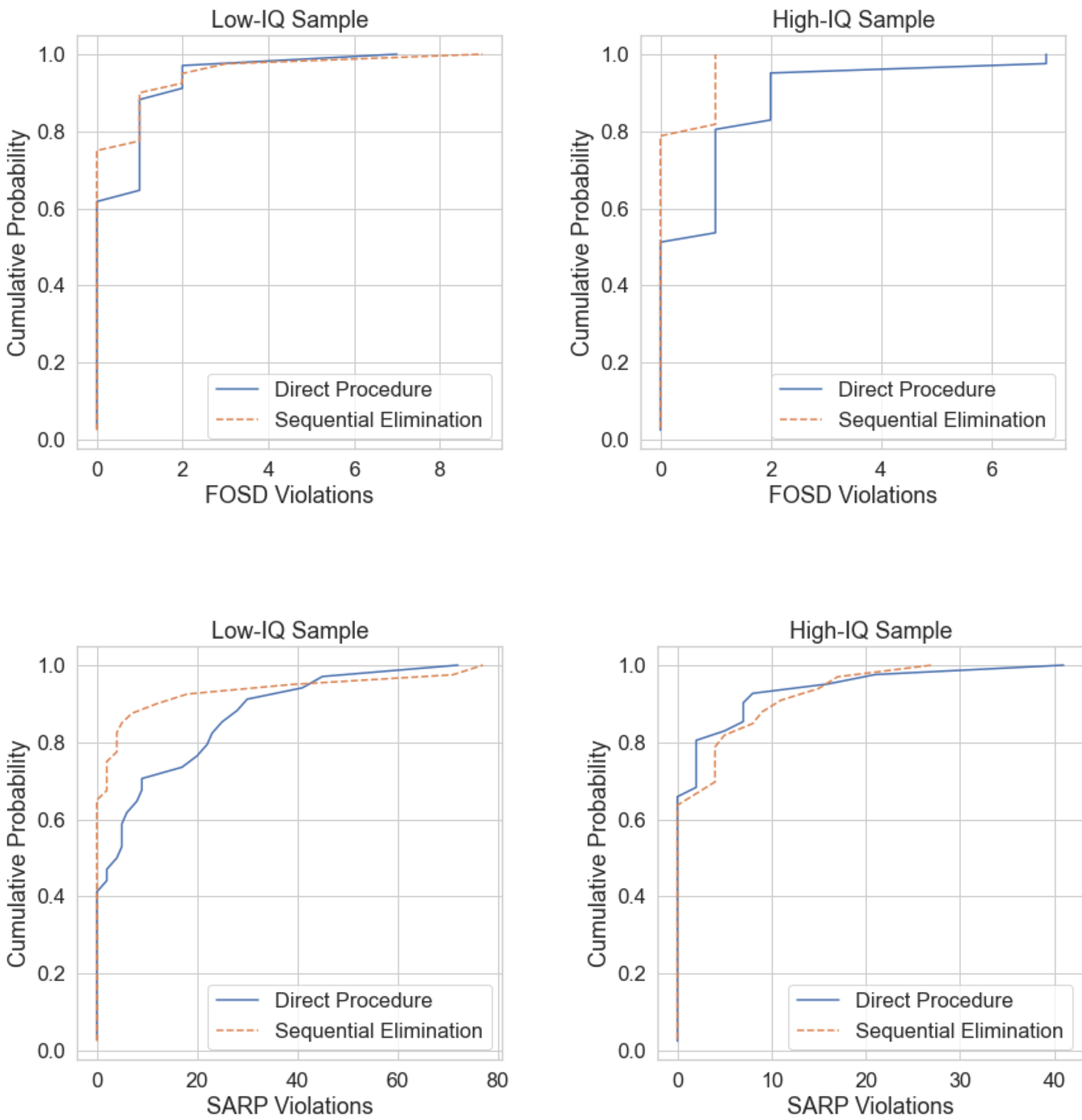


FIGURE C.4 (Continued). GROUP-BY-GROUP EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTIONS OF ECONOMIC RATIONALITY MEASURES

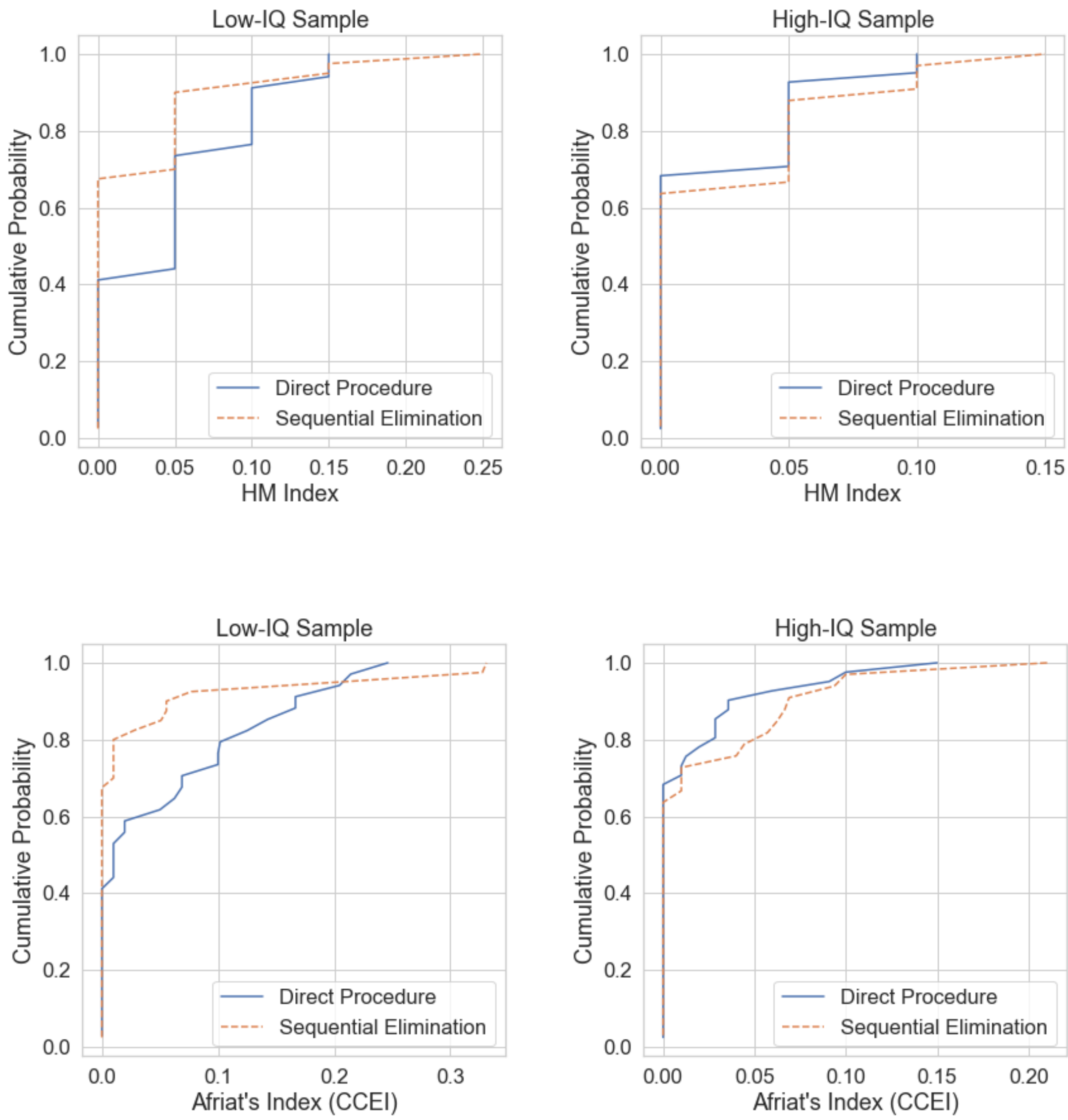


FIGURE C.4 (Continued). GROUP-BY-GROUP EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTIONS OF ECONOMIC RATIONALITY MEASURES

C.5 Risk Preferences

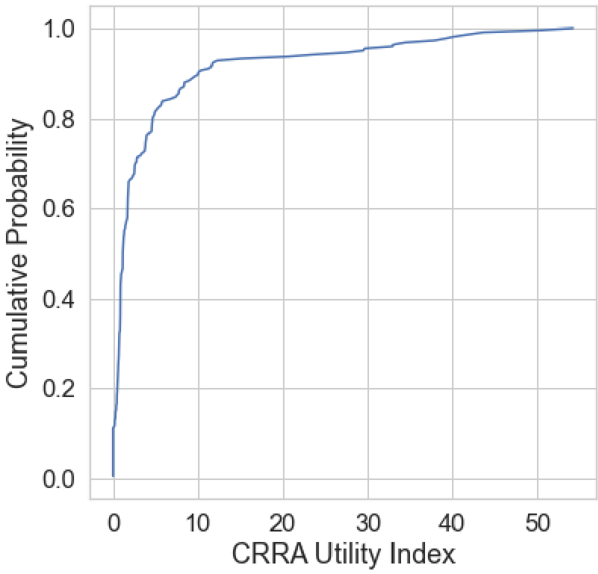


FIGURE C.5. EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTION OF ESTIMATED CRRA UTILITY INDEX

Appendix D Further Analysis and Robustness Checks

D.1 Individual Behavior during the Choice Procedures

This section examines how individuals may differ in their behavior during the direct procedure and sequential elimination. To this end, I focus on the orders in which options—represented by their presentation orders in decision problems—are examined (eliminated, respectively) during the Direct Procedure (Sequential Elimination, respectively), referred to as *examination orders* (*elimination orders*, respectively). For example, an examination order (elimination order, respectively) of [3,1,2,10,9,5,6,8,11,4,7] indicates that a subject sequentially examines (eliminated, respectively) the third, first,..., and seventh options in a decision problem under the Direct Procedure (Sequential Elimination, respectively). I assess the relationship between these orders in different groups using Spearman and Kendall rank coefficients.

Table D.1 presents the results. The top three rows show that the mean and median examination order of the group significantly correlate with the default (presentation) orders ($p < 0.01$); and this remains true for both low- and high-IQ subjects. The results suggest that the subjects tend to examine options sequentially following presentation orders under the Direct Procedure, regardless of their cognitive ability.

Meanwhile, Columns 2 and 4 indicate a significant correlation ($p < 0.1$) between the median elimination order and the default order. However, this is not robust to the case of the mean elimination order (Columns 1 and 3). In other words, there is insufficient evidence to conclude the presentation order's impact on individual elimination behavior; even if it exists, it is considerably less significant than its impact on individual examination behavior.

The last three rows show no significant similarity between subjects' behavior during the two procedures. This finding is also supported by the Mann-Whitney U test on the differences in the individual-level rank coefficients under the two procedures, as shown in the top three rows of Table D.2.

TABLE D.1. RANK CORRELATION COEFFICIENTS BETWEEN DIFFERENT ORDERS

Orders \ Coefficient	Spearman		Kendall	
	(1)	(2)	(3)	(4)
Examination and Default Orders	0.995***	1.0***	0.982***	1.0***
-Low-IQ Subjects	0.995***	1.0***	0.982***	1.0***
-High-IQ Subjects	0.995***	1.0***	0.982***	1.0***
Elimination and Default Orders	0.5	0.472	0.426	0.402
-Low-IQ Subjects	0.5	0.528*	0.426	0.446*
-High-IQ Subjects	0.5	-0.046	0.426	-0.078
Examination and Elimination Orders	0.502	0.5	0.434	0.426
-Low-IQ Subjects	0.502	0.5	0.434	0.426
-High-IQ Subjects	0.502	0.5	0.434	0.426

Note: Columns 1 and 3 measure rank coefficients based on the mean orders at the group level (rounded to integer), Columns 2 and 4 are based on the median orders (rounded to integer).
* $p < 0.1$, *** $p < 0.01$.

TABLE D.2. MANN-WHITNEY U TEST ON THE DIFFERENCES IN THE RANK COEFFICIENTS BETWEEN DIFFERENT GROUPS

Groups \ Coefficient	Spearman		Kendall	
	(1)	(2)	(3)	(4)
Direct Procedure and Sequential Elimination	5171.5***	5166.5***	5206.0***	5206.0***
-Low-IQ Subjects	1275.0***	1274.0***	1285.0***	1282.0***
-High-IQ Subjects	1289.5***	1286.0***	1296.0***	1299.0***
Low-IQ and High-IQ	2695.0	2707.5	2604.5	2629.5
-Under the Direct Procedure	794.5	794.5	718.0	718.0
-Under Sequential Elimination	741.5	754.5	733.5	756.5

Note: Columns 1 and 3 measure rank coefficients based on the mean orders at the group level (rounded to integer), Columns 2 and 4 are based on the median orders (rounded to integer).
* $p < 0.1$, *** $p < 0.01$.

Will distinct procedural behavior interact differently with a possible impact of presentation order on choices? This question is examined by Table D.3, which shows no significant difference in the presentation positions of choices between different (treatment and cognitive) groups. In light of this result, there unlikely exists a presentation order effect that accounts for the difference in rationality levels between the two choice procedures.

TABLE D.3. MANN-WHITNEY U TEST ON THE DIFFERENCE IN THE CHOICE POSITIONS BETWEEN DIFFERENT GROUPS

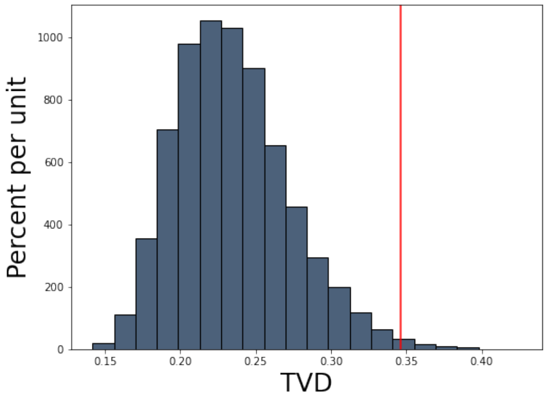
Choice Positions being compared	Mann-Whitney U Test Statistic Test Statistic
DP and SE	2604.5
DP and SE (Low-IQ)	714.5
DP and SE (High-IQ)	584.5
Low-IQ and High-IQ	3151.0
Low-IQ and High-IQ in the DP	848.5
Low-IQ and High-IQ in SE	703.0

D.2 Economic Rationality

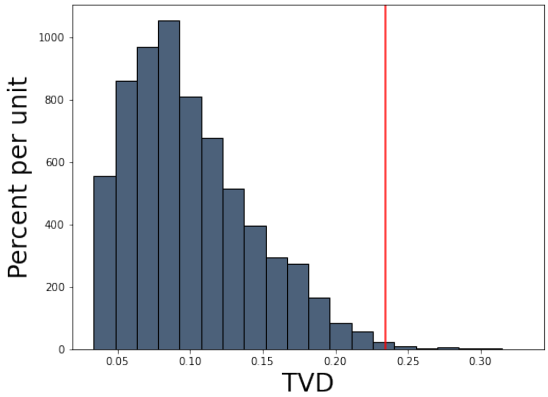
The results presented are robust to several alternative approaches. Two-sample permutation tests allow nonparametric testing of the difference in GARP violations under the two treatments. 10,000 data sets are generated by randomly shuffling the treatment assignments in the sample, and a calculation is made of the total Variation Distance (TVD) between the GARP violation distributions under these assignments. The null hypothesis is that the economic rationality of choices under the Direct Procedure and Sequential Elimination come from the same distribution. If the null hypothesis is true, the TVD given by the actual data should appear with a high probability in the shuffled data sets; otherwise, it should appear with a low probability. Figure D.1 plots the empirical distribution of the TVD in the permutations, which suggests rejection of the null hypothesis, since the observed differences in the TVD for both GARP and FOSD violations data (indicated by red lines) are statistically significant. This provides evidence for the effect of sequential elimination on economic rationality, not only in the sample but also in the population.

Figure D.2 shows permutation tests in the low-IQ group and the ones in the high-IQ group. In particular, the TVD difference in GARP violations between the Direct Procedure and Sequential Elimination is statistically significant for low-IQ subjects ($p = 0.004$, Figure D.2 (a)) but not for High-IQ subjects ($p = 0.1308$, Figure D.2 (b)). Reversely, with the switch from Direct Procedure to Sequential Elimination, the TVD difference in FOSD violations is statistically significant for high-IQ subjects ($p = 0.0262$, Figure D.2 (c)) but not for low-IQ subjects ($p = 0.2426$, Figure D.2 (d)). In sum, the nonparametric results are consistent with our previous regression analysis.

Table D.4 shows, in addition to the Table 2, negative binomial regression estimates for SARP violations and the HM index, due to their count data nature. Also shown are the OLS regression estimates for the CCEI, where the OLS coefficients exactly reproduce the marginal effects. Columns (1)-(4) indicate that the effect of sequential elimination on GARP violations remains similar for SARP violations ($p = 0.15$), but differs for HM index ($p = 0.63$) and CCEI



(a) GARP VIOLATIONS



(b) FOSD VIOLATIONS

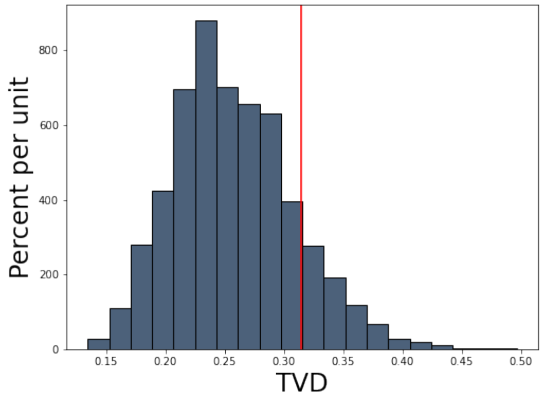
FIGURE D.1. PERMUTATION TESTS OF SEQUENTIAL ELIMINATION EFFECT ON ECONOMIC RATIONALITY

Notes: Empirical P-values are (a) 0.0058; (b) 0.0071

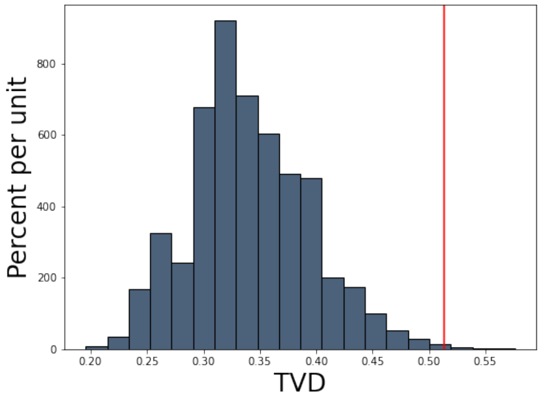
(p = 0.77). The HM index is sensitive to the total number of decision problems and CCEI is sensitive to the GARP violation associated with the maximum wealth loss, but not to the total number of violations, which is the central interest of this paper.

The experiment also elicits the subject's tendencies to commit sunk cost fallacy and non-consequentialism. The sunk cost fallacy suggests that individuals influenced by sunk cost concerns (e.g., time, effort, and money) tend to make non-optimal decisions, thereby violating consistency (Thaler, 1980, 1999). Adopting the Arkes and Blumer (1985)'s scenario, as described in Appendix B, individuals who choose the higher-sunk-cost option are considered subject to sunk cost fallacy. Consequentialism refers to the case where individuals value their choice irrespective of how it is generated. Recent evidence suggests that individuals may make nonoptimal decisions (i.e., those that go against their material interest), motivated in their decision by non-consequential factors such as decision rights (Fehr, Herz and Wilkening, 2013; Bartling, Fehr and Herz, 2014). It is possible that non-consequentialist responses have an impact on choice consistency. Subjects are therefore asked to indicate whether they prefer one of two options with identical consequences, or feel indifferent towards them. Subjects with a declared preference for one or the other is considered a non-consequentialist.

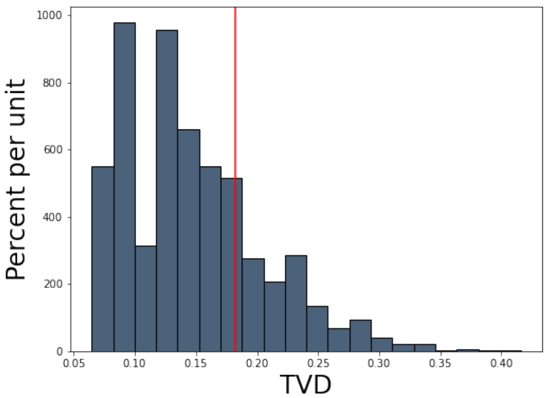
Table D.5 reports the robustness of the results to some alternative specifications. Column (1) replicates column (1) of Table 2, including, in addition, the sunk cost fallacy and the non-consequentialism. The effect of sequential elimination for low-IQ individuals (i.e., IQ-Q1 subjects in column (1)) is larger and still statistically significant ($p = 0.04$). Columns (2) and (3) replicate the aforementioned negative binomial estimation where subjects are categorized by IQ based on their positions in the distribution, first by terciles and then by quartiles. The variable of interest,



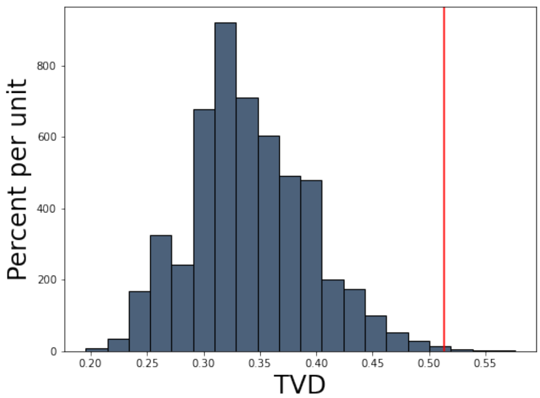
(a) GARP VIOLATIONS, LOW-IQ SAMPLE



(b) GARP VIOLATIONS, HIGH-IQ SAMPLE



(c) FOSD VIOLATIONS, LOW-IQ SAMPLE



(d) GARP VIOLATIONS, HIGH-IQ SAMPLE

FIGURE D.2. PERMUTATION TESTS OF SEQUENTIAL ELIMINATION EFFECT ON ECONOMIC RATIONALITY IN COGNITIVE GROUPS

Notes: Empirical P-values are (a) 0.004; (b) 0.1308; (c) 0.2426; (d) 0.0262.

Sequential Elimination, reduces GARP violations among subjects with IQs in the lowest tercile ($p = 0.04$) and the lowest quartile ($p = 0.03$).

TABLE D.4. DETERMINANTS OF ECONOMIC RATIONALITY

	GARP Violations (1)	SARP Violations (2)	HM Index (3)	CCEI (4)	FOSD Violations (5)
Sequential Elimination	-4.480*	-4.100*	-0.003	-0.003	-0.515**
	(3.045)	(2.871)	(0.007)	(0.011)	(0.215)
-Low-IQ Subjects	-9.409**	-8.762**	-0.014	-0.020	-0.226
	(5.246)	(4.962)	(0.011)	(0.019)	(0.233)
-High-IQ Subjects	0.799	0.833	0.008	0.014	-0.917**
	(1.302)	(1.532)	(0.008)	(0.010)	(0.434)
Age	-0.456*	-0.423*	-0.002**	-0.001**	-0.064***
	(0.253)	(0.242)	(0.001)	(0.001)	(0.024)
Female	0.885	-0.154	-0.005	0.003	0.170
	(2.138)	(2.079)	(0.007)	(0.009)	(0.177)
Education	-1.232	-0.936	0.002	-0.000	0.212
	(1.339)	(1.287)	(0.004)	(0.004)	(0.133)
High-IQ	-7.300**	-6.994***	-0.012*	-0.021**	0.145
	(2.900)	(2.711)	(0.007)	(0.010)	(0.211)
Selective Attention	-0.283	-0.266	-0.001	-0.003	-0.030
	(0.373)	(0.348)	(0.001)	(0.002)	(0.031)
Working Memory	-0.357	-0.382	-0.003	-0.001	-0.045
	(0.500)	(0.503)	(0.002)	(0.003)	(0.051)
Response Time (Minutes)	-0.491**	-0.442**	-0.001*	-0.002*	0.012
	(0.229)	(0.217)	(0.001)	(0.001)	(0.020)
Attitude towards Inconsistency	-0.840	-0.815*	-0.001	-0.002	0.021
	(0.511)	(0.478)	(0.001)	(0.002)	(0.033)
N	148	148	148	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE D.5. DETERMINANTS OF ECONOMIC RATIONALITY (ROBUSTNESS CHECKS)

	GARP Violations		
	2-Quantiles (1)	3-Quantiles (2)	4-Quantiles (3)
Sequential Elimination	-4.623*	-3.416*	-3.320*
	(3.079)	(2.648)	(2.554)
–1st IQ quartile	-9.747**	-9.955**	-8.871**
	(5.415)	(5.656)	(4.762)
–2nd IQ quartile	0.799	-2.234	-5.739
	(1.261)	(4.398)	(9.063)
–3rd IQ quartile		1.668	-0.257
		(1.245)	(1.864)
–4th IQ quartile			2.208
			(1.529)
Age	-0.422	-0.275	-0.337
	(0.266)	(0.251)	(0.251)
Female	1.008	-0.653	0.587
	(2.196)	(2.145)	(1.926)
Education	-1.490	-1.135	-1.373
	(1.416)	(1.136)	(1.170)
2nd IQ quartile	-7.413**	0.413	5.121
	(2.937)	(3.546)	(4.844)
3rd IQ quartile		-6.078**	-4.308
		(3.091)	(2.755)
4th IQ quartile			-5.850**
			(2.746)
Selective Attention	-0.232	-0.173	-0.196
	(0.358)	(0.286)	(0.301)
Working Memory	-0.360	-0.257	0.0461
	(0.501)	(0.449)	(0.426)
Response Time	-0.481**	-0.486**	-0.421**
	(0.223)	(0.201)	(0.191)
Attitude towards Inconsistency	-0.778	-0.775*	-0.588
	(0.484)	(0.471)	(0.441)
Sunk Cost Bias	1.509		
	(3.430)		
Non-Consequentialism	1.519		
	(2.252)		
N	148	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.3 Choice Revision

TABLE D.6. EFFECTS OF CHOICE REVISION ON GARP VIOLATIONS (ROBUSTNESS CHECKS)

	GARP Violations			
	(1)	(2)	(3)	(4)
Choice Revision (CR)	-3.508	-3.387	-1.983	-1.852
	(2.449)	(2.595)	(2.545)	(2.583)
-Direct Procedure		-4.541		-4.142
		(3.407)		(4.692)
-Low-IQ Subjects				-4.664
				(7.004)
-High-IQ Subjects				-3.182
				(2.695)
-Sequential Elimination		-2.105		0.469
		(3.885)		(3.265)
-Low-IQ Subjects				3.486
				(3.803)
-High-IQ Subjects				-5.078
				(6.181)
-Low-IQ Subjects			-1.080	-0.978
			(4.682)	(4.239)
-High-IQ Subjects			-2.910	-4.039
			(1.921)	(3.22)
Sequential Elimination (SE)	-1.565	-0.485	-0.553	-2.017
	(2.635)	(2.200)	(2.356)	(2.724)
High-IQ	-7.336***	-6.683***	-7.042***	-7.433**
	(2.675)	(2.390)	(2.697)	(3.091)
Age	-0.731**	-0.665**	-0.689**	-0.632**
	(0.304)	(0.288)	(0.290)	(0.300)
Female	-0.599	-0.596	-1.034	-1.590
	(2.552)	(2.413)	(2.586)	(2.797)
Education	0.154	0.295	0.204	-0.034
	(1.220)	(1.143)	(1.168)	(1.312)
Selective Attention	-0.127	-0.091	-0.019	-0.062
	(0.306)	(0.260)	(0.276)	(0.288)
Working Memory	-0.497	-0.422	-0.578	-0.572
	(0.517)	(0.475)	(0.515)	(0.533)
Response Time (Minutes, Block A)	-0.535**	-0.456**	-0.551**	-0.561**
	(0.234)	(0.226)	(0.235)	(0.234)
Response Time (Minutes, Block B)	0.769	0.625	0.720	0.787
	(0.490)	(0.435)	(0.461)	(0.504)
Attitude towards Inconsistency	-0.720	-0.656	-0.696*	-0.800*
	(0.442)	(0.409)	(0.417)	(0.475)
N	151	151	151	151

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE D.7. EFFECTS OF CHOICE REVISION ON FOSD VIOLATIONS (ROBUSTNESS CHECKS)

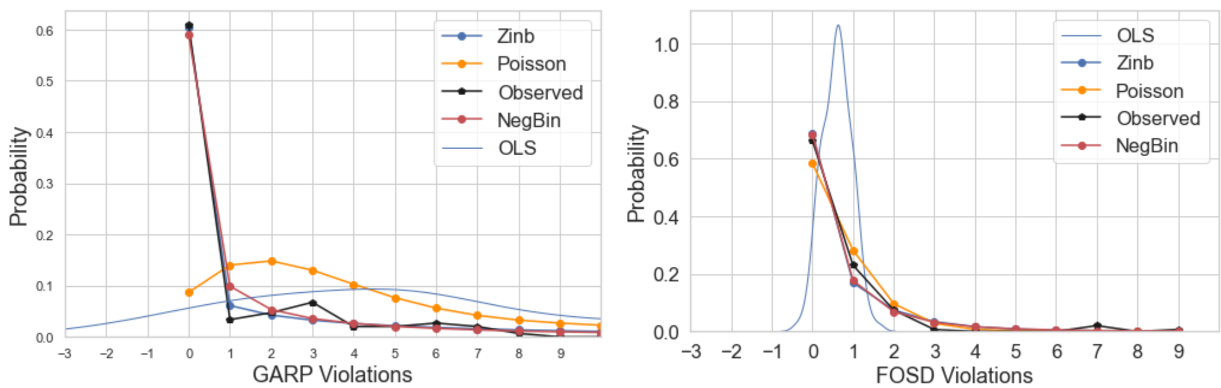
	FOSD Violations			
	(1)	(2)	(3)	(4)
Choice Revision (CR)	-0.368**	-0.321	-0.423**	-0.42**
	(0.205)	(0.211)	(0.256)	(0.244)
-Direct Procedure		-0.193		-0.379
		(0.370)		(0.449)
-Low-IQ Subjects				-0.611
				0.646
-High-IQ Subjects				(0.084)
				0.466
-Sequential Elimination		-0.433***		-.475
		(0.200)		(0.227)
-Low-IQ Subjects				-0.6101
				(0.330)
-High-IQ Subjects				(-0.206)
				(0.251)
-Low-IQ Subjects			-0.830**	-0.610
			(0.490)	(0.371)
-High-IQ Subjects			-0.011	(-0.070)
			(0.190)	0.247
Sequential Elimination (SE)	-0.489***	-0.462***	-0.559***	-0.417***
	(0.203)	(0.190)	(0.240)	(0.195)
High-IQ	-0.142	-0.177	-0.258	-0.222
	(0.166)	(0.167)	(0.199)	(0.178)
Age	-0.059***	-0.055***	-0.063***	-0.058***
	(0.020)	(0.018)	(0.023)	(0.020)
Female	0.098	0.130	0.113	0.172
	(0.165)	(0.159)	(0.176)	(0.160)
Education	0.139	0.133	0.122	0.112
	(0.100)	(0.096)	(0.094)	(0.090)
Selective Attention	0.001	-0.000	0.004	0.010
	(0.025)	(0.027)	(0.028)	(0.027)
Working Memory	-0.083	-0.088	-0.069	-0.074
	(0.059)	(0.060)	(0.054)	(0.053)
Response Time (Minutes, Block A)	0.011	0.007	0.012	0.008
	(0.017)	(0.016)	(0.017)	(0.016)
Response Time (Minutes, Block B)	-0.019	-0.026	-0.033	-0.022
	(0.043)	(0.044)	(0.050)	(0.046)
Attitude towards Inconsistency	-0.013	-0.006	-0.016	-0.014
	(0.028)	(0.026)	(0.030)	(0.027)
N	151	151	151	151

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix E Details of the Experimental Results

E.1 Model Selection

Figure E.1 presents the observed GARP and FOSD violations, together with and their values predicted by OLS, Poisson, negative binomial (*NegBin*) and zero-inflated negative binomial model (*Zinb*) models, showing that the last one provides a good fit for the observed data. The regressors in both models include sequential elimination, high-IQ, sequential elimination×high-IQ, selective attention, working memory, age, female, education, time, attitude towards inconsistency. The models are compared based on the Akaike information criterion (AIC), Bayesian information criterion (BIC), Likelihood Ratio (LR) Test, and Vuong Test (Vuong, 1989). In Table E.1, the negative differences in AIC and BIC suggest that the NegBin can be considered markedly better. The LR test and Vuong Test reject the null hypothesis that OLS and Poisson models perform better than NegBin at the 0.1% significance level. The Vuong test is not performed for comparing NegBin and Zinb, as Wilson (2015) shows that this comparison is incorrect. Finally, Table E.1 also shows the LR test for using NegBin versus Zinb, the results of which favor the former. Therefore, this paper uses NegBin for the empirical specifications.



(a) (b)

FIGURE E.1. OBSERVED DATA AND MODEL-PREDICTED VALUES

Notes: The original plot of OLS-predicted values is nearly a horizontal line because of the continuity of OLS. The graph presents an estimated kernel density based on the OLS-predicted values.

TABLE E.1. COMPARISONS OF MODELS FOR ESTIMATING THE EFFECTS OF SEQUENTIAL ELIMINATION

Models being compared	AIC difference	BIC difference	LR Test	Vuong Test
GARP Violations				
NegBin and Linear	-561.4985	-561.499	< 0.001	< 0.001
NegBin and Poisson	-1474.19	-1469.19	< 0.001	< 0.001
NegBin and Zinb	-1.0848	-34.0541	< 0.05	
FOSD Violations				
NegBin and Linear	-205.3137	-205.3137	< 0.001	< 0.05
NegBin and Poisson	-42.42791	-37.4307	< 0.001	< 0.001
NegBin and Zinb	20.11763	-12.8517	< 0.001	

E.2 Economic Rationality

TABLE E.2. DETERMINANTS OF ECONOMIC RATIONALITY (ORIGINAL FORM)

	GARP Violations (1)	SARP Violations (2)	HM Index (3)	CCEI (4)	FOSD Violations (5)
Sequential Elimination	-1.086***	-0.963***	-0.408	-0.020	-0.413
	(0.508)	(0.486)	(0.336)	(0.019)	(0.395)
High-IQ	-1.830***	-1.629***	-0.762**	-0.038**	0.570
	(0.460)	(0.439)	(0.323)	(0.015)	(0.432)
Sequential Elimination×High-IQ	1.386**	1.225*	0.764	0.034*	-1.086*
	(0.658)	(0.641)	(0.482)	(0.020)	(0.611)
Age	-0.072*	-0.064*	-0.057**	-0.001**	-0.100***
	(0.038)	(0.034)	(0.025)	(0.001)	(0.031)
Female	0.140	-0.023	-0.173	0.003	0.265
	(0.330)	(0.313)	(0.235)	(0.009)	(0.280)
Education	-0.195	-0.141	0.060	-0.000	0.332**
	(0.191)	(0.184)	(0.119)	(0.004)	(0.165)
Selective Attention	-0.045	-0.040	-0.017	-0.003	-0.048
	(0.053)	(0.049)	(0.034)	(0.002)	(0.045)
Working Memory	-0.056	-0.057	-0.117	-0.001	-0.071
	(0.076)	(0.073)	(0.076)	(0.003)	(0.075)
Response Time (Minutes)	-0.078***	-0.066**	-0.035*	-0.002*	0.019
	(0.027)	(0.027)	(0.020)	(0.001)	(0.030)
Attitude towards Inconsistency	-0.133**	-0.123**	-0.043	-0.002	0.033
	(0.060)	(0.057)	(0.039)	(0.002)	(0.051)
Constant	6.888***	6.507***	-0.384	0.166***	1.828*
	(1.143)	(1.084)	(0.738)	(0.047)	(1.017)
N	148	148	148	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.3 Choice Revision

TABLE E.3. EFFECTS OF CHOICE REVISION ON CONSISTENCY (ORIGINAL FORM)

	GARP Violations			
	(1)	(2)	(3)	(4)
Choice Revision (CR)	-0.560	-0.676	-0.110	-0.270
	(0.364)	(0.455)	(0.476)	(0.620)
Sequential Elimination (SE)	-0.373	-0.269	-0.091	-0.846
	(0.482)	(0.597)	(0.386)	(0.631)
High-IQ	-1.631***	-1.323***	-0.807	-1.194*
	(0.477)	(0.362)	(0.509)	(0.648)
SE×High-IQ	0.607			0.985
	(0.669)			(0.986)
Age	-0.117***	-0.113***	-0.113***	-0.101***
	(0.035)	(0.036)	(0.035)	(0.036)
Female	-0.096	-0.102	-0.170	-0.253
	(0.403)	(0.407)	(0.412)	(0.422)
Education	0.025	0.050	0.034	-0.005
	(0.195)	(0.195)	(0.192)	(0.208)
Selective Attention	-0.020	-0.015	-0.003	-0.010
	(0.049)	(0.044)	(0.045)	(0.046)
Working Memory	-0.079	-0.072	-0.095	-0.091
	(0.078)	(0.077)	(0.078)	(0.078)
Response Time (Minutes, Block A)	-0.085***	-0.078**	-0.090***	-0.089***
	(0.031)	(0.034)	(0.030)	(0.028)
Response Time (Minutes, Block B)	0.123*	0.106	0.118*	0.125*
	(0.071)	(0.069)	(0.069)	(0.071)
Attitude towards Inconsistency	-0.115*	-0.112*	-0.114**	-0.127**
	(0.059)	(0.061)	(0.058)	(0.059)
SE×CR		0.322		0.549
		(0.758)		(0.862)
High-IQ×CR			-0.883	-0.829
			(0.722)	(0.971)
High-IQ×CR×SE				-0.376
				(1.406)
Constant	7.096***	6.714***	6.472***	6.722***
	(1.159)	(1.131)	(1.099)	(1.140)
N	151	151	151	151

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE E.4. EFFECTS OF CHOICE REVISION ON FOSD VIOLATIONS (ORIGINAL FORM)

	FOSD Violations			
	(1)	(2)	(3)	(4)
Choice Revision (CR)	-0.629**	-0.229	-1.112**	-0.770
	(0.320)	(0.425)	(0.470)	(0.648)
Sequential Elimination (SE)	-0.594	-0.404	-0.962***	-0.200
	(0.388)	(0.416)	(0.299)	(0.611)
High-IQ	-0.003	-0.310	-0.992**	-0.636
	(0.378)	(0.291)	(0.494)	(0.650)
SE×High-IQ	-0.838			-0.738
	(0.580)			(0.813)
Age	-0.100***	-0.094***	-0.105***	-0.100***
	(0.030)	(0.028)	(0.031)	(0.029)
Female	0.167	0.223	0.188	0.295
	(0.288)	(0.279)	(0.299)	(0.277)
Education	0.238	0.229	0.205	0.194
	(0.152)	(0.148)	(0.148)	(0.146)
Selective Attention	0.002	-0.001	0.006	0.017
	(0.043)	(0.047)	(0.047)	(0.046)
Working Memory	-0.142*	-0.152*	-0.115	-0.128
	(0.086)	(0.089)	(0.080)	(0.083)
Response Time (Minutes, Block A)	0.018	0.013	0.020	0.013
	(0.028)	(0.028)	(0.028)	(0.026)
Response Time (Minutes, Block B)	-0.032	-0.045	-0.055	-0.038
	(0.073)	(0.074)	(0.081)	(0.078)
Attitude towards Inconsistency	-0.022	-0.011	-0.028	-0.024
	(0.047)	(0.045)	(0.050)	(0.047)
SE×CR		-0.927		-0.732
		(0.610)		(0.862)
High-IQ×CR			1.086*	0.881
			(0.612)	(0.831)
High-IQ×CR×SE				0.022
				(1.230)
Constant	2.692***	2.592***	3.158***	2.528***
	(0.947)	(0.926)	(1.046)	(0.946)
N	151	151	151	151

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.4 Individual Preference for Sequential Elimination

TABLE E.5. DETERMINANTS OF PREFERENCE FOR SEQUENTIAL ELIMINATION (ORIGINAL FORM)

	Probability of Choosing Sequential Elimination	
	(Probit) (1)	(Logistic) (2)
Age	-0.0151	-0.0235
	(0.0257)	(0.0431)
Female	0.391	0.684
	(0.339)	(0.587)
Education	0.409**	0.663**
	(0.164)	(0.279)
IQ	-0.151**	-0.254*
	(0.0738)	(0.133)
Selective Attention	-0.0890	-0.145
	(0.0589)	(0.104)
Working Memory	-0.137*	-0.228*
	(0.0752)	(0.130)
Attitude towards Inconsistency	0.0110	0.0203
	(0.0701)	(0.123)
Constant	3.135**	5.093**
	(1.341)	(2.344)
N	75	75

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.5 Risk Preferences

TABLE E.6. DETERMINANTS OF RISK PREFERENCES (ORIGINAL FORM)

	CRRA Utility Index	
	(1)	(2)
IQ	-0.397*	-0.358
	(0.230)	(0.227)
-Direct Procedure		0.071
		(0.320)
-Sequential Elimination		-0.799**
		(0.397)
Sequential Elimination	2.010	2.063
	(1.619)	(1.628)
Age	-0.0790	-0.078
	(0.127)	(0.128)
Female	1.964	1.974
	(1.383)	(1.380)
Education	0.702	0.633
	(0.695)	(0.705)
Selective Attention	-0.239	-0.216
	(0.252)	(0.240)
Working Memory	-0.400	-0.449
	(0.347)	(0.364)
Response Time (Minutes)	-0.151	-0.164
	(0.196)	(0.192)
Attitude towards Inconsistency	0.164	0.143
	(0.283)	(0.286)
N	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.6 Response Times

Table E.7 shows that subjects under Sequential Elimination spend more time making decision, on average (a); and this is particularly true for low subjects (b). To obtain a precise understanding of the relationship between response time and choice consistency, Table E.8 perform two negative binomial regressions: one includes an interaction term between response time and Sequential Elimination (Column (1)); the other includes triple interaction between response time, Sequential Elimination, and high-IQ (Column (2)). I do not find strong evidence of response times' effects when conditioned on specific subgroups of subjects, given that only the coefficient of the triple interaction term is observed with significance. Plausibly, the analysis of response times in specific subgroups is limited by the sample size of the present experiment.

TABLE E.7. DETERMINANTS OF RESPONSE TIMES

	Response Time (Minute)
	(1)
Sequential Elimination	3.788***
	(0.996)
-Low-IQ Subjects	4.041**
	(1.650)
-High-IQ Subjects	3.534***
	(0.961)
Age	-0.010
	(0.081)
Female	-0.297
	(0.910)
Education	0.275
	(0.454)
High-IQ	0.006
	(0.899)
Selective Attention	-0.256
	(0.212)
Working Memory	-0.091
	(0.228)
Attitude towards Inconsistency	0.412***
	(0.156)
N	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE E.8. EFFECTS OF RESPONSE TIMES ON CONSISTENCY

	GARP Violations	
	(1)	(2)
Response Time (Minutes)	-0.046	-0.001
	(0.058)	(0.075)
Response Time (Minutes)×Sequential Elimination	-0.029	-0.105
	(0.067)	(0.083)
Response Time (Minutes)×High-IQ		-0.154
		(0.132)
Response Time (Minutes)×Sequential Elimination ×High-IQ		0.299*
		(0.166)
Sequential Elimination	-0.132	-0.244
	(0.636)	(0.807)
Sequential Elimination×High-IQ		-1.228
		(1.543)
High-IQ	-1.159***	
	(0.352)	
Age	-0.082**	-0.066*
	(0.037)	(0.039)
Female	0.124	0.085
	(0.346)	(0.332)
Education	-0.140	-0.229
	(0.201)	(0.192)
High-IQ		-0.682
		(1.026)
Selective Attention	-0.017	-0.050
	(0.048)	(0.053)
Working Memory	-0.054	-0.099
	(0.073)	(0.081)
Attitude towards Inconsistency	-0.120*	-0.120*
	(0.062)	(0.066)
N	148	148

Notes: Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.