Individual Rationality under Cognitive Limitations: The Effect of Sequential Elimination

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Job Market Paper

This version: November 7, 2021

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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. In a limited attention framework, I show that, in sequential elimination, the choices made by a decision maker faced with at least two available alternatives are consistent with preference maximization, whereas this is not necessarily the case in 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 the consistency of subjects with low cognitive ability. Next, I explore the factors that influence individual preference for sequential elimination. Finally, I investigate the impacts of sequential elimination on risk preferences and individual satisfaction.

JEL codes: C90, D81, D91, G11, I31.

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

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1 Introduction

There is broad evidence that individual choices are inconsistent with preference maximization, and that this is especially true for people with lower cognitive ability (e.g., Burks et al. (2009); Cappelen et al. (2020)).[1] This could have substantial welfare implications. For example, Abaluck and Gruber (2011) find that elders tend to make inconsistent choices in the Medicare Part D program; while, if they had made consistent choices, they might have achieved a markedly (about 27%) higher level of welfare.[2] Inconsistency in elderly people may be related to their cognitive decline, which can be caused by brain degradation with normal aging (Hedden and Gabrieli (2004); Bishop, Lu and Yankner (2010)). Kim et al. (2018) provide evidence of the effect of educational intervention in improving consistency in secondary school students. This effect operates partially through enhancing cognitive ability. Despite the wealth of research on individual inconsistency, few studies have addressed the crucial question of how to improve individual consistency under cognitive limitations.

I provide the first study on the causal effects of different choice procedures on individual consistency. A primary source of inconsistency may be cognitive limitations (Simon (1955, 1979)), which plausibly result in an individual's inability to process all the alternatives on a menu. Thus, as the *limited attention* model insightfully postulates, people may only pay attention to a limited set of available alternatives (Eliaz and Spiegler (2011); Masatlioglu, Nakajima and Ozbay (2012); Dean, Kıbrıs and Masatlioglu (2017); Lleras et al. (2017)).[3] Upon closer examination, 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)) reveals that individuals consider at least two alternatives when faced with a menu of multiple alternatives.[4] I term this the *minimum property* of limited attention. Motivated by these findings, I study a decision maker (DM) with a rational preference relation and limited attention satisfying the minimum property.

Since Simon (1955), the notion of choice procedures has long been acknowledged for its fundamental role in shaping choice behavior.[5] Drawing on this notion, I develop a formal framework to examine the DM's choice consistency in two choice procedures. One is the *direct procedure*,

[1] Other empirical evidence of inconsistency from the revealed preference literature includes but not is limited to, Harbaugh, Krause and Berry (2001), Andreoni and Miller (2002), Choi et al. (2007), Echenique, Lee and Shum (2011), Choi et al. (2014), Fisman et al. (2015), Rustichini (2015), Carvalho, Meier and Wang (2016), Dean and Martin (2016). The term cognitive ability is often used in the literature interchangeably with general intelligence, cognitive capacity, cognitive skills, and cognitive function in the literature, all of which are most often expressed and measured by IQ scores.

[2] Further, Abaluck and Gruber (2016) show that the inconsistency costs of elders in the program increase over time.

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

[4] This evidence is reviewed in Section 1.1.

[5] See also Simon (1976), and recent studies including Aumann (2008, 2019), Salant (2011), Halevy and Mayraz (2020), and Oprea (2020).

where the DM chooses directly from the menu. Limited attention may cause choice inconsistency in this procedure due to the DM missing the best alternative in the menu. This leads me to the investigation of *sequential elimination*, in which the DM eliminates alternatives sequentially until only one survives. This procedure has been studied widely in marketing, psychology—and more recently,—economics.[6] It has been shown to reduce choice overload (Besedeš et al. (2015)) and to encourage people to consider more alternatives (Huber, Neale and Northcraft (1987); Yaniv and Schul (1997, 2000); Sokolova and Krishna (2016)). Building on the established evidence, I present the first research on the role of sequential elimination in improving individual consistency.

I show that the DM makes consistent choices in sequential elimination. An intuitive explanation for this result is that the best alternative in a menu survives in every elimination, either by not being considered or by beating the other alternatives. In effect, sequential elimination decomposes a potentially complex optimization problem into an equivalent sequence of elimination subproblems, each of which is arguably easier to solve.[7] Based on these results, I formulate the main hypothesis in this paper, which is that individuals make choices with a higher level of consistency in sequential elimination than in the direct procedure. Further, the cognitive-ability interpretation of limited attention implies that individuals with low cognitive ability may benefit greatly from sequential elimination. This leads me to another key hypothesis; namely, that sequential elimination has a greater impact on these individuals than on the population in general.

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 x or y amounts of experimental tokens 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.[8] 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)).[9] The hypotheses can be tested directly by comparing the numbers of GARP violations in the first two treatments. The third treatment helps provide insights into individual preference for sequential elimination. It also enables examination of the effect of sequential elimination in the context in which individuals freely determine the choice procedures. In addition, I compute the number of first-order stochastic dominance (FOSD) violations, which

[6]Section 1.1 presents the literature review of sequential elimination.

[7]Solving all the subproblems can be more taxing than solving the original problem, thus reducing individual satisfaction. I discuss this in Section 4.6.

[8]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.

[9]GARP is formally defined in Section 2.1. I discuss other consistency measures in Section 3.1.1.

are defined as choosing an option over another that offers better outcomes without additional risk. FOSD violations, while not implying GARP violations, are typically regarded as mistakes. GARP is arguably the minimal criterion for economic rationality, and FOSD complements GARP in decision-making under risk.

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) as compared with 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) as compared with Direct Procedure. There is no evidence 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 in Sequential Elimination relative to Direct Procedure (almost 97%) is statistically significant. Although beyond the scope of the present framework, this provides an empirical account of the advantage to be gained from sequential elimination by individuals with high cognitive ability. Importantly, these findings provide causal evidence in favor of the hypotheses and support the role of sequential elimination in improving economic rationality.

I present other experimental results to help build a firm understanding of sequential elimination. The experiment enables me to compare sequential elimination with choice revision, which has been shown to reduce increase the number of choices satisfying the normative axioms (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 is associated with fewer FOSD violations but not with fewer GARP violations, which to some extent underscores the benefits of sequential elimination. In Free Procedure, subjects with lower cognitive ability are more likely to select Sequential Elimination than those with higher cognitive ability. This suggests that people with limited cognitive ability may be willing to use sequential elimination in the context of decision-making under risk, which relates to many real-world situations. I find no conclusive evidence of the effect of sequential elimination when the sample is restricted to Free Procedure subjects. This lack of evidence may be due to the multicollinearity between cognitive ability and the choice of Sequential Elimination. Finally, the experiment reflects a negative correlation between cognitive ability and risk aversion, driven mainly by the marked correlation revealed in Sequential Elimination, in line with the findings from the early literature (Burks et al. (2009); Dohmen et al. (2010); Benjamin, Brown and Shapiro (2013); Falk et al. (2018)).

This paper gives rise to welfare implications. Firstly and most importantly, sequential elimination may boost individuals' economic rationality by mitigating the impacts of limited attention. As a minimal modification of the direct procedure, sequential elimination is intuitive and arguably inexpensive to use. Secondly, the analysis suggests that, whereas subjects are more satisfied with more consistent choices, they are less so with Sequential Elimination per se, probably because they find it unfamiliar or overtaxing.[10] Collectively, the boost of economic rationality given by the procedure may come at the cost of individual satisfaction. The overall welfare effect of sequential elimination requires closer scrutiny in this regard to enable stronger conclusions. Thirdly, the results may highlight the relevance of choice procedures in welfare policies and to some degree enhance support for policies based on the preferences revealed to be robust to choice procedures. On the other hand, policymakers may need to be cautious in evaluating policies when individual preferences are revealed to be distinct under different choice procedures.

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 the direct procedure that whereby the DM directly chooses from a limited set of alternatives on a menu, known as the *consideration set*. Recently, 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)).[11] 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)).[12] 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 reducing inconsistency by means of 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

[10] Subjects are asked to rate their satisfaction with choices and choice procedures separately and requested to report the reasons for their ratings.

[11] Krajbich and Rangel (2011) find that, in 83% of the decision tasks, subjects make their decisions only after paying attention to all three items. Reutskaja et al. (2011) find the subjects focus, on average, on at least three alternatives, with this value increasing with the number of alternatives.

[12] Honka, Hortaçsu and Vitorino (2017) estimate a structural model with endogenous consideration sets, which identifies that the consideration set size is on average larger than 2 in the US banking choices data. On a dataset of insurance purchases. Barseghyan, Molinari and Thirkettle (2021) estimate the random consideration level model in which the consideration set size is drawn from a distribution. The probability that the estimated attention level takes a value greater than or equal to 2 is 96.9%.

(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 all those alternatives that are not comparable to any of the others. Other emerging studies postulate that the DM may eliminate alternatives sequentially rationalized by 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 central premise of the aforementioned models is that the DM may not be intrinsically endowed with one well-behaved preference relation over all alternatives. In contrast and importantly, this paper's premise is that the DM compares all alternatives based on a rational preference relation, which can be revealed by means of sequential elimination.

The literature has documented the positive effects of sequential elimination on decision-making. Besedeš et al. (2015) find that sequential decision-making reduces 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.[13] 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 (i.e., the direct procedure). Marketing and psychology studies show that the elimination process leads to more alternatives being considered (Huber, Neale and Northcraft (1987); Yaniv and Schul (1997, 2000); Sokolova and Krishna (2016)). 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 individual consistency. 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. 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 977 representative households in Denver. However, Echenique, Imai and Saito (2021) find that younger subjects (i.e.,

[13] Besedeš et al. (2015) find no decision-making improvement from their "sequential elimination" design, where the unchosen alternatives in a small menu are eliminated and replaced by new ones randomly selected from the entire menu. My design differs from theirs by having subjects eliminate alternatives from the entire menu one by one.

aged 16-34) are closer to their notion of rationality known as the "objective expected utility" than older subjects (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 on improving individual consistency. 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 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 concludes and discusses directions for future research.

2 Framework

Let X be a nonempty finite set of alternatives with typical elements x, y, and z. Let $\mathcal{X}$ be the set of all nonempty subsets of X; this is the set of menus with typical elements A, B. Formally, a choice function c assigns to every $A \in \mathcal{X}$ a unique element $c(A)$ in A. Let $\succ$ be a preference relation over X that is complete, transitive and asymmetric. A choice function c is consistent if there exists a preference relation $\succ$ over X such that $c(A)$ is the $\succ$-best alternative for every A.

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

2.1 The Direct Procedure

I first study the DM's behavior in the direct procedure. The DM chooses the best alternative directly from her consideration set within a menu. The following definition is adapted from Masatlioglu, Nakajima and Ozbay (2012).

Definition 1. A choice function c is a *direct choice* if there exist a preference relation $\succ$ over

X and a consideration set mapping γ such that, for every A, $c(A)$ is the $\succ$-best alternative in $\gamma(A)$. Further, we have a *direct choice with full consideration* if γ is a full consideration.

I examine choice consistency by GARP, a necessary and sufficient condition for a choice function (on a non-empty arbitrary subset of $\mathcal{X}$) to be rationalized by a preference relation. To formally introduce GARP (in the present setting), x is said to be *revealed directly preferred* to y (written xR^Dy) if there exists some A such that $x, y \in A$ and $c(A) = x$. Also, x is said to be *revealed preferred* to y (written xRy) if there exists some sequence $\{x_1, x_2, ..., x_n\} \in X^n$ such that $xR^Dx_1, x_1R^Dx_2, ..., x_nR^Dy$.

GARP. For any $x, y \in X$, if xRy, then it is not the case that yR^Dx.

Unless the DM considers every available alternative, a direct choice is not necessarily consistent, as the following example shows. Consider that $X = \{x, y, z\}$ and $x \succ y \succ z$ describes the DM's preferences. Suppose that her consideration sets are $\{y, z\}$ from $\{x, y, z\}$ and $\{x, y\}$ from $\{x, y\}$. Consequently, her choices in the direct procedure are y in $\{x, y, z\}$ and x in $\{x, y\}$, which violates GARP. The following remark summarizes this discussion, which will be useful later for the formulation of the hypothesis.

Remark 1. *Let c be a direct choice, the following statements are true:*

(i) c does not necessarily satisfy GARP;

(ii) c satisfies GARP if and only if it is a direct choice with full consideration.

2.2 Sequential Elimination

Remark 1 implies that the DM may miss the best alternative in the direct procedure by not giving the menu full consideration. The 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 that the DM faces a menu $A = \{x, y, z\}$. Under this procedure, the DM goes through two rounds of elimination to select an alternative from A. In the first round, she eliminates z from A, leaving a set of survivors $s(A) = A \backslash \{z\} = \{x, y\}$. In the second round, the DM confronts $s(A)$ as a "new" menu. She then eliminates y from $s(A)$, leaving the survivor to be $s(s(A)) = s(A) \backslash \{y\} = \{x\}$ representing her choice x.

Formally, a *survivor function* s assigns to every $A \in \mathcal{X}$ a subset of A such that $|s(A)| = \max\{|A| - 1, 1\}$. For any s, the n-th iterate of s (where n is a positive integer), $s^{(n)}$ is defined by $s^{(n)}(A) = s(s^{(n-1)}(A))$ for $n > 1$ and $s^{(1)}(A) = s(A)$. Also, a corresponding choice function of s is defined by $c_s(A) \in s^{(|A|-1)}(A)$ for all $A \in \mathcal{X}$. In other words, a survivor function s fully describes the sequential elimination behavior of the DM when it is interpreted that the DM eliminates $A \backslash s(A)$ from A, and finally chooses $c_s(A)$ from A.

Definition 2. A survivor function s is a *sequential elimination* if there exist a preference relation $\succ$ over X and a consideration set mapping γ such that $A \backslash s(A)$ does not contain the $\succ$-best alternative in $\gamma(A)$ for all A with $|A| \geq 2$. Further, we have a *sequential elimination with full consideration* if γ is a full consideration.

Definition 2 states that the DM eliminates an alternative that is not maximal in the consideration set whenever she confronts a menu comprising more than one alternative. In other words, she compares at least two alternatives according to her preferences in every elimination. If a survivor s is a sequential elimination, c_s is said to be a *choice by sequential elimination.*

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

Proposition 1. *Given a survivor function s, the choice function c_s satisfies GARP if and only if s is a sequential elimination.*

Proposition 1 shows that the DM always makes choices consistent with preference maximization in sequential elimination. Thanks to the minimum property, the best alternative in a menu survives in every elimination, according to one or other of the following two cases. One is that the DM does not consider the best alternative, which remains on the menu. The other is that she considers the best alternative, which beats all the others. 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 Proposition 1 does not require the entire elimination process to be fully observable; the observation of choice behavior is sufficient. Also, Remark 1 and Proposition 1 imply that it is impossible to distinguish between a direct choice with full consideration and a choice by sequential elimination if the DM's choices satisfy GARP. This poses no problem here, given that this paper focuses precisely on individuals whose choices violate GARP in the direct procedure.

2.2.1 An Alternative Characterization

To gain further insight into the elimination process, I now assume that s is fully observable. What behavioral patterns can be observed *during* the sequential elimination process? To answer this question, I propose an alternative characterization of a sequential elimination based on a novel axiom of elimination behavior. Formally,

Axiom 1 (Inferiority)**.** For all $A \subset B \subseteq \mathcal{X}$, if $y, z \in A$, $y \notin s(A)$, $z \notin s(B)$, then there must exist $x \in B$ such that $x \in s(\{x, y\})$ and $x \in s(\{x, z\})$.

Suppose that the DM eliminates one alternative in a menu and another in a larger menu. Intuitively, Inferiority says that these two eliminated alternatives must be inferior to some other alternatives in the larger menu. The following theorem shows that this axiom fully characterizes a sequential elimination.[14]

Proposition 2. *A survivor function s satisfies Inferiority if and only if it is a sequential elimination.*

2.3 Testable Implications

Remark 1 and Proposition 1 imply that a preference maximizer with limited attention satisfying the minimum property would make consistent choices in sequential elimination but would not necessarily do so in 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. As suggested by Kahneman (1973), an individual's cognitive capacity (i.e., her total endowment of usable mental resources) could limit her attention to the alternatives. Individuals with low cognitive ability may suffer more notably from limited attention (i.e., they attend to fewer alternatives) than those with high cognitive ability. Taking these factors together, I reason that individuals 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. The number of GARP violations gives an exact measure of the deviation of an individual's choices from preference maximization. More GARP violations indicate a lower level of consistency with preference maximization. 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) in sequential elimination than in the direct procedure.*

Hypothesis 2. *Individuals with low cognitive ability make choices with a higher level of consistency (i.e., fewer GARP violations) in sequential elimination than in the direct procedure. Sequential elimination has a greater impact on these individuals than on the population in general.*

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

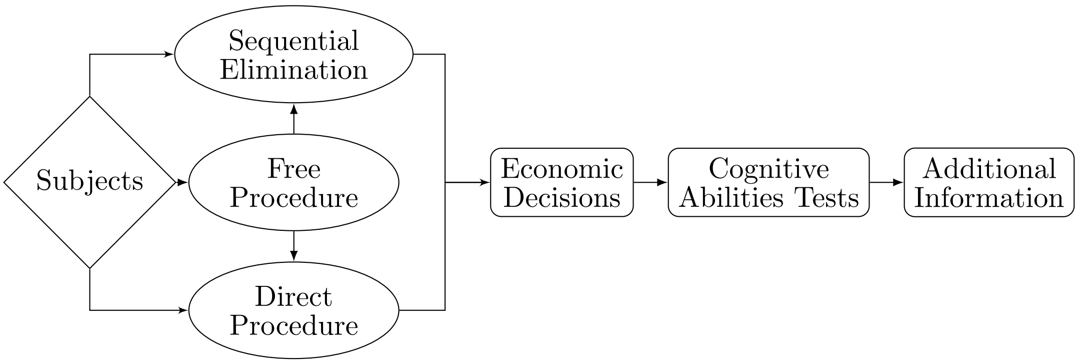
[14]The experiment is designed to examine consistency parsimoniously, i.e., by GARP violations. Thus, I do not test Inferiority, which requires an arguably strong assumption on the choice domain.

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 preference for consistency and demographics. The details of the experimental design are discussed below.

Figure 1: A Global View of The Experiment



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.[15] An *option* (x, y) rewards x or y tokens with equal probability. There is one decision problem to check comprehension.[16] 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.[17] GARP is arguably

[15] See Appendix B for a graphical illustration of the decision problem.

[16] 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).

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

the minimal criterion for economic rationality and the number of GARP violations indicate the degree to which choices can be rationalized by a preference, 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.[18] FOSD is proposed in decision theory as the minimal criterion for economic 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 offering better outcomes than provided by 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.[19] SARP differs from GARP by excluding indifference between alternatives in the preference. 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. Similarly, more SARP violations, a higher HM index, or a higher CCEI indicate a lower level of consistency.

3.1.2 Experimental Treatments

In every decision problem, the left-hand side of the screen shows a vertical list of options, labeled “Options”. In 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.[20] 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. In 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 Direct Procedure and Sequential Elimination. Thus, the difference in choice behavior between the two treatments enables precise testing of the hypothesis.

[18]FOSD violations are computed by assuming a symmetric preference for the two values of options. To be specific, subjects commits a FOSD violation if they choose an option (x, y) when there exists another option (z, w) in the same problem such that $w > x$ and $z > y$.

[19]See Apesteguia and Ballester (2015) and Halevy, Persitz and Zrill (2018) for detailed discussion of consistency measures.

[20]See Appendix B for screenshots of all treatments. In Direct Procedure, subjects are instructed to “examine” them by clicking on them.

In Free Procedure, subjects are asked to select either Direct Procedure or Sequential Elimination as their choice procedures, and then labeled as Direct Procedure (Free) subjects or Sequential Elimination (Free) subjects, accordingly. [21] The Free Procedure treatment enables the examination of two key questions relating to the hypotheses. Firstly, what type of people prefer sequential elimination? 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? Secondly, what is the effect of sequential elimination when it is the freely selected choice procedure?

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)).[22] 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.[23] 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 asked to remember them. After a 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. The literature documents cases of individual choices being revised to comply with axioms of normative decision theory (see the classic work of MacCrimmon (1968) and recently, Gaudeul and Crosetto (2019), Benjamin, Fontana and Kimball (2020), Breig and Feldman (2020), Nielsen

[21] Free Procedure subjects are given a trial problem with the two procedures randomly ordered.

[22] In a matrix reasoning question, subjects are presented with eight geometric shapes and instructed to identify which of six other geometric shapes presented as response choices will best complete the stimuli. In a three-dimensional rotation question, subjects are presented with cube renderings and asked to identify which of the response choices is a possible rotation of the target stimuli. Letter and number series and verbal reasoning questions are not included since they focus on measuring learning ability.

[23] The tests are implemented via the platform of Henninger et al. (2021). 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.

and Rehbeck (2020)).[24] 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.[25] 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.[26] 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 Individual Satisfaction

As a subjective criterion for assessing decision-making quality, individual satisfaction plays a non-negligible role in welfare analysis (Iyengar and Lepper (2000); Kőszegi and Rabin (2008); Bernheim (2009)). The relationship between economic rationality and individual satisfaction appears to remain unexplored in the literature. There also remains the question of the impact of sequential elimination on individual satisfaction. This study aims to address the issue by including individual satisfaction in the experiment. Specifically, subjects are asked to rate their satisfaction with their choices and choice procedures on a scale of 0 (least satisfied) to 10 (most satisfied).

3.2.3 Preference for Consistency

The literature (e.g., Kahneman (2003); DellaVigna (2009)) points out that, in some individuals, inconsistency of choices may be deliberate. Consequently, this study accounts for the possible impact of individual preference for consistency on choice consistency. Subjects are presented with a scenario which includes the presence of the attraction effect (Huber, Payne

[24]Note that Slovic and Tversky (1974) find that few subjects shift their choices towards the expected utility independence axiom; however, this result is subject to the unincentivized nature of the experiment.

[25]See Appendix B for screenshots. 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 (2019), 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.

[26]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.

and Puto (1982)); a common behavioral phenomenon which violates consistency with preference maximization (Tversky and Simonson (1993)).[27] 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 preference for consistency, i.e., the higher the rating, the lower the preference for consistency.

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. 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.[28] The sample subjects are plausibly younger and more educated than the population on average.[29] 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 Direct Procedure and Sequential Elimination. Table 1 presents the number of subjects per treatment. 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.[30]

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%)

[27] The scenario is described in Appendix B.

[28] A total of 253 subjects (53.1% female) were recruited. All subjects speak English as their first language and could complete the experiment only once. 30 subjects who had failed the comprehension check in the first block were filtered out.

[29] Appendix C gives the histograms of demographics and cognitive ability for the overall sample and per treatment.

[30] 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.

4 Experimental Results

4.1 Main Results

This section examines the hypotheses by analyzing the observed differences between 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)).[31]

I start by discussing the evidence for Hypothesis 1. Figure 2(a) shows that the average numbers of GARP violations in Sequential Elimination and 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 Direct Procedure, in line with Hypothesis 1. In addition, Figure 3 (a) depicts that the cumulative distribution of GARP violations in Direct Procedure almost (first-order) stochastically dominates that in Sequential Elimination, except on the extreme right tails of the distributions. That is, a subject is more likely to commit more GARP violations in Direct Procedure than in Sequential Elimination.

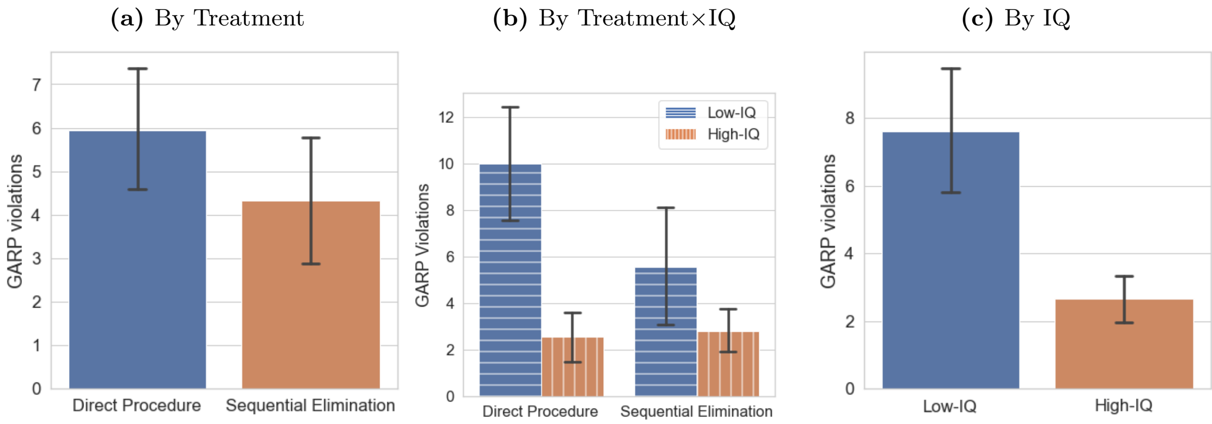
Table 2 presents the estimation results.[32] Column (1) indicates that Sequential Elimination reduces the number of GARP violations by nearly 4.5 as compared with Direct Procedure ($p = 0.07$). This suggests that Sequential Elimination improves consistency by almost 76% relative to Direct Procedure, a finding which could be economically relevant. The same column shows a positive and statistically significant relationship between high-IQ and consistency ($p = 0.01$), in line with the literature (Burks et al. (2009); Cappelen et al. (2020)). Indeed, high-IQ subjects are very consistent, both overall (see Figure 2 (c)), and per treatment (see Figure 2(b) and Figure 3(c)). Taken together, these results suggest that Sequential Elimination has limited power to improve consistency among high-IQ subjects, which may partially account for the lack of significance. This discussion suggests, furthermore, that the Sequential Elimination effect operates mainly through its impact in improving consistency among low-IQ subjects, which leads to the following discussion on Hypothesis 2.

[31] 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 preferences (Choi et al. (2014)). Cameron and Trivedi (2013) recommends the Poisson, negative binomial, and zero-inflated negative binomial models for count data. In Appendix E, I report 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.

[32] Table 2 presents results from the negative binomial regressions in the form of average marginal effects. P-values of 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 in Sequential Elimination is larger than or equal to that in Direct Procedure. The regressions are reported in the original form in Appendix E. For robustness checks, see Appendix D, which reports nonparametric tests of treatment effects, other specifications of the estimation, and estimations on other consistency measures.

Figure 2(b) shows that the occurrence of GARP violations among low-IQ subjects is approximately 44.2% lower, on average, in Sequential Elimination than in Direct Procedure (5.58 vs. 10 GARP violations, respectively), thus supporting Hypothesis 2. Furthermore, Figure 3 (b) displays that the cumulative distribution of GARP violations by low-IQ subjects in Direct Procedure strongly (first-order) stochastically dominates that in 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 Direct Procedure.[33] This reduction is substantial (over 94%) relative to their average of 10 GARP violations in 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.

Figure 2: Mean GARP Violations in The Experiment



Note: 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 ($p = 0.01$), that is, approximately 63% of the average 0.8 FOSD violations in 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, show 0.9 (almost 97%, $p = 0.02$) fewer FOSD violations in Sequential Elimination than in Direct Procedure (on average about 0.93 FOSD violations). The results provide empirical support for the idea that individuals with high cognitive ability may take advantage of sequential elimination to improve their decision-making quality.

[33] The robustness checks (see Appendix D) 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. CCEI is not sensitive to the total number of GARP violations, which is the main interest here.

Figure 3: Cumulative Distributions of GARP Violations in The Experiment

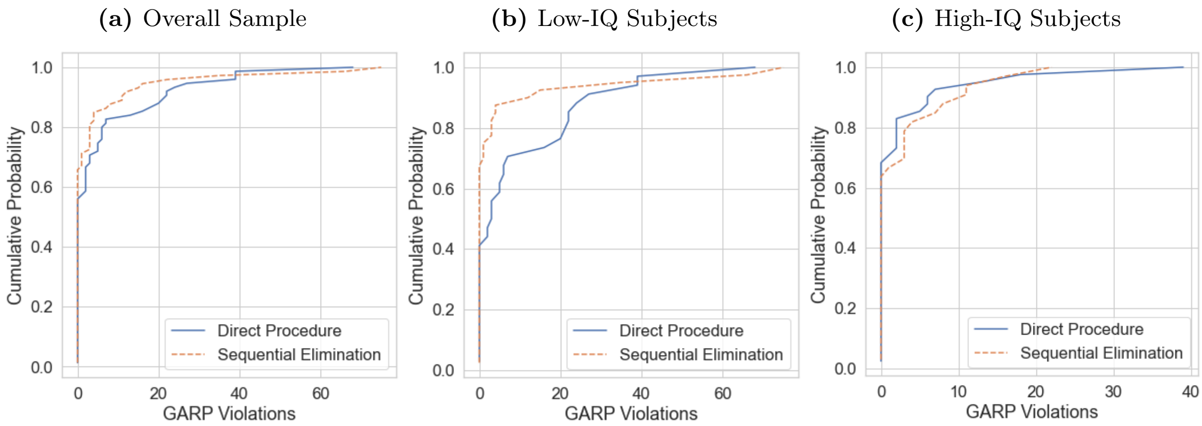


Table 2: Determinants of Economic Rationality

	(1) GARP Violations	(2) FOSD Violations
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)
Ease with Inconsistency	-0.840	0.021
	(0.511)	(0.033)
N	148	148

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

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).

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.

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 substantial problem for young people (Plassman et al. (1995); Aartsen et al. (2002); Rönnlund et al. (2005)).[34] 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 correlation 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 to evaluate the various implications of demographic factors on different measures of economic rationality.

Interestingly, ease with inconsistency (i.e., subjects' self-reported rating for ease in the inconsistent choice scenario) correlates positively with the number of GARP violations ($p = 0.10$). A potential explanation for this is that highly inconsistent individuals might not feel at ease with the scenario because of the (probably) unpleasant consequences they have suffered.[35] Longer response time is associated with fewer GARP violations ($p = 0.03$), in line with the well-known trade-off between slow decisions and higher accuracy (Fitts (1966); Wickelgren (1977)).

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

[35] The precise implications of the experience of inconsistency are unclear. I do not rule out the possibility that some individuals are at ease with inconsistency because they have mentally adapted to it.

4.3 Comparison of Sequential Elimination and Choice Revision

This section compares the effects of sequential elimination and choice revision. In brief, the resulting evidence shows that choice revision has some potential to reduce FOSD violations, but not necessarily GARP violations, thereby suggesting that, when it comes to avoiding inconsistency, sequential elimination has the advantage over choice revision.

Table 3 shows the estimation of choice revision effect.[36] As shown in Column (1), there is no sound evidence to show that choice revision improves individual consistency overall, whether conditioned on IQ scores or on treatment groups.[37] 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 than among non-revisers (on average about 0.69 FOSD violations). The significance of this effect holds when restricted to the low-IQ subjects in Sequential Elimination ($p = 0.03$). Collectively, these results suggest 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. This could likely be due to differences in choice revision design and complexity of choice settings between the cited studies and this one.[38] The present study could complement the existing research by evaluating the effect of choice revision in relatively complex decision-making tasks without explicitly presenting the normative axioms. Moreover, this discussion sheds light on the further question of the robustness of choice revision effects across contexts.

4.4 Sequential Elimination in Free Procedure

This section focuses on the Free Procedure treatment to analyze subjects' preferences for using Sequential Elimination, especially those with lower cognitive ability. Table 4 presents the results from probit and logit regressions, where the probability of choosing Sequential Elimination

[36] Table 3 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, where the variables for age, female, education, High-IQ, selective attention, working memory, response time, and ease with inconsistency are not shown. 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.

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

[38] The cited studies primarily present the normative axioms and use binary choice tasks. Benjamin, Fontana and Kimball (2020) use choice tasks that are mainly binary, with up to five options. They find that choice revision reduces the portion of subjects showing inconsistency with expected utility axioms by almost 2/3. Breig and Feldman (2020), using binary choice tasks, find that subjects revise 75% of their choices towards consistency. Nielsen and Rehbeck (2020) find that 80% of choice revisions lead choices to be consistent with a set of normative axioms.

Table 3: The Effect of Choice Revision on Economic Rationality

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

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Control variables not shown in this table: Age, Female, Education, IQ Score, Selective Attention, Working Memory, and Ease with Inconsistency.

is regressed on demographics and cognitive ability.[39] A positive correlation is observed between the probability of choosing Sequential Elimination and education. Although further research is needed to determine the main channel of this correlation, it could indicate that sequential elimination presents a potential challenge to people with relatively low educational attainments. Importantly, as Table 1 shows, over 82% of the low-IQ subjects choose Sequential Elimination. 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.

The analysis continues by investigating the effect of sequential elimination on economic rationality under the Free Procedure treatment. Table 5 shows that, unlike the case for the exogenous treatments, the sequential elimination effect becomes nonsignificant for reducing the numbers of GARP and FOSD violations in Free Procedure, both overall and conditioned on IQ groups.[40] The nonsignificance may stem from the multicollinearity between the variables high-IQ and Sequential Elimination. This result should not be extrapolated to the population, however, because of the possible under-sampling of low-IQ subjects in Direct Procedure (Free), which has only seven low-IQ subjects. Irrespective of choice procedures, high-IQ, selective attention,

[39]Table 4 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.

[40]The results from the negative binomial regressions are presented in the form of average marginal effects. The regressions appear in their original form in Appendix E. The estimations for SARP violations, HM index, and CCEI are reported in Appendix D.

Table 4: Determinants of the Preference for Sequential Elimination

	Probability of Choosing Sequential Elimination	
	(Probit)	(Logistic)
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 Score	-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)
Ease with Inconsistency	0.003	0.00339
	(0.019)	(0.021)
N	75	75

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

and working memory are found to correlate negatively with FOSD violations ($p = 0.01, 0.03$, $p < 0.001$) in the Free Procedure sample, thus highlighting the importance of cognitive ability in this context.

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, the results reported here cannot confirm the effect of sequential elimination in the context where subjects freely determine the choice procedure. The conclusion from this section is that there is a need for further investigation in this context.

4.5 Risk preferences

This section presents the analysis of risk preferences under the expected utility model using the coefficient of relative risk aversion (CRRA) revealed from the subjects' choice data.[41] Before stating the results, it is worth mentioning that, although the literature tends to find a negative correlation 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 correlation cannot always be replicated and sometimes even becomes positive

[41] CRRA coefficients are estimated using the code packages from Halevy, Persitz and Zrill (2018). Based on the CRRA form of the expected utility model, the estimation recovers parameters using nonlinear least squares. The histogram of the CRRA revealed in the experiment is given in Appendix B, where it can be seen that 80% of the values range from 0 to 4.7.

Table 5: Determinants of Economic Rationality in Free Procedure

	(1) GARP Violations	(2) FOSD Violations
Sequential Elimination (Free)	-16.472	0.222
	(18.569)	(0.223)
-for Low-IQ subjects	-15.822	0.338
	(25.069)	(0.321)
-for High-IQ subjects	-17.786	-0.029
	(13.858)	(0.143)
Age	0.239	0.007
	(0.748)	(0.011)
Female	7.551	0.298
	(9.008)	(0.192)
Education	-5.313	-0.084
	(4.453)	(0.087)
High-IQ	-3.879	-0.369***
	(5.744)	(0.135)
Selective Attention	0.194	-0.042**
	(1.441)	(0.020)
Working Memory	-3.363	-0.087***
	(2.435)	(0.025)
Response Time (minutes)	-0.915	-0.067**
	(0.702)	(0.027)
Ease with Inconsistency	-1.582	-0.004
	(1.129)	(0.033)
N	75	75

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

(Mather et al. (2012); Tymula et al. (2012); Andersson et al. (2016)).[42] 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 in Direct Procedure but not in Sequential Elimination. Thus, the experiment potentially contributes to the discussion by comparing the correlations between cognitive ability and risk preferences under the two procedures.

Table 6 presents the estimation results based on two specifications.[43] In Column (1), CRRA is directly regressed on IQ score and a complete set of explanatory variables. Coinciding with early reported findings, an overall negative correlation appears between IQ score and CRRA ($p = 0.09$). No other factor, including sequential elimination, appears to correlate significantly

[42] 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 correlation in a multiple-price list (MPL) where there are more opportunities to err towards the risky option. They argue that the choice errors cause an underestimation of risk aversion.

[43] Table 6 reports the linear regression results where the variables age, female, education, response time, and ease with inconsistency are not shown. The complete table appears in Appendix E.

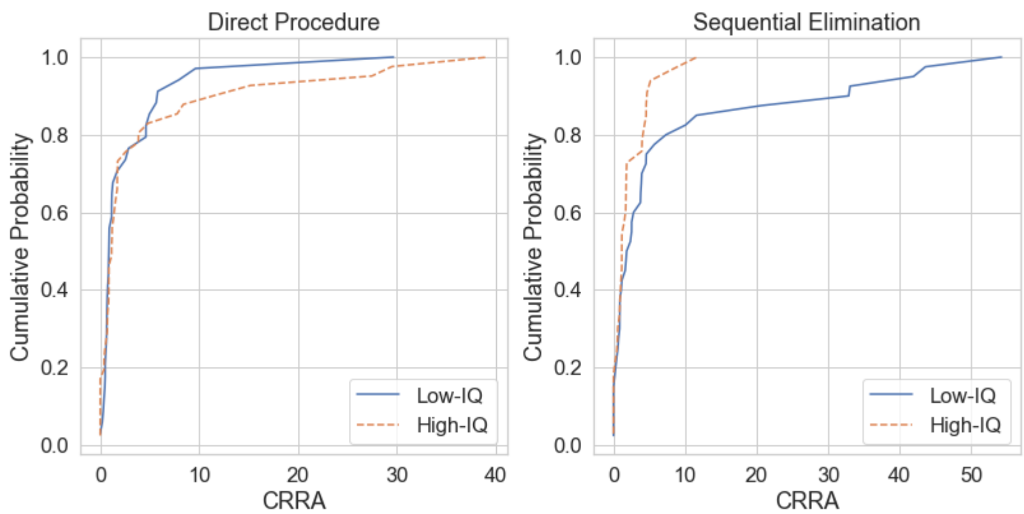
with risk aversion. Conjecturally, therefore, the sequential elimination effect may depend on cognitive ability, based on the previous results showing its heterogeneous effects on consistency.

The estimation in Column (2) is based on the specification which incorporates the interaction between high-IQ and Sequential Elimination in addition to the specification reported in Column (1). Verifying the conjecture, Sequential Elimination accounts for an increase in the low-IQ subjects' CRRA ($p = 0.03$), together with a decrease in that of the high-IQ subjects, compared to Direct Procedure.[44] Clearly, the distinction in cumulative CRRA distributions 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 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 in Direct Procedure may not fully reveal their risk preferences, potentially as a result of mistakes caused by limited attention, as would be consistent with Andersson et al. (2016). On the other hand, the aforementioned studies primarily derive their results from a binary choice setting. 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 correlation between cognitive ability and risk aversion. This correlation is confirmed in sequential elimination, where choice consistency is theoretically established and empirically supported by the previous results of this study. Crucially, these findings raise the question whether the robustness of this correlation holds for complex choice settings.

Figure 4: Cumulative distributions of Revealed CRRA in Treatments



[44]The estimated effect of sequential elimination for high-IQ subjects is the sum of the coefficients of Sequential Elimination and Sequential Elimination×High-IQ, which is 5.515 ($p = 0.03$) -6.997 ($p = 0.01$)=-1.482.

Table 6: Determinants of Risk Preferences

	CRRA	
	(1)	(2)
Sequential Elimination	2.010	5.522**
	(1.619)	(2.522)
Sequential Elimination×High-IQ		-6.997**
		(2.787)
IQ Score	-0.397*	
	(0.230)	
High-IQ		2.363
		(1.631)
Selective Attention	-0.239	-0.223
	(0.252)	(0.248)
Working Memory	-0.400	-0.475
	(0.347)	(0.364)
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, and Ease with Inconsistency.

4.6 Individual Satisfaction

The aim in this section is to investigate the impacts of choice consistency and choice procedures on individual satisfaction. Table 7 explores the determinants of individual satisfaction using ordered logit models.[45] Columns (1)-(2) indicate that lower choice consistency (i.e., more GARP violations) is related to lower choice satisfaction ($p = 0.09$), as is a higher number of FOSD violations ($p = 0.02$).[46] Columns (3)-(4) show that subjects report lower satisfaction with Sequential Elimination than with Direct Procedure ($p = 0.09$, and 0.05). A text analysis of the subjects' reports suggests that the low satisfaction ratings associated with Sequential Elimination may be attributable to the fact that some subjects are inexperienced with the procedure and some find it taxing.[47] In all columns, an increase in response time in Block B (i.e., the response time in the second instance) corresponds to a lower degree of satisfaction both with the choices made and the procedures used ($p < 0.01$). However, this is not the case for an increase in response time in Block A (i.e., the response time in the first instance). Intuition suggests

[45]Table 7 reports the regression results where the variables age, female, education, IQ Score, selective attention, working memory, and ease with inconsistency are not shown. The complete table and the regression in the form of odds ratios appear in Appendix E. The analysis is based on the sample of subjects who passed the comprehension check in the payment block. GARP violations are calculated based on choices from the payment block.

[46]In Appendix D, similar effects are found for SARP violations ($p = 0.09$), HM index ($p = 0.086$), and CCEI ($p = 0.139$).

[47]For example, nine subjects in the Sequential Elimination treatment report unfamiliarity with the procedure. Seven subjects describe the procedure as repetitive and time-consuming. An implementation of a latent Dirichlet allocation (LDA) model extracts two topics from the subjects' comments on Sequential Elimination, one containing the term "easy" and another containing the term "difficult".

possible fatigue effects due to the extra time and effort required to revise choices.

In sum, the experiment reveals positive associations between economic rationality and individual satisfaction. There is a potential trade-off of using sequential elimination or choice revision; they can boost economic rationality, possibly at the cost of individual satisfaction.

Table 7: Determinants of Individual Satisfaction

	Satisfaction with Choice		Satisfaction with Procedure	
	(1)	(2)	(3)	(4)
GARP violations	-0.012*		-0.013*	
	(0.007)		(0.008)	
FOSD violations		-0.265**		-0.187
		(0.116)		(0.120)
Sequential Elimination	-0.161	-0.328	-0.506*	-0.597*
	(0.301)	(0.304)	(0.304)	(0.306)
Free Procedure	0.111	-0.046	0.229	0.133
	(0.295)	(0.296)	(0.288)	(0.290)
Response Time (minutes, Block A)	0.004	0.013	-0.019	-0.012
	(0.021)	(0.022)	(0.020)	(0.021)
Response Time (minutes, Block B)	-0.097**	-0.129***	-0.092**	-0.112**
	(0.048)	(0.049)	(0.045)	(0.046)
N	228	228	228	228

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Control variables not shown in this table: Age, Female, Education, IQ Score, Selective Attention, Working Memory, and Ease with Inconsistency.

5 Discussion and Concluding Remarks

This paper has shown that sequential elimination—a choice procedure that is well known, 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.

The theoretical framework implies that it is sufficient for the individual 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.

The literature has proposed the models of sequential elimination (e.g., Masatlioglu and Nakajima (2007), Manzini and Mariotti (2007)) to describe individual choice behavior. However, the experimental results from this paper suggest that these models might not be necessarily descriptive in a standard choice problem, at least for individuals with low cognitive ability, as otherwise the treatment differences would not be observed. Perhaps a more important question is *when* individuals perform sequential elimination. The result that most low-IQ subjects choose to use sequential elimination in the Free Procedure treatment indicates the possibility that providing a suitable environment for sequential elimination can facilitate its use. Furthermore, psychological studies (Zajonc (1968); Pliner (1982)) find that people tend to develop preferences for things they are familiar with. This suggests that education and practice with sequential elimination might mitigate individuals' negative feelings towards the procedure. Individuals, especially those with low cognitive ability, could benefit greatly from more regular use of sequential elimination. Taking all this together, it seems reasonable to envision a long-run improvement in overall welfare, potentially greater than that found in this study.

Sequential elimination has a wide range of possible applications in the real world, being applicable to numerous meaningful contexts—ranging from career choices, through apartment purchases, to health insurance plans—where the nature of the options may be complex, and individuals are often aiming for the "optimal" choice. Beyond decision-making under risk, it would be desirable to test the robustness of sequential elimination in different choice domains, such as consumption 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

A.1 Proofs for Proposition 1

Sufficiency Let c_s be a choice by sequential elimination. Let s, $\succ$, γ be a corresponding sequential elimination, a preference relation, and a minimum consideration γ. Suppose that c_s is a not consistent choice, i.e., there exists some A such that $c_s(A)$ is not the $\succ -best$ alternative in A. Let x be the $\succ -best$ alternative in A and $x \notin s^{(|A|-1)}(A)$.

Let $e_1(A) = A \backslash s(A)$ and $e_{i+1}(A) = s^{(i)}(A) \backslash s^{(i+1)}(A)$ for all $i \in \{1, ..., |A|-2\}$. By definition of c_s, $x \notin e_{|A|-1}(A)$ since $s^{(|A|-1)}(A) \succ e_{|A|-1}(A)$. Also, $x \notin e_{|A|-2}(A)$ since either $e^{|A|-1}(A) \succ e_{|A|-2}(A)$ or $s^{(|A|-1)}(A) \succ e_{|A|-2}(A)$. Similarly, $x \notin e_i(A)$ for $i \in \{1, ..., |A|-3\}$. But then $x \notin A$ since $\cup_{i=1,..,|A|-1} e_i(A) \cup s^{(|A|-1)}(A) = A$, a contradiction. Since c_s is a consistent choice, it satisfies GARP (Afriat (1967); Varian (1982, 1983)).

Necessity Let c_s be a choice function that satisfies GARP and s be a corresponding survivor function. There exists a preference relation $\succ$, which is defined by $x \succ y$ if $s(\{x, y\}) = x$. For any A, $c_s(A)$ is the $\succ$-best alternative in A. Let $\gamma(A) = A$ for all A. Since $c_s(A) \neq e_{i+1}(A)$ for for all $i \in \{1, ..., |A|-2\}$ and all A. $A \backslash s(A)$ does not contain the $\succ$-best alternative in $\gamma(A)$. Therefore, s is a sequential elimination and c_s is a choice by sequential elimination.

A.2 Proofs for Proposition 2

Sufficiency Let s be a sequential elimination. By Proposition 1, c^s satisfies GARP. Suppose that $y, z \in A$, $y \notin s(A)$, $z \notin s(B)$ for some $A \subset B$. Let x be the $\succ$-best alternative in B. $x \neq z$ since $z \notin s(B)$. By Proposition 1, $x \succ z$. Then there are two cases. First, if $x \in A$, then x is the $\succ$-best alternative in A and $x \in s(A)$ by Proposition 1. Therefore, $x \succ y$. Second, $x \notin A$, $x \succ w$ for any $w \in A$, implying also that $x \succ y$. In sum, this gives $x \succ y$ and $x \succ z$, or equivalently, $x \in s(\{x, y\})$ and $x \in s(\{x, z\})$.

Necessity Let s be a survivor function that satisfies Inferiority. I first show that there is a reference relation $\succ$. For all $x, y \in X$, I define $x \succ y$ if $x \in s(\{x, y\})$. $\succ$ is complete and asymmetric by definition.

For transitivity, take some x, y, z such that $x \succ y$ and $y \succ z$, i.e., $x \in s(\{x, y\})$ and $y \in= s(\{y, z\})$. Suppose that $c_s(\{x, y, z\}) = y$, which implies that $s(\{x, y, z\}) = \{y, z\}$ since $s(\{x, y\}) = \{x\}$. However, $s(\{x, y, z\}) = \{y, z\}$ and $s(\{x, y\}) = \{x\}$ imply that $z \in s(\{y, z\})$ by Inferiority, which is a contradiction to $y \in s(\{y, z\})$. Suppose that $c_s(\{x, y, z\}) = z$, similarly, it must be that $s(\{x, y, z\}) = \{x, z\}$, and hence $s(\{x, z\}) = \{z\}$. However, Inferiority and

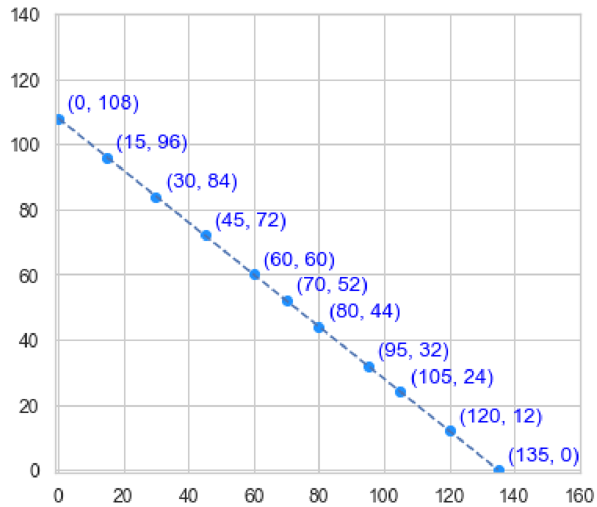
$y \in s(\{y, z\})$ imply that $x \in s(\{x, z\})$, which is a contradiction. Therefore $c_s(\{x, y, z\}) = x$. There could be two possible cases, $s(\{x, y, z\}) = \{x, y\}$ or $s(\{x, y, z\}) = \{x, z\}$. In the first case, $y \notin s(\{x, y, z\})$, by Axiom 2 with $y \in s(\{y, z\})$), we have $x \in s(\{x, z\})$. In the second case, $s(\{x, y, z\}) = \{x, z\}$ and $c_s(\{x, y, z\}) = x$ imply that $x \in s(\{x, z\})$. That is, $x \succ z$.

Lastly, I show that $c_s(A)$ is the $\succ$-best alternative of A. Supposing otherwise, there exists some $x \neq c_s(A)$ that is the $\succ$-best alternative of A. Thus, $x \in s(\{x, c_s(A)\})$. There exists some number i such that $c_s(A) \in s^{(i)}(A)$, $x \notin s^{(i)}(A)$ with some i. By Inferiority, there exist $y \in A$ such that $y \in s(\{x, y\})$), a contradiction to the definition of x. Therefore, $c_s(A)$ is the $\succ$-best alternative of A. γ denotes full consideration, i.e., $\gamma(A) = A$ for A. By construction, $A \backslash s(A)$ does not contain $\succ$-best element in $\gamma(s(A))$, i.e., $c_s(A)$. That is, s is a sequential elimination.

Appendix B Details of Experimental Design

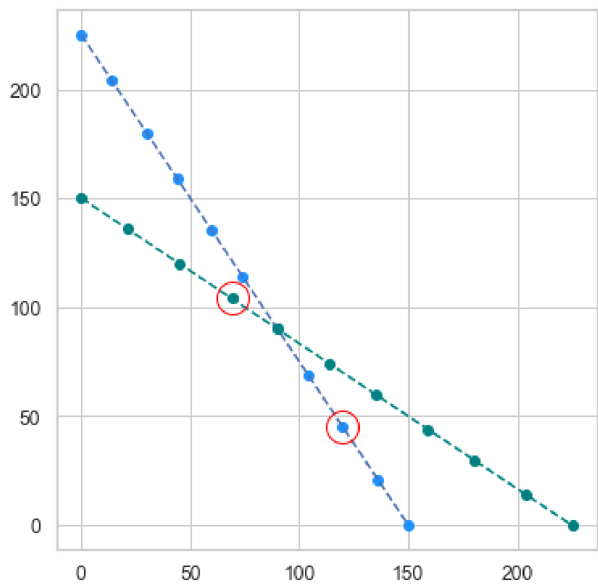
B.1 The Decision Problems and GARP Violations

Figure 5: A Graphical Illustration of The Decision Problem



Notes: The budget line represents a menu in the experiment. Each point on this line indicate an option. Subjects are not presented with this type of graphical illustrations in the experiment.

Figure 6: A Graphical Illustration of A Simple Violation of GARP



Note: 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.

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%.

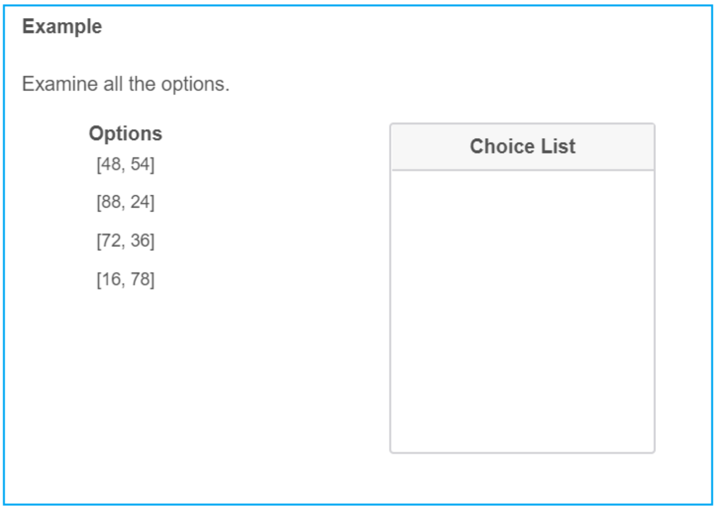
In each decision problem, you are encouraged to examine all options and should choose only one option that you prefer. There is no right and wrong answer to each decision problem. We are interested in studying your preferences.

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.

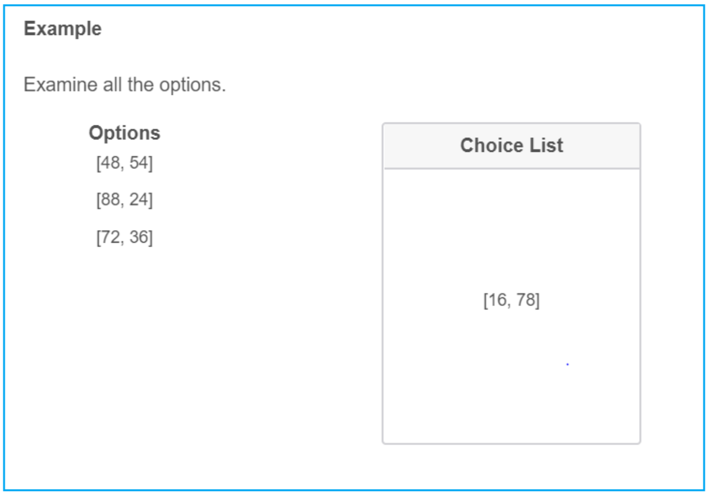
You will earn real money, depending on your decisions. Please make careful decisions.

Block A (The Direct Procedure)

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:



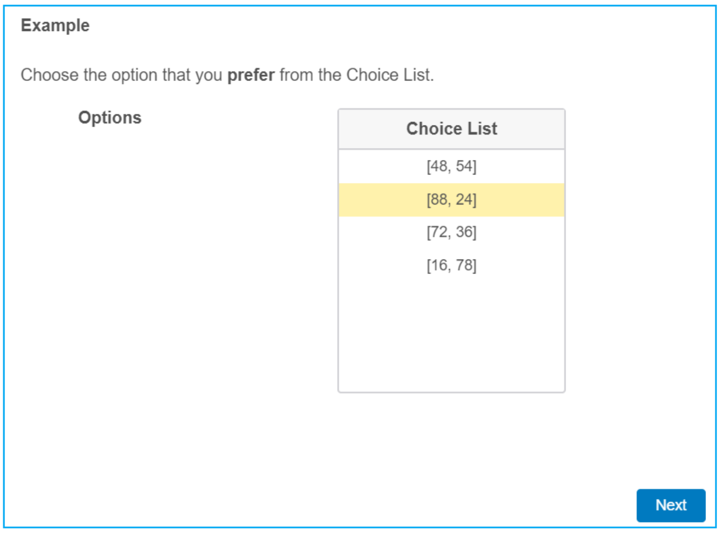
For instance, if you have examined the option [16, 78], you can click on it. It will then be moved to the "**Choice List**".



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.



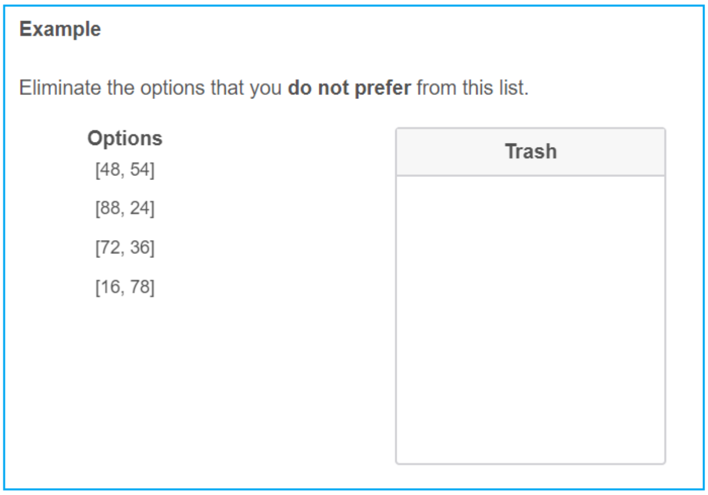
To familiarize you with the decision problems, you will have a practice problem. It will not affect your payment. Then you will be asked to complete all the problems.

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

Block A (Sequential Elimination)

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.

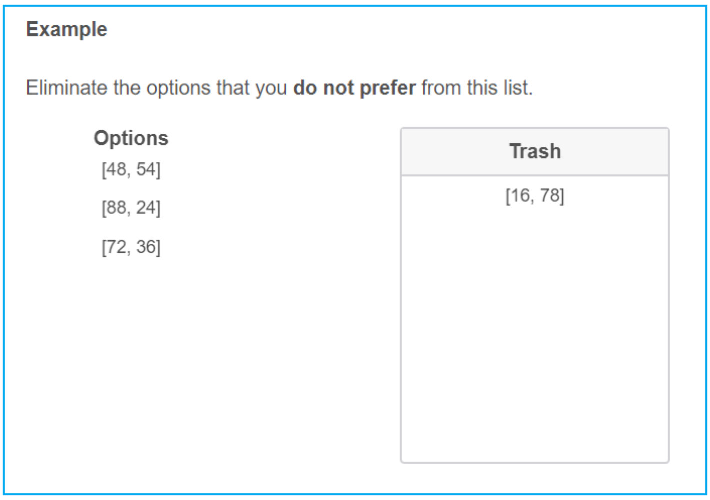
Below, you can see an example of sequential elimination:



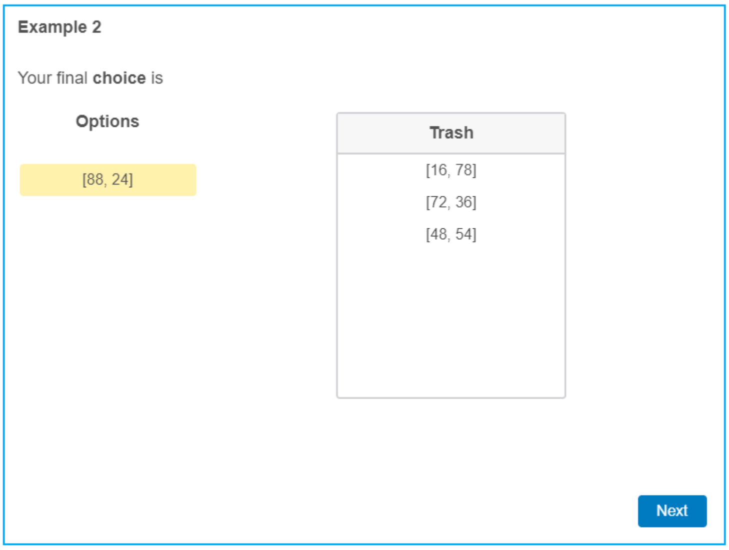
For instance, if you eliminate [16, 78] by clicking on it, it will be moved to the ”**Trash**”.

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.

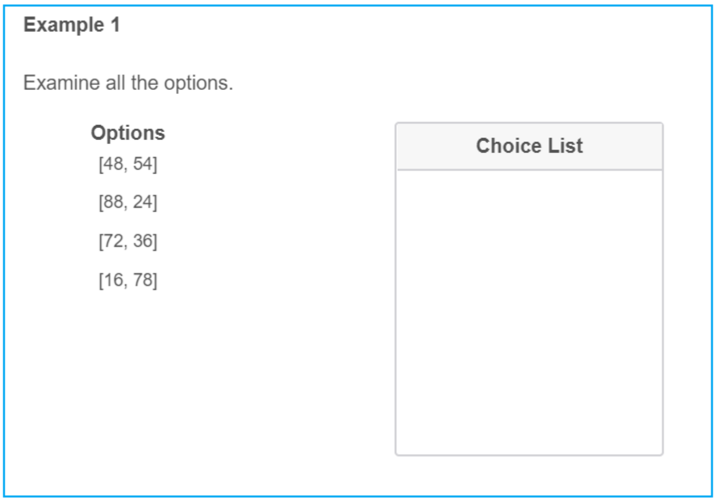
Important: Once you have clicked on "Next", you **cannot** go back and change your choice.

Block A (Free Procedure)

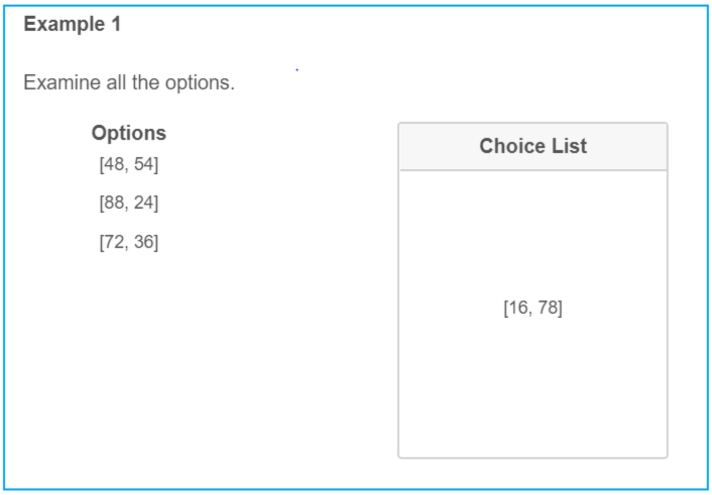
First, you have to make a choice between two choice procedures: sequential examination and sequential elimination. The two procedures will be explained below with examples. Then you will participate in 21 decision problems using the procedure chosen by you.

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**.

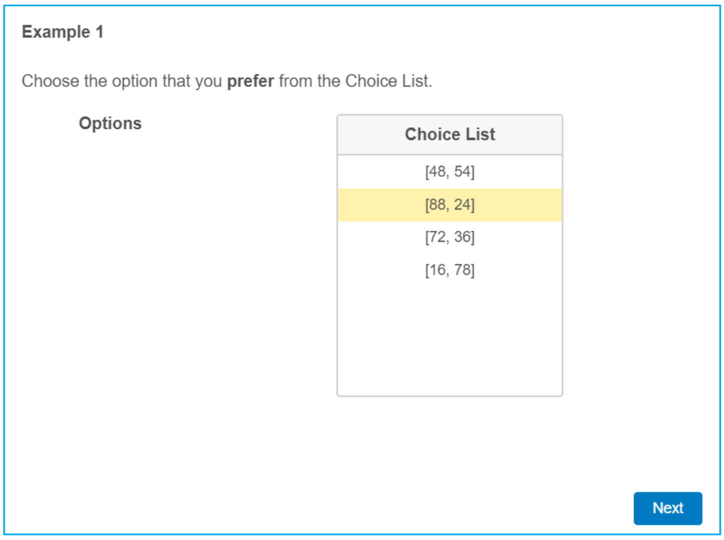
Below, you can see an example of sequential examination:



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



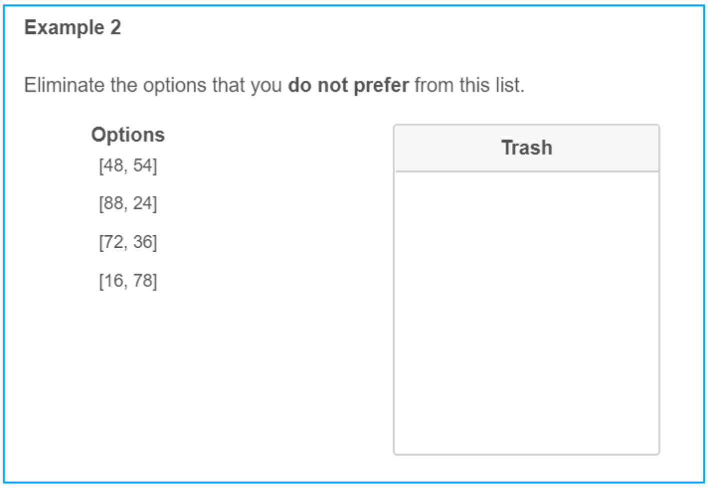
You should examine all the options by clicking on them. Then you can choose the option that you prefer in the "**Choice List**" by clicking on it. Your final choice will be highlighted in yellow. For instance, in the screen below, your choice is [88, 24].



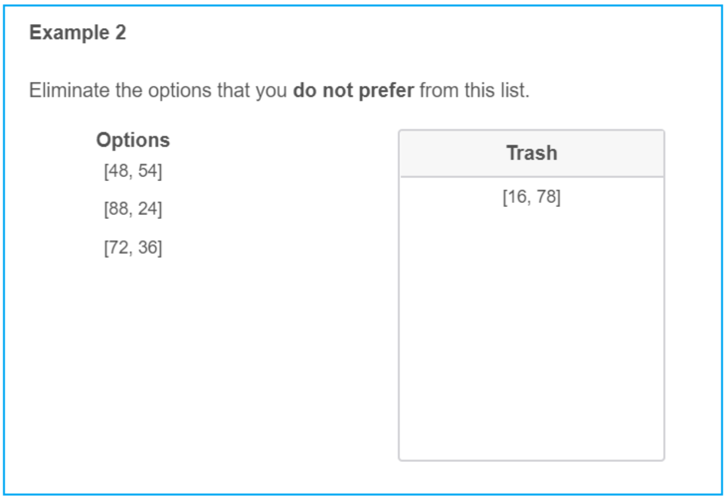
You should click on "Next" to confirm your choice and proceed to the next problem.

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:



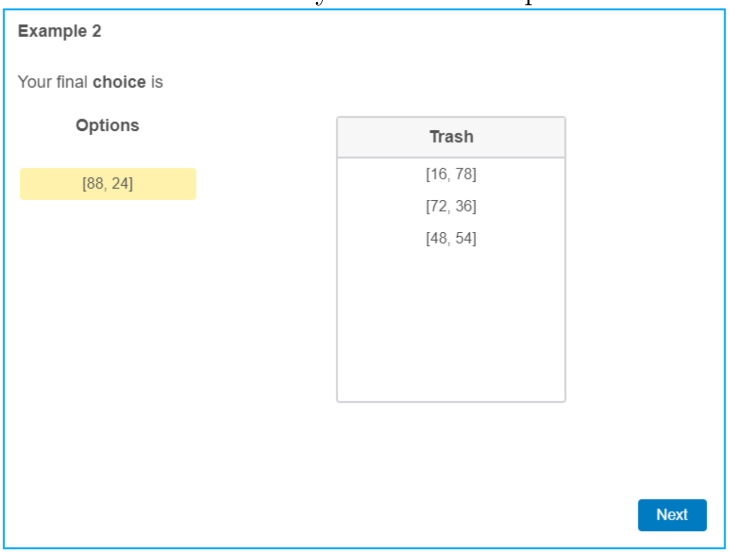
For instance, if you eliminate [16, 78] by clicking on it, it will be moved to the "**Trash**".



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.

Procedure Selection Frame

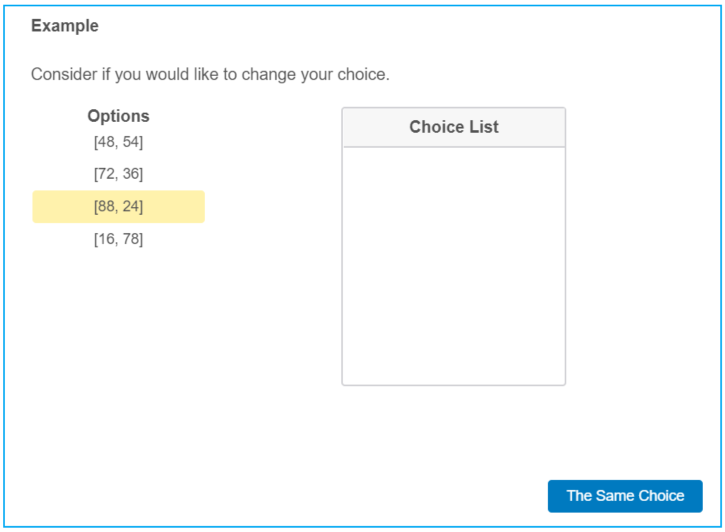
Please indicate which procedure that you would like to use in Section 1.

- Sequential Examination
- Sequential Elimination

Block B (The Direct Procedure)

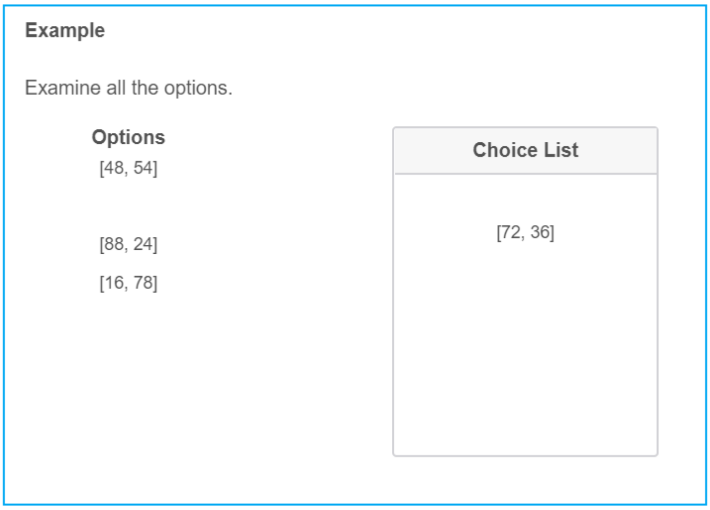
In this block, you will confront the **same** 21 decision problems as those in Block A. You will see your choice from the corresponding problem in Block A highlighted in yellow. You will be asked to consider if you would like to change you choice.

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.

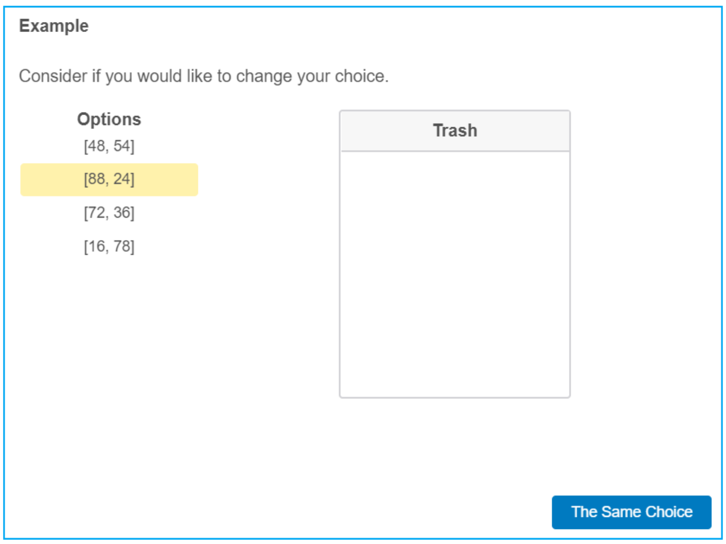
Remember that we will ask you to choose between Blocks A and B for payment at the end of Section 1.

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

Block B (Sequential Elimination)

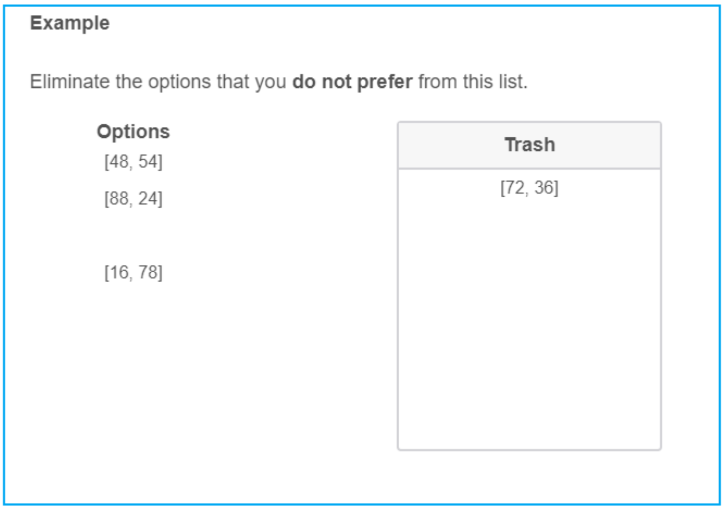
In this block, you will confront the **same** 21 decision problems as those in Block A. You will see your choice from the corresponding problem in Block A highlighted in yellow. You will be asked to consider if you would like to change you choice.

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 Frame

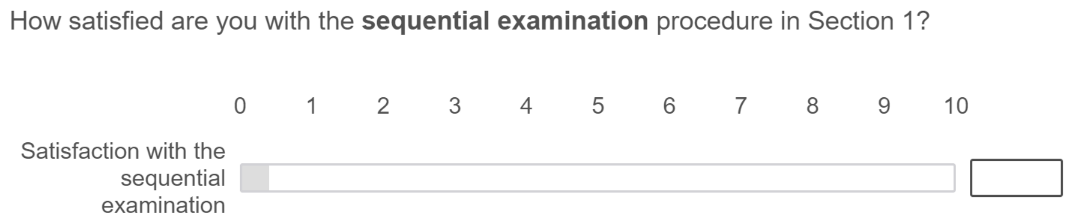
Please indicate that which block you would like to choose for your payment in Section 1.

- Block A
- Block B

Individual Satisfaction (The Direct Procedure) Frame

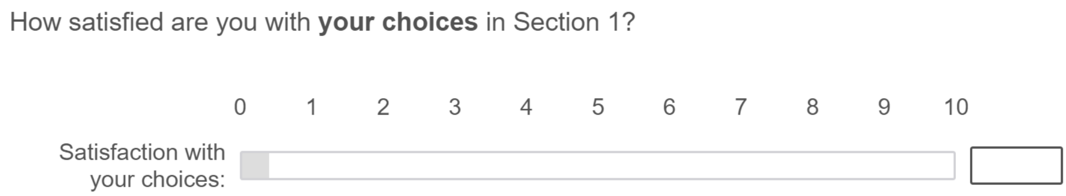
Now, we would like to understand how satisfied you are with the decisions you made in Section 1.

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.


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

0 1 2 3 4 5 6 7 8 9 10

Satisfaction with the sequential examination


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

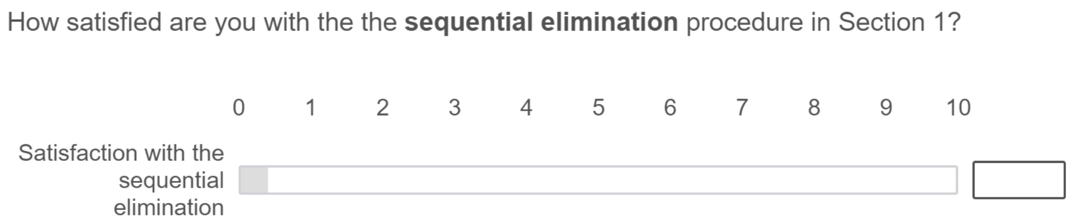
0 1 2 3 4 5 6 7 8 9 10

Satisfaction with your choices:

Individual Satisfaction (Sequential Elimination) Frame

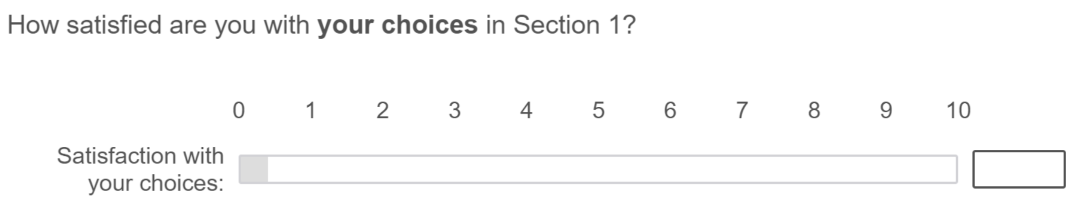
Now, we would like to understand how satisfied you are with the decisions you made in Section 1.

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:

B.2.3 Screenshots of Treatments

Figure 7: The Direct Procedure, a subject enters a decision problem

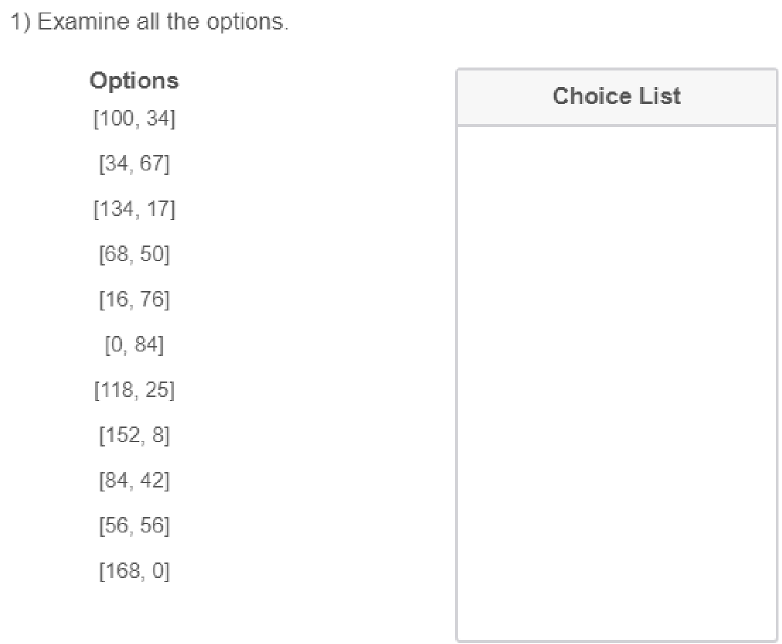


Figure 8: The Direct Procedure, a subject clicks on an option

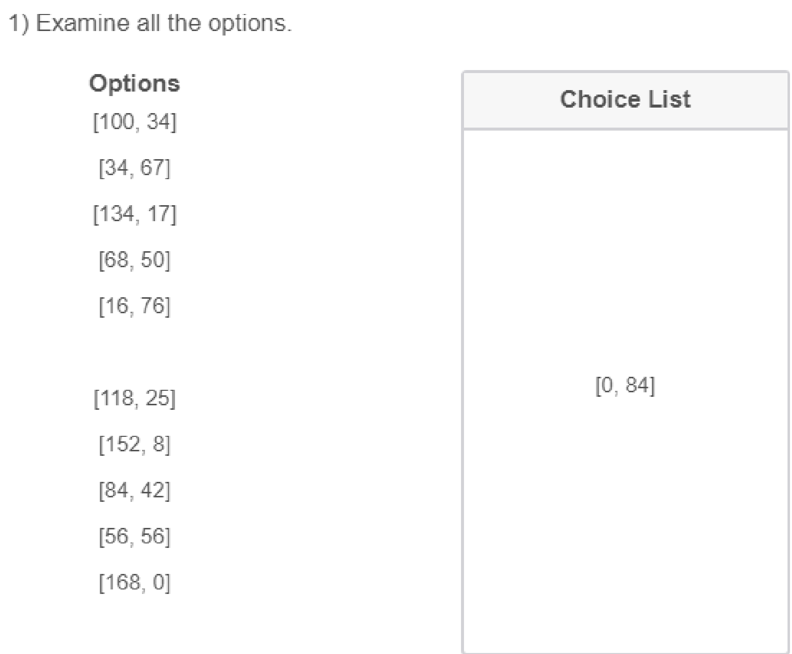


Figure 9: The Direct Procedure, a subject has clicked on all options

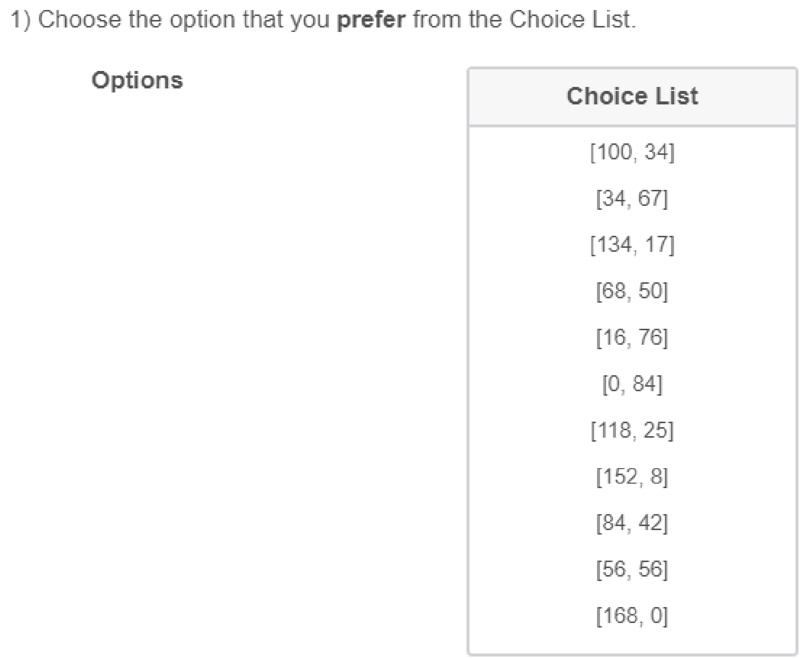


Figure 10: The Direct Procedure, a subject chooses an option in the Choice List

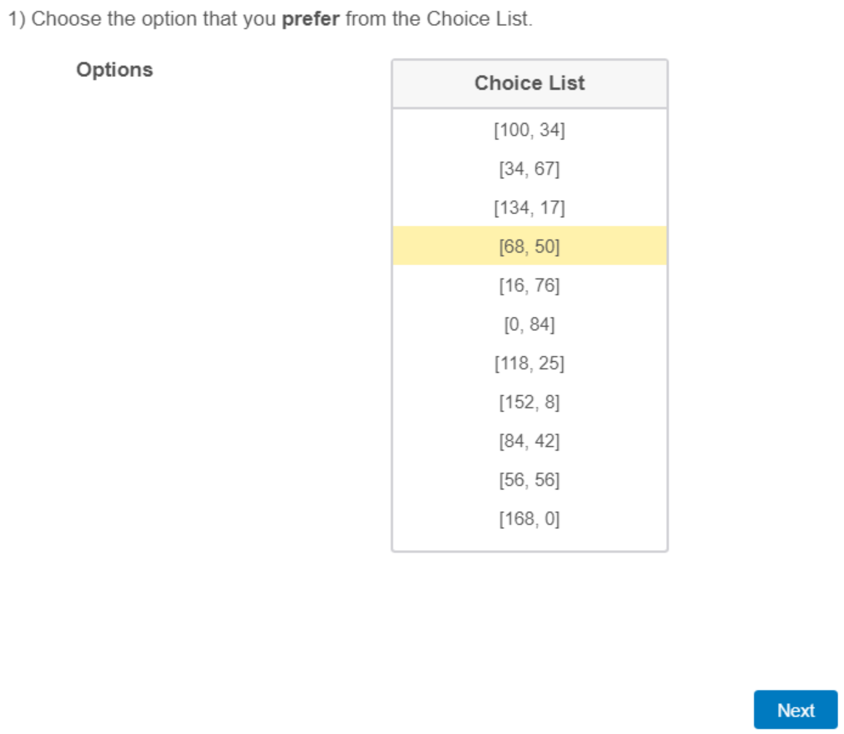


Figure 11: Sequential Elimination, a subject enters a decision problem

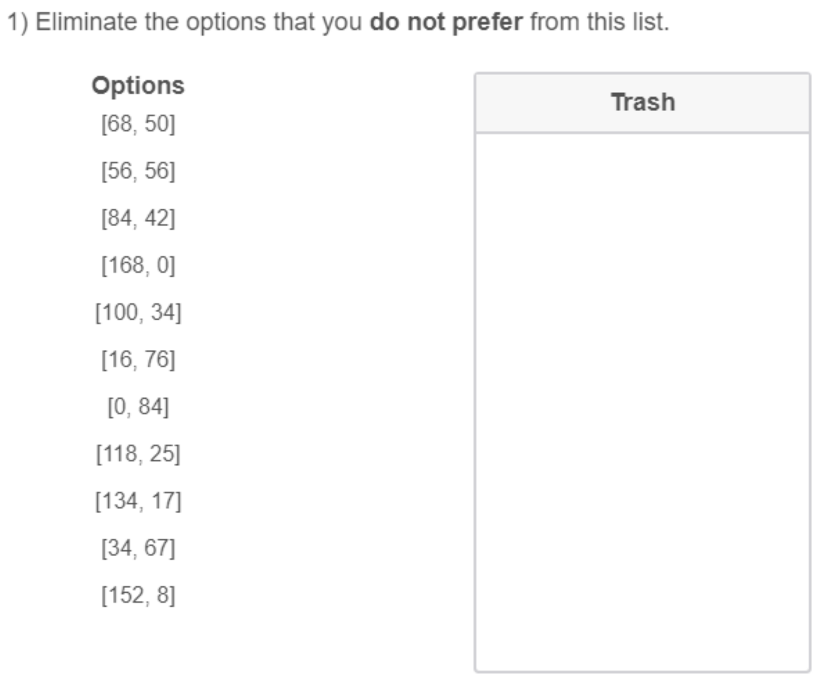


Figure 12: Sequential Elimination, a subject eliminates on an option

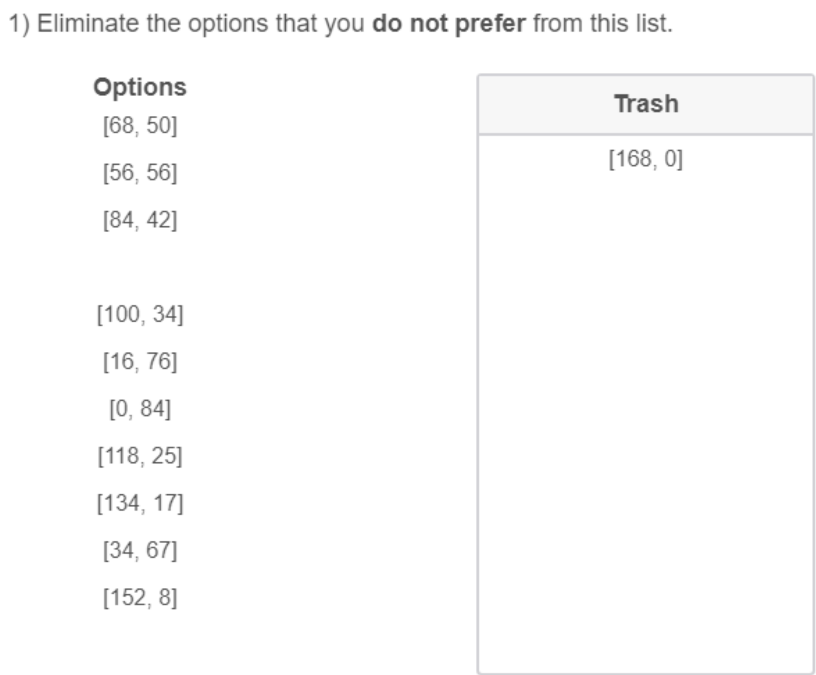


Figure 13: Sequential Elimination, a subject has eliminated all but one options

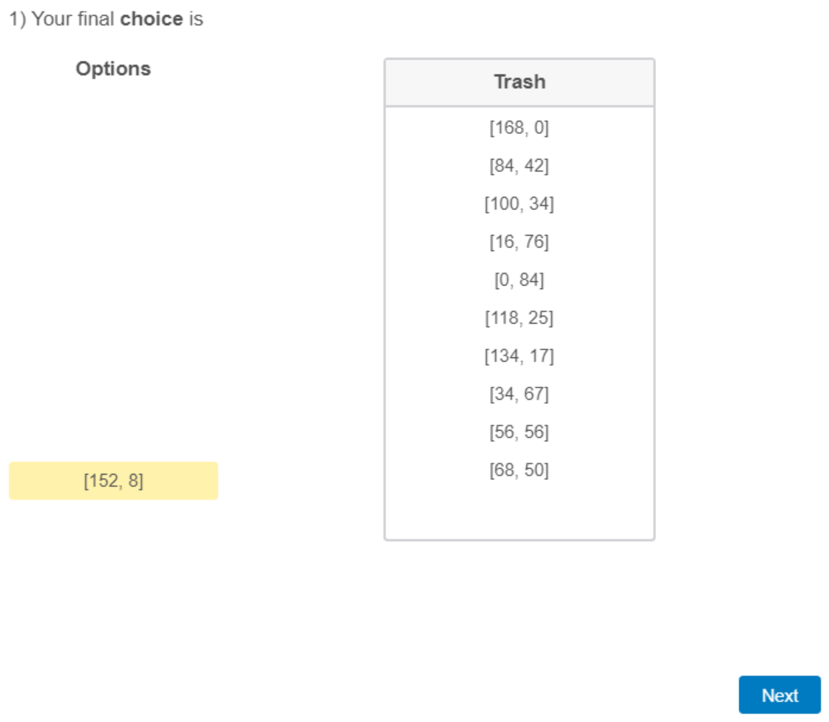
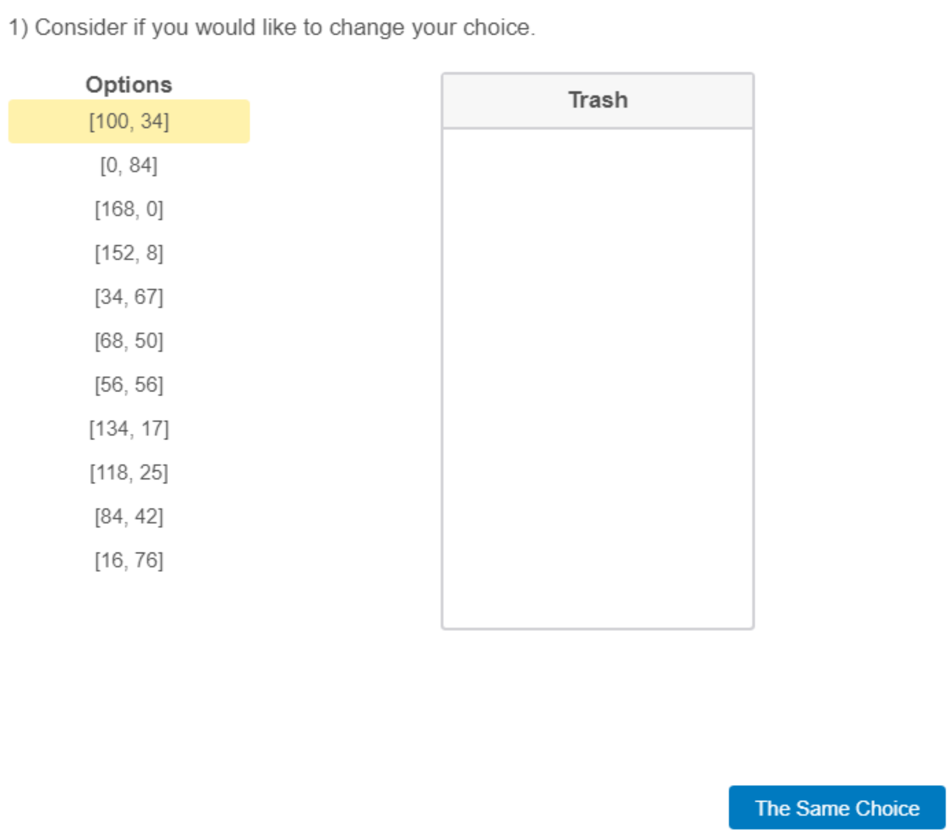


Figure 14: Choice Revision (Block B), a subject enters a decision problem



B.2.4 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.

Figure 15: An Example of Matrix Reasoning Problem

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

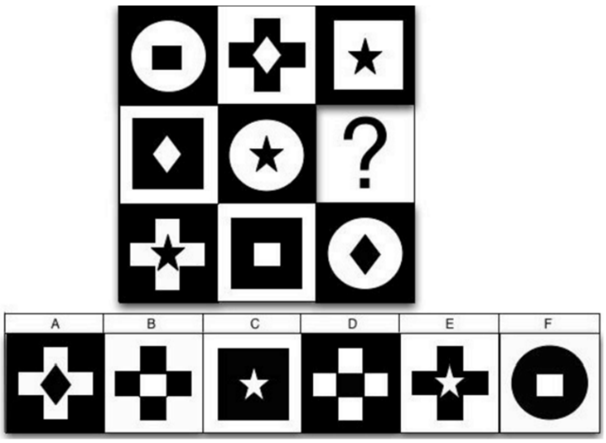
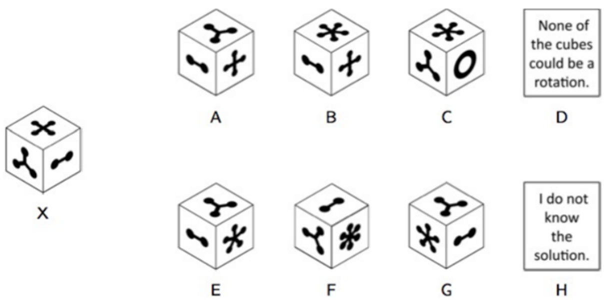


Figure 16: An Example of Three-dimensional Rotation Problem

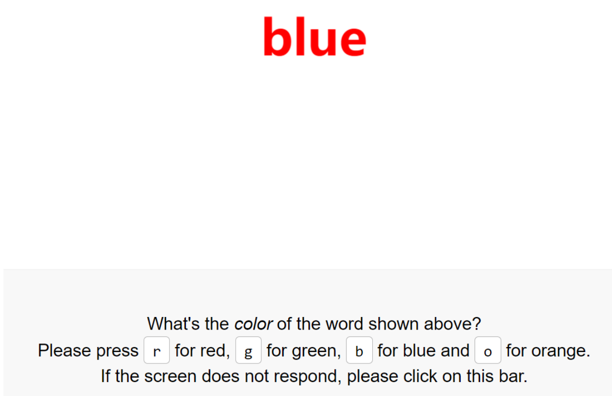
Please indicate which is the best answer to complete the figure below.



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.

Figure 17: An Example of Stroop Task



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 the entire sequence.

Figure 18: An Example of Sternbeg Task, Memorization Phase

Figure 19: An Example of Sternbeg Task, Recall Phase

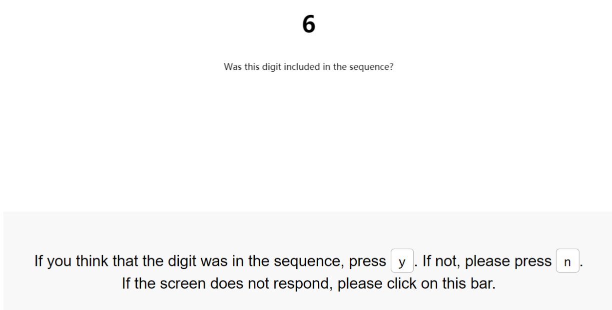
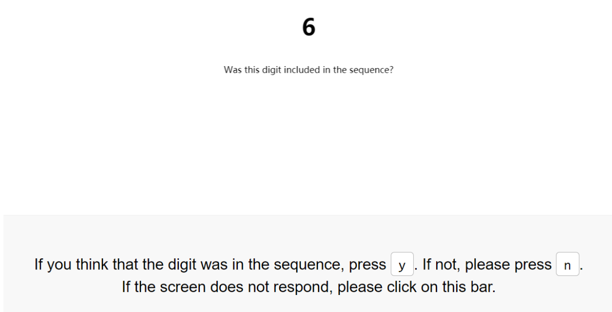


Figure 20: An Example of Sternbeg Task, Recall Phase



B.2.5 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.

Ease with 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

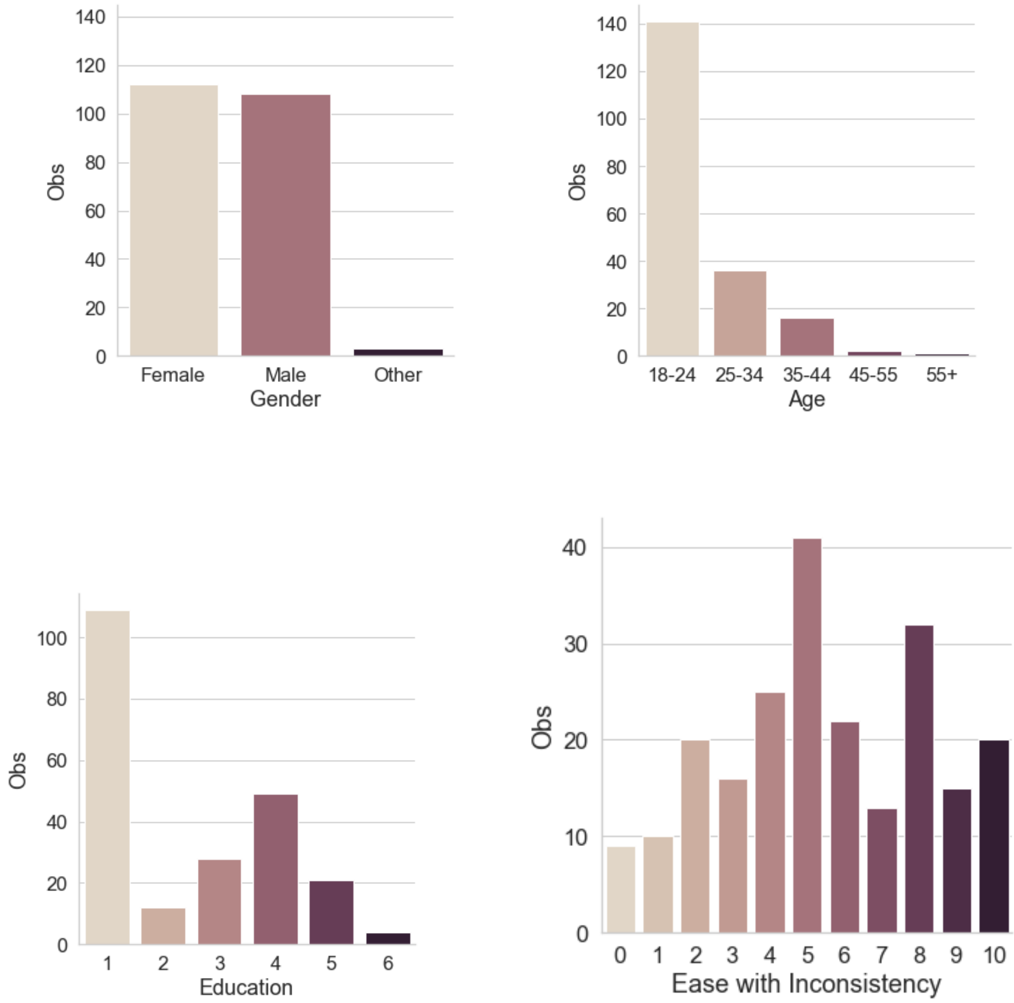
Imagine two trips you may make this summer. You plan Trip 1 by yourself. Someone plans Trip 2 for you. The plans for both trips are the same. You will visit the same places, take the same photos and enjoy the same foods. In other words, you will enjoy the same experiences on both trips. Which trip do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

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

Appendix C Descriptive Statistics in the Experiment

C.1 Demographics

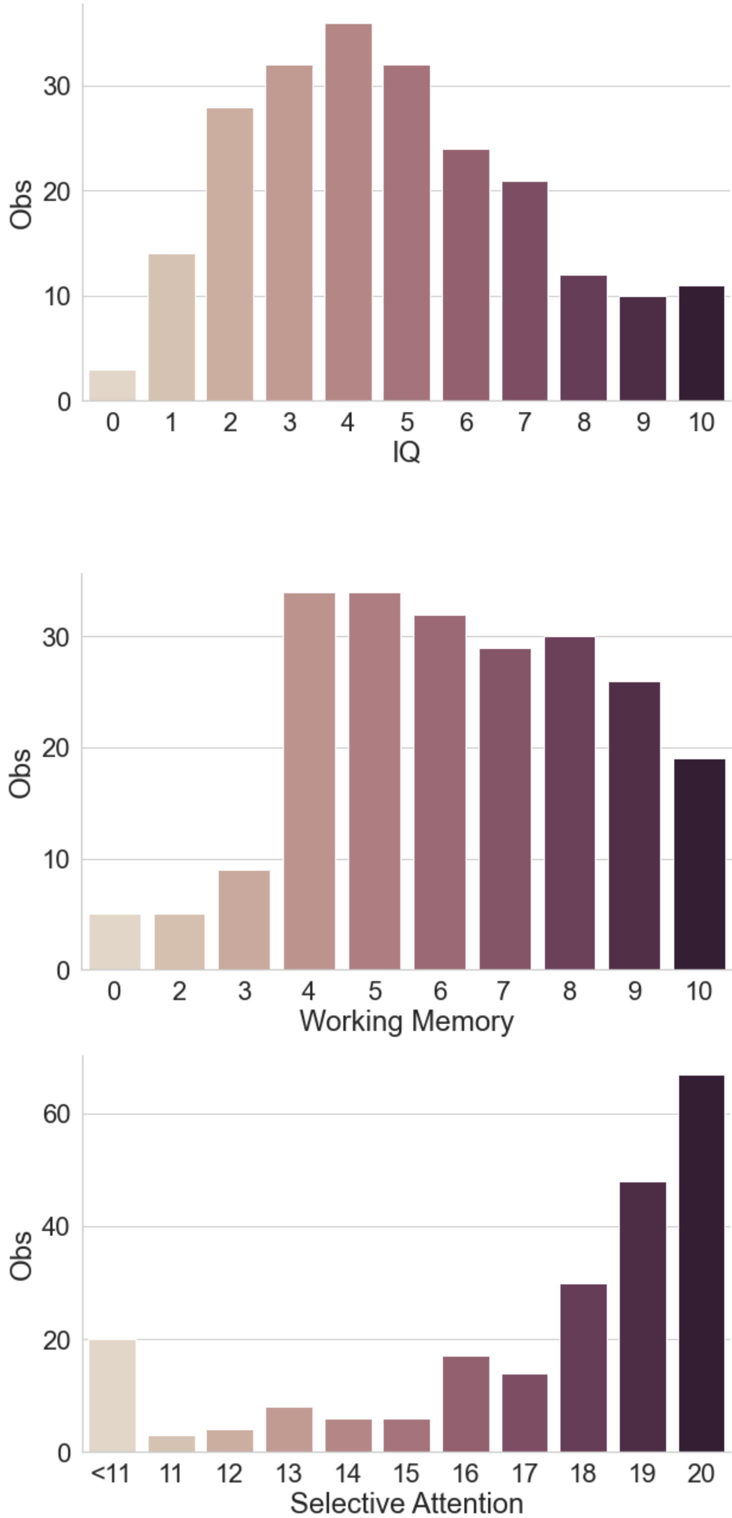
Figure 21: Histograms of Demographics (Overall Sample)



Note: 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 22: Histograms of Cognitive Ability (Overall Sample)



C.3 Balance Checks

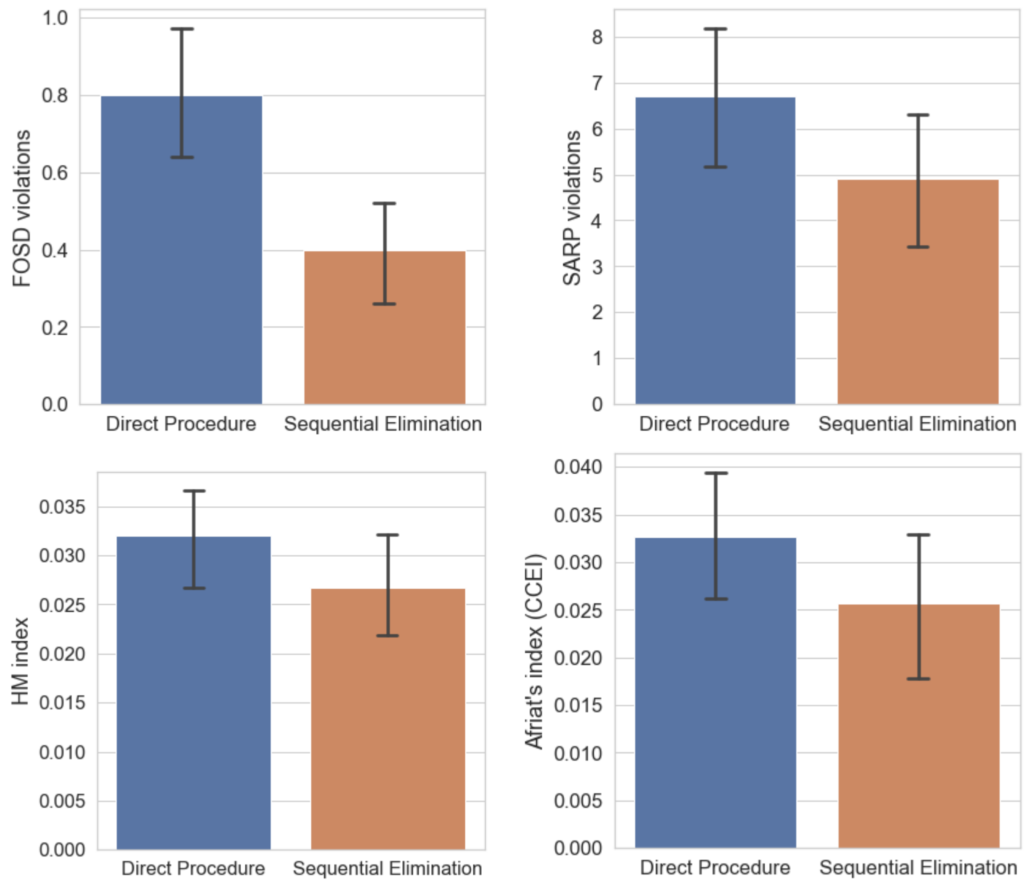
Table 8: Descriptive Statistics and Balance

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)
Ease with Inconsistency	5.800	5.329	-0.471
	(2.899)	(2.911)	(0.478)
Observations	75	73	148

Standard errors in parentheses.

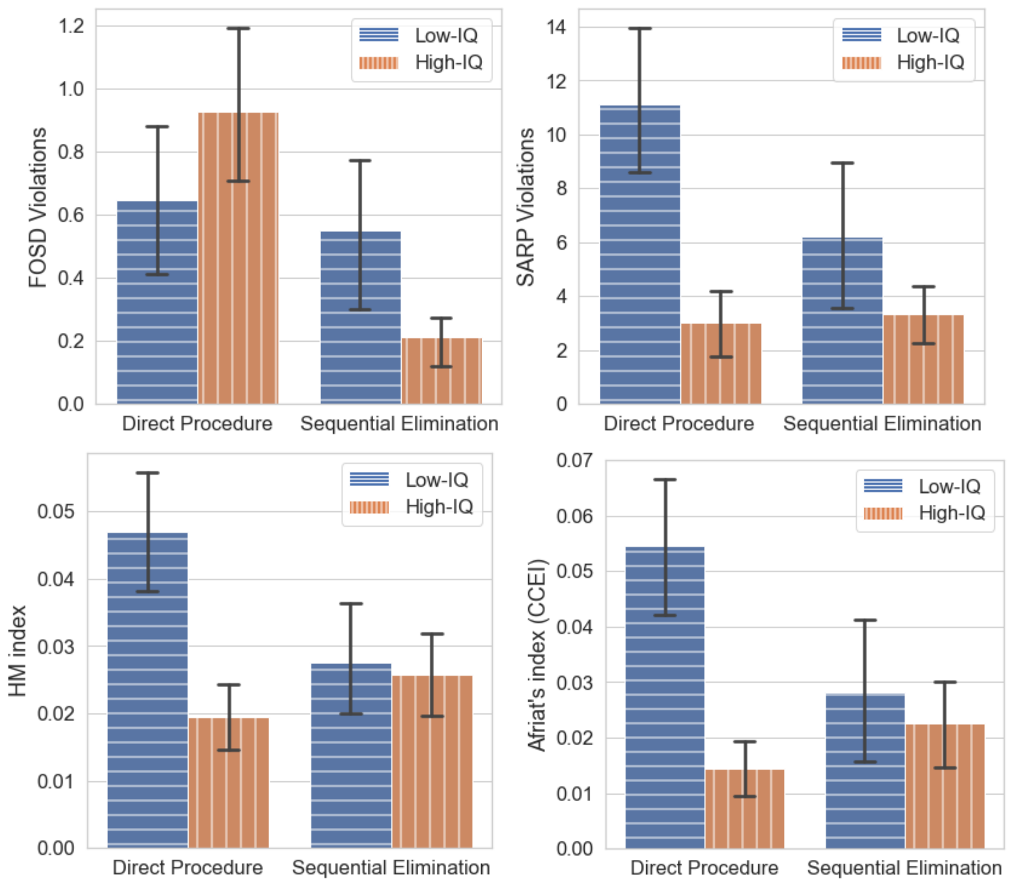
C.4 Economic Rationality Measures

Figure 23: Economic Rationality in the Experiment (1)



Note: Error bars indicate the standard error of means.

Figure 24: Economic Rationality in the Experiment (2)



Note: Error bars indicate the standard error of means.

Figure 25: Empirical CDFs of Economic Rationality Measures in the Experiment (1)

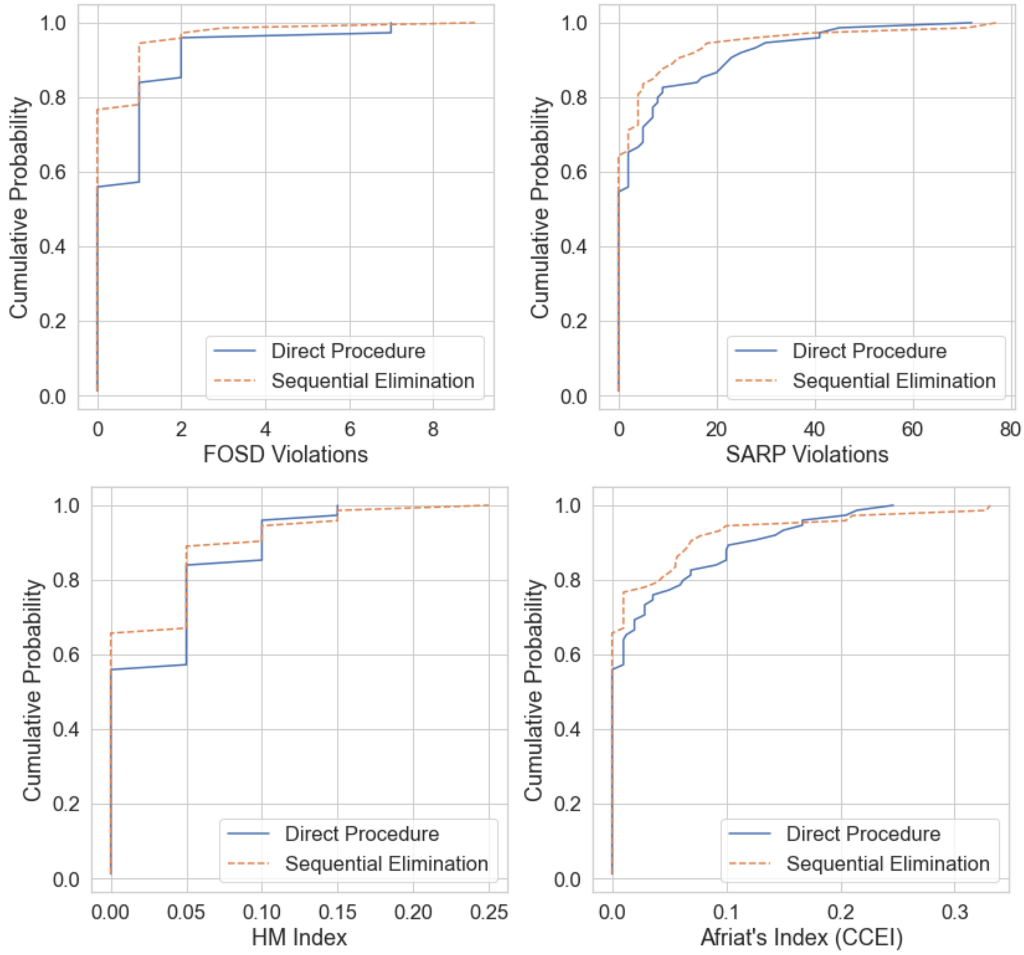


Figure 26: Empirical CDFs of Economic Rationality Measures in the Experiment (2)

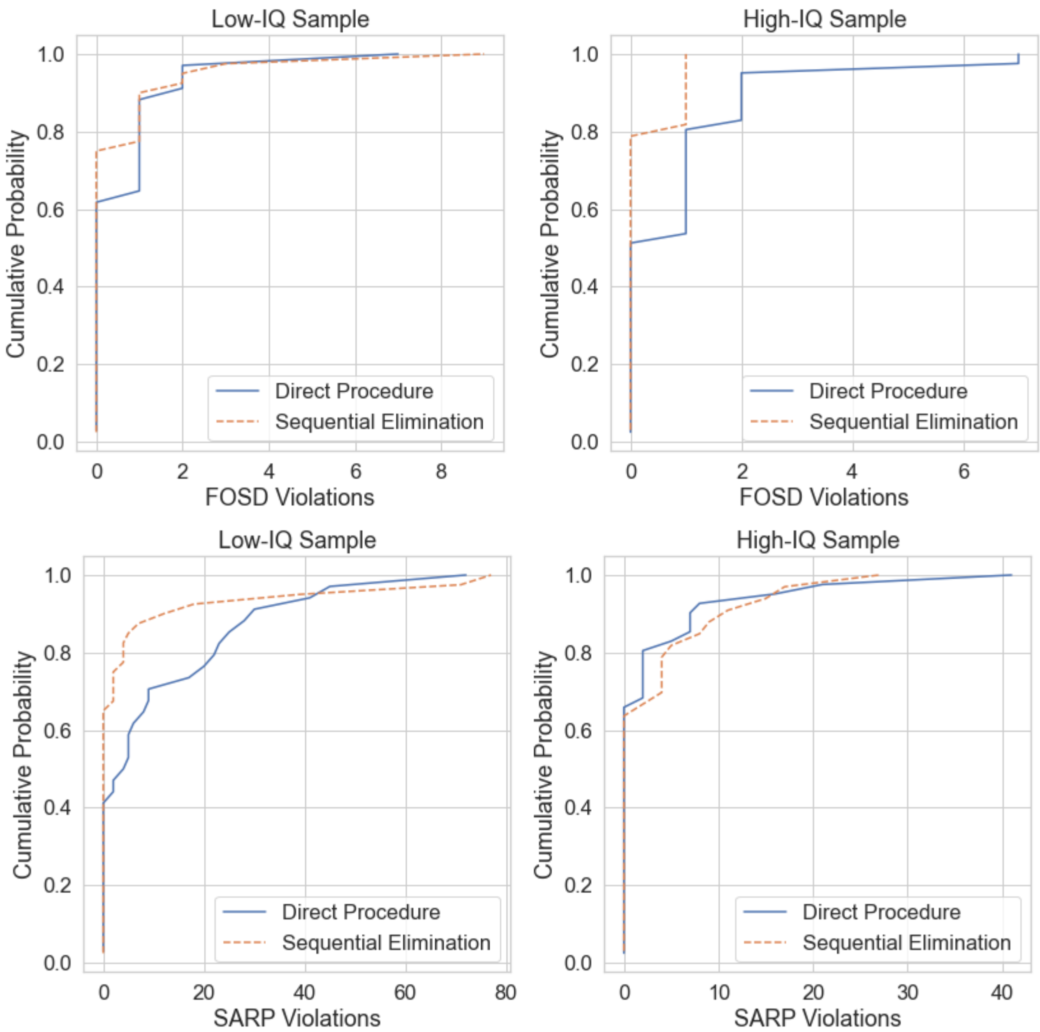
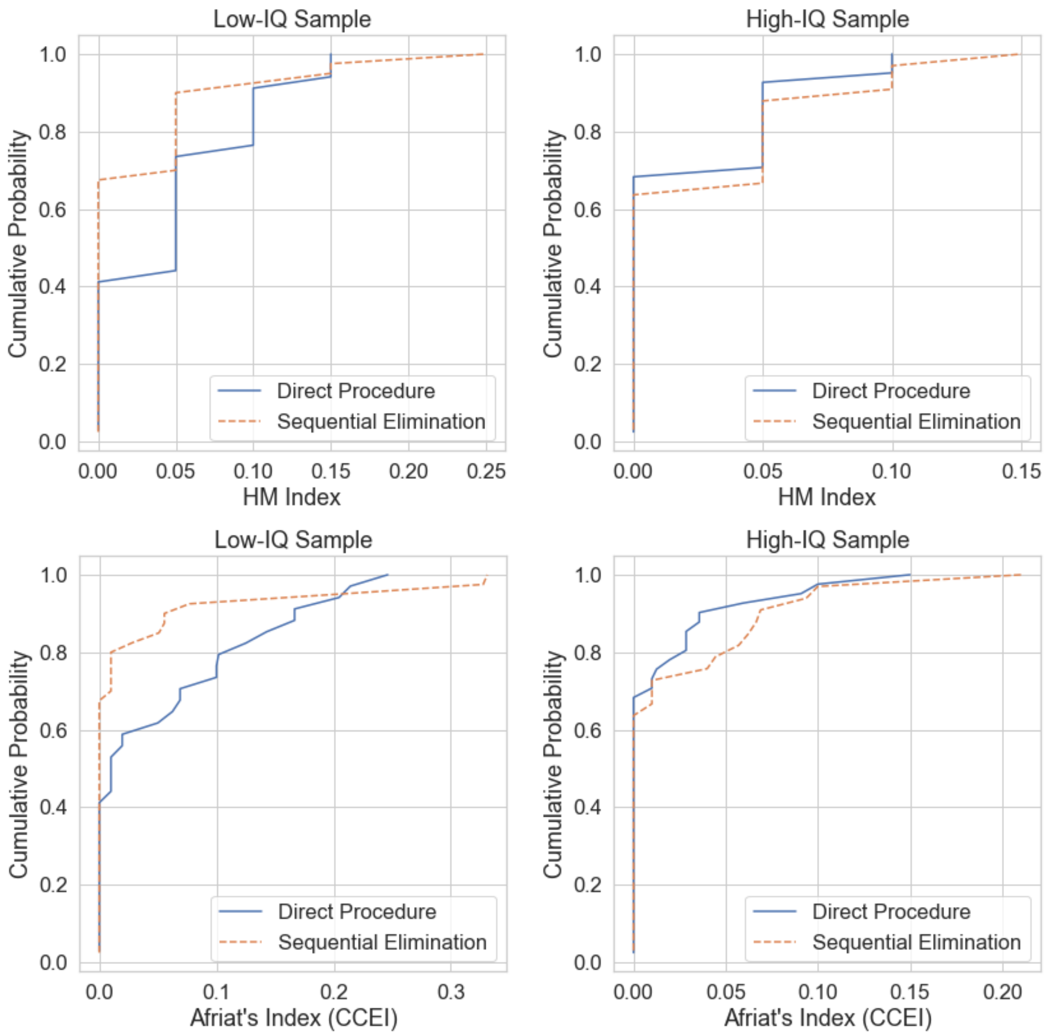
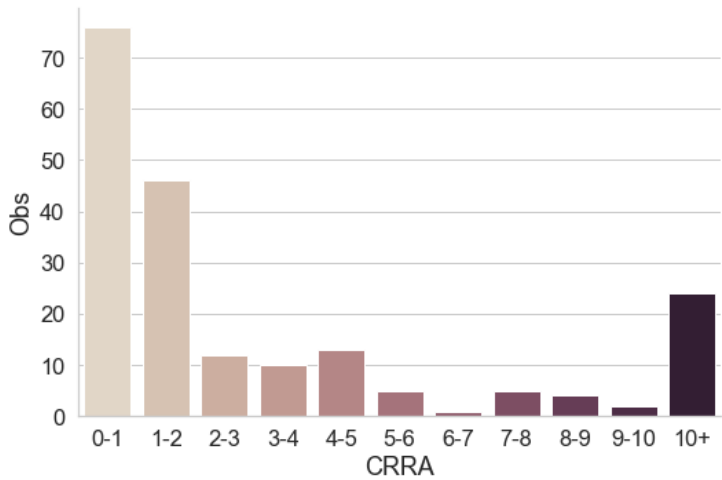


Figure 27: Empirical CDFs of Economic Rationality Measures in the Experiment (3)



C.5 Risk Preferences

Figure 28: Histogram of the Revealed CRRA in the Experiment



Appendix D Robustness Checks

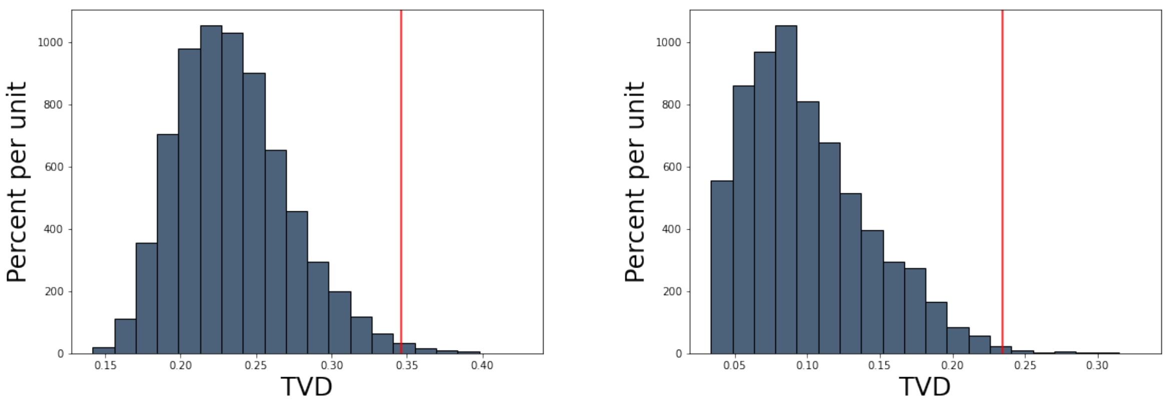
D.1 Economic Rationality

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 economic rationality of choices in 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 29 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 30 shows permutation tests in the low-IQ subsample and the ones in the high-IQ subsample. 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 30 (a)) but not for High-IQ subjects ($p = 0.1308$, Figure 30 (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 30 (c)) but not for low-IQ subjects ($p = 0.2426$, Figure 30 (d)). In sum, the nonparametric results are consistent with our previous regression analysis.

Figure 29: Permutations Test of Sequential Elimination Effect on Economic Rationality

(a) GARP Violations **(b)** FOSD Violations



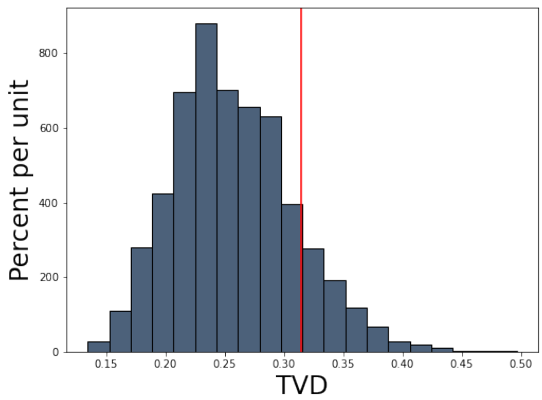
Notes: Empirical P-value=0.0058

Notes: Empirical P-value=0.0071

Table 9 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 ($p = 0.77$). 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.

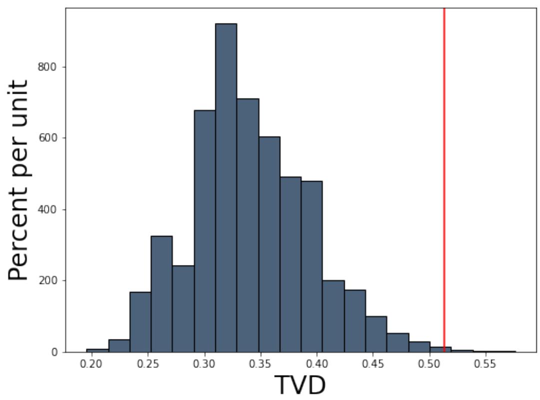
Figure 30: Permutations Test of Treatments on Economic Rationality in Subsamples

(a) GARP Violations, Low-IQ Sample



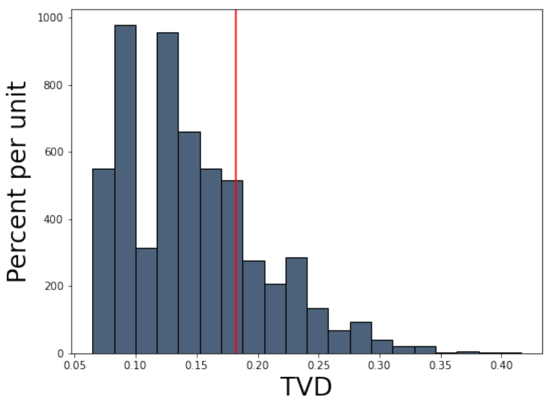
Notes: Empirical P-value=0.004

(b) GARP Violations, High-IQ Sample



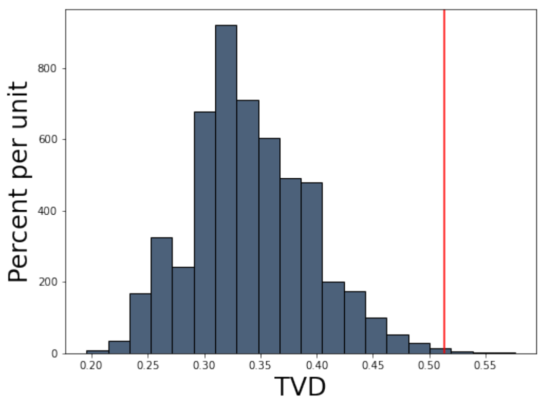
Notes: Empirical P-value=0.1308

(c) FOSD Violations, Low-IQ Sample



Notes: Empirical P-value=0.2426

(d) GARP Violations, High-IQ Sample



Notes: Empirical P-value=0.0262

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) 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 (See Appendix E for the decision problem). Subjects with a declared preference for one or the other is considered a non-consequentialist.

Table 10 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

Table 9: Determinants of Economic Rationality

	(1) GARP Violations	(2) SARP Violations	(3) HM Index	(4) CCEI	(5) FOSD Violations
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)
Ease with 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

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

categorized by IQ based on their positions in the distribution, first by terciles and then by quartiles. The variable of interest, Sequential Elimination, reduces GARP violations among subjects with IQs in the lowest tercile ($p = 0.04$) and the lowest quartile ($p = 0.03$).

Table 10: Determinants of Consistency in Subsamples

	GARP Violations		
	(1)	(2)	(3)
	2-Quantiles	3-Quantiles	4-Quantiles
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)
Ease with 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

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D.2 Choice Revision

Table 11: The Effect of Choice Revision on Consistency (Average Marginal Effects)

	(1)	(2)	(3)	(4)
		GARP Violations		
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)
Ease with Inconsistency	-0.720	-0.656	-0.696*	-0.800*
	(0.442)	(0.409)	(0.417)	(0.475)
N	151	151	151	151

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 12: The Choice Revision Effects on FOSD Violations (Average Marginal Effects)

	(1)	(2)	(3)	(4)
		FOSD Violations		
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)
Ease with Inconsistency	-0.013	-0.006	-0.016	-0.014
	(0.028)	(0.026)	(0.030)	(0.027)
N	151	151	151	151

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.3 Economic Rationality in Free Procedure

Table 16 shows, in addition to the Table 5, regression estimates for SARP violations, CCEI, and the HM index.

Table 13: Determinants of Economic Rationality (Free Procedure, Average Mariginal Effects)

	(1) GARP Violations	(2) SARP Violations	(3) HM Index	(4) CCEI (OLS)	(5) FOSD Violations
Sequential Elimination	-16.472	-13.923	-0.008	-0.026	0.222
	(18.569)	(16.763)	(0.013)	(0.023)	(0.223)
– Low-IQ Subjects	-15.822	-11.899	0.001	-0.011	0.338
	(25.069)	(22.988)	(0.017)	(0.033)	(0.321)
– High-IQ Subjects	-17.786	-17.698	-0.023	-0.051**	-0.029
	(13.858)	(14.222)	(0.019)	(0.025)	(0.143)
Age	0.239	0.214	0.000	-0.001	0.007
	(0.748)	(0.882)	(0.001)	(0.001)	(0.011)
Female	7.551	10.677	0.017	0.021	0.298
	(9.008)	(10.950)	(0.014)	(0.021)	(0.192)
Education	-5.313	-6.460	-0.008	0.000	-0.084
	(4.453)	(5.136)	(0.007)	(0.008)	(0.087)
High-IQ	-3.879	-4.380	0.009	-0.008	-0.369***
	(5.744)	(6.134)	(0.011)	(0.013)	(0.135)
Selective Attention	0.194	0.333	-0.001	-0.003	-0.042**
	(1.441)	(1.681)	(0.001)	(0.002)	(0.020)
Working Memory	-3.363	-3.809	-0.006***	-0.006***	-0.087***
	(2.435)	(2.780)	(0.002)	(0.002)	(0.025)
Response Time (minutes)	-0.915	-0.819	-0.002	-0.003	-0.067**
	(0.702)	(0.838)	(0.002)	(0.003)	(0.027)
Ease with Inconsistency	-1.582	-1.560	-0.003	-0.004	-0.004
	(1.129)	(1.197)	(0.003)	(0.004)	(0.033)
N	75	75	75	75	75

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.4 Individual Satisfaction

Table 14 shows, in addition to the Table 7, the effect of consistency measured by SARP violations, HM index, and CCEI on individual satisfaction.

Table 14: Determinants of Individual Satisfaction (Odd Ratios)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Satisfaction with Choice					Satisfaction with Procedure				
GARP violations	0.988*					0.987*				
	(0.007)					(0.008)				
SARP violations		0.989*					0.989			
		(0.007)					(0.007)			
HM index			0.009*					0.056		
			(0.025)					(0.163)		
CCEI				0.052					0.005**	
				(0.104)					(0.010)	
FOSD violations					0.767**					0.830
					(0.089)					(0.099)
Sequential Elimination	0.852	0.852	0.797	0.833	0.720	0.603*	0.603*	0.590*	0.613	0.551*
	(0.256)	(0.256)	(0.239)	(0.250)	(0.219)	(0.183)	(0.183)	(0.179)	(0.186)	(0.169)
Procedure Selection	1.118	1.116	1.029	1.087	0.955	1.258	1.254	1.201	1.288	1.142
	(0.330)	(0.329)	(0.302)	(0.320)	(0.283)	(0.362)	(0.361)	(0.345)	(0.371)	(0.331)
Response Time (minutes, Block A)	1.004	1.004	1.006	1.004	1.013	0.981	0.981	0.984	0.977	0.988
	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Response Time (minutes, Block B)	0.908**	0.908**	0.899**	0.896**	0.879***	0.912**	0.912**	0.905**	0.901**	0.894**
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.041)	(0.041)	(0.041)	(0.040)	(0.041)
Age	1.023	1.023	1.021	1.018	1.024	1.004	1.004	1.002	0.998	1.003
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)
Female	0.730	0.729	0.755	0.755	0.763	1.063	1.063	1.093	1.063	1.127
	(0.175)	(0.175)	(0.180)	(0.180)	(0.182)	(0.254)	(0.254)	(0.260)	(0.253)	(0.269)
Education	0.958	0.957	0.970	0.978	0.967	0.949	0.949	0.963	0.955	0.968
	(0.113)	(0.113)	(0.114)	(0.114)	(0.113)	(0.109)	(0.109)	(0.110)	(0.109)	(0.110)
IQ	1.016	1.016	1.014	1.014	1.013	1.022	1.022	1.024	1.015	1.020
	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.054)	(0.054)	(0.054)	(0.053)	(0.054)
Working Memory	0.961	0.960	0.951	0.957	0.949	0.951	0.951	0.947	0.945	0.946
	(0.052)	(0.052)	(0.052)	(0.052)	(0.051)	(0.051)	(0.051)	(0.051)	(0.050)	(0.051)
Selective Attention	1.050	1.050	1.056	1.051	1.053	1.024	1.025	1.037	1.017	1.027
	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)	(0.039)	(0.039)	(0.038)	(0.038)	(0.038)
Ease with Inconsistency	0.984	0.984	0.985	0.986	0.984	0.995	0.995	0.999	0.988	0.998
	(0.044)	(0.044)	(0.044)	(0.044)	(0.043)	(0.046)	(0.046)	(0.046)	(0.045)	(0.046)
N	228	228	228	228	228	228	228	228	228	228

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

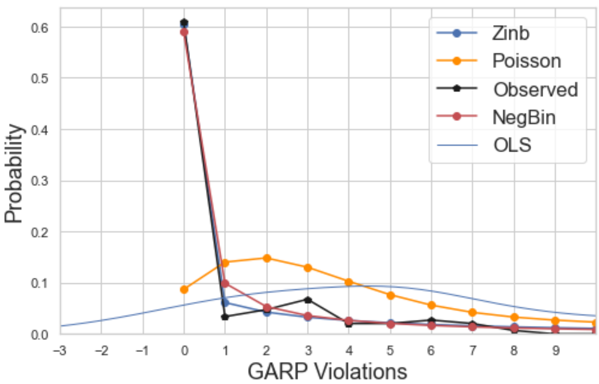
Appendix E Details of the Experimental Results

E.1 Model Selection

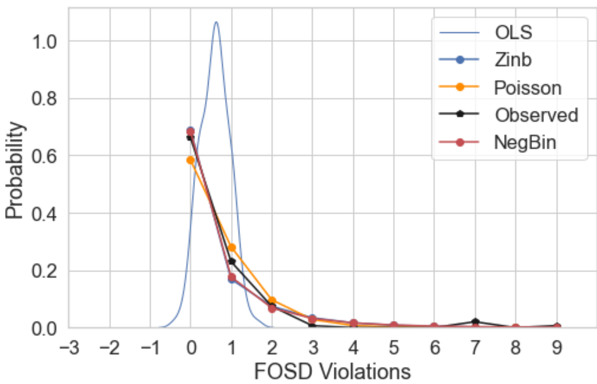
Figure 31 presents the observed GARP and FOSD violations, together with and their values predicted by OLS, Poisson, negative binomial (*NegBin*) and zero-inflated negative binomial model (*Zinb*) models, showing that the last one provides a good fit for the observed data. The regressors in both models include sequential elimination, high-IQ, sequential elimination×high-IQ, selective attention, working memory, age, female, education, time, ease with 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 15, 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 15 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.

Figure 31: Observed Data and Model-predicted Values

(a) GARP Violations



(b) FOSD Violations



Note: 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 15: Model Selection Criteria and Performance

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

E.2 Economic Rationality

Table 16: Determinants of Economic Rationality (Original Form)

	(1) GARP Violations	(2) SARP Violations	(3) HM Index	(4) CCEI	(5) FOSD Violations
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)
Ease with 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

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

E.3 Choice Revision

Table 17: The Effect of Choice Revision on Consistency (Original Form)

	(1)	(2)	(3)	(4)
	GARP Violations			
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)
Ease with 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

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 18: The Effect of Choice Revision on FOSD Violations (Original Form)

	(1)	(2)	(3)	(4)
	FOSD Violations			
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)
Ease with 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

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.4 Sequential Elimination in Free Procedure

Table 19: Determinants of Preference for Sequential Elimination (Original Form)

	Probability of Choosing Sequential Elimination	
	(Probit)	(Logistic)
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 Score	-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)
Ease with Inconsistency	0.0110	0.0203
	(0.0701)	(0.123)
Constant	3.135**	5.093**
	(1.341)	(2.344)
N	75	75

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

Table 20: Determinants of Consistency (Free Procedure, Original Form)

	(1) GARP Violations	(2) SARP Violations	(3) HM Index	(4) CCEI (OLS)	(5) FOSD Violations
Sequential Elimination	-1.231	-0.875	0.022	-0.288	0.800
	(1.406)	(1.373)	(0.649)	(0.809)	(1.073)
Sequential Elimination×High-IQ	-0.986	-1.145	-0.594	-1.198	-0.971
	(1.610)	(1.566)	(0.807)	(1.031)	(1.342)
Age	0.026	0.021	0.006	-0.024	0.016
	(0.078)	(0.084)	(0.024)	(0.029)	(0.025)
Female	0.762	0.970	0.516	0.545	0.662
	(0.753)	(0.755)	(0.399)	(0.502)	(0.416)
Education	-0.579*	-0.630**	-0.251	0.008	-0.191
	(0.332)	(0.314)	(0.241)	(0.221)	(0.192)
High-IQ	-0.113	0.000	0.686	0.411	-0.400
	(1.057)	(1.057)	(0.590)	(0.750)	(1.246)
Selective Attention	0.021	0.033	-0.040	-0.078	-0.096*
	(0.153)	(0.158)	(0.044)	(0.050)	(0.050)
Working Memory	-0.366**	-0.371**	-0.177***	-0.161**	-0.197***
	(0.164)	(0.173)	(0.061)	(0.065)	(0.053)
Response Time (minutes)	-0.100	-0.080	-0.078*	-0.080	-0.153***
	(0.063)	(0.074)	(0.046)	(0.079)	(0.057)
Ease with Inconsistency	-0.172**	-0.152*	-0.104	-0.119	-0.009
	(0.083)	(0.087)	(0.091)	(0.113)	(0.075)
Constant	6.168*	5.759	-0.764	0.645	2.233
	(3.586)	(3.798)	(0.988)	(1.346)	(1.469)
N	75	75	75	75	75

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.5 Risk Preferences

Table 21: Determinants of Risk Preferences

	(1)	(2)
	CRRA	
Sequential Elimination	2.010	5.522**
	(1.619)	(2.522)
Sequential Elimination×High-IQ		-6.997**
		(2.787)
Age	-0.0790	-0.0751
	(0.127)	(0.127)
Female	1.964	2.134
	(1.383)	(1.394)
Education	0.702	0.536
	(0.695)	(0.710)
IQ Score	-0.397*	
	(0.230)	
High-IQ		2.363
		(1.631)
Selective Attention	-0.239	-0.223
	(0.252)	(0.248)
Working Memory	-0.400	-0.475
	(0.347)	(0.364)
Response Time (minutes)	-0.151	-0.146
	(0.196)	(0.197)
Ease with Inconsistency	0.164	0.180
	(0.283)	(0.280)
Constant	11.786*	8.764
	(6.640)	(5.782)
N	148	148

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.6 Individual Satisfaction

Table 22: Determinants of Individual Satisfaction (Original Form)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Satisfaction with Choice					Satisfaction with Procedure				
GARP violations	-0.012*					-0.013*				
	(0.007)					(0.008)				
SARP violations		-0.011*					-0.012			
		(0.007)					(0.007)			
HM index			-4.703*					-2.885		
			(2.742)					(2.920)		
CCEI				-2.957					-5.397**	
				(1.999)					(2.099)	
FOSD violations					-0.265**					-0.187
					(0.116)					(0.120)
Sequential Elimination	0.111	0.110	0.028	0.083	-0.046	0.229	0.227	0.183	0.253	0.133
	(0.295)	(0.295)	(0.294)	(0.294)	(0.296)	(0.288)	(0.288)	(0.287)	(0.288)	(0.290)
Free Procedure	-0.161	-0.160	-0.226	-0.183	-0.328	-0.506*	-0.506*	-0.527*	-0.490	-0.597*
	(0.301)	(0.301)	(0.300)	(0.300)	(0.304)	(0.304)	(0.304)	(0.303)	(0.303)	(0.306)
Response Time (minutes, Block A)	0.004	0.004	0.006	0.004	0.013	-0.019	-0.019	-0.016	-0.024	-0.012
	(0.021)	(0.021)	(0.020)	(0.021)	(0.022)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
Response Time (minutes, Block B)	-0.097**	-0.096**	-0.107**	-0.109**	-0.129***	-0.092**	-0.092**	-0.100**	-0.105**	-0.112**
	(0.048)	(0.048)	(0.048)	(0.048)	(0.049)	(0.045)	(0.045)	(0.045)	(0.045)	(0.046)
Age	0.022	0.022	0.021	0.018	0.024	0.004	0.004	0.002	-0.003	0.003
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Female	-0.315	-0.317	-0.281	-0.281	-0.271	0.061	0.061	0.089	0.061	0.120
	(0.240)	(0.240)	(0.238)	(0.238)	(0.239)	(0.239)	(0.239)	(0.238)	(0.238)	(0.239)
Education	-0.043	-0.044	-0.031	-0.022	-0.033	-0.053	-0.053	-0.037	-0.046	-0.033
	(0.118)	(0.118)	(0.117)	(0.117)	(0.117)	(0.115)	(0.115)	(0.114)	(0.114)	(0.114)
IQ Score	0.016	0.016	0.014	0.014	0.013	0.022	0.022	0.024	0.015	0.020
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.052)	(0.052)	(0.053)	(0.052)	(0.053)
Working Memory	-0.040	-0.040	-0.050	-0.043	-0.053	-0.050	-0.050	-0.054	-0.057	-0.055
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.053)	(0.054)
Selective Attention	0.048	0.048	0.055	0.050	0.051	0.024	0.025	0.036	0.017	0.027
	(0.036)	(0.036)	(0.035)	(0.036)	(0.036)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)
Ease with Inconsistency	-0.016	-0.016	-0.015	-0.014	-0.016	-0.005	-0.005	-0.001	-0.012	-0.002
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
N	228	228	228	228	228	228	228	228	228	228

Standard errors in parentheses.

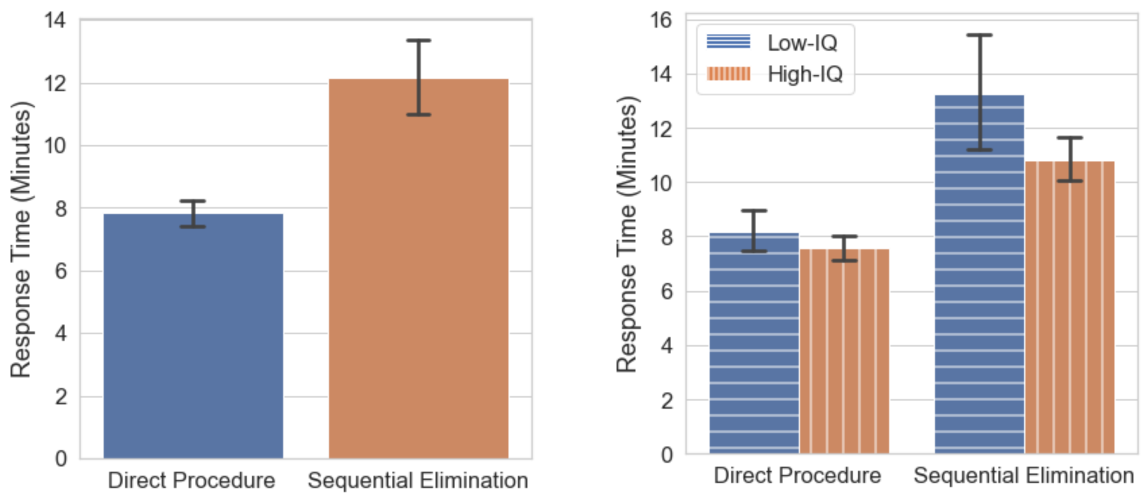
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.7 Response Time

Figure 32 shows that subjects in 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, six estimations are performed, two using the treatment subsamples (Direct Procedure and Sequential Elimination), four using finer subsamples containing subjects from specific IQ groups under specific treatments. Column (1) in Table 23 shows that an increase in IQ score significantly reduces GARP violations in the Direct Procedure (p= 0.054).[48] Column (2) shows that there is a significantly negative relationship (p=0.071) between response time and GARP violations for the low-IQ subjects in the Direct Procedure, whereas this is not the case for low-IQ subjects in Sequential Elimination (Column (3)). Columns (4)-(6) suggest, in contrast, that neither IQ score nor response time contributes much to choice consistency in Sequential Elimination.

Figure 32: Mean Response Time in The Experiment

(a) By Treatment **(b)** By Treatment×IQ



Note: Error bars indicate the standard error of means.

Figure 33 presents a visualization of the role played by response time based on the fitted negative binomial regression models in each subsample. In general, the number of GARP violations decreases as response time increases, in line with the speed-accuracy trade-off hypothesis. The fitted curves for the Direct Procedure subjects (particularly low-IQ subjects) are much steeper, suggesting that response time plays a vital role in improving choice consistency in these groups. Meanwhile, the marginal effect of response time for subjects in Sequential Elimination is smaller than in the Direct Procedure, as implied by the flatter fitted curves. The results suggest that sequential elimination produces a substantially different effect from that obtained by merely increasing response time, i.e., it mitigates the impact of cognitive limitations.

[48] Their estimated coefficients in the negative binomial regression have p-values < 0.001 and 0.029.

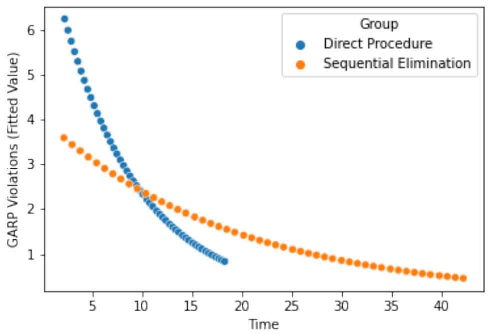
Table 23: Determinants of Consistency in Subsamples (Average Marginal Effects)

	(1)	(2)	(3)	(4)	(5)	(6)
	GARP Violations					
	Control Group			Treatment Group		
	(All)	(Low-IQ)	(High-IQ)	(All)	(Low-IQ)	(High-IQ)
Response Time (minutes)	-1.222	-1.583*	-0.543	-0.296	-0.804	-0.336
	(0.884)	(0.920)	(0.464)	(0.207)	(0.569)	(1.244)
Age	0.205	-1.132	-0.143	-0.375	-0.796	-1.709
	(0.776)	(1.057)	(0.290)	(0.270)	(0.863)	(3.043)
Female	5.521	9.288	0.446	-2.734	0.0512	-5.009
	(4.974)	(8.549)	(1.590)	(2.551)	(5.456)	(9.413)
Education	-1.948	1.890	-0.777	-0.0507	-7.224	8.273
	(2.639)	(3.521)	(0.917)	(1.420)	(6.635)	(17.00)
IQ Score	-4.840*			-0.313		
	(2.610)			(0.567)		
Selective Attention	-0.129	1.851	-0.670	-0.443	-0.0706	-0.812
	(0.803)	(1.182)	(0.549)	(0.366)	(0.835)	(1.621)
Working Memory	0.224	1.704	-0.168	-0.602	-0.592	-2.480
	(1.108)	(1.910)	(0.581)	(0.591)	(1.112)	(4.789)
Ease with Inconsistency	-0.661	-1.335	-0.371	-1.501	-0.616	-3.355
	(0.822)	(1.097)	(0.476)	(1.029)	(1.327)	(6.207)
N	75	34	41	73	40	33

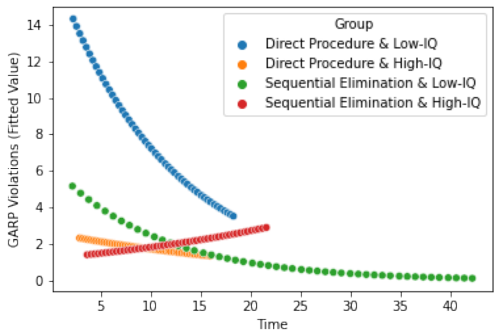
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 33: The Effect of Response Time In Subsamples

(a) By Group



(b) By Group × High-IQ



E.8 Test Analysis

The topics are extracted from the comments on sequential elimination using the latent dirichlet allocation (LDA) model. The two topics extracted are:

Figure 34: 10 Most Common Words In The Comments On Sequential Elimination

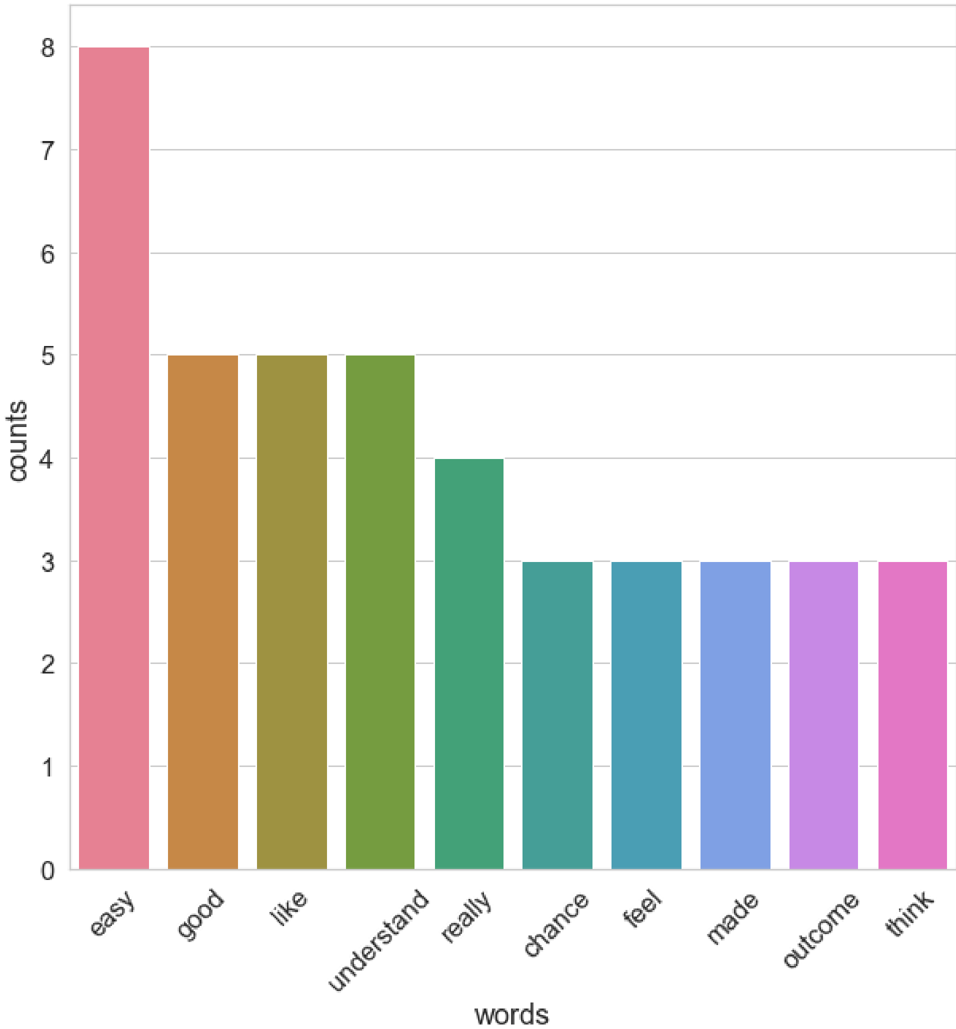


Table 24: Topics found via LDA

Topics	Words
1	easy understand think like first process good gave really well
2	best difficult think time wanted quite least picked potential went