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Attitudes toward choice with incomplete preferences: An experimental study[☆]

Ritxar Arlegi[a,*], Sacha Bourgeois-Gironde[b], Mikel Hualde[a]

[a] *Department of economics, Public University of Navarre and Institute for Advanced Research in Business and Economics (INARBE), Campus Arrosadia s/n- Pamplona 31006,Navarra,Spain*

[b] *Centre de Recherches en Economie et Droit - Université Paris 2 - Panthéon-Assas. Institut Jean-Nicod, Ecole Normale Supérieure - PSL, France*

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ABSTRACT

We present an experiment to test different individual attitudes toward choice, such as *preference for flexibility, choice aversion, betweenness* and *choice neutrality*. Unlike other related experimental papers, we want to analyze whether different choice attitudes can coexist for the same subject, depending on the characteristics of the choice set she is facing. In particular, our main hypothesis is that the presence of incomparability among the alternatives in the choice set, and the time at which such incomparability is solved, affect crucially the kind of attitude towards choice that the subject will exhibit. We find that, indeed, choice attitudes are not homogeneous across choice sets, yet they are conditional on the preferences over the alternatives. We also find some evidence supporting that subjects tend to value heuristically sets as a whole.

1. Introduction

According to the standard microeconomic theory the value of a budget set is that of its best alternative. Translated to the more general setting of evaluating opportunity sets (or "menus") this evaluation rule is known as the *indirect utility* criterion (Arrow, 1995). A direct consequence of this criterion is that adding to or removing from a menu a suboptimal alternative does not affect its value.

An increasing number of theoretical works challenge this view claiming that individuals may display different attitudes toward the *act of choice*, so that availing more or less alternatives may indeed affect the value of the menu, even if these alternatives are suboptimal (or "dominated"). This distorts the indirect utility paradigm of rationality, where the decision

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* Corresponding author.
E-mail address: rarlegi@unavarra.es (R. Arlegi).

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maker is *neutral* to the mere act of choice. We highlight three prominent examples of such alternative views. An individual displays *choice-preference* when she strictly prefers enlarging an opportunity set even if such enlargement is made by means of dominated alternatives. For example, the individual may prefer option x to y, but she may also prefer having the possibility to choose from $\{x, y\}$ than being forced to choose $\{x\}$. *Choice aversion* is opposite to choice-preference. Under choice aversion it can be the case that an individual prefers either $\{x\}$ or $\{y\}$ rather than having to make a choice between $\{x, y\}$. Unlike for the choice aversion models, under "betweenness", aversion to choice arises as a consequence of certain interrelations of the alternatives in the menu. Betweenness is usually related to a preference for commitment in the presence of regret and temptation aversion (Gul and Pesendorfer, 2001; Dekel et al., 2009; Sarver, 2008). This entails that the individual may prefer being obliged to choose $\{x\}$ rather than having to choose from $\{x, y\}$, but she may prefer $\{x, y\}$ rather than being obliged to choose $\{y\}$.

Although these views actually point to different attitudes and have sometimes been deemed as exclusive one from the other (for instance, obviously, choice preference and choice aversion), our present purpose is to show that there exist formal and observable conditions for their compatibility or at least juxtaposition, within a same individual, as can be manifested by the interaction between her valuation of an option set and her actual choice behavior. Attitudes toward choice finely depend upon the way a complete preference and a consistent valuation process can be individually constructed or not over an option set.

We are interested in the intra-personal compatibility of different attitudes toward choice. We claim that they are not only psychological characteristics of the decision maker but that they depend to a large extent on environmental factors, in particular, to the features of the choice problem and of the alternatives to be selected, which allows or not for the formation of a complete preference relation and of a consistent valuation process of the considered sets of options. Arlegi et al. (2021) propose a theoretical model where choice-preference, choice aversion and the indirect utility criterion (or "choice-neutrality") can be made compatible under a proper specification of the model. In particular, three types of binary relations over the alternatives are defined: a binary relation P interpreted as a *undoubted strict preference*; a binary relation $\otimes_1$ of *tentative incomparability*, which is expected to be solved before the final alternative has to be selected from the set, and a binary relation $\otimes_2$ of *assertive incomparability*, which is not expected to be solved before the final alternative from a set has to be selected. Each of the three binary relations connects with a different attitude toward choice: An alternative that is dominated according to P does not add any value when added to a set, alternatives related by $\otimes_1$ involve flexibility and therefore a preference for a greater choice, and alternatives related by $\otimes_2$ involve a psychological cost of incomparability that leads to aversion to choice. The three binary relations can coexist in an individual decision problem, and therefore the decision maker may exhibit the three different choice attitudes.

Close to our purpose, Le Lec and Tarroux (2020) designed an experiment consisting of a first stage during which participants had to evaluate all the possible choice sets formed by combinations of four alternatives, including singletons. In the second stage participants choose one item from one of the menus randomly selected. The alternatives consisted of 30-minutes access to websites of well-known media of different types: a popular general TV channel; a more youth oriented TV channel; a culture-oriented TV channel and a leading newspaper. In that way, it could not be a priori presumed that the participants preferred any particular alternative over any other. Such a preference is deduced from their evaluation of the corresponding singletons. The results suggest that participants are choice-averse and that *adding* suboptimal options reduces the value of a set. The value of the set is sensitive to the value of all its alternatives, even when they are suboptimal. The authors provide two possible explanations for their findings. One is that individuals fear making bad decisions in the second stage. The other is that subjects value the menus heuristically as a whole, and not on the basis of their final consequences. The paradigm used in that experiment is instrumental for us to investigate possible correlations between the degree of determinacy of a preference (whether it can be presumed complete or not) and various possible attitudes toward choice (aversion, neutrality or preference for more available options in a set).

In this paper we present an experiment that essentially combines and develops both the theoretical work by Arlegi et al. (2021) and the experimental work by Le Lec and Tarroux (2020) (henceforth LT20), in a view to systematically address the question of how attitudes toward choices are driven by set-valuation and preference completeness factors, themselves driven by diverse compositions of option sets. In our own experimental setting, alternatives within option sets are designed in such a way that we can presume that the three types of preference or incomparability relations, as recalled above, will occur. In this way we try to check which correlation between the types of binary relations among alternatives and the different types of attitudes toward choice arise in the lab. Unlike in LT20, where alternatives, consisting of enjoying reading a webpage during 30 min, are *final* consumption goods, in our design alternatives are means to obtain monetary earnings. Some of them give clearly better chances to obtain earnings than others (they are related by P); among some other pairs of alternatives the comparison in terms of the chances they give to obtain earnings is deliberately unclear and difficult to be made (they are related by $\otimes_2$) and, finally, some alternatives involve an uncertainty that will be solved before an option has to be selected from the menu in the final stage of the decision process (they are related by $\otimes_1$).

On the basis of this design, we are in a position to address our two main questions: i) How the more or less determinate $(P, \otimes_1, \otimes_2)$ binary relations holding over the alternatives we display affect the valuation of options sets and ii) To which extent we observe a correlation between those binary relations and attitudes toward choice as modelled in Arlegi et al. (2021).

Literature review

Apart of the mentioned works by Arlegi et al. (2021) and LT20, there are several works that study, by separate, the different attitudes toward choice addressed at the beginning of the introduction.

Regarding the choice-preference attitude, there are at least two possible explanations. One is that freedom of choice has an *intrinsic value* (Suppes, 1987; Sen, 1988; Pattanaik and Xu, 1990; 2000; Bossert et al., 1994). Another possible explanation is a *preference for flexibility*, according to which the preference for $\{x, y\}$ over $\{x\}$ may arise when the preferences over the single alternatives are not totally certain at the moment of evaluating the menus. Such uncertainty is then expected to be solved before the final alternative has to be selected from the set at the second stage of the decision process (see Kreps, 1979; Nehring, 1999; Ahn and Sarver, 2013; Gorno and Natenzon, 2018). Intrinsic value of freedom of choice enters in contradiction with the standard principles of rationality, but preference for flexibility is compatible with them under an appropriate modelling by means of contingent utility functions.[1]

Sonsino and Mandelbaum (2001) explain choice aversion as an aversion to the complexity of the decision problem at hand, which can be directly related with the cardinality of the options set. Ortoleva (2013) proposes an explanation in terms of "thinking aversion", according to which the decision-maker anticipates the cost of thinking that is needed in order to identify the best alternative when the final choice must be made. Guerdjikova and Zimper (2008), Danan et al. (2012) and Arlegi et al. (2021) link choice aversion with a psychological aversion to indecisiveness or incompleteness of the preferences over the single alternatives in a situation where such incompleteness is not expected to be solved when the final alternative has to be selected from the opportunity set.

As for betweeness, temptation models, like Gul and Pesendorfer (2001) and Dekel et al. (2009), explain it by considering y as a *tempting* alternative, so that the individual anticipates a self-control effort to choose x from $\{x, y\}$, which makes her prefer $\{x\}$ to $\{x, y\}$. At the same time, she also knows that she prefers to choose x over y, which should make her prefer $\{x, y\}$ to $\{y\}$. In regret models (Sarver, 2008) x is superior to y in expected utility terms, which makes $\{x, y\}$ be preferred to $\{y\}$, but there are contingencies where y may be better, so that $\{x\}$ is preferred to $\{x, y\}$ as a way to avoid the regret of not having chosen y if such contingencies finally hold.

Several studies have focused on experimentally testing the different attitudes toward choice referred above prior to LT20. Sonsino and Mandelbaum (2001) analyse preference for flexibility and complexity aversion in an experiment where different menus consisting of investment plans were offered to the participants. The plans differed in size (either three or eight options). Each option contained three possible states of nature and there were two treatments for each plan. Under their "probabilistic treatment" subjects were told that they would know the probability associated to each state. Under their "complete information" (CI) treatment they were told that they would know the exact state of nature. Thus, complexity is designed at two levels: the size of the menu and the information conditions. The size parameter acts in two opposite directions: preference for flexibility and complexity aversion. Expected payoffs are designed to isolate the complexity effects. The results show that the size aversion effect has more impact than the preference for flexibility effect under the CI treatment, but the opposite holds under the probabilistic treatment. Moreover, there is a negative cross interaction of complexity effects: complexity aversion with respect to the information conditions shows up only for small sets, and size aversion shows up only for informationally simpler treatments. This finding motivates further investigations about the precise conditions that would make the three attitudes defined above as jointly exemplified among participants.

Toussaert (2018) examines temptation as a source of betweenness. The tempting alternative is the possibility to read an interesting story about one of the participants in the experiment. There is also a task to be performed, consisting in looking to an updating number and taking note of it in a prompting box that appeared 5 times. Subjects received 2 pounds per correct answer. If the subject chose reading the story, then only 4 out of the 5 times would be randomly valid. Preferences over three menus are examined: {not being able to read the story}; {being forced to read the story}, or {being able to choose between reading the story or not}. 40% of subjects displayed betweenness; 6.7% showed aversion; 34.1% showed choice-preference, and 9.2% were consistent with the indirect utility criterion (the remaining 10% showed other orderings). Here there is no apparent compatibility between types of attitudes within participants, but this result shows the prevalence of two main attitudes across the population, choice preference and betweenness, which are also central targets in our own experimental setting.

Cettolin and Riedl (2019) conducted different experiments where participants faced a series of decisions where they were presented with a risky and an ambiguous prospect. Both prospects were similar with respect to the possible outcomes. In each of the situations subjects could either choose one of the two prospects, or select an option that delegates the choice between the two prospects to a fair random device. The results obtained show that there is a significant percentage of subjects that choose the delegation option and such a choice is attributable to incompleteness in their preferences and the wish to resort to a device that would definitely fix their cognitive uncertainty.

In Section 2 we detail the experimental design, and spell out our main hypothesis. Section 3 presents the results and conclusions are proposed in Section 4.

[1] Arlegi and Nieto (2001a,b), defend that apparent intrinsic value of freedom of choice may be masking, in fact, a preference for flexibility in Kreps (1979) terms.

2. Experimental design

The experiment was conducted in the Inarbe Laboratory of Experimental Economics at the Public University of Navarra in different sessions in November 2020 and in May 2021. 107 people enrolled in the experiment, but finally 99 participants showed up among the 6 sessions which took place. All subjects were either undergraduate or graduate students. There were 39 men and 60 women. Participants spent around 90 min and earned an average of e14.63. The experiment was run using the software z-Tree (Fischbacher, 2007).

There were four eligible alternatives in the experiment. Each alternative consisted in guessing a particular value of a magnitude related with a specific sport competition. Guessing had to be made on the basis of past data of the corresponding magnitude that subjects could observe for a limited time. Prizes depended directly on the accuracy of the guessing. Some alternatives were clearly easier to guess than others because, given the data, the reasonable ranges of possible answers were evidently smaller. Other alternatives were, in principle, incomparable, because they were of similar nature; their ranges were alike and because the limited time that subjects had to observe the data did not allow them to make precise calculations. In no case any processed numerical information of the alternatives, such as the values of the mean and the standard deviation, were provided to the participants.

Once subjects had observed the four alternatives at stake and made an idea of their desirability (ease to guess), they had to evaluate certain menus made of them. Menus differed on the internal relationships of dominance and/or incomparability of their elements. The valuations of the menus were used to check our hypothesis about the effect of such relationships on the different attitudes towards choice.

In particular, the four alternatives were the following:

- Handball_1_7: Consisted in guessing the difference in points between the first and the 7th classified teams in a handball competition in 2011. For this purpose subjects observed the classification and scores of the six previous seasons. The range of data is 12, with a minimum value of 12 and a maximum value of 24.
  This was the information seen by the participants:

2004/2005	Wins	Losses	Points	2005/2006	Wins	Losses	Points	2006/2007	Wins	Losses	Points
First	21	4	43	First	23	2	47	First	23	3	46
Second	18	5	39	Second	19	5	40	Second	23	3	46
Third	17	6	37	Third	18	8	36	Third	20	5	41
Fourth	16	7	35	Fourth	17	7	36	Fourth	19	6	39
Fifth	15	9	32	Fifth	17	9	34	Fifth	13	9	30
Sixth	13	10	29	Sixth	11	11	26	Sixth	12	11	27
Seventh	13	12	27	Seventh	8	10	24	Seventh	12	11	27
2007/2008	Wins	Losses	Points	2008/2009	Wins	Losses	Points	2009/2010	Wins	Losses	Points
First	21	3	44	First	19	4	41	First	23	1	46
Second	17	7	36	Second	20	6	40	Second	19	4	39
Third	17	7	36	Third	19	6	39	Third	17	5	36
Fourth	16	7	35	Fourth	17	5	38	Fourth	16	6	34
Fifth	16	7	35	Fifth	14	7	33	Fifth	16	8	32
Sixth	15	7	34	Sixth	15	11	30	Sixth	13	10	27
Seventh	13	9	30	Seventh	13	10	29	Seventh	11	13	22

- Hockey_Wins_Losses: Consisted in guessing the difference between the won and the lost matches by the winner of a hockey competition in 2010. Subjects observed the corresponding information of the six previous seasons. The range of the data of this task was 16, with a minimum value of 18 and a maximum value of 34. The information seen by participants was:

2004/2005	Wins	Losses	2005/2006	Wins	Losses	2006/2007	Wins	Losses
WINNER	41	19	WINNER	52	21	WINNER	53	22
Second	45	24	Second	52	24	Second	48	25
Third	43	23	Third	42	31	Third	40	31
Fourth	41	30	Fourth	41	33	Fourth	42	34
Fifth	37	34	Fifth	29	37	Fifth	35	41
2007/2008	Wins	Losses	2008/2009	Wins	Losses	2009/2010	Wins	Losses
WINNER	47	25	WINNER	53	19	WINNER	45	27
Second	43	31	Second	41	30	Second	44	32
Third	41	29	Third	41	32	Third	39	30
Fourth	39	31	Fourth	36	35	Fourth	39	33
Fifth	36	35	Fifth	34	35	Fifth	30	38

- Budget_1_5: Consisted in guessing the difference between the budgets in year 2020 of the team with the highest budget and the team with the 5th highest budget of a competition. Subjects observed the budgets of the six previous seasons. The range of this task was 377,500,000, with a minimum value of 514,000,000 and a maximum value of 891,500,000.

2014	Budget	2015	Budget	2016	Budget
First	647,650,000	First	700,500,000	First	787,200,000
Second	598,450,000	Second	618,500,000	Second	743,100,000
Third	289,000,000	Third	336,000,000	Third	456,900,000
Fourth	137,300,000	Fourth	254,500,000	Fourth	287,900,000
Fifth	122,850,000	Fifth	186,500,000	Fifth	236,400,000
2017	Budget	2018	Budget	2019	Budget
First	772,500,000	First	1,160,000,000	First	1,200,000,000
Second	716,200,000	Second	1,090,000,000	Second	1,190,000,000
Third	585,000,000	Third	872,250,000	Third	844,150,000
Fourth	269,450,000	Fourth	442,650,000	Fourth	493,350,000
Fifth	230,900,000	Fifth	268,500,000	Fifth	337,150,000

- Soccer_Licenses_Or_%Licenses:
  This alternative could consist in guessing either the number of soccer licenses registered at a soccer federation or the percentage of these licenses with respect to the total sport licenses issued in a country. The timing of the resolution of this uncertainty is described later on. The range of the task “licenses” was 207,103 with a minimum value of 855,987 and a maximum of 1,063,090. The range of the task “percentage of licenses” was 2.3.

2013	Licenses	% Licenses	2014	Licenses	% Licenses	2015	Licenses	% Licenses
Soccer	855,987	25.2	Soccer	874,093	25.8	Soccer	909,761	26
Rugby	4,463	0.1	Rugby	4,833	0.1	Rugby	5,127	0.1
Greyhounds	10,180	0.3	Greyhounds	10,151	0.3	Greyhounds	10,312	0.3
Gymnastics	30,822	0.9	Gymnastics	24,032	0.7	Gymnastics	38,842	1.1
Golf	294,844	8.7	Golf	283,849	8.4	Golf	276,150	7.9
2016	Licenses	% Licenses	2017	Licenses	% Licenses	2018	Licenses	%Licenses
Soccer	942,674	26.3	Soccer	1,027,907	27.3	Soccer	1,063,090	27.5
Rugby	5,907	0.2	Rugby	6,408	0.2	Rugby	7,080	0.2
Greyhounds	11,201	0.3	Greyhounds	11,600	0.3	Greyhounds	121,901	0.3
Gymnastics	40,066	1.1	Gymnastics	45,863	1.2	Gymnastics	49,719	1.3
Golf	271,865	7.6	Golf	270,463	7.2	Golf	270,996	7

Henceforth, we call those alternatives, respectively, h, k, b and l.

The prize for choosing an alternative was 15 euro minus the difference between the correct answer and the given answer (in absolute value). Thus, the payoffs are capped at 0 and at 15.

The experiment was divided into three stages.

First Stage: Preference formation

The participants observed the information of the four eligible alternatives, one after the other, during 15 s each. The aim of this stage was for the subjects to form a preference relation over the alternatives, depending on the difficulty to guess the corresponding required value and the associated expected earnings. The provided time was supposed to be enough to get an idea of the difficulty of the tasks, but not to make a precise calculation that allowed to form a clear preference among some alternatives. In particular, we assumed that within the 15 s intervals during which the participants were acquainted with the options in presence, we suppose that they had enough time to realize the relative rate of error, due to approximation of the correct answer, that is liable to affect her answer or guess. In particular, they could realize that the expected error if guessing the budget, or if guessing the number of licenses, was clearly greater than the one for alternatives h and k, and for these in turn the expected error was clearly greater than if guessing the percentage of licenses. Similarly, we assumed that 15 s were, on the other hand, not enough to make alternatives h and k clearly comparable in terms of the expected error.

Second stage: Choice set valuation.

Subjects had to value, by means of the iterative Multiple Price List (iMPL) method (Andersen et al., 2006), different choice sets consisting of combinations of the four eligible alternatives. In particular, the subjects repeatedly stated if they preferred either an amount of money or choosing an alternative from the corresponding choice set. The amount of money varied from 1 to 12 in increments of €1. By this table we get an estimation of the value that the subject attaches to the alternative. At each moment of the questionnaire, if the participant did not choose “indifferent” then she had to fill another table that contained the intermediate prices between the price of the last time she chose “task” and the price of the first time she chose “money” in steps of €0.1.

With this information we state that the value of a choice set is equal to the “indifference” answer and in case there is no such indifference answer we state that it is equal to the average of the prices at which the subject switches her preference (e.g. if a subject does not answer indifference and states that she prefers doing the estimation rather than receiving €6.4 but she prefers €6.5 rather than doing the estimation, then we state that she values the set by €6.45).

Participants were announced that, in the third stage, a choice set and price would be chosen randomly for each participant. If the subject chose money for that set she would receive the corresponding amount of money, if she chose making a choice from the set she would have a limited time of 40 s to do it.

Participants were also said that, in the case that the selected set contained the alternative l, the computer would decide randomly which of the two estimations should be done *before* having to select an alternative from the set (either l or the accompanying alternative).

Participants had to value the following sets:

$\{h\}, \{l\}, \{b\}, \{k\}, \{k, b\}, \{h, k\}, \{h, l\}, \{h, k, b\}$

The set of all valuable sets is denoted by $\mathcal{X}$, that is, $\mathcal{X} = \{\{h\}, \{l\}, \{b\}, \{k\}, \{k, b\}, \{h, k\}, \{h, l\}, \{h, k, b\}\}$

We did not include all the possible combinations of the eligible alternatives in order to minimize random answers due to tedious repetition.

Henceforth we denote the value given by the subject in this stage to a set $X \in \mathcal{X}$ by $V(X)$.

Third stage: Choose an alternative

At the beginning of the third stage, a choice set and a price were chosen randomly for each participant. If she had chosen “money” at the previous stage she received the chosen amount of money, if she had chosen “choice set” she had 40 s to select an alternative to make the corresponding calculation and give an answer, as announced at the end of stage 2. During the 40 s she had access to the information of all the alternatives in the set (i.e she was seeing the data of the six previous years of all those alternatives). If the participant had chosen indifference the computer selected either “money” or “choice set” randomly.

As already said, alternative l is contingent, so that, if the randomly selected set by the computer contained it and the participant had chosen “choice set” instead of money then the computer clarified whether l consisted in guessing the number of licenses (the difficult one) or the percentage of licenses (the easy one).

Prior to the experiment the instructions were read aloud. For the sake of explanation some examples of the type of task that subjects were required to do were presented. Alternatives in this introductory stage were designed so that their structure were similar to the ones that subjects would face in the true experiment but different enough as not to lead to any bias or learning effect. The names of the alternatives reflected the task that had to be done. There were two alternatives with similar mean value and standard deviation, one alternative which was more difficult than the previous two alternatives and a contingent alternative. This contingent alternative was named *Basket_Points_OR_Blocks* because the participants had to guess *either* the points scored in a season by the top scorer of a team (very difficult task) *or* the block executed by the lowest scorer (very easy task) of a basketball league. We carefully explained that, in case of being part of a choice set the contingency (i.e if it consists in guessing the difficult task or in guessing the easy one) was going to be solved *previous* to having to pick an alternative from the set. We also emphasized that they had to choose one and only one alternative. Finally they had to answer two control questions related to these two aspects (i.e the contingency and the concept of “choice” set).

After completing the experiment all participants were asked to complete a shortened Raven Test and also an iMPL consisting of a lottery which yielded €40 with probability 0.5 and €0 with probability 0.5. Only one participant per session was selected randomly for the lottery. This decision was taken randomly after they had completed the iMPL.[2] The Raven Test was administered to make an estimation of the cognitive abilities of the subjects and the lottery iMPL in order to estimate their risk aversion.

2.1. Hypotheses

As already pointed out, the four alternatives were designed in such a way that we should expect a *clear* strict preference, P, of the subjects between some alternatives but not all. In particular, for set $\{h, k, b, l\}$, we should expect $P = \{(h, b), (k, b)\}$. The reason is that, given the ranges of the values of the different alternatives and the way how prizes are designed (subjects earn €15 minus the error in their answer), we assume that b should be clearly perceived as inferior to both h and k. As a direct consequence, we should expect $V(\{h\}) > V(\{b\})$ and $V(\{k\}) > V(\{b\})$.

We have taken the ranges of the data series as indicative of the difficulty of the tasks. The values of the mean and standard deviation of each alternative suggests the same kind of dominance relations: h and k clearly dominate b in such terms and, given the limited time to observe the data, our assumption is that it was not enough to discern whether h or k was easier to undertake. However, given that only 6 values for each alternative were available, it is difficult to guarantee that the distribution is normal, so we have considered the range of data as a better indicator of the difficulty of the task than the mean and standard deviation.

In particular, for h the mean is 18 and the median is 17.5. If the time series continued within the historical range, stating that the correct answer is the mean, it would lead to a minimal earning of €9 and a maximal earning of €15. The skewness coefficient is 0.10319. For alternative k the mean is 26.33 while the median is 26.5. If the time series continued within the historical range, stating that the correct answer is the mean, this would lead to a minimal earning of €6.67 and a maximal earning of €15. The skewness coeficient is -0.070811. Remember that subjects had only 15 s to make the necessary

[2] The previous instructions as well as the experiment are detailed in the online supplemental material.

calculations to obtain the historial data of the task (6 substractions before making whatever other calculation). Based on this, our assumption is that h and k are similar, independently of the shape of the utility function for risk.

However, when looking at the ranges of tasks b and that of calculating the number of licenses we clearly observe that they are more difficult than h and k, which makes very unlikely obtaining any earning by performing any of the two tasks. Finally, the range of the task “percentage of licenses” is 2.3. If the time series continued in the historical range, stating that the correct answer is the mean would lead to a minimal earning of €13.85 and a maximal earning of €15.

Other criteria could have been considered to presume the difficulty to do the different guessings. In particular, one might consider the effect of familiarity with the task. With this respect, people are probably less used to predict budgets or numbers of licenses than the type of scores required for “handball” or “hockey”, which are precisely available at betting houses. Nevertheless, this, in principle should not affect the relation of “incomparability” between h and k, since both consist of guessing scores, and it would reinforce our idea that both, h and k, dominate b.

In any case, the absence of a clear strict preference between h and k should lead to a similar valuation of them ($V(\{h\}) \approx V(\{k\})$). Regarding the special case of the probabilistic alternative, l, its valuation (as a singleton) should depend on the attitude toward risk of the subject, so no particular preference was presumed.

For any set $X \in \mathcal{X}$ we denote by $\max X$ the alternative contained in X to which the subject gives the maximal value when it is valued as a singleton, that is, $\forall X \in \mathcal{X}$, $\max X = x \in X$ s.t $V(\{\max X\}) = \max_{x \in X} V(\{x\})$. Similarly, let $\min X = x \in X$ s.t $V(\{\min X\}) = \min_{x \in X} V(\{x\})$.

We distinguish the following five attitudes toward choice:

Attitudes toward choice	Comparison between $V(X)$, $V(\{\max X\})$ and $V(\{\min X\})$
Choice-Preference	$V(X) > V(\{\max X\})$
Choice-Aversion	$V(X) < V(\{\min X\})$
Betweenness	$V(\{\min X\}) \le V(X) < V(\{\max X\})$
Neutrality	$V(\{\min X\}) < V(X) = V(\{\max X\})$
Indifference-Neutrality	$V(\{\min X\}) = V(X) = V(\{\max X\})$

When the participant values a set by more than the most valued item contained in it we say that she shows *choice-preference*. When she values the set less than the least valued element we say that she shows *choice-aversion*. If she values a set between the best and the worst element of the set we say that she shows *betweenness*. If she values a set by means of its preferred element and all the elements are not equally valued we call to this *neutrality*. Finally, when the participant values equally all the items as well as the set that contains them we say that she shows *indifference-neutrality*.

As pointed out in the Introduction, *Choice-preference* may arise for, at least, two reasons. One is the intrinsic value of freedom of choice (Sen, 1988; Pattanaik and Xu, 1990) according to which, whatever the characteristics of the alternatives, the individual prefers having more options. Another possible reason is the preference for flexibility (Kreps, 1979; Arlegi and Nieto, 2001a; 2001b; Pejsachowicz and Toussaert, 2017). This arises when, in an environment of uncertainty about the future preferences, the availability of more alternatives allows to make a better choice once such uncertainty is resolved.

In our design, when valuing a set that contained alternative l, the uncertainty about whether it was better or worse than the others in the set was announced to be solved before the final choice had to be made. In fact l was designed in such a way that it could be either clearly superior to any other alternative if it resulted in guessing the percentage of licenses (the standard deviation was very small in that case), or clearly inferior to any other alternative if it resulted in guessing the total number of licenses (because of the huge standard deviation in this case). Thus, singleton $\{l\}$ is a risky set but, when the subject had to value any other set that contains l as an option, she should know that it provided an opportunity to pick a very attractive alternative if it resulted to be the percentage guessing. Also, she should realize that this alternative could be rejected at no cost if it resulted to be the total number of licenses guessing. As a consequence, we should expect that the addition of l to any set improves its value.

In addition, we should expect a broader preference for choice in set $\{h, l\}$ than in other twofold sets that do not contain l because the two possible reasons for the choice-preference attitude converge in $\{h, l\}$: the intrinsic value of freedom of choice and the preference for flexibility.

Choice-aversion is based on the idea of aversion to incomplete preferences (Arlegi et al., 2021) or aversion to indecisiveness (Danan et al., 2012). That is, not having a well-defined preference over the alternatives could lead to some decision costs that the decision maker would like to avoid. For this reason the individual would choose a restricted set.

In our experiment the difficulty to define a clear preference for one alternative over another might come from the limited time to make all the necessary calculations or approximate estimations. Set $\{h, k\}$ was the clear candidate for this to happen. The time during which subjects had to visualize the information of both alternatives was, presumably, enough to perceive that their means and standard deviations were rather similar, but also enough to realize that the available time to pick one of the two was insufficient to make the necessary calculations that allowed to elucidate this ambiguity, that is, to form a clear preference for one alternative over the other. In order to avoid the psychological discomfort of not being able to form such a preference, the subject might prefer not being obliged to choose, that is, having only either $\{h\}$ or $\{k\}$. Obviously, this kind of aversion is less likely to appear when the preference relation is well-defined. For example, the limited time to visualize the information of alternatives k and b should be enough for the subject to perceive that the latter was clearly inferior than the former. Thus, there should be no reason for her to experience choice-aversion in set $\{k, b\}$, even if she knew that she had a limited time to make the choice, because she could neglect the information of b at no cost.

Table 1
Average value of the singletons.

Alternative	Average value
Budget (b)	3.82
Handball (h)	5.54
Hockey (k)	5.33
Licenses (l)	4.82

This aversion effect should not be blended with the information overload phenomenon (Le Lec et al., 2016) or the choice overload one (Iyengar and Lepper, 2000). In our design all the alternatives contained the same amount of information (six calculations had to be done) and the number of alternatives contained in each set was very low (at most three). Given this, if either information overload or choice overload were present, these attitudes should be equally distributed among sets, whilst aversion should be more pronounced in the sets where the incomparabilities can arise.

Betweenness is usually related to the idea of temptation (Gul and Pesendorfer, 2001; Toussaert, 2018). Under this interpretation an alternative that is dominated and undesired when evaluating the opportunity set might be tempting and chosen when the final choice has to be made, and the individual is aware of this. By the design of our experiment no alternative had, in principle, the characteristics of being tempting. However, we have included betweenness as a possible attitude for the sake of exhaustiveness and also to adapt to LT20's findings. LT20 give two possible explanations to this phenomenon.[3] One is that subjects value the set heuristically making some kind of weighted average of the value of the items in the set. The other one is the fear to make a bad decision when subjects are able to anticipate their own bounded rationality.

In our context, if betweenness arose it could be interpreted as if the subject valued the set as a whole object rather than as an instrument to pick up one alternative. LT20 describe the fear to make a bad decision as " {...} *fear of making decisions in the future that are not those that they would prefer today, due to their own bounded rationality or the possibility of an undesirable change in their preferences*". That is, under such an interpretation there is a chance of choosing what is not the best option. This reasoning is clearly related with temptation, where there is also a discordance between preferences at different stages.

In our experiment, in most sets there is supposedly a strong preference relation over some alternatives, which is constant along time because their objective values are fixed. $\{h, k\}$ is the only set where, if observed, betweenness could be provoked by the fear of making a bad decision. In the remaining cases (where a dominated alternative is present) the heuristic valuation rule would be the reasonable explanation. In this way, our design sheds light on the possible sources of the betweenness attitude observed in LT20.

Both betweenness and choice-aversion involve valuing a set less than its best alternative but, and as already explained, choice-aversion would be interpreted as a psychological discomfort for having to choose without having a clear preference over the options.

According to the *neutrality* attitude the subject values the alternatives in the set in a different way, but the value of the set is exactly that of its best alternative. This is consistent with the standard indirect utility criterion in microeconomic theory. *Indifference-neutrality* is also consistent with this criterion, but applies to a situation where all the alternatives of the set are equally valued separately. In fact, both can be interpreted as a consequence of valuing $V(X) = V(\{\max X\})$. If, in addition, $V(\max X) > V(\{\min X\})$ then we have neutrality. If $V(\{\max X\}) = V(\{\min X\})$ then we have indifference-neutrality. Both represent the same attitude toward choice in the sense that the availability of more alternatives is not valuable either positively or negatively as far as the maximal alternative is granted. However, we have distinguished between neutrality and indifference-neutrality because we are interested in observing to which extent the absence of a strict preference over alternatives leads to indifference or choice-aversion.

The neutrality attitude toward choice should be expected to be larger for set $\{h, b\}$ because of the objective superiority of h over b. However, we should also expect such an attitude in any other twofold set where, for whatever reason, the subject values one of the alternatives much more than the other.

3. Results

3.1. Overview

Table 1 shows the average value that subjects gave to sets $\{b\}$, $\{h\}$, $\{k\}$ and $\{l\}$ in the choice set valuation stage. This can be naturally interpreted as the average value that they gave to the corresponding alternatives.

Result 1. The average value of $\{b\}$ is the lowest of the four singletons.

The values given to the alternatives are ordinally consistent with what was expected but not cardinally. That is, the average values received by the alternatives correspond to the relative difficulty of the tasks: Alternatives with a higher

[3] LT20 call "choice aversion" to what we call here "betweenness".

Table 2
Difference between the set valuation and the valuation of the maximal alternative of the set.

	Average
$V(\{h,k,b\}) - \max\{h,k,b\}$	-1.07***
$V(\{h,l\}) - \max\{h,l\}$	-0.72***
$V(\{k,b\}) - \max\{k,b\}$	-0.89***
$V(\{h,k\}) - \max\{h,k\}$	-0.54***

Table 3
Difference between the set value and the average value of the alternatives of the set.

	Average
$V(\{h,l\}) - avg\{h,l\}$	0.13
$V(\{h,k\}) - avg\{h,k\}$	-0.03
$V(\{k,b\}) - avg\{k,b\}$	0.07
$V(\{h,k,b\}) - avg\{h,k,b\}$	0.08

mean and standard deviation received a lower value. In the case of alternative l, although it could turn to have a huge standard deviation (in any case lower than the deviation of b), it could also result to be a very easy task (0.7 sd), so that its valuation was also expected to be higher than the valuation of b.

However, the valuations do not correspond to the expected earnings associated to each alternative. In particular, considering that the prize was €15 minus the error and that b had a so high standard deviation (€237,664,721) we should not expect that any subject would be willing to pay for having the option to make an estimation of it. This suggests that subjects, after looking at the information in the tables, were able to perceive the relative difficulty of the tasks, but not to translate the numerical information into expected earnings and into the corresponding valuation given the way the prize was calculated.

Result 2. On average, the value of a choice set is lower than that of its preferred element.

Table 2 shows that the the value of the maximal element of a set is higher than the value of the set.[4]

According to the data in Table 2, on average, adding suboptimal alternatives reduces the value of the set. This result is consistent with the findings in LT20. Given our classification of attitudes, this could be consistent with a generic choice-aversion attitude or with a generic betweenness attitude.

As already explained, alternatives are designed in such a way that some attitudes could be assumed depending on the presumed attractiveness of the alternatives that compound the set. However, we observe that, on average, the four choice sets are valued lower than their maximal alternative. This happens, even, in the case of set $\{k,b\}$, where we could presume that, b being so clearly inferior, the difference between $V(\{k,b\})$ and $V(\{b\})$ should be very small because b can be discarded without any kind of deliberation. Something similar can be said about set $\{h,l\}$. When valued alone, l is a risky alternative, however, when being part of the opportunity set $\{h,l\}$, due to its special contingent characteristics, l becomes a very attractive alternative that incorporates flexibility to the unique availability of h. That is, we should expect the value of $\{h,l\}$ to be greater than the value of $\{h\}$ in this case. However, we also observe that $\{h,l\}$ has on average a lower valuation than $\max\{h,l\}$. All the facts above reinforce LT20's view that the subjects perform some kind of average valuation of the alternatives in the set, even if they consist of "opportunity" sets.

Table 3 gives more information about this issue by showing the difference between the set value and the average[5] value of its alternatives.

The data show that there is not statistical evidence to reject the hypothesis that the valuation of a set is the average of its items valuations.

As a conclusion, observing the two tables we can discard that all subjects are either choice-neutral, choice-averse or that they have preference for choice, i.e we can discard any of those attitudes as generically applicable to every set. In fact we can discard any of those attitudes for each set. Among the attitudes described in Section 2.1 only betweenness remains as an acceptable hypothesis for the generic attitude toward choice of the subjects.

All the data above is calculated on average, so they could be the result of opposite attitudes toward choice across agents (e.g. choice-preference and choice-aversion). The next subsection examines this possibility.

[4] * represents the level of significance for the Wilcoxon signed-ranked test being *** 0.01 level, ** 0.05 level and * 0.10 level. All the statistical tests related to the results are available in the Appendix.

[5] For a generic set A, $avgA$ denotes the average value of its alternatives.

Table 4
Attitudes distribution among choice sets.

Control	Preference	Aversion	Between	Neutrality	Indif
$\{h, l\}$	14%	14%	38%	17%	16%
$\{h, k\}$	22%	33%	13%	5%	27%
$\{k, b\}$	16%	29%	25%	14%	16%
$\{h, k, b\}$	19%	27%	27%	14%	13%

3.2. Attitudes distribution

In the previous section we have discarded that all subjects have the same generic attitude toward choice (except for the betweenness case) and that any choice set generates the same attitude in all the subjects (again, except for the betweenness case). In this subsection we study whether the average results above are provoked by a general betweenness attitude or, differently, they are the result of the coexistence of diverse attitudes toward choice. In the latter case we check whether certain attitudes are more pronounced depending of the sets and if the distribution of attitudes is in consonance with our conjectures.

The next table represents, for each of the sets, the percentage of subjects that showed each of the attitudes described in the previous section. We use the sample of the 63 subjects who answered correctly all control questions.

Choice-preference

We do not observe differences in the prevalence of the choice-preference attitude among choice sets. Our conjecture was that such an attitude would arise in the case of set $\{h, l\}$ due to the flexibility that l introduces with respect to $\{h\}$. When reading the instructions it was carefully explained that the uncertainty attached to l was going to be cleared up *before* the final alternative had to be chosen from the set. This involved a more complex description of l: first, *nature* determined the outcome associated to l, and then the subject had to compare the resulting outcome with h in order to make the final choice. Even though under the appropriate reasoning alternative l should not induce decision costs to the decision maker, it seems that the relatively complex tree structure of the decision process was negatively perceived by the subjects, ignoring the advantage that l involved when presented with h.

Choice-aversion

Result 3. The proportion of subjects that show choice-aversion is lower in $\{h, l\}$

We observe that the only set in which the proportion of subjects that shows choice-aversion is significantly lower is $\{h, l\}$, which is precisely the set for which we expected a higher choice-preference attitude. Given that choice-aversion and choice-preference are opposite attitudes, this fact is, in principle, in line with our conjectures. However, the lower prevalence of aversion in set $\{h, l\}$ is not substituted by a higher prevalence of choice-preference, as it could be expected, but by a higher prevalence of the betweenness attitude.

A possible explanation of this is that subjects perceived set $\{h, l\}$ not as a two-options set, but as a three-possible results set (the value of h and the two contingent values of l), making an average evaluation of the three. Given that we do not have the information of the evaluation of the two possible values of l by separate, we cannot check whether this is what actually happened.

Betweenness

Result 4. The proportion of subjects that show betweenness is the lowest in $\{h, k\}$.

This result shows that the only set that contains two incomparable alternatives is the one with the lowest proportion of subjects that show betweenness.

The lower prevalence of betweenness in set $\{h, k\}$ might be explained by the smaller difference between the maximal and the minimal values of the elements in the set. This argument would be correct if the valuation of the (non-singleton) sets had been random, so that the probability of observing values in the range between the maximum and the minimum would be lower when this range were smaller. However, the Friedman test for related samples states with a significance level of 0.019 that the distributions of the values of the four choice sets are not equal. That is, as far as there is a positive difference between the maximum and the minimum values of the alternatives in the set there is room for the individual to exhibit any of the possible attitudes toward choice, independently of the cardinality of those values.

We go deeper into the interpretation of this result in the last discussion section, where we can relate it to other findings.

Indirect utility

Result 5. The lowest proportion of subjects showing neutrality is observed in $\{h, k\}$ (where it is not supposed to be a clear preference relation). Furthermore, only in this set the proportion of subjects that show indifference-neutrality is significantly higher than the proportion of subjects that show neutrality.

"Neutrality" and "Indifference-neutrality" (the two last columns in Table 4) are both consistent with the standard indirect utility rule to value opportunity sets. We do not find differences in the sum of percentage of the two columns for all sets,

Table 5
Range of attitudes distribution among sets in LT20.

	Preference	Aversion	Between	Neutrality	Indifference-neutrality
Highest %	23%	13%	48%	22%	42%
Lowest %	11%	2%	24%	7%	22%

which suggests that there is a relatively constant percentage of people that valuate sets by means of its best alternative. They identify the best element, and then they value the set by means of that element.

Result 5 confirms then that the similar average valuation of the alternatives h and k obeys to the fact that a high proportion of subjects have actually perceived these alternatives as similar. This similarity has lead to a small presence of the neutrality attitude.

3.2.1. Attitudes heterogeneity without presumed preferences

As pointed out in the introduction, an important difference between our design and LT20 is that in our case there is a presumed *objective* preference for some alternatives over some others. In LT20 alternatives are designed as final consumable goods over which there is not any presumed preference. In our experiment alternatives are means to obtain earnings because they provide useful quantitative information to make the necessary calculations. In our design some alternatives provide clearly more chances to make a more accurate calculation in the third stage and therefore a higher chance to obtain a greater prize. In addition, alternative l is different to the others regarding its informational nature. This allows to presume different attitudes toward choice depending on the objective attractiveness of the alternatives that compound the set. We have found that there is certain consistency between the results and our conjectures about how the presumed preferences affected the choice attitudes, at least from the perspective of the distribution of attitudes among sets. In this section we try to contrast our results by comparison with the results in LT20. In particular, we take the raw data provided in the supplementary material of LT20 and apply to them our five-attitudes classification.

The table below contains the proportion of people who showed our five attitudes toward choice in LT20's experiment. For each attitude, "Highest" ("Lowest") is the maximum (minimum) of the percentages of subjects that showed the corresponding attitude across the different sets in LT20. We test if the proportion of subjects that show some attitude in a given set of our experiment is significantly lower (higher) than the lowest (highest) proportion observed in their experiment. This will allow to know more about the effect of the presence of objective preferences over the alternatives in our experiment.

According to the data in Table 5 we do not find differences between the percentages of subjects showing choice-preference in our experiment and in LT20. In our experiment this percentage is in the range $[14\%, 22\%]$ (see Table 4) while in their experiment this range is $[11\%, 23\%]$. This reinforces the idea that, even though l was designed to induce preference for flexibility, it has been in fact perceived as a dominated option.

Result 6. The percentage of subjects showing choice-aversion is above the range of LT20 in all sets except $\{h, l\}$.

In our result the range of the percentage of subjects showing choice-aversion is $[14\%, 33\%]$ ([2%,13%] in LT20). This suggests that the time pressure imposed in the experiment created an environment that favored the choice aversion attitude. Given this pressure, subjects preferred to avoid the act of choice and to focus on the given task.

Result 7. Only in set $\{h, k\}$, the percentage of people that show betweenness is below the range of LT20.

Regarding the betweenness attitude, the percentage of people showing betweenness in our experiment is within the range in LT20's experiment ([24%,48%]) except for set $\{h, k\}$ (13%), where such percentage is remarkably lower. This reinforces Result 4, in the sense that the betweenness attitude is inversely related with the difficulty to compare the alternatives in the set.

Result 8. The proportion of subjects who show indifference-neutrality in our experiment is below the range of LT20 except in set $\{h, k\}$, where it is within the range.

In this result we have used only the doubletons in LT20 as a benchmark.[6] The reason is that, in order to observe indifference-neutrality, all the alternatives must be equally valued, and this is more likely to happen when there are fewer alternatives.

According to our hypothesis there is an objective superiority of both k and h over b in $\{k, b\}$ and in $\{h, k, b\}$, while $\{h, k\}$ is the only set where the alternatives can be interpreted as equally attractive by anyone. In contrast, in LT20's experiment there is not any aprioristic preference from some alternatives over others: some individuals may prefer (and do it in fact) some options and other individuals others. For this reason we could expect the proportion of subjects who show indifference-neutrality in our experiment for $\{k, b\}$ and $\{h, k, b\}$ to be below LT20's range, but at the same time we should expect that proportion to be *above* (and not within) the range LT20's range for set $\{h, k\}$.

6 For the other attitudes we have used all the sets in LT20 as a benchmark. If we take only the doubletons the remaining results do not change.

Nevertheless, our hypothesis about $\{h, k\}$ was that aversion to choice was more likely to arise due to the incomparability effect. Thus, the fact of indifference-neutrality being within LT20's range is consistent with our assumption that the lack of preference can lead to a substitution of indifference-neutrality by aversion.

As for the neutrality attitude, we do not find differences between the percentages in LT20 and our experiment.

3.3. Additional results

3.3.1. Generic attitudes

The data provided in the previous section clearly discard that all subjects share the same attitude toward choice. We also consider interesting observing to what extent attitudes are constant across sets, that is, whether individuals tend to maintain the same attitude independently of the set to be valued. With this respect we have that 12% of the participants systematically valued every set by means of its preferred alternative; 3% systematically valued every set more than its preferred element, and 3% made it less than the least preferred element. No one valued systematically every set according to betweenness. Thus, 81% displayed different attitudes toward choice depending on the set to be valued.

As in the previous section, a comparison with LT20's experiment by using their raw data may also shed light to our conclusions. There we find that 21% of subjects value always all sets by means of its preferred alternative and no one values always all sets by means of other attitudes. Thus, the percentage of subjects who value systematically all sets in the same way seems similar in our experiment and in LT20 (81% and 79% respectively), and most of them do it by means of the indirect utility of the set.

However, the number of sets that subjects have to evaluate in their experiment is much larger, and therefore it is more difficult to find subjects who value always a set higher, equal or lower than its preferred alternative. For the sake of comparability we have grouped the sets in LT20 in subgroups of four sets: one set with three alternatives plus three with two alternatives. We have considered all the possible combinations of this type, and for each of them we have counted the subjects who followed the same attitude toward choice for the four sets. By making an average of all the possible subgroups we have obtained that 25% of subjects systematically valued every set by means of its preferred alternative; 3% systematically valued every set more than its preferred element; 0% made it less than the least preferred element and 4% showed systematically betweenness. In total 68% of people displayed different attitudes depending on the set to be valued.

This difference (68% versus 81% in our experiment) suggests that in our experiment, the heterogeneity of the alternatives, with respect to which preferences apply, is a factor that influences the attitudes displayed by our subjects when they evaluate the different sets of options. However, it is remarkable that only 3% of subjects exhibited flexibility for set $\{h, l\}$ and choice aversion for $\{h, k\}$. This is a very low percentage, against our hypothesis about how agents would value both attitudes as conjectured. Clearly more research is needed at this stage. Thus, we can conclude that data are only partially in line with our conjectures and the theoretical model in Arlegi et al. (2021), in the sense that heterogeneous attitudes are observed across sets depending on the internal relations between the alternatives, but the percentage of subjects following simultaneously the expected attitudes is very small.

3.3.2. Cognitive abilities

After completing the three stages of the experiment participants answered a shortened Raven Test in order to estimate their cognitive abilities. The data show that there is no correlation between the difference in absolute value between the valuation of the set and the valuation of the preferred item, except for set $\{k, b\}$, where we find that this correlation is negative. That is, subjects with higher cognitive abilities tend to value the set closer to the best alternative of set $\{k, b\}$. This suggests that the criterion to value sets by those subjects is tantamount to the indirect utility rule, which is supposed to be the most "rational" way to value the sets. In fact, $\{k, b\}$ is the natural candidate for this to happen because it is the only set that contains two alternatives clearly related by a dominance relation.

The last part of the experiment consisted in attaching a value between €1 and €20 to a lottery whose equiprobable prize was either €40 or €0.

We find that the cognitive abilities are positively correlated with the value attached to the lottery, that is, subjects with higher cognitive abilities were less risk-averse. This is consistent with an extent literature on the topic (see Dohmen et al., 2010; Benjamin et al., 2013; Burks et al., 2009, among others).

Both the values in the Raven test and the value of the lottery are positively correlated with the value of the alternatives except with alternative *b*. The relationship with *b* is something expected. This is a very poor alternative and individuals with higher capacities have been more able to detect it. As for the rest of alternatives, we can interpret that, in fact, they are "risky" alternatives, where risk depends on each one's capacity to process their information. Thus, it seems that individuals with a higher value in the Raven test have been conscious of their higher computational capacities.

4. Overall discussion and conclusions

In this experiment we have tried to check how the presence or absence of preferences over alternatives leads to different attitudes toward choice, that is, to the preference, aversion or neutrality toward the availability of several opportunities.

The valuation of the single alternatives resulted to be ordinally consistent with their presumed value. However, alternative *b*, which was extremely unlikely to provide some profit, was valued higher than expected. This suggests that the iMPL method provokes a framing effect as indicated in Andersen et al. (2006). We were interested in identifying preferences over sets, that is, how the valuation of the choice sets depends on the valuation of the alternatives contained in them. Given that the framing effect only affects the absolute valuations of the alternatives, our relative evaluation of the sets in relation to their alternatives should not be affected by it.

Attitudes toward choice are not independent of the alternatives compounding a set. The percentage of people who value all sets following the same attitude is incidental except for the case of the indirect utility rule.

On average, the value of a choice set is lower than the value of the preferred element of that set. This could mean that there is general choice-aversion *à la* LT20, that is, what we call a "betweenness attitude" in this paper. However, when analyzing the attitudes distribution among sets we observe that this average result is a mix of diverse attitudes toward choice. Choice attitudes are not homogeneous across sets, yet they are conditional on the preferences over the alternatives. To reinforce this finding we have compared the distribution of attitudes toward choice in our experiment with the distribution in LT20, where there are no presumed preferences among alternatives.

Regarding the choice-preference attitude (a set is valued more than its best element) we do not observe differences neither among sets nor if comparing with LT20. This is particularly remarkable in the case of set $\{h, l\}$, precisely designed to lead, rationally, to such an attitude because of the flexibility provided by l. This indicates that subjects have not been able to identify the potential benefits of l. A possible explanation for this behavior is that, even though we designed the alternative l specifically to avoid this problem, subjects perceived l as a noisy and costly alternative in terms of thinking due to its contingent nature, as described in Ortoleva (2013).

As for choice-aversion we observe that, in general, this attitude is significantly higher than in LT20, where preferences over alternatives are not presumed. This holds for all sets except $\{h, l\}$, for which we expected preference for flexibility to arise. However, the distribution of the choice-aversion attitude among the sets in our experiment is more uniform than expected. In particular, we expected a clear prevalence of choice aversion in set $\{h, k\}$ given the difficulty to compare the two alternatives. We interpret this results as a consequence of: (i) the perception of the alternative l as noisy and difficult to value and (ii) the choice-aversive atmosphere provoked by the time constraint that has affected similarly to all sets. Time pressure has been implemented in the experiment as a way to avoid a neat comparability of some alternatives (h and k in particular). Our presumption was that the given time was enough to identify clearly some relations of domination but not others. It seems that we have failed on translating this pressure to some but not all the alternatives. In any case, we think that even though differences in the distribution of aversion to choice are smaller than expected, the mere observability of this attitude on a lab experiment is quite novel. More experiments would be needed to learn more about the role of time constraint and incomparabilities in the choice-aversive attitude.

When we focus on the betweenness attitude we observe that it is smaller for set $\{h, k\}$, that is, the set where alternatives are difficult to compare. This holds in relation with other sets in our experiment and also in comparison with the decision problems in LT20. However, in relation with LT20, we do not find significant differences in the betweenness attitude. LT20 provides two explanations for this attitude. One is the fear to make a bad decision and the other is the result of a heuristic rule. Our design of the alternatives is intended to disentangle this question. Given that in our sets (except $\{h, k\}$) there is a clear preference for one of the alternatives, if the source of betweenness is the fear to make a bad decision the prevalence of betweenness should be smaller in our experiment than in LT20 (except for set $\{h, k\}$, where it should be greater). We obtain the opposite results, which suggests that the "heuristical" one is the most plausible explanation.

Set $\{h, k\}$, where alternatives were expected to be valued similarly and where there is room for incomparability, presents a higher proportion of subjects showing indifference-neutrality. It is the only one for which this proportion is consistent with LT20. Given that the alternatives are thought to be valued similarly it could be expected to find higher levels of indifference-neutrality than in LT20. As explained in the previous section, this can be due to a substitution of indifference-neutrality by aversion, rooted in the incomparability between h and k.

Finally, with respect to neutrality we find that, as expected, in the set where the two alternatives are designed as similar ($\{h, k\}$) the presence of this attitude is the lowest of all sets.

Linking the lower presence of betweenness in $\{h, k\}$ with the higher presence of indifference-neutrality (but not higher than LT20); the general low presence of neutrality both in LT20 and in our experiment (with no differences between both experiments), and the general high presence of aversion in our experiment if compared with LT20, we can conclude synthetically that:

- Subjects do not, in general, follow the indirect utility criterion when there is a dominated alternative. Instead, they value the choice sets as a whole by means of a "betweenness heuristic". This would explain that the this attitude prevails more when alternatives are not supposed to be perceived as similar. However, the individuals with higher cognitive abilities have a greater tendency to value sets with a dominated alternative by the indirect utility criterion.
- A priori, the absence of a clear preference relation can lead either to follow the indirect utility criterion (indifference-neutrality); to choice-aversion or to choice-preference. In our experiment time pressure has provoked a replacement of indifference-neutrality by aversion. This would explain that the prevalence of choice-preference is similar in our experiment and in LT20, but indifference-neutrality is less prevalent in our experiment (except for the case $\{h, k\}$ where, as explained above, we should expect a higher prevalence, but it ends up to be similar).
- LT20 obtain that most of agents value sets less than its preferred alternative. They call this "choice-aversion" although, as already explained, this includes what we have labelled "betweenness" and "choice-aversion". In fact, most of what LT20

call "choice-aversion" corresponds to a betweenness attitude. They provide two explanations for their choice aversion prevalence. One is that subjects value imperfectly opportunity sets as a whole and the other is the fear to make a bad decision due to a reversal in the preferences. In our design there is a clear domination of one alternative over the other at the moment of selecting all alternatives except for set $\{h, k\}$. This means that (except for set $\{h, k\}$) there is not room for such a reversal of the preferences, that is, the decision maker should be sure about the preferences that she will have in the last stage. However, we observe that, for all sets except $\{h, k\}$, the prevalence of betweenness (labelled as "choice-aversion" by LT20) in our experiment is consistent with LT20 (Result 7). This suggests that the reason for LT20's findings is that individuals value heuristically sets as a whole by being driven by the fear of making a wrong decision.

A possible explanation of our results could also be that subjects were not able to fully compare *all* the alternatives they were presented in the menus due to tiredness and the complexity of the task.[7] Some of the results could be in fact, at least partially, explained by this.

In particular, Result 1 reflects that, on average, the values given to the alternatives were ordinally consistent with our conjecture that alternatives h and k were difficult to compare but both dominated alternative b. Thus, at least on average, preferences were not systematically incomplete. However, it is true that the valuations given to the alternatives did not correspond to their real cardinal value, so this could also be a consequence of some kind of *vague* preferences due to tiredness.

Result 2, which reflects some kind of generalized choice aversive attitude, would fit with an overall incompleteness or vagueness of preferences that causes a general tendency to avoid choice. Also, Table 4 shows that choice aversion is not significantly higher in set $\{h, k\}$ (where both alternatives were supposed to be incomparable) than in set $\{k, b\}$ (were k dominates b), so it is possible that even though, when evaluated as singletons, subjects were able to perceive such dominance of k over b, when presented together they were not able to make a bis-a-bis comparison. Something similar could be said about Result 6, where we show that choice aversion is more accentuated in our experiment than in LT20.

However, our data about generic attitudes (Section 3.3.1) show that 81% of subjects displayed different attitudes toward choice depending on the set to be valued. This would not be consistent with an overall incompleteness of preferences due to tiredness. It seems that subjects perceived differences in the bis-a-bis relationships of the alternatives for different sets, and that they translated those differences into different attitudes toward choice.

Other data that support the idea that subjects were able to discriminate between options is that those to had to make meaningful choices in the final stage of the experiment were consistent with their previous evaluation of the singletons. Once that we remove all subjects that valued the randomly selected set less than the randomly selected price and subjects that had to choose from either a singleton or set $\{h, l\}$[8] we have that, at the final stage of the experiment, 17 subjects had to make a choice from either set $\{h, k\}$, $\{k, b\}$ or $\{h, k, b\}$. From them only one did not choose consistently with his previous evaluation of the singletons. The sample is small, but the proportion suggests that subjects understood the evaluation task and the choice task, and were consistent with the valuation of the singletons made at the second stage of the experiment.

As a consideration about the scope of our results, we refer to the literature on identification problems, which teaches us that as far as incompleteness of preferences is indeed spread among subjects, the conclusions obtained from observed choices should be conveniently restrained (see, for example, Rigotti and Beresteanu, 2021).

Finally, it could also be argued that the fact that 63 out of 107 subjects answered correctly the control questions reveals that the misunderstanding of the choice problem may make observed behavior deviate from theoretical predictions. The discussion above makes us be confident that agents, in general, understood the kind of decision to make. However, as broadly discussed in the preceding sections, the advantage of availing alternative l was probably absorbed by its complex structure. This has surely affected our predictions about the presence of preference for flexibility and invites to a more careful experimental design in future work.

Data availability

Data will be made available on request.

Appendix A

The SPSS outcomes are available (in Spanish) in the supplemental material. Next we present a summary of them.

A1. Overview

We have restricted to the sample of the subjects who answered correctly both control questions. The results, in general, do not change by taking either all the subjects or those who answered correctly one of the two control questions (63 subjects).

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[7] We thank an anonymous referee for suggesting this explanation.

[8] Given that the contingency associated to l was cleared up before the choice has to be made, this set is not eligible for the consistency analysis.

Table 6
Pairwise comparisons of the alternatives.

Sample1-Sample 2	Test Statistic	Significance Level
Budget-Licenses	-.573	.013
Budget-Hockey	-.857	.000
Budget-Handball	-.984	.000
Licenses-Hockey	.286	.214
Licenses-Handball	.413	.073
Hockey-Handball	.122	.581

Table 7
Difference between the set valuation and the valuation of the maximal alternative of the set.

	Average	Significance level
$V(\{h,k,b\}) - \max\{h,k,b\}$	-0.89***	0.000
$V(\{h,l\}) - \max\{h,l\}$	-0.68***	0.000
$V(\{k,b\}) - \max\{k,b\}$	-0.87***	0.000
$V(\{h,k\}) - \max\{h,k\}$	-0.47***	0.007

Table 8
Difference between the set valuation and the average valuation of the alternatives of the set.

	Average	Significance level
$V(\{h,l\}) - avg\{h,l\}$	0.13	.315
$V(\{h,k\}) - avg\{h,k\}$	-0.03	.905
$V(\{k,b\}) - avg\{k,b\}$	0.08	.499
$V(\{h,k,b\}) - avg\{h,k,b\}$	0.7	.588

Table 9
Z-test for the difference in the proportions of subjects showing neutrality and indifference neutrality.

	Z statistic	Significance level
$\{h,l\}$	0.239462	0.4054
$\{h,k\}$	3.41299	0.0003
$\{k,b\}$	0.247803	0.4021
$\{h,k,b\}$	0.261183	0.397

First, we have tested whether there were significant differences in the values that subjects attached to the four single alternatives of the experiment. The Friedman test for related samples states with a significance level of 0.000 that the distribution of the values of the four alternatives are not equal.

The Friedman test also states with a significance level of 0.019 that the values of the four choice sets ($\{h,l\}, \{h,k\}, \{k,b\}, \{h,k,b\}$) are not equal. This outcome has not be included in any result but it suggests that the valuation of the choice sets is not random.

Table 6 shows the result of the Friedman test for pairwise comparisons. Result 1 of the paper is based on this table.

Table 7 shows the Wilcoxon signed-rank test for the difference in valuations between choice sets and their preferred item. Result 2 of the paper is based on this table.

Table 8 shows the Wilcoxon signed-rank test for the difference in valuations between choice sets and the average value of their items.

A2. Attitudes distribution

Choice-preference

In set $\{h,l\}$ the proportion of subjects who valued the set higher than the highest valued alternative was the lowest of the four choice sets (15.66%), and in $\{h,k\}$ it was the highest (22.89%). The difference between both values is not significant. The standardized statistic Z is 1.15214 with a one tail *P*-value of 0.1246. **Choice-Aversion**

In set $\{h,l\}$ the proportion of subjects who valued the set lower than the least valued alternative was the lowest of the four choice sets (14.29%), in set $\{h,k,b\}$ this percentage was the second lowest (26.98%). The difference between both values is significant. The standardized statistic Z is 1.75995 with a one tail *P*-value of 0.03921.

Betweenness

In set $\{h,k\}$ the proportion of subjects who valued the set higher than the least valued alternative and lower than the highest valued alternative was the lowest of the four choice sets (12.7%), in set $\{k,b\}$ this percentage was the second lowest

Table 10
Shows the values of the correlations addressed in Section 3.3.2.

	Alternative Hypothesis	Z statistic	Significance level
Aversion	% $\{h, k, b\}$ > Highest	1.96781	0.02454
Betweenness	% $\{h, k\}$ < Lowest	1.65762	0.0487
Indifference-neutrality	% $\{k, b\}$ < Lowest	1.76454	0.03882

Correlaciones

		l	b	h	k	abs (V({hkb})-max{hkb})	abs (V({hk})-max{hk})	abs (V({hl})-max{hl})	raven	abs (V({kb})-max{kb})	lottery
l	Correlacin de Pearson	1	.542**	.633**	.665**	0.123	0.101	-0.041	0246	-0.033	.363**
	Sig. (bilateral)		0.000	0.000	0.000	0.339	0.432	0.747	0.052	0.800	0.003
	N	63	63	63	63	63	63	63	63	63	63
b	Correlacin de Pearson	.542**	1	.525**	.566**	0.080	-0.045	.294*	0.134	0.035	0.155
	Sig. (bilateral)	0.000		0.000	0.000	0.535	0.728	0.019	0.294	0.786	0.227
	N	63	63	63	63	63	63	63	63	63	63
h	Correlacin de Pearson	.633**	.525**	1	.828**	0.081	0.208	0.233	.361**	0.102	.488**
	Sig. (bilateral)	0.000	0.000		0.000	0.530	0.102	0.066	0.004	0.426	0.000
	N	63	63	63	63	63	63	63	63	63	63
k	Correlacin de Pearson	.665**	.566**	.828**	1	0.212	-0.003	0.149	.321*	0.177	.438**
	Sig. (bilateral)	0.000	0.000	0.000		0.096	0.982	0.244	0.010	0.165	0.000
	N	63	63	63	63	63	63	63	63	63	63
abs(V({hkb})-max{hkb}	Correlacin de Pearson	0.123	0.080	0.081	0.212	1	.456**	.264*	-0.161	.689**	-0.062
	Sig. (bilateral)	0.339	0.535	0.530	0.096		0.000	0.036	0.206	0.000	0.628
	N	63	63	63	63	63	63	63	63	63	63
abs(V({hk})-max{hk})	Correlacin de Pearson	0.101	-0.045	0.208	-0.003	.456**	1	0.127	-0,189	0.236	0.059
	Sig. (bilateral)	0.432	0.728	0.102	0.982	0.000		0.320	0.137	0.063	0.647
	N	63	63	63	63	63	63	63	63	63	63
abs(V({hl})-max{hl})	Correlacin de Pearson	-0.041	.294*	0.233	0.149	.264*	0.127	1	-0.010	.282*	0.194
	Sig. (bilateral)	0.747	0.019	0.066	0.244	0.036	0.320		0.940	0.025	0.127
	N	63	63	63	63	63	63	63	63	63	63
raven	Correlacin de Pearson	0246	0134	.361**	.321*	-0.161	-0.189	-0.010	1	-0.242	.344**
	Sig. (bilateral)	0.052	0.294	0.004	0.010	0.206	0.137	0.940		0.056	0.006
	N	63	63	63	63	63	63	63	63	63	63
abs(V({kb})-max{kb})	Correlacin de Pearson	-0.033	0.035	0.102	0.177	.689**	0.236	.282*	-0.242	1	-0.012
	Sig. (bilateral)	0.800	0.786	0.426	0.165	0.000	0.063	0.025	0.056		0.923
	N	63	63	63	63	63	63	63	63	63	63
lottery	Correlacin de Pearson	.363**	0.155	.488**	.438**	-0.062	0.059	0.194	.344**	-0.012	1
	Sig. (bilateral)	0.003	0.227	0.000	0.000	0.628	0.647	0.127	0.006	0.923	
	N	63	63	63	63	63	63	63	63	63	63

(25.4%). The difference between both values is significant. The standardized statistic Z is 1.81511 with a one tail P-value of 0.03475.

If we test for the difference between this last proportion and the proportion of subjects who showed betweenness in the set $\{h, l\}$ (where this proportion is the highest), the difference between both values is not significant. The standardized statistic Z is 1.53121 with a one tail P-value of 0.06286

Neutrality and indifference-neutrality

In the set $\{h, k\}$ the proportion of subjects who valued the set equally to the highest valued alternative was the lowest of the four choice sets (4.76%), in the set $\{k, b\}$ this percentage was the second lowest (14.29%). The difference between both values is significant. The standardized statistic Z is 1.82201 with a one tail p-value of 0.03423.

The test for the difference between this last proportion and the proportion of subjects who showed neutrality in set $\{h, l\}$ (where this proportion is the highest) gives that this difference is not significant. The standardized statistic Z is 0.48685 with a one tail P-value of 0.3132

Result 5 has two statements. For the second statement we have compared the proportion of subjects who show neutrality for a given set with the proportion of subjects who show indifference-neutrality for the same set (Table 9).

A3. Attitudes heterogeneity without presumed preferences

Table 10 summarizes the statistic Z and the one tail P-value of the results 6,7 and 8. “% A” represents the percentage of people who have followed a given attitude in set “A”. Notice that when comparing the indifference-neutrality attitude we have restricted the benchmark to the doubletons of LT20 (as explained in the paper), and therefore the lowest value is 29.03% and not 14%.

In Section 3.3.1 we say that the percentage of people who display different attitudes depending on the elements of the set is different in our experiment and in LT20 (68% vs. 81%). If we test for the difference between these proportions the one tailed P-value for the Z statistic is 0.0493. However, we should remark that the percentage 68% is referring to an average value of all the possible combinations of four sets consisting of three twofolds and a set of three alternatives.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2022.09.027.

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