Neuropsychological Trends

37
April 2025

Is two better than more? The critical moment of choosing between alternatives

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ABSTRACT

This research explores the decoy effect, mainly in the form of compromise effect, within realistic workplace decision-making scenarios. A sample of 51 healthy participants faced three scenarios where they initially chose between two alternatives, then reconsidered their choice when a third, higher-value option was introduced. Results indicated that the introduction of the third option significantly influenced decisions, confirming the impact of contextual factors in decision-making processes. Notably, when the three-option scenario was presented first than the two-option set, the decoy effect seemed to be stronger. This could suggest that prior exposure to two-option choices may anchor preferences and weaken the decoy effect. Additionally, reaction times were longer in three-alternative conditions, reflecting increased cognitive workload. The findings highlight that decision-making is influenced by presentation order and cognitive biases, challenging rational choice theories. These insights may have practical implications for organizational decision-making, suggesting that structuring choices strategically can guide preferences.

Keywords: decision-making; decoy effect; compromise effect; cognitive biases

1. Introduction

Classical rational choice theories consider individuals as rational decision makers with consistent and well-defined preferences who choose the option that maximizes their personal utility or benefit. These theories claim that, when faced with a decision, individuals should have a clear preference that is independent of the specific context. They are grounded in axioms such as the *independence of irrelevant alternatives* (IIA), that assume that the relative preference between two alternatives is independent from other proposed alternatives (Ray, 1973), or the *regularity condition*, according to which the probability of choosing an option from a given set remains unchanged when new alternatives are introduced (Luce, 1977). However, empirical research has consistently demonstrated that decision-making is influenced by a variety of psychological and contextual factors, including among many others, external cues such as feedback (Crivelli et al., 2023), social conformity (Selart et al., 2020), motivation and self-awareness (Balconi, Angioletti, et al., 2023; Balconi & Lucchiari, 2005; Fronda et al., 2024).

Decision-making is considered a key component of the broader family of high-order cognitive functions known as executive functions (EFs) (Balconi, 2023; Crivelli et al., 2019b; Del Missier et al., 2010; Rovelli & Allegretta, 2023), which also include working memory, cognitive flexibility, inhibitory control, and others. EFs play a crucial role in regulating impulses, supporting goal directed behavior and adapting to changing environmental demands.

As with other EFs, decision-making is subject to cognitive biases that can influence and alter a person's decision based on the specific context of the decision-making situation. Examples include nudging, a technique that leverages subtle cues and environmental design to encourage certain choices (Balconi, Acconito, et al., 2023; Li & Chapman, 2013), as well as reframing and decoy effects, where decisions change based on how options are presented (Angioletti et al., 2024; Padamwar & Dawra, 2024).

The decoy effect has been extensively studied within marketing and behavioral psychology (Huber et al., 1982; Milberg et al., 2014; Padamwar & Dawra, 2024). Broadly, it refers to the phenomenon according to which introducing a new alternative into a set of choices can alter the preference and probability of choosing one of the existing alternatives. In its classic form, the decoy effect takes the form of "attraction effect" or "asymmetric dominance effect" and was first introduced by Huber (Huber et al., 1982). He demonstrated that the probability of choosing a target product (P1) over another product (P2) increased when a third decoy product (P3) was introduced. This decoy is similar to but not dominated by P1 (it is slightly inferior), making P1 appear more favorable. For example, if P1 is low in both price and quality, while

P2 is high in both, P3 is designed to have the same price as P1 but even lower quality, thereby reinforcing the evaluation and preference for P1.

Besides, the introduction of a third, non-dominated option also creates a context effect in decision-making tasks. Adding a more extreme choice to a binary set can in fact increase the probability of choosing the middle alternative, since people tend to prefer an option when it serves as a compromise, that is the middle option within the set (Sheng et al., 2005; Simonson, 1989). This is called "compromise effect" and can be considered as a type of decoy effect (Padamwar & Dawra, 2024).

Decoy effect has been studied in different contexts, such as buying situations, bargaining, dyadic and group decision-making and even in animal studies, proving to be a robust effect (Padamwar & Dawra, 2024). Several factors moderating occurrence and intensity of the decoy effect have been proposed, including characteristics of the choice situation, individual differences such as decision-making styles, and attributes of the alternatives (Angioletti et al., 2024; Padamwar & Dawra, 2024). Besides, neuroscience research (Hu & Yu, 2014) highlighted some neural basis of individual differences in susceptibility to the decoy effect, specifically in the activation of the left anterior cingulate cortex (ACC). An enhanced activation of this area suggests that additional cognitive control is required when individuals try to inhibit automatic processes derived from the decoy effect and rely more on analytic strategy (Crivelli et al., 2019a). Results showing longer reaction times (RTs) for decisions with three-options compared to two-options conditions support the idea that a decoy option introduces higher cognitive workload (Hu & Yu, 2014; Marini & Paglieri, 2019). Nevertheless, the driving mechanism of decoy effect and its moderating factors are still not fully understood (Simonson, 2014) and some studies even failed to replicate the attraction effect and questioned its practical relevance, especially when applied to more realistic scenarios (Frederick et al., 2014; Yang & Lynn, 2014).

Typically, research on the decoy effects measures individuals' preference before introducing a decoy alternative and then assesses whether the same individuals change their choices after the decoy introduction. However, studies have shown that experimental design itself can directly influence the strength of the attraction effect. In particular, certain decoy effects tend to be weaker in repeated measures designs compared to independent groups designs (Milberg et al., 2014). This discrepancy may be explained by a carryover effect, wherein participants tend to reproduce their initial choice even after the decoy is introduced (Kowal & Faulkner, 2016).

Furthermore, while some studies have explored the spatial positioning of the decoy within a three-option set, less attention has been given to the impact of the order in which alternatives are presented. The sequencing of choices -

whether individuals are first exposed to a binary choice before encountering a third option - could influence decoy effect due to carryover effect. One study did investigate this aspect, but within a specific context of delay discounting (Kowal & Faulkner, 2016). The researchers found that when participants completed a binary questionnaire first, the effectiveness of decoys in subsequent three-alternative questions decreased. This was likely due to a "memory effect", where participants' previous responses influenced their decision-making in later choices, reducing the impact of the decoy in the three-alternative set. This suggests that the order of presentation may play a significant role in decision-making outcomes and warrants further examination.

Additionally, other cognitive biases may counteract or interact with decoy effect. For example, the "anchoring effect", in which individuals tend to rely heavily on the initial information presented (that becomes an "anchor") when making decisions (Furnham & Boo, 2011; Tversky & Kahneman, 1974). For example, seeing a higher option price for a product as first information can lead people to estimate the product's value higher, and this could diminish the impact of a decoy. Similarly, the "status quo bias", that is the preference for doing nothing or maintaining one's current choice rather than switching to a new alternative (Samuelson & Zeckhauser, 1988) may reduce the effect of external context (Crivelli et al., 2023). These biases highlight the complexity of real-world decision-making, where multiple cognitive mechanisms operate simultaneously, sometimes amplifying and sometimes mitigating the effects of specific choice manipulations.

The present study aims to further explore the decoy effect, specifically in the form of the compromise effect, within ecological decision-making scenarios. By introducing a third, more extreme alternative, the study examines its influence on decision-making behavior in a realistic workplace context, an environment easily relatable and where decision-making skills are highly relevant. Additionally, the study explores whether the presentation order of alternatives (binary vs. triadic) affects decision-making and the intensity of the decoy effect. Finally, the study aims to assess the cognitive impact of introducing a third option by analyzing participants reaction time (RTs) as a behavioral measure of information processing and cognitive workload.

In line with previous studies on the decoy and compromise effect we expect that the introduction of a third alternative of higher value will significantly alter participants' preferences in the three-alternative condition, presumably with a higher preference for the middle option, compared to the two-alternative condition.

We hypothesize that the order of presentation of the choice sets (binary first vs. triadic first) will influence the strength of the decoy effect. Specifically, as previously found by Kowal & Faulkner (2016), we expect that when participants

first complete the binary choice task the decoy effect in the subsequent three-alternative set will be lower due to carryover effects of the first decision.

Regarding RTs, we hypothesize that they will be significantly longer when participants are presented with three alternatives compared to two alternatives, since evaluating a third decoy alternative may increase the cognitive load and lead to longer decision times.

2. Method

2.1 Participants

A group of 51 healthy individuals aged 18-28 years (M_{age} = 22.02, SD = 2.21, Male = 29) participated in the study on a voluntary basis without financial compensation. All participants signed an informed consent form and were informed of their right to withdraw from the study at any time.
Participants were selected considering specific exclusion criteria, which included high levels of depression and perceived stress, a history of psychiatric or neurological disorders, abnormal short- or long-term memory, low general cognitive functioning, or current treatment with psychoactive drugs that could interfere with cognitive decision-making processes.

The study was approved by the Ethics Committee of the Department of Psychology of the Catholic University of the Sacred Heart, Milan, Italy (approval code: 125/24 – "Valutare il Decision-Making: consapevolezza e metacognizione decisionale"; approval date: 23 July 2024). It was conducted in accordance with the principles of the Declaration of Helsinki (2013) and complied with the GDPR (Reg. EU 2016/679) and related ethical guidelines.

2.2 Procedure and experimental task

The experiment took place in a quiet, dedicated room, where the participants were seated comfortably in front of a computer positioned at a distance of about 80 cm. Before the start of the experiment, participants signed a written informed consent form to confirm their voluntary participation. They were then informed of the experimental design and procedures.

The Alternatives Valuation task (Valt) consists of three critical decision scenarios ("Scenario 1, 2 and 3") set in the workplace, each divided into two steps. In the first step (i.e., T1), participants were asked to choose between two options with different economic values arranged in ascending order, selecting the one they consider best for them. After making their choice, they were asked

to provide a written explanation for their decision. In the second step, a third option with the highest economic value was introduced and the participants had to make their choice again and then justify it.

For instance, for the first scenario, in the first step (T1), participants were presented with the following script: *"Your company needs to buy 6 new office printers. You contact your supplier, who suggests 2 alternatives."*

They were then shown a list of two purchase options and asked to make their choice by answering the question *"What is your choice?".* Subsequently, subjects were required to provide a written account of the motivations underpinning their decision.

In the second step (labelled as T2), the scenario remained the same, but a third alternative was introduced. Thus, they were presented with an updated script: *"Your company needs to buy 6 new office printers. You contact your supplier, who suggests 3 alternatives"* and then they were asked again to make their selection by answering the question *"What is your choice?"* and providing a written explanation for their choice.

After this first decisional scenario, two other different situations were presented in the same modalities. Therefore, the second scenario consisted of two steps, T3 and T4, while the third scenario included two more steps, T5 and T6. It is important to note that the order in which steps are presented changed in the second scenario, specifically, T3 was the three-alternative step and T4 was the two-alternative step. For the third scenario, however, the sequence of alternatives was again two-alternative and then three-alternative (Figure 1).

In addition to the response scores, reaction times (RTs) were measured for each scenario. RTs were used as a behavioral measure to evaluate task performance, offering insights into the speed and efficiency of information processing. Furthermore, they provided an indirect indicator of the cognitive workload and the effort required during the decision-making process (Kramer, 2020; van Winsum, 2018).

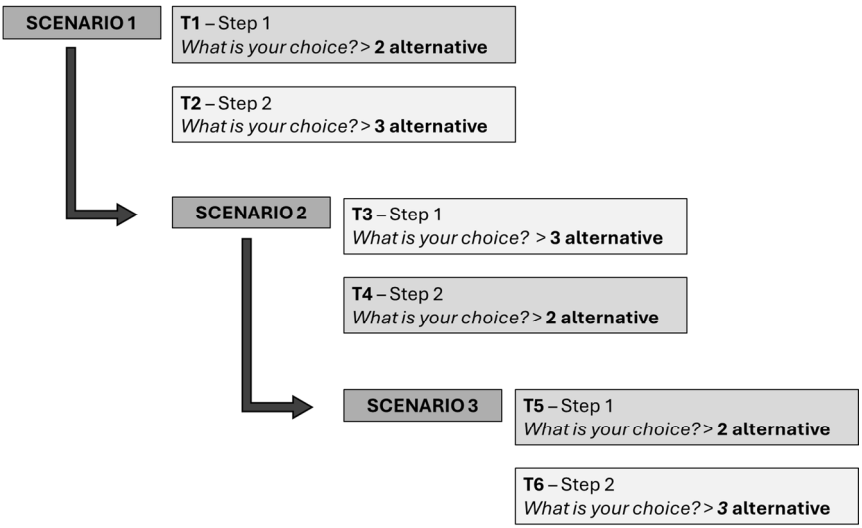

Figure 1. Graphical description of the task procedure for the three scenarios

2.3 Data analysis

For the data analysis, an ANOVA was performed with *Time* (4: T1, T2, T3, T4, T5, T6) as a within-subjects factor. The *Time* variable refers to the choice steps in which participants were asked to choose what they considered to be the best of two or three alternatives. In particular, T1, T4 and T5 refer to the first situation with two alternatives, whereas T2, T3 and T6 refer to the second situation with three options.

Then, another ANOVA was conducted with *Evaluation* (2: 2alternatives, 3alternatives) as independent variable, in relation to the RTs. Specifically, 2alternatives refers to all the two-options steps and 3alternatives to the all three-options step.

Finally, one last ANOVA was conducted with *DELTA* (3: Scenario1, Scenario2, Scenario3) as the within-subject factor. The variable *DELTA* refers to the gap between the answers given by the subjects when they had to choose between two alternatives and between three alternatives (i.e., Scenario1=T1-T2, where T1 refers to the two-option step and T2 to the three-option step).

Pairwise comparisons were applied to the data in case of significant effects. Simple effects for significant interaction were further checked via pairwise comparisons, and Bonferroni correction was used to reduce multiple

comparisons potential biases. For all the ANOVA tests, the degrees of freedom were corrected using Greenhouse–Geisser epsilon where appropriate. Furthermore, the normality of the data distribution was preliminarily assessed by checking kurtosis and asymmetry indices. The normality assumption of the distribution was supported by these preliminary tests. The size of statistically significant effects was estimated by computing partial eta-squared (η^2) indices.

3. Results

The ANOVAs with Time as independent variable showed a main effect for Time (F[2,190] = 11.6, p = <.001, η^2 = .165). Pairwise comparisons revealed higher values in T2 (p = .026), T3 (p = < .001) e T4 (p = .048) compared to T1. Secondly, major values in T3 compared to T2 (p = .006), T4 (p = < .001), T5 (p = <.001) e T6 (p = .021). Finally, it was observed higher scores in T6 than in T5 (p = .013) (Figure 2).

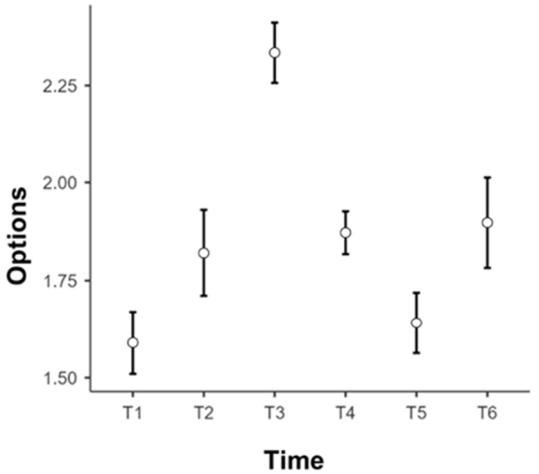

Figure 2. The graph represents the means of responses in the choice steps. T1, T4 and T5 refer to situation with two alternatives; T2, T3 and T6 refer to situation with three options. Bars represent the Standard Error (SE) of ±1

Additionally, the ANOVA regarding the RTs which considered *Evaluation* as independent variable showed a main effect for *Evaluation* (F[1,50] = 107, p = <.001, η^2 = .300), with major values in 3alternatives compared to 2alternatives (Figure 3).

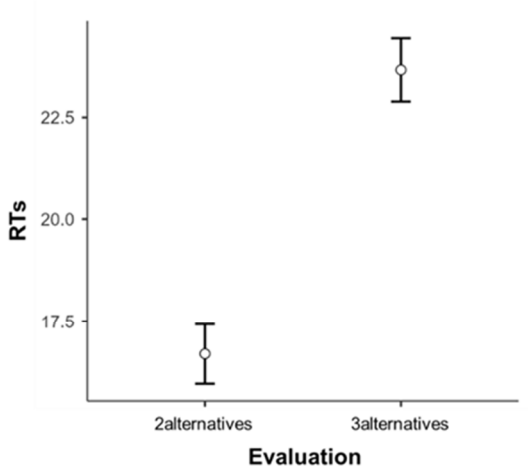

Figure 3. The graph represents RTs for evaluation. 2alternatives refers to all the two-options steps and 3alternatives to the all three-options step. Bars represent the Standard Error (SE) of ±1

Finally, there was a main effect of time in the ANOVAs with *DELTA* as the independent variable (F[2,88] = 4.64, p = .012, η^2=.066). Pairwise comparisons showed higher values in Scenario3 than Scenario2 (p = .015) (Figure 4).

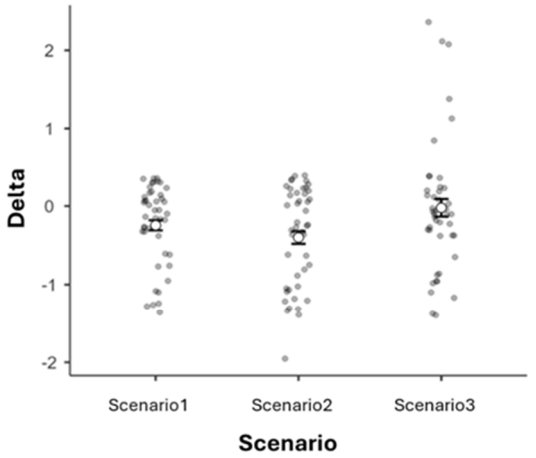

Figure 4. The graph represents the delta among two-options vs. three-option step for each scenario. Bars represent the Standard Error (SE) of ±1

4. Discussion

The present study aimed to investigate the decoy effect, particularly in its compromise form, within an ecological work-related decision-making scenario. The findings provide further evidence that introducing a third more extreme alternative in a set of two options significantly alters decision-making processes, confirming the influence of contextual factors on choice behavior. Additionally, the study aimed to investigate whether the order of presentation of the decoy options have an impact in modulating its effectiveness, finding that when the three-alternatives condition is presented first, there seems to be a greater shift in participants' choice.

Particularly, the results of the first ANOVA show significant higher values of mean responses in all the three-alternative conditions (T2, T3, T6) compared to their two-alternative counterparts (T1, T4, T5). These findings suggest that participants tend to change their choice when a third, more extreme option is introduced. This result supports several other studies (Huber et al., 1982; Milberg et al., 2014; Padamwar & Dawra, 2024; Sheng et al., 2005; Simonson, 2014) showing that individuals are not always consistent with their decisions and that their preferences are influenced by the specific context

in which the choice situation is presented, questioning the assumptions of rational choice theories (Luce, 1977; Ray, 1973).

Interestingly, T3 (the three-alternative set in the second scenario) is the condition that exhibits the highest overall response averages. Notably, this is the only scenario in which the three alternatives are presented to the participants before encountering the two alternatives set. Besides, analysis performed on the delta, which represents the gap between the means of two-option choices and three-option choices, shows that this gap is wider in the second scenario, with a significant difference compared to the third scenario. These results suggest that when participants are first introduced to a choice situation with three options, they tend to choose higher values right away, compared to when they are first presented with two alternatives and then a third higher one is added. These findings are in line with a previous study (Kowal & Faulkner, 2016) that investigated the effect of binary vs. triadic order of presentation, finding that the decoy effect was weaker when the binary set was presented before the triadic one. The author suggests that a carryover effect from initial decisions can attenuate the impact of the decoy introduced later.

One possible explanation is that individuals may in fact anchor their preferences to their initial selection, reducing their susceptibility to the decoy effect later introduced. In fact, once a decision is made, people do not always reconsider it, even when influenced to do so. This can be attributed to the status quo bias (Samuelson & Zeckhauser, 1988), which fosters a sense of reassurance and effectiveness in one's previous choice (Samuelson & Zeckhauser, 1988; Staw, 1981), and can lead individuals to persist with their decisions, even when, for instance, faced with negative feedback (Crivelli et al., 2023).

Moreover, several studies (Furnham & Boo, 2011) demonstrated that decision-makers are biased toward an initial presented value when they make judgments and tend to be influenced by it. This anchoring effect (Tversky & Kahneman, 1974) causes the first value to be seen as a reference point for people to adjust their range of plausible values (Strack & Mussweiler, 1997). In our study, presenting the three-alternative set first, in which the highest value was already included, may have established a reference range with higher prices. This could have led participants to favor the more expensive options, selecting either the middle or the highest-priced choice. In contrast, when only two options were initially presented, participants may have anchored their judgment within their first choice, that was within that lower price range.

In addition to choice behavior, reaction times (RTs) were analyzed as indicators of cognitive workload and task performance. The findings indicated significantly longer RTs in the three-alternative conditions compared to the two-alternative conditions. This supports the notion that evaluating a third option imposes additional cognitive demands (Hu & Yu, 2014; Marini &

Paglieri, 2019). The increased cognitive load may arise from the need to compare an additional attribute, reevaluate prior decisions, and integrate new information before making a final choice.

Taken together, these results suggest that in a realistic decision-making scenario the decoy effect is present, however its impact may be mitigated by other cognitive biases that shape decision-making processes, as well as by the timing of when the decoy option is introduced to individuals.

The scenarios designed for the study tried to replicate realistic situations that reflect decisions in a typical business setting. The findings of this study can have practical implications for employees and policymakers to guide decision-making processes in organizational settings, as well as other settings requiring complex decision-making. For instance, structuring options in a way that presents an optimal middle-ground alternative could facilitate balanced decision-making, reducing extreme choices. Additionally, understanding the role of presentation order can inform how choices are framed in various contexts. Nevertheless, the specific focus on economic choices in workplace scenarios can make it difficult to extend these results to different contexts. Besides, questions asked participants to choose what to buy on behalf of the company, whereas the decision-making process might be different when more personal motivation and resources come into play. This is part of a more general limitation of the study of decision-making and the biases affecting it, namely, that they are influenced by a variety of personal and situational factors. Future studies could better investigate the role of some of these factors, such as age, experience, or individual decision-making styles.

Another limitation of the study is that only three scenarios were presented to participants. A larger set of scenarios could provide a more comprehensive understanding of how the decoy effect interacts with other biases across different contexts. Additionally, asking participants to purchase three different items across the three scenarios might have influenced their decision-making process. The variation in the nature of the products could introduce additional factors, such as differences in perceived value or familiarity with the product. Despite these limitations, the findings of this research contribute to the understanding of decision-making mechanisms and provide practical insights for structuring choices in professional settings. Further research is needed to explore the broader applicability of these effects across different populations and decision domains.

Funding

This research was supported by the Catholic University of the Sacred Heart [D1 2023 - Funding acquisition: MB].

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical statement

The study involving human participants was conducted in accordance with the Declaration of Helsinki (2013), reviewed and approved by the Ethics Committee of the Catholic University of the Sacred Heart, Milan, Italy (approval code: 125/24 – Valutare il Decision-Making: consapevolezza e metacognizione decisionale; approval date: 23rd July 2024).

Data accessibility

The data presented in this study are available on request from the corresponding author due to ethical reasons for sensitive personal data protection (requests will be evaluated according to the GDPR - Reg. UE 2016/679 and its ethical guidelines).

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