
Confidently conflicted: The impact of value confidence on choice varies with choice context

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Abstract

How people choose among a set of options is affected both by how they evaluate each option, and how they perceive the competition among those options. For instance, separate lines of work have shown that people weigh their options differently depending on (a) how confident they are in their valuation of each, and (b) whether or not selecting one option from a set excludes the possibility of selecting others. It remains unclear whether and how these two factors interact in shaping not only choices but also how difficult it feels to make a choice. To examine this interaction, we compared typical exclusive choices to non-exclusive choices, in which participants can choose additional items from the set after their initial choice. We tested how the value a person assigned to each option interacted with their confidence in those values to shape initial choices, subsequent choices, and experiences of choice conflict. When participants were required to choose one option from a set, we found that they were more likely to choose a low-value option that they had low confidence in than one they had high confidence in, and vice versa for high-value options. However, when participants had the flexibility to continue choosing additional items or not, we found that this effect was either absent or even reversed. We also replicated previous findings that participants experience the most conflict when choosing among the most and the least valuable options, but showed that this U-shaped effect was attenuated with lower levels of confidence in one's value estimates. Our work sheds new light on mechanisms of decision-making by highlighting that the impact of value confidence on choices critically depends on whether an option needs to be chosen at all. By adding nuance to previous findings our results provide a starting point for better understanding the mechanisms underlying value-based decisions, and what makes some choices harder than others.

Keywords: value-based decision-making, value confidence, choice conflict, choice exclusivity

1 Introduction

As early as breakfast time, we need to weigh our options and choose among them. These choices are guided by how much we value each of our options (e.g., scone vs. croissant), information that accumulates for the respective options and competes to determine our ultimate response. However, this evidence accumulation process can be modulated both by properties of value estimation and of the choice context itself.

For instance, recent work has shown that a person’s confidence in the values of each of their options (e.g., based on more consistent or mixed experiences with a given breakfast item) influences how they choose between those options. When people are overall more confident in their estimates of option values, their choices are faster and more accurate/consistent [1, 2, 3]. These findings have been accounted for by Bayesian value estimation, where lower precision samples lead to less updating and the momentary value estimate is consequently shrunk towards one’s prior (e.g., the average value of options in one’s environment) [4].

A separate line of work has shown that how we accumulate value-related evidence is influenced by our perception of the level of competition between our options. When selecting our favorite option precludes the choice of other options (as if selecting from a breakfast menu; *exclusive choices*), we are slower and experience greater choice conflict than when we are allowed to subsequently choose additional options (as if selecting from a breakfast buffet; *non-exclusive choices*) [5]. These results have been accounted for with choice models that vary in the level of competition (e.g., mutual inhibition) across options during non-exclusive compared to exclusive choice [5, 6].

Important questions remain unanswered at the intersection of these two lines of work. For instance, how does the influence of value confidence on choice differ when an initial choice excludes or doesn’t exclude additional choices? How does it further influence choices of whether to select additional options, and how many? How do all of these factors collectively influence the subjective experience of conflict during a decision? To address these questions, we had participants make decisions that were either exclusive (requiring only one choice) or non-exclusive (requiring at least one choice, but allowing for additional selections from the same set) (Fig. 1). We measured how confident participants were in each of their option values, and tested how this value confidence impacted choice behavior, and perceived choice conflict during initial and subsequent choices. We hypothesized that low confidence during subsequent choices (where multiple options *can* be chosen, but no option *needs* to be chosen), would produce less down-weighting of high-value items and less up-weighting of low-value items. We verify this and other hypotheses across two studies, showing that the interaction of confidence and value depends on one’s choice context.

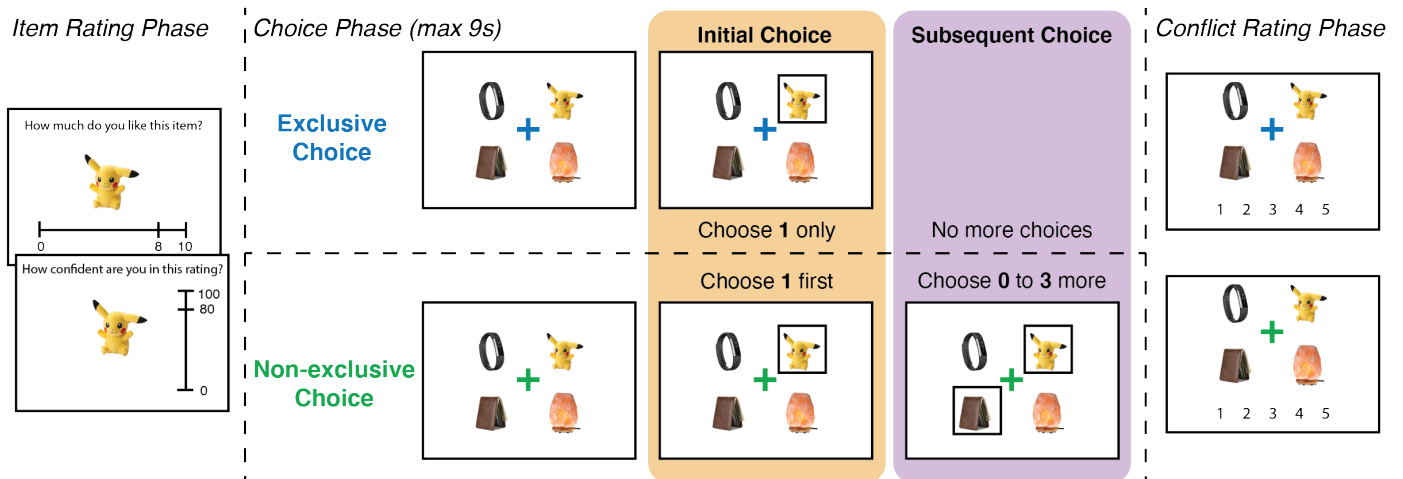


Figure 1. Task paradigm. Participants rate how much they like items and their confidence in these value ratings. Participants then choose among sets of 4 options, each. On exclusive choice trials, the trial ends post-initial choice. On non-exclusive choice trials, participants are allowed to select as many additional products as they like. Finally, participants rate the level of conflict they experienced during each choice.

2 Method

Participants across two studies (Study 1; N = 56, 25 males, 31 females, age = 36.5 ± 18.5 ys, Study 2; N = 77, 30 males, 47 females, age = 34.4 ± 20.6 ys) performed an experiment consisting of three phases: 1) item rating, 2) choice, and 3) conflict rating (Fig. 1). During item ratings (200 items total), participants were asked to rate how much they liked a consumer item on a scale from 0 (not at all) to 10 (a great deal), followed by a prompt to rate how confident they were

in this rating on a scale from 0 (not confident at all) to 100 (absolutely confident). Based on the individual ratings, we constructed personalized choice sets that varied in the relative and overall values of options (120 sets total). In the choice phase, participants made either *exclusive* (menu-type), or *non-exclusive* (buffet-type) choices among sets of 4 options. On *exclusive* choice trials, participants were allowed to choose only one product from the choice set. Once they clicked on this product, a box appeared around it and they proceeded to the next trial. On *non-exclusive* choice trials, participants were able to continue selecting as many options as they preferred after they chose the most preferred item first. The choice types were intermixed, occurred with equal likelihood, and were color-coded by a fixation cross in the center. Participants had 9s to complete their choice(s) for a given option set. Following the choice phase, participants were then asked to rate their subjective experience of conflict during each choice on a 5 point Likert-scale.

3 Results

3.1 The influence of value confidence and choice exclusivity on initial choices.

To test how confidence and choice exclusivity jointly impact choice behavior, we analyzed initial choices and response times as a function of choice condition, overall value, value difference, set confidence (mean confidence in all the items' values for a given set), and confidence in the chosen option, as within subject regressors, while controlling for confidence bias (a given participant's average level of confidence across all rated items).

Consistent with previous findings from separate lines of work [3, 5, 7], participants were faster (S1: $b = -0.01, p < .001$, S2: $b = -0.01, p < .001$) and more consistent (S1: $b = .04, p = .001$, S2: $b = 0.09, p < .001$) the higher the set confidence [Fig. 2; [3, 7]], and slower making exclusive compared to nonexclusive choices (S1: $b = -0.02, p < .001$; S2: $b = -0.02, p < .001$), in line with greater mutual inhibition in exclusive choice [5]. We found no reliable interactions between confidence and context ($ps > .05$). This suggests that confidence plays similar roles during initial choice (when one item has to be chosen), irrespective of choice exclusivity.

3.2 The influence of confidence on continued option selection in non-exclusive choices.

Our task allows us to investigate the impact of choice context beyond these initial choices, for instance how confidence and value impact how many additional items were chosen in the nonexclusive context. As expected, participants selected more additional items as the overall value of the set increased (S1: $b = 0.63, p < .001$, S2: $b = 0.67, p < .001$; Fig. 3A), and fewer additional items the greater the difference in value between the first item and the rest of the set (S1: $b = -0.05, p = .001$, S2: $b = -0.08, p < .001$; Fig. 3B) [5]. Importantly, this value difference effect, reflecting that the only good item had already been selected, was amplified when participants were more confident in their option set values (S1: $b = -0.04, p = .003$, S2: $b = -0.02, p = .036$; Fig. 3B) - when set confidence was low, participants were less sensitive to value difference when selecting additional options. In Study 2, but not Study 1, we found that higher set confidence also led people to choose more additional options overall (S2: $b = .06, p < .001$, S1: $b = 0.02, p = .086$), and that it amplified the positive influence of overall value on option selection (S2: $b = 0.03, p = .011$, S1: $b = -.01, p = .552$; Fig. 3A).

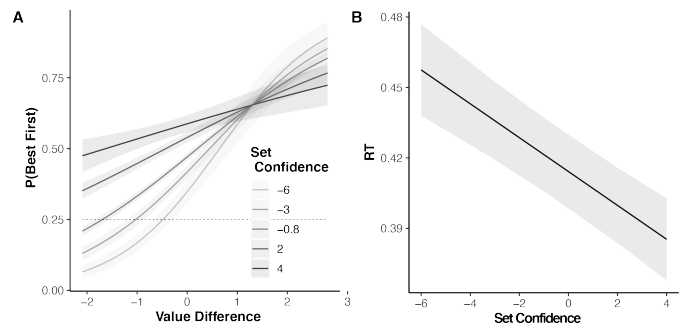


Figure 2. Set confidence effects on initial choice. (A) The probability of choosing the best item increases with increasing Value difference and for higher set confidence. **(B)** Reaction time decreases with higher set confidence.

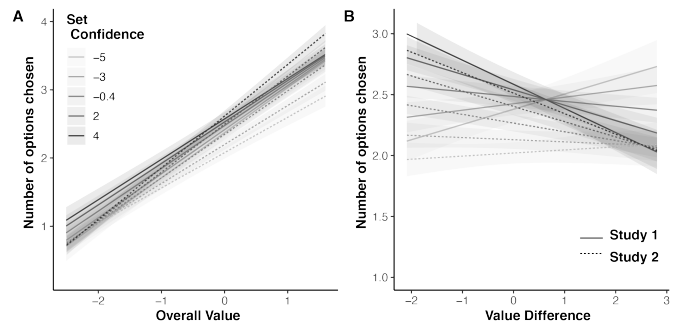


Figure 3. Set confidence effects on number of items chosen. (A) The number of items chosen increases with overall value, and more so for higher set confidence in Study 2. **(B)** Number of options chosen decreases with increasing value difference and more consistently so for higher set confidence.

To directly compare the decision process for initial relative to subsequent choices, we examined value and confidence in an item-wise manner (vs. at the level of the set) to see how these predict the likelihood of choosing a given item initially or subsequently. As expected, across both types of choice, participants were more likely to choose more valuable items (P(chosen first): S1: $b = 0.48, p < .001$, S2: $b = 0.45, p < .001$; P(chosen subsequent): S1: $b = 0.78, p < .001$, S2: $b = 0.85, p < .001$; Fig. 4) [5]. When choices were obligatory (initial choice), the influence of an item's value was diminished or amplified according to one's confidence in that value estimate (S1: $b = 0.08, p < .001$, S2: $b = 0.13, p < .001$; Fig. 4A). Participants treated low-confidence low-value items as more valuable and low-confidence high-value items as less valuable on average, consistent with Bayesian value estimation accounts [4, 7].

However, this pattern was qualitatively different when additional selection was voluntary (subsequent choices). In these cases, the effect of an item's value on choice was flatter when confidence was high than when it was low (S1: $b = -0.05, p = .121$, S2: $b = -0.11, p = .001$; Fig. 4B). In other words, participants in this context refrained from choosing low-confidence, low-value items, but were similarly if not more inclined to choose low-confidence, high-value items. This inverted confidence effect suggests that when allowed to forego all items, people no longer treat low-confidence, low-value items as more valuable, and low-confidence, high-value items as less valuable. Thus in initial choices, low-confidence's benefits for low value items and costs for high value items might be shaped by the dreaded alternative of selecting certainly bad options or forgoing potentially better options.

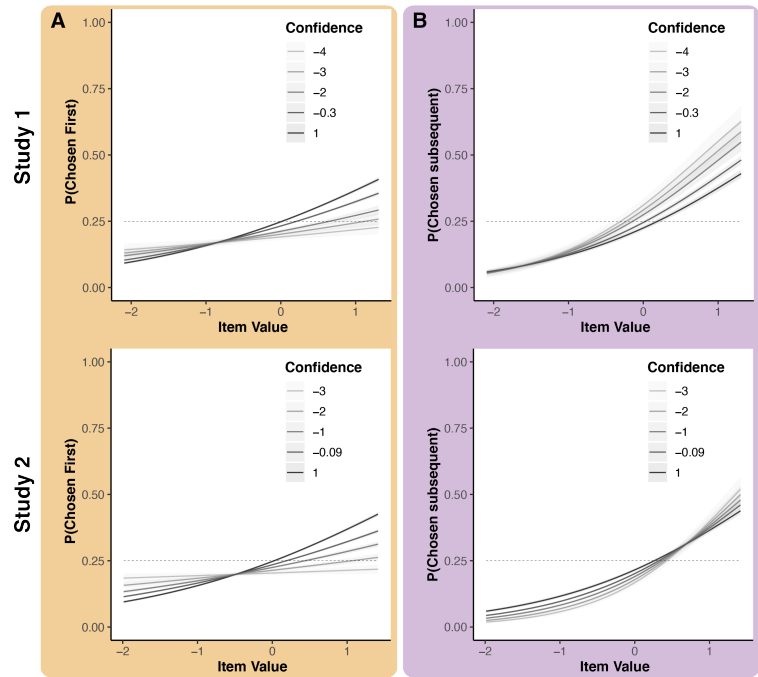


Figure 4. Confidence effects on initial vs. subsequent choice. (A) Lower value confidence reduces value effects on initial choice. **(B)** Unlike in initial choices, in subsequent choices value effect on choice are not reduced for lower value confidence.

3.3 The influence of confidence and choice exclusivity on experienced choice conflict.

As in previous studies [8, 9], participants reported experiencing the greatest conflict when choosing among especially high-value or especially low-value options (Linear; S1: $b = 16.46, p < .001$, S2: $b = -7.14, p < .001$, Quadratic; S1: $b = 16.01, p < .001$, S2: $b = 7.11, p < .001$). This finding was hypothesized to reflect reference-dependent valuation, resulting in avoid-avoid conflict when choosing among low value options and approach-approach conflict when choosing among high value options [9]. We found that this effect is modulated by set confidence, such that the U-shaped effect is strongest at higher levels of set confidence, and flattens with lower set confidence (S1: $b = 3.37, p = .008$, S2: $b = 4.13, p = .001$; Fig. 5).

This could reflect weaker avoid-avoid and approach-approach conflict when choosing among higher and lower values options, respectively [9], perhaps due to regression to the mean for lower confidence, as predicted by Bayesian value estimation. Participants also experienced less conflict overall when making non-exclusive relative to exclusive choices (S1: $b = -0.18, p < .001$, S2: $b =$

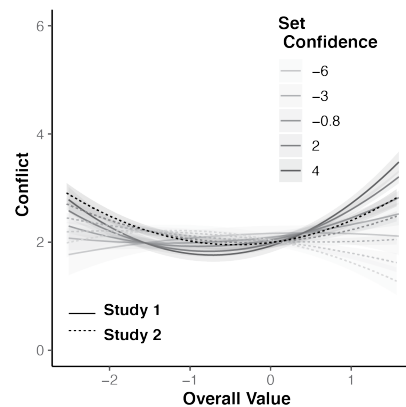


Figure 5. Experienced conflict in decision making. The U-shaped value effect (higher conflict experienced for more extreme overall value) is reduced for lower set confidence.

$-0.12, p < .001$; cf. [5]), but this did not robustly interact with value confidence across both studies (S1: $b = 0.05, p = .003$, S2: $b = -0.02, p = .101$).

4 Conclusion

We demonstrated that value confidence not only affects our choices but also the conflict we experience when making them. Notably, we show that the way in which value confidence affects choice depends on whether at least one item must be chosen or not. Taken together, these findings provide a crucial stepping stone for delving further into the specific mechanisms underlying choice dynamics and how they relate to the subjective experience of choice conflict. In doing so, we may identify strategies to make hard choices easier and feel better about making them.

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