Search predicts and changes patience in intertemporal choice

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Intertemporal choice impacts many important outcomes, such as decisions about health, education, wealth, and the environment. However, the psychological processes underlying decisions involving outcomes at different points in time remain unclear, limiting opportunities to intervene and improve people's patience. This research examines information-search strategies used during intertemporal choice and their impact on decisions. In experiment 1, we demonstrate that search strategies vary substantially across individuals. We subsequently identify two distinct search strategies across individuals. Comparative searchers, who compare features across options, discount future options less and are more susceptible to acceleration versus delay framing than integrative searchers, who integrate the features of an option. Experiment 2 manipulates search using an unobtrusive method to establish a causal relationship between strategy and choice, randomly assigning participants to conditions promoting either comparative or integrative search. Again, comparative search promotes greater patience than integrative search. Additionally, when participants adopt a comparative search strategy, they also exhibit greater effects of acceleration versus delay framing. Although most participants reported that the manipulation did not change their behavior, promoting comparative search decreased discounting of future rewards substantially and speeded patient choices. These findings highlight the central role that heterogeneity in psychological processes plays in shaping intertemporal choice. Importantly, these results indicate that theories that ignore variability in search strategies may be inadvertently aggregating over different subpopulations that use very different processes. The findings also inform interventions in choice architecture to increase patience and improve consumer welfare.

temporal discounting | delay of gratification | decision making | process tracing | choice architecture

Almost all important decisions involve outcomes over time: saving money for retirement, changing diets for health, or conserving energy for the environment. These choices have wide-ranging impact, and multiple disciplines—economics, psychology, public health, policy, and neuroscience—have used quantitative theories to model impatience. These models are often based on observing choices between a smaller reward delivered sooner and a larger reward delivered later (1–3). Individual differences in patience are represented by discount rates in these models and have significant associations with many outcomes later in life, including income, educational attainment, body mass index, and other health outcomes (4, 5). For example, one study found that discount rates measured when people were 13 y old predicted their educational achievement, income, and mortality when they were 47 y old (4).

While these discounting models are valuable in predicting real-world behavior, they do not by themselves suggest interventions to alter people's patience. People who show more or less discounting of future rewards may be using different psychological processes while weighing the options, leading them to seek out and combine different information while making their choices. There are three main reasons a more in-depth examination of these underlying psychological processes would be useful. First, discount factors vary across different decision-making contexts or presentations of options (6–8). One example involves framing choices as decisions to delay or accelerate consumption. When choosing between rewards, one option is often portrayed as the status quo. People can choose to delay consumption by switching from the smaller/sooner to the larger/later option or accelerate consumption by switching from the larger/later to the smaller/sooner option. Patience is greater for acceleration compared with delay framing (8–10). Standard discounting models cannot account for this preference shift. Second, insight into psychological processes provides a potential means to modify maladaptive behaviors. By elucidating how differences in psychological process change discounting, we can design behavioral interventions to improve consumer welfare (11, 12). Finally, insights into psychological processes may provide deeper understanding of the neural substrates underlying time preferences. The goal of this paper is to reveal how psychological processes related to information search alter patience in intertemporal choice.

Previous research identifies two broad types of intertemporal choice models. Integrative models suggest that decision makers consider the value of each reward, discount it according to the timing of its delivery, and choose the option with the highest discounted utility (13). Exponential (3) and hyperbolic (1, 2) models are common examples of integrative approaches. While most integrative models do not explicitly hypothesize about search processes (13), by

Significance

People often make decisions with consequences that unfold over time. When facing such intertemporal choices, people use different search strategies. We examine how these search strategies differ and how they relate to patience in intertemporal choice. We demonstrate that search varies substantially across individuals and identify two main search strategies—comparative or integrative search. Importantly, comparative search correlates with greater patience and higher susceptibility to contextual influences on choice. We manipulated search using an unobtrusive technique, revealing a causal relationship between strategy and choice. Comparative searchers make more patient choices and exhibit larger framing effects than integrative searchers. An understanding of how differences in psychological processes change discounting can inform the design of behavioral interventions to improve consumer welfare.

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emphasizing discounting rewards based on the timing of their delivery, they implicitly predict that people decide by integrating the information about the reward and timing of each option.

In contrast, comparative models suggest that people make choices by comparing the attributes of the options (13–19). These cognitive models were developed, in part, to explain why observed discount rates vary across contexts and generally do a better job than integrative models in predicting changes in patience across contexts (13–16). These models differ in details but share the idea that people compare the attributes of the two options, because people either make tradeoffs between the differences in the amounts of the rewards and the timing of delivery (18) or compare the similarity of attributes between options (19).

Tracking information acquisition has proven useful in studying psychological processes in other decision domains, such as game theory and risky choice (20–23). Since integrative and comparative models imply different search processes, tracking information search can provide a window to the underlying cognition. In contrast to other research focusing on the relative time spent looking at options (24, 25), here we focus on examining transitions between attributes of options. By focusing on transition data, we aim to identify underlying search strategies that shape choice. Our goal in this paper is not to pit one model versus the other but rather to explore if the observed psychological search processes are consistent with one or both families of models.

There are good reasons to expect to find evidence supporting both families of models. Empirical evidence demonstrates that different models fit different people better (26), suggesting strategies likely vary across individuals. There are also strong parallels between these two model families and choice strategies in other areas, such as risky choice (27). The present research not only characterizes variability in search processes but also examines whether search is linked to choice. Evidence connecting search and intertemporal choice remains scarce, and individual differences in search are largely unexamined.

The present research focuses on three research questions. First, does variability in search strategy occur primarily as an individual difference across people or as a function of the choice options? Second, do differences in search affect choice, altering overall patience or contextual influences on discounting? Third, can manipulating search change patience? Given recent demonstrations that relative attention can shape value judgments (24), we sought to demonstrate causally that differences in search strategy can affect choice by manipulating the search process.

It is not obvious which search strategies would promote patience. At first blush one might think integrative models, developed as normative accounts, might be associated with more deliberation and more patience. In contrast, comparative models often incorporate heuristics—simplifying strategies that might ease or speed decision making (28–30). Comparative models, however, often involve calculating the differences in rewards versus differences in delivery time. Making the tradeoff clear may promote patient choice. Elucidating the relationship between these two families of psychological processes and patience can inform future behavioral interventions to promote patience.

We examine the psychological processes used in intertemporal choice in two experiments. Participants made decisions between smaller/sooner and larger/later rewards that were framed as decisions either to delay or accelerate consumption. The present experiments tracked participants' information search while they were deciding between the two options. In experiment 1 we examined natural variability in search strategies and its relationship to patience. In experiment 2 we manipulated information search strategy to examine its causal effect on patience.

Results

Experiment 1.

Variation in search strategies. Participants completed an intertemporal choice task (Fig. 1) using MouselabWEB (31). MouselabWEB tracks how participants sample information when making their decisions, including transitions between specific pieces of information and the duration and frequency of acquiring each item of information while deliberating (*SI Appendix*, Fig. S1). For half of the trials the smaller/sooner option (delay condition) was the default, and for the other half of the trials the larger/later option (acceleration condition) was the default. We also ran a supplementary eye-tracking study that replicates our results (*SI Appendix*, *Supplemental Eye Tracking Experiment* and Figs. S5 and S6), indicating the current findings are not driven by the process-tracing method used.

We first examined whether variability in search behavior is driven predominantly by differences in the features of a choice (i.e., monetary amounts and time delays) or by individual differences. It is possible that different strategies are used by different people or that different options evoke different strategies. To explore variation in search, we first counted the number of transitions, ignoring direction, made by each respondent on each trial for each of the six possible transitions. We modeled these transition counts as a function of the choice options and the participant. Comparing the finite-population SDs for the two random intercepts allows inferences about the variance in transitions explained by features of the options compared with features of the individual. The finite-population SDs for both the option (0.04, 95% CI = 0.02–0.06) and individual (0.29, 95% CI = 0.26–0.32) were significantly greater than 0 (Fig. 2), indicating both contributed to search behavior during the task. However, the participant random effect was a significantly stronger predictor, explaining more than six times the variation in search behavior than the option random effect ($P < 0.001$). These findings demonstrate that individual differences play a more important role in determining search behavior than the features of the options being considered. Overall, search behavior varies substantially across individuals but is relatively stable within individuals across choices.

Identifying two common search strategies. Since strategies vary substantially across individuals, we next explored whether there were common patterns in information acquisition. We used k-means clustering to identify common strategies based on the transitions participants made while viewing options (22, 32). A two-cluster solution provided the best fit and produced two similarly sized groups (*SI Appendix*, *Supplemental Results* and Table S2). This data-driven solution complements previous work on search during choice, which typically highlights two main search strategies (30). The search behavior of each cluster is displayed in Fig. 3 (also see *SI Appendix*, *Supplemental Results* and Tables S4–S6). The group depicted on the left, which we refer to as "comparative searchers," acquired information about one attribute and compared it across options (e.g., comparing the monetary amount of the two options), resulting in more transitions between options. Conversely, the group depicted on the right, which we refer to as "integrative searchers," acquired information about one option across multiple attributes (e.g., viewing the monetary amount and the delay timing for the larger/later option), resulting in more transitions within options. The comparative and integrative groups' search behavior therefore appears to reflect two different processes for evaluating the options presented, consistent with the use of different strategies.

Search strategies predict choice. Are these two different processes associated with different choices? To answer this, we conducted a hierarchical logistic regression modeling choices as a function of framing (acceleration or delay) and strategy (comparative or integrative) (Fig. 4*A*). There was a significant effect of strategy, $\beta = -0.41$, SE = 0.12, $P = 0.001$, as comparative searchers were ~60% more likely to choose the larger/later option than integrative

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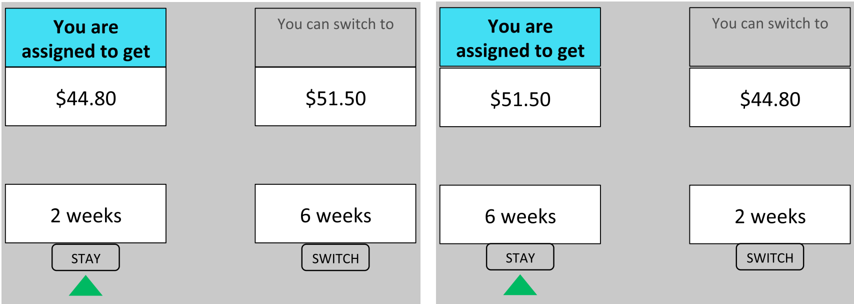

Fig. 1. Sample trial from the intertemporal choice task. Participants chose between a smaller reward delivered sooner and a larger reward delivered later. The trial on the left features a delay frame, as the smaller/sooner option is the default, and participants can choose to delay consumption and switch to the larger/later option. Conversely, the trial on the right features an acceleration frame, as the larger/later option is the default, and participants can choose to accelerate consumption and switch to the smaller/sooner option. During the task, information was occluded. To view information about the option, participants needed to move the mouse over the piece of information they sought to view.

searchers. There was also a significant effect of framing, β = −0.12, SE = 0.03, $P < 0.001$, as participants were more likely to choose the larger/later option when the choice was framed as a decision to accelerate versus delay consumption, replicating prior research (8–10). There was also a significant interaction between framing and strategy, β = 0.08, SE = 0.03, $P = 0.004$. While comparative searchers exhibited a significant effect of framing, β = 0.41 SE = 0.09, $P < 0.001$, integrative searchers did not, β = 0.07, SE = 0.08, $P = 0.363$. In sum, comparative searchers were more patient and more likely to exhibit sensitivity to option framing than integrative searchers, suggesting a relationship between search strategy and patience. Thus, search strategies are related to both overall patience and framing effects on discounting.

The sequence people use to explore information while deliberating predicts their choices. However, these two search strategies may differ in other ways, particularly in the relative amount of time spent looking at the monetary amounts versus the delivery time (Fig. 3 and *SI Appendix*, Tables S5 and S6). To see if this difference in the relative time spent looking at attributes drove the observed effects on choice, we computed each participant's mean Payne index (a measure of the relative number of comparative versus integrative transitions) across all trials as a measure of their search transitions and a separate measure of the relative time spent looking at amount attributes compared with time attributes. Choices were then modeled using Payne index, framing (acceleration or delay), and their interaction, along with the relative looking time measure. Consistent with the previous analysis, there were significant main effects of Payne index, β = −0.64, SE = 0.21, $P = 0.002$, and framing, β = −0.15, SE = 0.03, $P < 0.001$. Relative looking time also significantly predicted choice, β = 0.66, SE = 0.13, $P < 0.001$, as those who looked at amount attributes more than time attributes were also more patient. Importantly, the interaction between Payne index and framing was significant, β = 0.14, SE = 0.05, $P = 0.005$. Participants who engaged in more comparative searching also exhibited larger effects of acceleration versus delay framing, replicating the findings reported in the main analysis. These analyses demonstrate that the observed effects of individual differences in search strategy are driven by differences in transitions during deliberation and cannot be explained solely by relative attention to option attributes.

Experiment 2. Experiment 1 demonstrated a linkage between search strategy and intertemporal patience. However, in experiment 1 this evidence was correlational, and it remained unclear whether search merely reflects participants' intertemporal preferences or causally influences those preferences. To test the causal relationship between search strategies and patience, we experimentally manipulated search patterns in experiment 2 and examined their influence on intertemporal choice. We manipulated the search strategy by introducing a small delay (1,000 ms) between the time when a participant placed the cursor over a piece of information and the time the information was revealed following search transitions that we sought to discourage. In the easy comparative condition, the information was revealed immediately after comparative transitions (e.g., default amount to alternate amount) but was delayed after integrative transitions (e.g., default amount to default delivery time). In the easy integrative condition, the opposite was true. Prior work has shown that similar delays in website updating do not influence human–computer interactions (33). Separate behavioral pretesting in an independent sample confirmed this, as the manipulation did not feel unnatural, participants did not notice anything unusual about the delays, and participants did not believe the delays influenced their decisions (*SI Appendix*, *Supplemental Experimental Pretest*).

Analyses of participants' search behavior reveal that the assigned condition significantly altered their information strategies overall, even within the first few trials of the task, despite their reporting that the delays did not influence how they performed the task (*SI Appendix*, *Supplemental Results* and Fig. S7). When forced to guess the nature of the manipulation, only 6 of the 207 participants correctly identified the manipulation. Although the manipulation effectively alters search strategies, participants do not view it as onerous. As a manipulation check, we verified that the Payne index differed between the two conditions. Participants in the easy comparative (mean = −0.85) condition had lower Payne indices than those in the easy integrative condition (mean = 0.87), β = 0.86, SE = 0.01, $P < 0.001$, verifying that the manipulation changed search behavior in the expected direction. Importantly, the manipulation did not disrupt participants' subjective experience in performing the task.

To investigate whether search condition altered participants' decisions, a hierarchical logistic regression modeled choices as a function of framing (acceleration or delay) and search condition

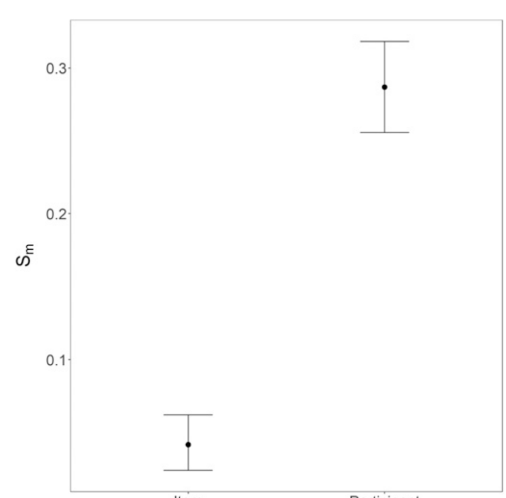

Fig. 2. Point estimates and 95% CIs of the finite-population SDs (S_m), calculated using the Bayesian posterior simulation for the hierarchical Bayesian model of transition data.

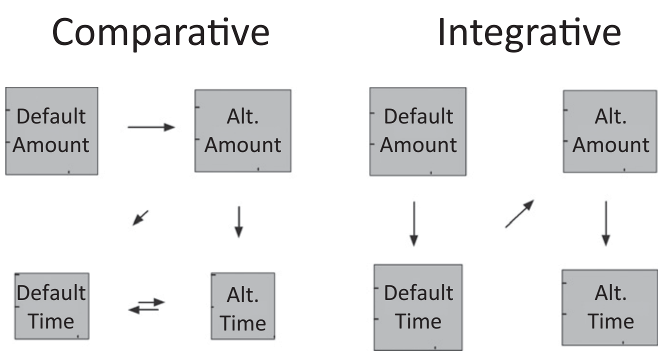

Fig. 3. Icon plots displaying search behavior for the two groups identified by the *k*-means cluster analysis. Each box represents one of the four pieces of information in each trial. Box height indicates how many times participants acquired that piece of information on average (each tick marks 0.5 transitions). Box width indicates the duration of the time participants spent viewing that piece of information on average (each tick marks 500 ms). Arrows indicate the average transitions on a given trial, with arrow length representing how commonly the transition occurred. Transitions occurring less than 2.5% of the time are omitted to improve display legibility. "Alt." refers to the alternative, nondefault option. (*Left*) Comparative searchers were more likely to engage in attribute-based searching. (*Right*) Integrative searchers were more likely to engage in alternative-based searching.

(easy comparative or easy integrative) (Fig. 4*B*) across all trials. There was a significant effect of search condition, β = –0.23, SE = 0.10, $P = 0.027$, with participants in the easy comparative condition exhibiting greater patience than those in the easy integrative condition. Participants were also more patient when options were framed as decisions to accelerate rather than delay consumption, β = –0.06, SE = 0.03, $P = 0.044$. The interaction between the two factors was not significant, $P = 0.761$. These findings indicate that manipulating search behavior causally alters patience. Response-time analyses also revealed that participants in the easy comparative condition made patient choices significantly faster (*SI Appendix, Supplemental Results*), indicating that comparative search does not lengthen deliberation but rather makes patient choices faster.

Search strategy has a causal effect on patience, but the interaction between search and framing is not significant across all trials. However, while participants generally used the strategy promoted by their condition, they sometimes used a different search pattern. For instance, participants could avoid the delay following discouraged transitions if they deployed diagonal transitions (*SI Appendix, Supplemental Results*). We also performed analyses that restricted our analyses to trials in which participants did not use diagonal transitions to avoid the delay (Fig. 4*C* and *SI Appendix, Supplemental Results*). In these data, there were still significant effects of search condition, β = –0.36, SE = 0.10, $P < 0.001$, and option framing, β = –0.17, SE = 0.04, $P < 0.001$. Importantly, the interaction between search condition and framing was significant, β = 0.15, SE = 0.04, $P < 0.001$. In alignment with experiment 1, participants in the easy comparative condition exhibited a significant effect of framing, β = 0.65, SE = 0.12, $P < 0.001$, while those in the easy integrative condition did not, β = 0.04, SE = 0.10, $P = 0.702$. When using the encouraged search strategy, comparative search resulted in more sensitivity to framing than integrative search.

Discussion

The current research highlights the importance of examining information search, and mental processes more generally, to understand intertemporal choice. Our analyses reveal substantial individual differences in search strategies which explain six times more variance than differences in the options presented. We identified two common search strategies: comparative search, in which individuals compare information about one feature across options, and integrative search, in which individuals acquire information about one option across multiple features. These two search strategies accord well with previous theories of information acquisition in decision making (34) and have substantial ramifications for choice. Experiment 1 demonstrated that participants who engage in comparative search are more patient overall and are more likely to display framing effects than those who engage in integrative search. To test whether this relationship was causal, in experiment 2 we manipulated participants' search strategy and showed that encouraging participants to use a comparative search strategy resulted in more patient decisions than did encouraging participants to use an integrative search strategy. Additionally, in trials in which participants used the encouraged search strategy, those searching comparatively exhibited a larger effect of acceleration versus delay framing.

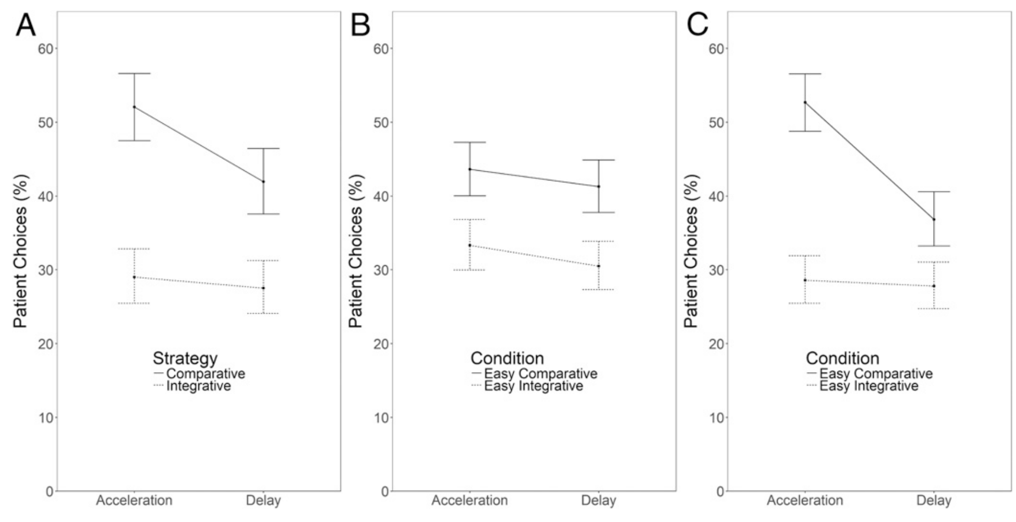

Fig. 4. Percentage of larger/later options chosen by participants. (*A*) Experiment 1. Comparative searchers were more likely overall to select the larger/later option than integrative searchers and were more likely to exhibit an effect of acceleration framing. (*B*) Experiment 2, all trials. Those in the easy comparative condition were more patient overall than those in the easy integrative condition. (*C*) Experiment 2, restricted to trials in which search behavior matched the strategy encouraged by manipulation. Those in the easy comparative condition were both more patient and exhibited a significant effect of acceleration versus delay framing. Error bars represent ±1 SEM.

To put the change in patience caused by the present manipulation in context, we estimated the discounting shown by participants in each condition using a hyperbolic model. If participants had been offered $1,000 in 1 mo, those in the integrative condition would have accepted $725 today instead, while those in the comparative condition would have required $820 today. Strikingly, this manipulation was effective even though participants reported the task felt natural and they did not believe the manipulation influenced their behavior.

It is interesting that the comparative strategy promoted more patience, given previous work suggesting that these strategies are similar to heuristics, which speed decision making but may lead to suboptimal choices (28–30). However, comparative searching may increase patience by forcing an explicit tradeoff between money and time. By comparing the differences between the two options on each attribute, participants likely focus on the cost of immediate consumption (35). This comparison favors the larger/later option, encouraging more patience. Comparative searching may therefore share some mechanisms with other interventions that increase patience by focusing attention on monetary tradeoffs, such as the hidden zero effect (36). Additionally, strategies often differ along two dimensions: the type of processing accompanying search and the completeness of search. Speculation about the completeness of search has been offered by some who suggest that not all information about the options may be acquired when making a choice. For example, the tradeoff model (18) suggests that if the difference in reward amounts is large, participants ignore information about the delivery timing.

In both experiments, when participants employed comparative searching, they also exhibited an enhanced effect of acceleration versus delay framing. This finding may help explain why cognitive models that incorporate explicit attribute comparisons typically fit observed behavior better than traditional hyperbolic discounting models, particularly when the choice context changes (14, 15). As hyperbolic models implicitly predict integrative searching, models that allow for comparative searching may also allow an increased influence of contextual effects, resulting in the improved model performance observed. However, it is important to note that manipulating the search strategy enhanced the effect of acceleration versus delay framing only if the encouraged search strategy was used, while the effects on patience emerged across all trials. Additionally, as we did not collect baseline measures of search before exposure to the manipulation in experiment 2, we cannot evaluate the full extent to which the manipulation altered search strategies or whether different search strategies were differentially influenced by the manipulation. This is a promising area for future research. A related important question is what determines whether an individual chooses to use a comparative or integrative strategy. In the current research, we did not find a relationship between strategy selection and several potential demographic predictors (e.g., income or age) (*SI Appendix*, *Supplemental Results* and Table S7), but perhaps other traits (e.g., conscientiousness, numeracy) might predict the propensity to use comparative or integrative search. While we find that search is fairly stable within individuals, other research has shown that people flexibly adapt their strategy to the decisions presented (30). Future work should examine whether individual differences in search are relatively stable across longer time periods (e.g., months) or with more dramatic changes in options (e.g., having more than two options).

The present findings are related to other recent work showing that differences in attention predict decision making (24, 25). While previous research focused on the relative amount of time spent looking at different options, here we examine the transitions between pieces of information. Additionally, previous research in this area has emphasized comparing the utility of different options. Instead, comparative searchers in the present work make comparisons between individual attributes of the available options. This finding aligns with models of psychological processes in intertemporal choice (18). Finally, these results are not explained by differences in the relative time spent looking at different attributes, as demonstrated in experiment 1. These findings make a distinct contribution to theories of decision making by discovering a causal relationship between search strategies and intertemporal choice.

These results underscore the substantial impact of individual differences on both search processes and choice behavior. This heterogeneity has largely been unexplored to date and may account for some of the complexity in models of intertemporal choice. For example, it could be that absolute amounts of rewards matter in integrative search but relative differences between rewards are used in comparative search. If different people use different strategies, or if different strategies are used for different kinds of choices, ignoring this heterogeneity will produce worse accounts of choices and will require complex models that reflect a mixture of simpler, heterogeneous processes. Accounting for this heterogeneity could produce a more accurate, parsimonious picture. Previous research demonstrates that some models fit some people better than others (26). Similarly, given the substantial interest in characterizing the neural mechanisms underlying intertemporal choice (37, 38), it may be that the neural substrates vary as a function of strategy use, as in risky or social decision making (e.g., refs. 39 and 40). Aggregate analyses that ignore these differences may be less informative because they conflate different ways of making intertemporal choices.

Overall, these results point to a central, causal role of psychological search processes in shaping intertemporal choice. This causal link suggests that process-oriented choice architecture interventions might alter search strategies and subsequently choice (11). Given the power of choice architecture to improve real-world decision making (12) and the relevance of intertemporal choice to numerous decisions that impact consumers, future work should investigate whether promoting specific search strategies improves consumer welfare. Our results also reveal that some behavioral interventions, such as framing options, may be more effective for people using comparative but not integrative search strategies. In addition to their practical application, our findings suggest that, in the absence of information about individual differences in search strategies, previous psychological and neuroscientific models may have inadvertently aggregated across very different kinds of cognition influencing temporal discounting. Heterogeneity in strategies exerts important influences on intertemporal choice, and changing search strategies may help people find patience.

Materials and Methods

Experiment 1.

Participants. We recruited 193 participants (77 women; mean age, 34.0 y) old via Amazon Mechanical Turk. All participants provided informed consent, and the experiment procedures were approved by the Columbia University Institutional Review Board.

Procedure. On each trial, participants chose between a smaller monetary reward that would be delivered sooner (e.g., $42.40 today) or a larger monetary reward that would be delivered later (e.g., $48.80 in 4 wk) (*SI Appendix*, Table S1). The outcome amounts ranged from $15.10 to $85.40, and the delivery timing ranged from 0 to 6 wk. The choices were framed as decisions either to delay or accelerate delivery of the reward by making either the smaller/sooner or the larger/later reward the default (Fig. 1). When the smaller/sooner reward was the default, deciding to switch to the larger/later reward would involve delaying receipt of the reward. When the larger/later reward was the default, deciding to switch to the smaller/sooner reward would involve accelerating receipt of the reward. Participants completed two blocks of the task, one with acceleration framing and one with delay framing (the order was counterbalanced across participants). Each block of 18 trials was preceded by one practice trial. Participants were informed that 1 in 100 participants would be randomly selected and would be paid the option they selected on a random trial. In the current task, we chose not to counterbalance two aspects of the display: the side on which the default option was presented and which attribute was listed on which row. We did not counterbalance the default side to reinforce its nature as the status quo option. Since most people read left to right, this helped ensure that the default would be viewed first, reinforcing its status as the endowed option. We elected not to counterbalance which attributes appeared in each row since other research has demonstrated that such counterbalancing does not influence behavior (41, 42).

To record information acquisition, options were presented using MouselabWEB (23). This process-tracing method tracks participants' mouse movements to assess how they acquire information about options. In MouselabWEB, each piece of unique information is occluded (*SI Appendix*, Fig. S1, *Left*). To view that piece of information, the participant moves the mouse over the relevant box, and the information contained within that box is revealed (*SI Appendix*, Fig. S1, *Center*). Once the participant moves the mouse away from the box, the information is occluded again (*SI Appendix*, Fig. S1, *Right*). Since to view or revisit a piece of information, the participant must move the mouse to the relevant box, mouse movements therefore track information search and acquisition. Mouselab data approximate other process-tracing approaches, such as eye tracking (*SI Appendix, Supplemental Eye Tracking Experiment*) (43). We computed a Payne index for each trial to summarize search behavior in the task (34). The Payne index is computed by calculating the relative difference between alternative-based and attribute-based transitions: (alternative − attribute)/(alternative + attribute). The measure is bounded at an absolute value of 1, with positive values indicating more integrative (alternative-based) processing, and negative values indicating more comparative (attribute-based) processing. We also calculated a separate measure of the relative time spent looking at amount attributes compared with the time spent looking at time attributes [(time spent acquiring monetary amounts – time spent acquiring delivery times)/total time spent acquiring information] to examine whether the relative time spent looking at attributes might account for the observed effects of transitions on choice.

Experiment 2.

Participants. We recruited 207 participants (87 women; mean age, 34.3 y) via Amazon Mechanical Turk. All participants provided informed consent, and the experiment procedures were approved by the Columbia University Institutional Review Board.

Procedure. The task in experiment 2 was identical to the task in experiment 1 with one key difference: Rather than allowing participants to search the display freely when making their decisions, we manipulated the ease of search strategies, randomly assigning participants to conditions. We made either comparative or integrative transitions relatively more difficult by introducing a 1,000-ms delay between the time when a participant's cursor entered a box and the time when the information in that box was revealed. All other transitions caused the box to open immediately. Each participant was randomly assigned to one of two conditions. For those in the easy comparative condition, there was a delay in the display of information whenever they transitioned between the attributes of an option, while there was no delay when they transitioned between attributes of different options. For those in the easy integrative condition, there was a delay in the display of information whenever they transitioned between attributes of different options, while there was no delay when they transitioned between attributes of an option. These two conditions were designed to encourage participants to use either the comparative or the integrative search strategy identified in experiment 1. As in experiment 1, participants were informed that 1 in 100 participants would be compensated based on the decisions that participant made in the task. While overall participants' search behavior matched their assigned condition (*SI Appendix*, Fig. S7), we also sought to examine the effects of strategy, focusing only on trials in which participants' search patterns matched their assigned strategy. We therefore also categorized trials based on the extent to which the transitions were consistent with the assigned condition (*SI Appendix, Supplemental Results*). Additional details are available in *SI Appendix*.

All hierarchical logistic regressions in both experiments were conducted using contrast coding. Data are available on the Open Science Framework at https://osf.io/vmk52/.

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