Research Article

Asymmetric Discounting in Intertemporal Choice

A Query-Theory Account

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ABSTRACT—*People are impatient and discount future rewards more when they are asked to delay consumption than when they are offered the chance to accelerate consumption. The three experiments reported here provide a process-level account for this asymmetry, with implications for designing decision environments that promote less impulsivity. In Experiment 1, a thought-listing procedure showed that people decompose discount valuation into two queries. Whether one considers delayed or accelerated receipt of a gift certificate influences the order in which memory is queried to support immediate versus delayed consumption, and the order of queries affects the relative number of patient versus impatient thoughts. Relative frequency and clustering of impatient thoughts predicts discounting and mediates the discounting asymmetry. Experiment 2 implicated query order causally: When participants listed reasons for immediate versus delayed consumption in the order used spontaneously in acceleration and delay decisions, the discounting asymmetry was replicated; reversing the order in which reasons were listed eliminated the asymmetry. The results of Experiment 3, which used an implicit-memory task, support a memory-interference account of the effect of query order.*

People's willingness to trade immediate pleasure for later benefits determines whether they save adequately for retirement, imbibe too much alcohol, or reduce energy consumption to curb climate risks for future generations (Kirby & Herrnstein, 1995; Mischel, Grusec, & Masters, 1969; Weber, 2004, 2006). Choices between alternatives that differ in size and time to delivery (e.g., a $50 gift certificate today or a $100 gift certificate a year from today) are modeled by the discounted-utility model (Samuelson, 1937), and discount rates are inferred from people's choices. Although classical economics assumes exponential (constant per period) discounting, people discount future outcomes more steeply when they have the opportunity for immediate gratification than when all outcomes occur in the future (hyperbolic discounting; Frederick, Loewenstein, & O'Donoghue, 2002).

A puzzling phenomenon, independent of the assumed discount function, is that the degree of discounting depends on the direction of comparison. People who are asked to *delay* consumption—who expect outcome x_1 at time t_1 and indicate an amount x_2 that would make the delay to later time t_2 acceptable to them—demand a large increase in x; that is, they discount future outcome x_2 greatly. People who have the opportunity to *accelerate* consumption—who expect to receive outcome x_2 at a later time t_2 and indicate the smallest amount x_1 they would accept to move consumption to an earlier time t_1—typically discount far less (Loewenstein, 1988). Understanding the processes that give rise to less impulsive discounting in acceleration decisions may suggest ways to reduce excessive discounting of future consequences in more commonly encountered delay decisions.

Asymmetric discounting (Loewenstein, 1988) is typically explained by loss aversion as formalized by prospect theory (Kahneman & Tversky, 1979). People are assumed to encode delay of consumption as a loss and acceleration as a gain; thus, delay has greater disutility than acceleration has utility. Prospect theory claims that people choose "as if" they evaluate outcomes on a two-component value function with a steeper slope for losses than for gains, but is silent on the underlying psychological mechanisms.

QUERY THEORY

A more psychological class of explanations suggests that variants in valuations (valuating time differences in terms of acceleration vs. delay or the value of an object using buying vs.

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selling prices) shift the decision maker's focus of attention in a manner consistent with differences in implicit goals (Fischer, Carmon, Ariely, & Zauberman, 1999; Weber & Kirsner, 1997). Carmon and Ariely (2000) suggested, for example, that both buyers and sellers in endowment-effect studies (Thaler, 1980) focus more on what they may have to give up than on what they gain; buyers give up money to gain the good, whereas sellers give up the good to gain money.

Johnson, Häubl, and Keinan (in press) developed this notion further in query theory, their process account of the endowment effect. Query theory assumes that preferences, like all knowledge, are subject to the processes and dynamics of memory encoding and retrieval, and explores whether memory and attentional processes can explain observed anomalies in evaluation and choice. If preferences are constructed rather than well known to the decision maker (Payne, Bettman, & Johnson, 1993), then factors influencing the accessibility of information about the object or action under evaluation should determine preferences (Kahneman, Ritov, & Schkade, 1999).

Query theory makes four assumptions:

- Hypothesis 1: Decision makers naturally decompose valuation questions such as "Should I delay receiving this gift certificate?" into component queries (Collins & Michalski, 1989). For intertemporal-choice decisions, two obvious component queries are "Why should I consume now?" and "Why should I wait to get more later?" Other valuation questions result in different component queries (Johnson et al., in press).
- Hypothesis 2: These (tacitly posed) queries are executed serially, and query order differs between valuation conditions; initial queries assess the value of the status quo.
- Hypothesis 3: Because of output interference, retrieval is less successful for later queries than for earlier queries; therefore, differences in query order lead to differences in retrieved information.
- Hypothesis 4: Resulting differences in the balance of support (for or against consumption delay in the case of intertemporal choice) lead to differences in discounting.

The hypothesis that output interference is responsible for the effect of query order on the resulting balance of support derives from memory research showing that cued retrieval of a subset of items from a memorized list can negatively affect the successful retrieval of remaining items (Anderson, Bjork, & Bjork, 1994; Anderson & Spellman, 1995; Roediger, 1973). Retrieval of the initial subset is facilitated by the inhibition of competing items, lowering their accessibility (retrieval-induced forgetting; Anderson et al., 1994; Anderson & Spellman, 1995; Perfect, Moulin, Conway, & Perry, 2002). Heightened accessibility of the initially retrieved items also increases their likelihood of intrusion during attempts to retrieve the remaining items (a part-set cuing effect; Peynircioglu & Moro, 1995). Query theory assumes that decision makers initially query their memory for a subset of information relevant to the decision, a process that is similar to the initial cued recall of a subset of items from a memorized list in retrieval-induced forgetting or part-list cuing experiments. In preference construction, the initial cue depends on specifics of the task and is generated by the decision maker, and information about the decision has been stored in long-term memory long before the choice situation arises.

In the study we report here, we tested query theory's hypotheses. Experiment 1 tested the four hypotheses using a thought-listing procedure. Experiment 2 manipulated query order to examine its causal role in the discounting asymmetry. In Experiment 3, we replaced the thought-listing procedure with an implicit measure of differences in memory accessibility predicted by the memory-interference account.

EXPERIMENT 1

Method

One hundred seventy-six volunteers from the Columbia Center for the Decision Sciences (CDS) Virtual-Lab database (42% male; median household income: $42,000/year; median age: 38, range: 18–75) responded to an e-mail solicitation and completed an on-line survey.[1]

Intertemporal-Choice Conditions

Half of the participants were told that they had been selected to possibly receive a $50 Amazon gift certificate that day, but could opt to receive a gift certificate of larger value in 3 months (*delay* condition). The other half were told that they had been selected to possibly receive a $75 Amazon gift certificate in 3 months, but could opt instead to receive a gift certificate of lesser value that day (*acceleration* condition). Participants knew that every survey participant would receive an $8 participation fee, but that one participant had been randomly preselected to actually receive an Amazon gift certificate, either that day or in 3 months, depending on his or her expressed preference in the survey. The precise amounts were determined in a way that encouraged respondents to express their true preferences between immediate and delayed certificates (Becker, DeGroot, & Marschak, 1963). To ensure that participants fully understood their intertemporal-choice condition and how their answers determined which gift certificate they might receive, we had them answer two multiple-choice questions correctly before continuing.

Thought Listing

Before participants indicated their intertemporal preference, they were prompted to "tell us everything that you are thinking of as you consider this decision." A carefully designed interactive Web form and practice in a different content domain ensured

[1]Respondents in all three experiments came from the same population. Nobody participated in more than one experiment.

that respondents listed between 1 and 12 thoughts for their decision; the mean number of thoughts listed was 3.6.

Choice Titration

Delay respondents were given a series of choices between a $50 gift certificate that day and a gift certificate 3 months later; the value of the delayed gift certificate increased from $50 to $100 in $5 increments. Acceleration respondents were given a series of choices between a $75 gift certificate in 3 months and a gift certificate that day; the value of the immediate gift certificate decreased from $75 to $25 in $5 decrements. The indifference point was the value midway between the dollar amounts of the varying gift certificate at which participants switched from consistently preferring the fixed gift certificate to consistently preferring the gift certificate with the varying amount.

Thought Coding

Near the end of the session, respondents rated each thought they had generated earlier on three dimensions: (a) Was it about the present, the future, both, or neither? (b) Did it favor receiving the gift certificate right away, later, or neither? (c) Was it abstract or concrete?[2]

Results

Twelve respondents were eliminated because their response times were implausibly short or because their preferences in the choice titration were nonmonotonic.[3]

Discount Factor

Discounting was quantified as $\delta = (x_1/x_2)^{(1/(t_2-t_1))}$, where x_1 is the amount received that day ($t_1 = 0$) that was seen as equivalent to the amount x_2 received in 3 months ($t_2 = 1/4$ year; Read, 2001). The discount factor indicates how much $1 the day of the survey was worth in a year: a value of 1 indicates no discounting, and smaller values ($\delta < 1$) indicate greater discounting.

Asymmetric Discounting

We replicated prior demonstrations of asymmetric discounting in both the direction of the asymmetry and its magnitude (Fig. 1, top panel). Respondents discounted the value of a later gift certificate more when delaying ($\delta = .34$) than when accelerating ($\delta = .57$) its arrival, $F(1, 163) = 17.43, p < .0001, p_{rep} = 1.00$.[4]

Query Decomposition and Task-Specific Query Order

As predicted by Hypothesis 1 of query theory, generated thoughts fell into two categories, "impatient thoughts" favoring receipt of the immediate gift certificate and "patient thoughts" favoring receipt of the later-and-larger gift certificate. We measured thought clustering using the standardized median rank difference: $SMRD = 2(MR_p - MR_i)/n$, where MR_p is the median rank of patient thoughts, MR_i is the median rank of impatient thoughts, and n is the total number of thoughts (Johnson et al., in press). Randomly interspersed thoughts produce an *SMRD* of zero. The bottom panel of Figure 1 shows that, as predicted by Hypothesis 2, impatient and patient thoughts clustered differently in the two conditions: Impatient thoughts occurred earlier in the delay condition ($SMRD = +.22$) and later in the acceleration condition ($SMRD = -.18$), $F(1, 161) = 7.71, p = .006, p_{rep} = .97$.

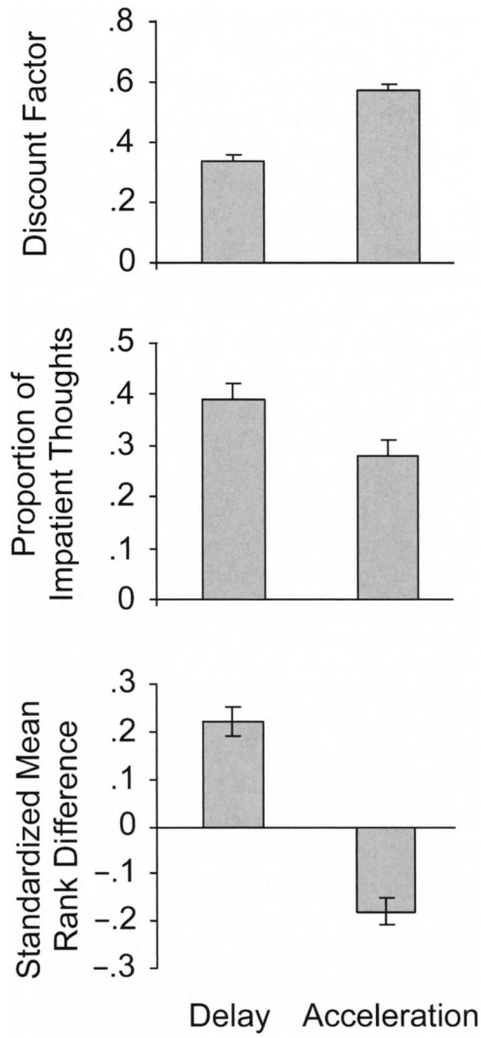

Fig. 1. Results of Experiment 1: mean discount factor (δ; top panel), proportion of impatient thoughts generated during thought listing (middle panel), and clustering of impatient thoughts (bottom panel) as a function of condition (delay vs. acceleration). Smaller values of δ indicate greater discounting. A positive value for the standardized mean rank difference indicates impatient thoughts were generated before patient thoughts, and a negative value indicates the opposite.

[2]The self-codings correlated highly with the codings of blind raters (average $r = .88$).

[3]The elimination rate was less than 7% in all three experiments reported in this study.

[4]The p_{rep} statistic is the probability of replicating the effect (Killeen, 2005).

Order-Dependent Balance of Support

The middle panel of Figure 1 shows that, as predicted by Hypothesis 3, respondents generated a larger proportion of impatient thoughts in the delay condition (.39) than in the acceleration condition (.28), $t(163) = -2.26, p = .03, p_{rep} = .94$.

Prominence of Impatient Thoughts and Discount Factor

Proportion of impatient thoughts and their clustering (*SMRD* score) were related, though not redundant ($r = .68$). A principal-components factor analysis provided the weighting to combine them into a single prominence-of-impatient-thoughts factor (eigenvalue = 1.64), which predicted respondents' discount factors extremely well ($r = .54$). For every unit increase in prominence of impatient thoughts, respondents' discount factors decreased by .13, $t(162) = -6.94, p < .0001, p_{rep} = 1$.

Mediation of Discounting Asymmetry by Prominence of Impatient Thoughts

Figure 2 shows regression coefficients and their 95% confidence intervals for the effect of condition on discount factor, with and without the inclusion of the mediator, the prominence of impatient thoughts. As predicted by Hypothesis 4, inclusion of the prominence of impatient thoughts significantly reduced the effect of condition on the discount factor from .34 to .26, providing evidence for partial mediation.[5]

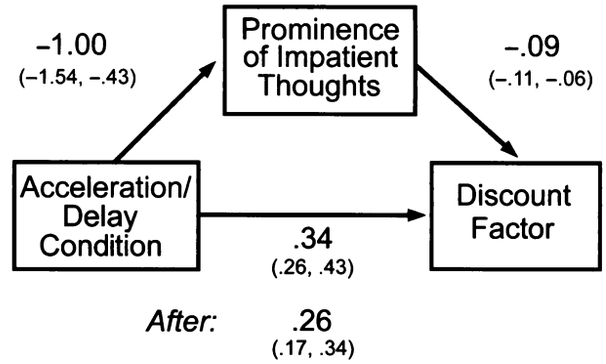

Fig. 2. Mediation analysis for Experiment 1, using the bootstrapping methodology of Shrout and Bolger (2002). The directional arrows denote regression analyses; regression coefficients and their bootstrapped 95% confidence intervals (CIs) are shown adjacent to the arrows. CIs not including 0 indicate a significant regression coefficient. The coefficient and CI labeled "After" indicate the results for the relation between condition and discount factor after the mediator, prominence of impatient thoughts, was added to the equation.

Discussion

Addition of the thought-listing task to the typical intertemporal-choice paradigm did not change the typical pattern of results. This suggests that the thought-listing task merely made the usually tacit querying of arguments explicit. As predicted, patient and impatient thoughts clustered. Intertemporal condition (acceleration vs. delay) affected query order, changing the proportion of impatient thoughts, which, in turn, predicted discounting. The effect of condition on thought generation mediated observed differences in discounting between the two conditions. This result suggests that memory queries and their order might play a causal role in preference construction. In Experiment 2, we investigated this possible causal connection by manipulating query order.

EXPERIMENT 2

Query theory suggests that the opportunity to delay consumption causes decision makers to first marshal evidence favoring the status quo (immediate consumption) and then to look for evidence favoring delayed consumption, and that the opportunity to accelerate consumption does the opposite. The observed asymmetry in discounting, caused by the fact that answers to the first query interfere with answers to the second query, should be obtained if one explicitly asks people to generate reasons for immediate and delayed consumption in the order that is "natural" for their intertemporal condition. If, however, one prompts them to ask the same two queries in the reversed order ("unnatural," given their condition), the asymmetry in the prominence of impatient thoughts, and thus in discounting, should be reduced or even reversed. In Experiment 2, we tested this prediction.

Method

One hundred twelve CDS Virtual-Lab volunteers completed this on-line study. The two intertemporal conditions and other details were identical to those of Experiment 1, except for the thought-listing task. In Experiment 2, respondents were prompted separately to list (a) reasons to accept the smaller gift certificate that day and (b) reasons to accept the larger gift certificate later. The screen prompting reasons for accepting the smaller gift certificate that day explained that both positive aspects of immediate receipt and negative aspects of delayed receipt could be listed. Half of the respondents received the two queries in the order hypothesized to be natural for their intertemporal condition, as indicated by the results of Experiment 1 and query theory's hypothesis that the initial focus is on reasons justifying the status quo. Thus, the natural order in the delay condition was to list reasons for accepting the smaller gift certificate that day before listing reasons for accepting the larger gift certificate later, and the natural order in the acceleration condition was the reverse. The other half of the respondents received the two queries in the opposite, unnatural order.

Results

The top panel of Figure 3 shows that when patient and impatient thoughts were explicitly prompted in their natural order, the asymmetry in discounting observed in Experiment 1 and other studies was replicated: Discounting was greater in the delay

[5]The value of R^2 for the model increased from .27 to .43.

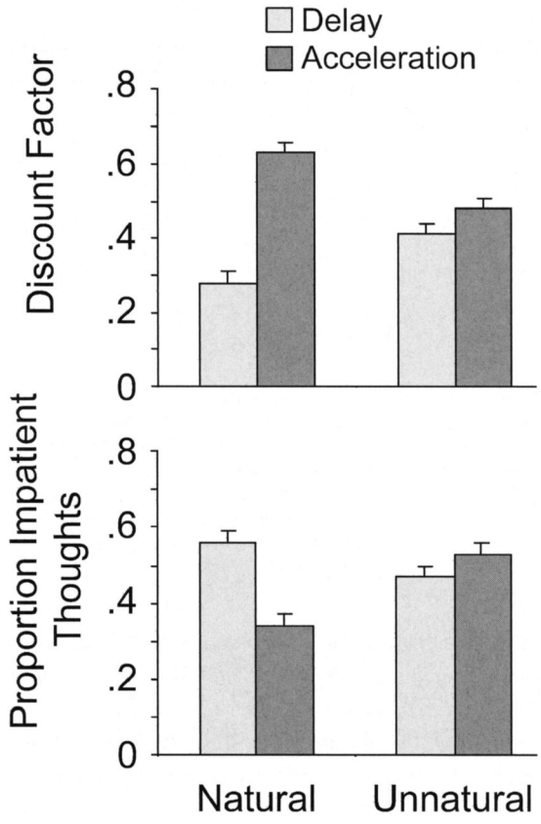

Fig. 3. Results of Experiment 2: mean discount factor (δ; top panel) and proportion of impatient thoughts (bottom panel) in the delay and acceleration conditions, as a function of manipulated query order (natural vs. unnatural).

condition ($\delta = .28$) than in the acceleration condition ($\delta = .63$), $F(1, 50) = 13.61, p < .001, p_{rep} = .99$. When the two types of thoughts were prompted in the opposite, unnatural order, there was no significant difference in discounting between the delay and acceleration conditions, $\delta = .41$ and $\delta = .48$, respectively, $F(1, 58) = 1.84, p > .10, p_{rep} = .73$.

The bottom panel of Figure 3 shows that the query-order manipulation also affected the proportion of impatient thoughts participants listed.[6] More impatient thoughts were generated when the query for reasons for accepting the gift certificate immediately came first. Consistent with the observed discounting, the proportion of impatient thoughts differed significantly by intertemporal condition when queries were in the natural order, $t(50) = 4.98, p < .0001, p_{rep} > .99$, but not when they were in the unnatural order, $t(58) < 1$.

Discussion

Experiment 2 provides converging support for query theory's assumption about the natural order of queries in acceleration and delay decisions and suggests that query order is causally involved in discounting and the discounting asymmetry. When reasons for immediate versus delayed consumption were explicitly and sequentially solicited in the order natural for each intertemporal condition, we replicated previous results. When queries were solicited in the opposite order, the asymmetry in discounting was eliminated. It should be noted that the asymmetry in discounting and the proportion of impatient thoughts did not reverse in the unnatural-query-order condition. Automatic processes operating as the result of intertemporal condition (i.e., tacit queries in the natural order) might have counteracted the results of the explicit, unnatural thought-generation instructions.

EXPERIMENT 3

It is possible that the thought-listing task of Experiment 1, although ostensibly nondirective and open-ended, was interpreted by respondents as a demand to justify their decisions. If so, then the discount factor might have determined listed thoughts, rather than the other way around, and the observed asymmetry in discounting might have been the result of processes that have nothing to do with the order of tacit sequential queries and with responses to initial queries reducing the accessibility of responses to later queries. Experiment 3 avoided this possible confound by employing an implicit measure of differential accessibility of patient and impatient thoughts in the delay and acceleration conditions. This implicit measure would not have been affected by any perceived need on the part of respondents to list thoughts consistent with their choice. It also provides a better test of whether memory inhibition results in differential thought accessibility in the two intertemporal conditions, as the thought-listing procedure is open to alternative interpretations (e.g., different stopping rules for earlier vs. later queries, task-switching difficulties).

Method

Eighty-nine CDS Virtual-Lab volunteers completed this on-line study. The experimental details were identical to those of Experiment 1, with the following difference. After choosing between the immediate, smaller and the delayed, larger gift certificates, half of the respondents were presented with an aspect-categorization task,[7] an implicit measure of hypothesized knowledge activation during preference construction. This task was adapted from one used by Perfect et al. (2002) to assess accessibility effects in retrieval-induced forgetting. Respondents were presented with 20 short sentences ("aspects") and were told that some of them had been generated by other respondents as reasons for a decision like the one they had just made, whereas others had been generated as reasons for some other decision. Respondents were asked to indicate for each presented aspect whether it had been generated as a thought

[6]The total number of thoughts (patient, impatient, and other) generated did not differ by intertemporal condition or query order, ranging from 2 to 8, with a mean of 4.8.

[7]The other half completed a task not discussed here.

during a decision like the one they had just made about a gift certificate (in which case they were to press the "Q" key) or whether it had been generated as a thought in another decision (in which case they were to press the "P" key). Respondents were instructed to indicate their answer as quickly as possible while still being sure of their answer. We selected 10 thoughts commonly listed in Experiments 1 and 2 (*targets*), half supporting immediate consumption (e.g., "can use it to buy something now," "waiting is bad"), and half supporting delayed consumption (e.g., "I don't need the money now," "good things come to those who wait"). Ten other aspects (*foils*) were thoughts generated by respondents in similar experiments in other choice domains (e.g., "the mug is dusty," from an endowment-effect experiment).

If respondents in the delay condition first query reasons supporting immediate consumption, and if this inhibits reasons supporting delayed consumption, then reasons supporting immediate consumption should be more accessible to these respondents, and they should therefore be faster to verify such reasons than to verify reasons supporting delayed consumption. The opposite should be true in the acceleration condition. Thus, our key hypothesis was that reaction time (RT) should show in interaction between condition (acceleration vs. delay) and target-item type (supporting later vs. immediate consumption).

Results

For a third time, we replicated the asymmetry in the discount factor: Respondents discounted more in the delay condition ($\delta = .38$) than in the acceleration condition ($\delta = .57$), $t(1, 88) = 3.00$, $p < .005$, $p_{rep} = .98$. This allowed us to examine differences in RTs in the aspect-categorization task. Overall categorization accuracy was 96.7% and did not differ significantly by condition or item type. Figure 4 shows that RTs varied as predicted. Although the RTs for categorizing foils did not differ by condition, categorizing targets advocating immediate consumption was faster for respondents in the delay condition than for respondents in the acceleration condition. In contrast, categorizing targets advocating delayed consumption was faster for respondents in the acceleration condition than for respondents in the delay condition. The interaction of target type and condition was significant, $F(1, 508) = 4.97$, $p = .027$, $p_{rep} = .94$, and the result was robust to different dependent-measure transformations.

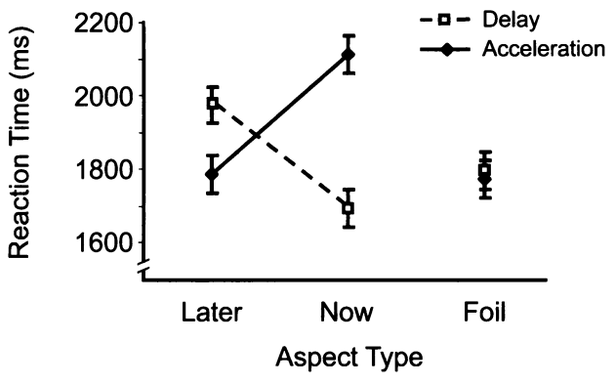

Fig. 4. Reaction time for categorizing different types of aspects (those favoring immediate consumption—"Now"; those favoring delayed consumption—"Later"; and those favoring neither—"Foils") as a function of intertemporal condition (delay vs. acceleration) in Experiment 3.

Discussion

Experiment 3 found systematic differences in the accessibility of arguments supporting different choice options as a function of intertemporal condition. As predicted by query theory's memory-interference account, arguments for actions contrary to the condition-specific status quo were less accessible than arguments for the status quo.

GENERAL DISCUSSION

The three experiments reported here examined the possible role of preference construction in the discounting asymmetry of intertemporal choice. Experiment 1 provides support for the four assumptions of query theory, the central part of the preferences-as-memory framework proposed by Weber and Johnson (2006). Component processes in decisions to accelerate consumption differed in several ways from component processes in decisions to delay consumption. Thoughts favoring either immediate or delayed consumption showed significant clustering, a result suggesting that participants may have (tacitly) executed two serial memory queries. Query order differed by condition and was consistent with an initial evaluation of arguments for the status quo (assigned decision default). In both conditions, fewer arguments were generated for the second than for the first query, so that the balance of support differed between conditions. The balance of thoughts generated by respondents predicted their discounting and also mediated the asymmetry in discounting between the two intertemporal conditions.

Experiment 2 tested the causal role of the order of memory queries by manipulating query order. Half of the respondents in the delay condition were explicitly asked to first provide arguments favoring immediate consumption and then provide arguments favoring delayed consumption, and half of the respondents in the accelerate condition were asked to do the opposite. The results for these groups replicated the typically observed asymmetry in discounting, with greater discounting in the delay condition. However, reversing the natural order of queries reduced the asymmetry in discounting to the point of nonsignificance, thus providing a recipe for the design of decision environments that can reduce the impulsive discounting of future costs or benefits that has been observed in many real-world delay decisions, such as the decision to contribute to a pension. Changing the discount factor in a delay decision from .28 (as in the natural-order condition) to .41 (as in the

unnatural-order condition) changes the amount of money one would be willing to settle for immediately instead of receiving $100,000 in 3 months from $72,740 to $80,020.

The memory-accessibility RT data from the implicit aspect-categorization task of Experiment 3 provide converging evidence for the serial-memory-query and interference hypotheses of query theory, using a task that eliminates possible task demands of the explicit thought-listing task of Experiment 1. Although the RT data of Experiment 3 are consistent with a memory-inhibition account, additional studies are needed to rule out other possible mechanisms. Difficulty with task switching (an executive-function deficiency), for example, could also explain the interference effects we observed (Salthouse, Atkinson, & Berish, 2003).

As noted earlier, we think of the preference-construction processes described by query theory as a process-model instantiation and explanation of the effects described mathematically by the loss-aversion feature of prospect theory (Kahneman & Tversky, 1979). Researchers have suggested other process-model instantiations of loss aversion, including one in which loss aversion is assumed to be mediated by differences in the strength of affective reactions to perceived losses or perceived gains, as the name "loss aversion" suggests. This affective interpretation of loss aversion falls short of accounting for the full range of results observed in this study, in particular, the results of Experiment 2. If loss aversion is simply due to the fact that giving up immediate consumption hurts more than acquiring immediate consumption feels good, then it is unclear why changing the order in which respondents explicitly bring to mind arguments for immediate versus delayed consumption should affect discounting. Loss aversion conceived of as a feeling and as asymmetry in affective reactions to choice outcomes as a function of intertemporal condition should not be affected by manipulations of query order.

Another cognitive process theory that has recently been used to explain a large number of behavioral phenomena (including some involving intertemporal choice) using a small number of principles related to memory representation is construal-level theory (Trope & Liberman, 2003). It has been used, for example, to explain intertemporal preference reversals by assuming that distant actions (attending a conference a year from now) are represented more abstractly (in terms of more attractive higher-level goals) and immediate actions (taking a conference trip tomorrow) are represented more concretely (in terms of less attractive lower-level means). Without some auxiliary assumptions, however, construal-level theory seems unable to address asymmetries in discounting between acceleration and delay decisions when they involve comparing the same two choice options, an immediate one and a later one.

Query theory owes a debt to reason-based-choice explanations of systematic inconsistencies in preference (Shafir, Simonson, & Tversky, 1993), according to which such inconsistencies are the result of subtle task differences that may affect the implicit goals of the decision maker (Lichtenstein & Slovic, 1971; Tversky, Sattath, & Slovic, 1988). Although query theory shares the idea that task conditions affect the generation or consideration of reasons and that reasons influence choice, it goes far beyond reason-based choice in multiple ways. It postulates sequential reason retrieval in task-specific orders, adds a theory of order-specific output interference, and thus makes explicit testable predictions. From a methodological perspective, the explicit thought-listing procedure (Experiment 1) and the implicit measure of memory accessibility of reasons after decision making (Experiment 3) introduced in this article may prove to be useful tools for testing reason-based-choice hypotheses in other contexts.

Excessive discounting of future costs or benefits often has dysfunctional consequences (O'Donoghue & Rabin, 1999). A process account, such as query theory, suggests both causes for such excessive discounting and possible remedies. Query theory posits that one cause of excessive discounting is the preponderance of thoughts favoring immediate consumption. Indeed, in Experiment 1, the proportion and clustering of patient versus impatient thoughts predicted not only discounting asymmetries, but also the degree of discounting across both intertemporal conditions. Experiment 2 demonstrated that a causal process theory of discounting can suggest ways of being more patient. Explicit protocols for generating reasons for different courses of action in a specific order have the potential to moderate the heavy discounting of future outcomes, frequently regretted later, that is observed when people contemplate delay of gratification.

The influence of memory processes and memory representations on decision making has recently received greater attention than in the past (McKenzie & Nelson, 2003; Reyna, Lloyd, & Brainerd, 2003). Much of this work has concentrated on inferential processes. Examples include the computational memory-process model MINERVA-DM, which is designed to explain probabilistic inference and judgment (Dougherty, Gettys, & Ogden, 1999; Dougherty & Hunter, 2003; Dougherty, Gronlund, & Gettys, 2003), and work on false memories (Reyna & Lloyd, 1997). The preferences-as-memories program extends such modeling to the area of preferential choice, where memory-process considerations have been scarce (Weber, Goldstein, & Barlas, 1995). Query theory has been successful in explaining and even eliminating the endowment effect (Johnson et al., in press) and, in this study, explains the asymmetry in discounting between acceleration and delay decisions. Although consistent with mathematical formalizations of the phenomenon in prospect theory (i.e., loss aversion), the preference-construction account of query theory has the advantage of suggesting interventions that can reduce excessive impatience in intertemporal decisions.

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