Decisional Conflict Predicts Impatience

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ABSTRACT Self-control conflicts—decisions that pit short-term temptations against long-term goals—are some of the most difficult decisions that individuals face, as these decisions set desires of immediate gratification against the knowledge that patience produces larger rewards. Despite the centrality of conflict to theoretical and lay understandings of self-control, conflict is less thoroughly investigated than choices or attitudes. In this article, we measure real-time spatial conflict through participants' mouse movements during self-control decision making in the context of intertemporal choice. Across four studies, we show that (*a*) online conflict as measured by mouse movements is highly correlated with the subjective difficulty of the decision, and (*b*) conflict within these decisions strongly predicts individuals' impatience as indexed by their discount function. We discuss implications of these findings, including for the underlying mechanisms of self-control, as well as the methodological approach of using mouse-tracking to measure conflict elicited by self-control dilemmas.

Decision making fundamentally requires resolving the conflict that arises when choosing one of multiple attractive outcomes. This conflict—whether consciously experienced or present below conscious awareness (Kleiman and Hassin 2011; Savary et al. 2015)—is the hallmark of difficult decisions and is especially pronounced when options vary along dimensions that are not easily comparable (Bettman and Sujan 1987; Malkoc, Zauberman, and Ulu 2005). Indeed, this conflict is the defining feature of several classes of decisions, most notably self-control conflicts (Hoch and Loewenstein 1991; Baumeister 2002; Mischel 2014). Self-control decisions pit desires of immediate gratification against the knowledge that delaying gratification produces larger rewards—a trade-off that frequently elicits conflict (Vohs and Baumeister 2004).

Despite the integral role that conflict plays in the experience of self-control decisions—and the effect of conflict on decision making according to many theories of self-control (Thaler and Shefrin 1981; Trope and Fishbach 2000; Stroebe et al. 2008; Hofmann, Friese, and Strack 2009; Kotabe and Hofmann 2015)—most research investigating conflict in decisions measures conflict in a retrospective and/or indirect manner. Recent research, for instance, has used experience-sampling procedures to have participants reflect on and report how conflicted they were when experiencing a self-control dilemma (e.g., Hofmann et al. 2012, 2014; Lopez et al. 2014). Although this kind of approach does an excellent job of painting a landscape of consumers' daily experiences succeeding and failing at self-control, the self-report format may not be optimal for a fine-grained assessment of when and how decisional conflict emerges and is resolved. Moreover, although asking people to report experienced conflict has face validity, participants may edit their answers due to self-presentation concerns, may not have introspective access to the presence of a conflict (see Kleiman and Hassin 2011), and must make these judgments "offline" when self-control is less immediately relevant. Other work has argued for the theoretical importance of conflict but inferred it indirectly from choices (that are made after conflict has been resolved and do not on their own directly reflect conflict) or changes in attitudes and construals of temptations (e.g., Fishbach and Shah 2006) and goals (Gollwitzer and Brandstätter 1997; Ferguson 2007), both of which do not capture conflict in real time. Finally, some researchers have investigated conflict through reaction times (Kerns et al. 2004); however, many factors contribute to response times (e.g., accuracy motives), and it can be unclear whether slower reaction times are due to greater conflict per se.

These retrospective and indirect measurement approaches may miss valuable information about the underlying choice processes. For instance, a consumer who initially chooses an apple over a candy bar without much difficulty compared with an individual who wrestles internally with the decision tells us not only information about that specific choice but

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JACR, volume 4, number 1. Published online December 11, 2018. http://dx.doi.org/10.1086/700842

is also likely predictive of subsequent behavior in similar situations. The importance of tapping into conflict has been emphasized by the attitude strength literature (Petty and Krosnick 1995; van Harreveld, Nohlen, and Schneider 2015; Luttrell et al. 2016), which has shown that attitudes held with greater certainty and less ambivalence are longer lasting, more resilient to persuasion, and more predictive of subsequent behavior.

In this article, we use mouse-tracking (McKinstry, Dale, and Spivey 2008; Freeman and Ambady 2009; Wojnowicz et al. 2009; Freeman and Ambady 2010)—an emerging technique in cognitive and social psychology in which researchers measure participants' computer-mouse movements while making a decision (see fig. 1)—to demonstrate the utility of a real-time measure of decisional conflict, with a particular focus on self-control conflicts. Although traditional models of choice suggest that motor output follows a choice, recent work suggests that motor movements reflect cognitive processes unfolding in real time (Song and Nakayama 2006; Spivey 2008). Mouse movements have been shown to correspond to the underlying categorization processes in a variety of domains, including stereotyping and prejudice (Freeman and Ambady 2009; Wojnowicz et al. 2009) and ambivalence (Gillebaart, Schneider, and De Ridder 2016; Schneider and Schwarz 2017).

A major advantage of mouse-tracking is that it offers a data-rich window into how a decision evolves. This richness affords many complementary approaches to analyzing mouse trajectories (Hehman, Stolier, and Freeman 2015). In this article, we focus on the most prevalent analysis technique—investigating the directness of mouse movements toward the ultimate choice in a two-alternative forced choice format. Conflict can be inferred by the degree to which the movement during choice veers toward the unchosen option (i.e., how much the unchosen option attracts participants' mouse movements). These deflections are a sensitive measure of response conflict (for a recent review, see Freeman 2018; Stillman, Shen, and Ferguson 2018). For instance, when categorizing a face as male or female, participants' mouse movements are drawn more toward the "female" response option when a male face has stereotypically feminine features (e.g., long hair) than when it has stereotypically masculine features (e.g., short hair; Freeman and Ambady 2009).

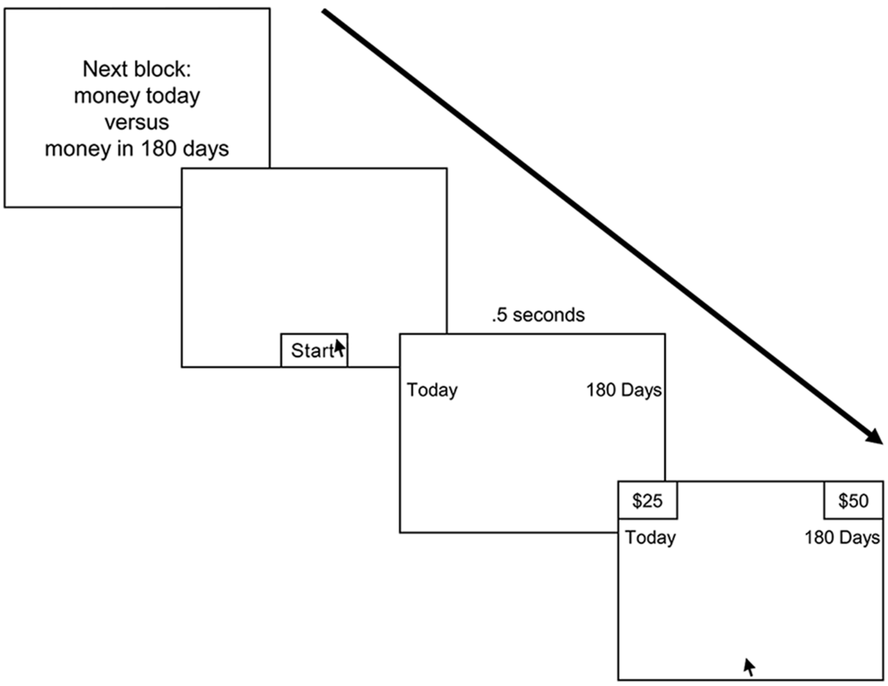

Figure 1. Schematic of studies 1–4. At the beginning of each block, participants were told when the delayed option would be received. Each trial started with a screen that was blank except for a button labeled "start" in the bottom center of the screen. Once participants clicked this button, the cursor and start box disappeared, and the delay information was displayed for 500 milliseconds. After this display, the magnitude of rewards was displayed in the upper left- and upper right-hand corners. At this time, participants regained control of their cursor and used it to indicate which option they preferred.

Mouse-tracking has recently been applied to questions of self-control across domains of healthy eating and intertemporal choice (e.g., Gillebaart et al. 2016; Ha et al. 2016). Some initial work, for instance, suggests that the subjective values of the temptation relative to the goal predicts greater conflict as measured by mouse-tracking (Dshemuchadse, Scherbaum, and Goschke 2013; O'Hora et al. 2016). Other work in self-control has focused not on conflict but rather on how self-control influences the timing with which different attributes are incorporated into decisions (Sullivan et al. 2015; Lim et al. 2018). Our recent work has begun to explore issues of conflict in self-control dilemmas—in particular, we recently showed that individuals with better self-control (whether measured or manipulated) showed less conflict (compared with low self-control individuals) when choosing long-term goals over short-term temptations. We further showed preliminary evidence that conflict within these decision-predicted behavior (Stillman, Medvedev, and Ferguson 2017). However, this past work did not test whether mouse movements are sensitive to changes in the relative attractiveness of the choice stimuli; therefore, it is unclear whether and how mouse-tracking conflict will map onto decisional difficulty. Furthermore, our past work did not relate mouse trajectories to more nuanced assessments of participants' tendency to delay gratification, such as those revealed by participants' discount function.

The present article thus had two goals. First, we wanted to provide further evidence that mouse movements do indeed reflect the difficulty of a given decision. If mouse-tracking is able to detect this conflict, we would expect greater conflict when the subjective value of the two choices are more similar. Second, we sought to demonstrate the importance of measuring conflict for predicting impatience. If conflict is as central to self-control as theory and subjective experience would lead us to believe, then tapping directly into decisional conflict should provide strong predictive power for patterns of patience and impatience across decisions.

We investigate these questions within the domain of intertemporal choice (Ainslie 1975; Loewenstein and Prelec 1992; Kirby and Maraković 1995; Kirby, Petry, and Bickel 1999). These classic self-control dilemmas pit a small reward available immediately (e.g., $5 today) against a larger reward available after a delay (e.g., $10 in a month). These decisions can be difficult because they pit the desire of immediate gratification against the knowledge that waiting confers a larger reward. Across four studies, we first test how the relative subjective value of both options influences trajectory directness, with the prediction that the more similar the subjective values are, the greater the conflict and therefore the less direct the mouse trajectories will be. We then test whether (and how strongly) the directness of mouse trajectories on these trials predicts participants' discount function (which we use as a proxy for patience/impatience; Ainslie 1975; Kirby, Winston, and Santiesteban 2005).

STUDIES 1–4

Studies 1–4 all follow the same structure—we measured participants' mouse trajectories while they made many intertemporal choice decisions (see fig. 1). We then estimated the discount function for each participant and analyzed (*a*) whether the difference in subjective values of the choices on a given trial predicted attraction to the unchosen option via trajectory curvature and (*b*) whether mouse trajectories predicted discount rates. Studies 1–2 are a reanalysis of previously reported data (Stillman et al. 2017, studies 3a–3b), and studies 3–4 consist of newly collected data. We further state that these four studies constitute the entirety of studies we have conducted using mouse tracking to investigate intertemporal choice and thus represent our full "file drawer" up to this date. All materials, data, and analysis scripts are available at Open Science Framework (https://osf.io/t43vk/).

METHODS

Participants

In sum, 191, 140, 93, and 108 undergraduate students participated in studies 1–4, respectively. We exclude from analyses the small percentage of participants in each study who did not complete all trials or who chose only the larger-later or the smaller-sooner option across all trials, yielding 188, 137, 90, and 107 analyzable participants (total N across studies = 522).

Procedure

Participants completed 180 (study 1), 195 (study 2–3), or 210 (study 4) intertemporal choice trials (see the appendix, available online, for a complete list). These decisions always offered a smaller amount of money available immediately (the "smaller-sooner"; e.g., $25) against a larger amount available at some delay (the "larger-later"; e.g., $50 in 180 days). Due to the relatively large amount of information that participants have to comprehend on a given trial (the magnitude of each option, and the delay of the larger-later), we had participants complete trials in blocks of 15 trials in which the delay of the larger-later was kept constant. At the start of each block, we told participants how long the delay would be for that block. Further, the side of the screen that corresponded to the larger-later and smaller-sooner was kept the same across all trials and was counterbalanced between participants.

Each trial began with a screen that was blank except for a black box in the bottom center labeled “start.” Once participants clicked on the start box, their mouse cursor disappeared, and the delay information (e.g., “today” and “180 days”) appeared in the top-left and top-right areas of the screen to remind participants of when each option would be received. After 500 milliseconds of the delay information being displayed, the magnitude information (e.g., \$25 and \$50) appeared in the top-left and top-right corners of the screen, and participants’ mouse-cursors reappeared in the bottom-center of the screen. Participants then selected their choice using the mouse (see fig. 1).

Participants were further instructed to start moving the mouse as soon as the magnitude information was displayed, and if they did not start moving the mouse in 750 milliseconds, they were given a reminder message following the trial. Further, studies 1–2 each had a self-control manipulation (query order [Weber et al. 2007] and construal level [Fujita et al. 2006], respectively) prior to the mouse-tracking trials. For the present analyses, we ignore condition differences within these studies (more details available in Stillman et al. 2017). Study 3 also had participants complete a number of self-report questionnaires that are not directly related to the present investigation.[1] Study 1 further encouraged participants with real money using a modified lottery procedure in which we told participants that one participant would have one decision chosen at random, and that decision would be paid out with real money.

RESULTS

Data Preparation

Data Cleaning. Following established procedures (Freeman and Ambady 2010), we time-normalized the trajectories into 101 time bins and rescaled every response such that each trajectory terminated at the top-right response location. We then removed trajectories that were greater than 3 standard deviations from the mean on reaction time, area under the curve (AUC; see fig. 2), and time until initial mouse movement. This excluded 4%, 3%, 4%, and 3% of trials for studies 1–4, respectively. Mean initialization times (i.e., how long, on average, participants waited to move their mouse after the choices were displayed) for studies 1–4 were 195, 158, 118, and 151 milliseconds, respectively, suggesting that participants followed instructions and began moving their mouse well before making a decision.

Metric of Conflict. To gauge conflict on a given decision, we analyzed the area under the curve (AUC). This metric quantifies the area between an ideal trajectory (i.e., straight toward the chosen option) and the participants’ actual trajectory (see fig. 2).

Temporal Discounting. We estimated participants’ hyperbolic discount rate via the hierarchical Bayesian model of decision-making (hBayesDM) R package (Ahn, Haines, and Zhang 2017). This two-parameter model yields, for each participant, a discount rate (k) and an inverse temperature parameter (beta). The variable k corresponds to the degree to which participants delay future rewards to present rewards,

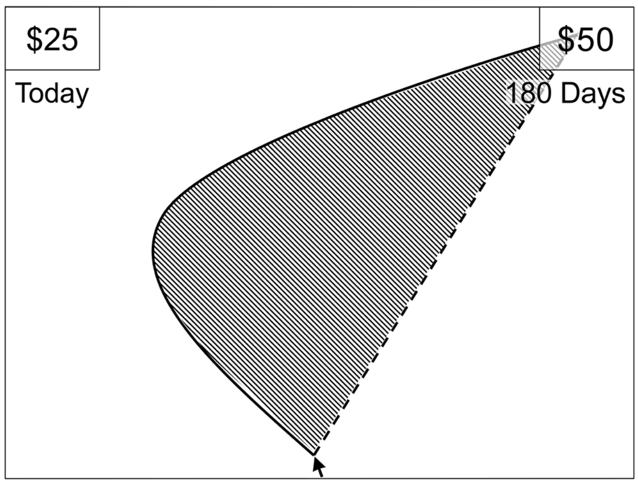

Figure 2. Quantifying conflict via mouse-tracking. Sample trial in which the participant was drawn toward the smaller-sooner before ultimately choosing the larger-later (*solid black line*). To quantify conflict, we first construct an “ideal” straight trajectory toward the response and then take the area between the actual and ideal trajectories (*shaded region*)—termed the area under the curve (AUC). Trajectories that deviate more from the ideal trajectory have greater AUC, and the decision is inferred to be more conflicting relative to trajectories that are more direct.

1. Specifically, participants filled out a number of self-report self-control items. Our hypothesis was that those with better self-control would be more direct when choosing the larger-later over the smaller sooner. However, we found no significant influence of self-reported self-control. Although unexpected, this is consistent with past work that has not found robust relationships between discount rates and self-reported self-control (Duckworth and Kern 2011)—a pattern we largely replicate in the present study.

with higher values corresponding to greater discounting of future rewards. Therefore, as k increases, the larger the delayed reward must be in order for participants to select it over the immediate reward. Summaries of k across studies are given in table 1.

The Relationship between Conflict and Trial Difficulty

We first wanted to replicate and extend past work (e.g., Dshemuchadse et al. 2013; O'Hora et al. 2016) suggesting that trajectory directness is reflective of the response conflict present during a given decision. Specifically, we predicted that the differences in subjective values on a given trial would predict greater conflict as measured by the degree to which mouse movements were attracted to the unchosen alternative. To investigate this, for each participant and for each trial, we used the discount rate obtained above to calculate their subjective value for both the larger-later and smaller sooner options. We then calculated the absolute value of the difference between the two subjective values. Using variable intercept mixed-effects models, we then predicted trial-by-trial conflict from the difference in subjective value, with the hypothesis that trials for which the subjective values are more similar (and therefore their difference is closer to zero) should produce more conflict than trials for which the subjective values are further apart.

Consistent with this, across all four studies, the further apart the two subjective values are, the less conflict occurs on a given trial. Study 1: $b = -0.02$, SE $= 0.0009$, $t(32, 611.61) = -24.82$, $p < .001$. Study 2: $b = -0.01$, SE $= 0.0007$, $t(25, 768.63) = -16.62$, $p < .001$. Study 3: $b = -0.02$, SE $= 0.001$, $t(16, 705.25) = -12.36$, $p < .001$. Study 4: $b = -0.01$, SE $= 0.001$, $t(21, 663.95) = -10.85$, $p < .001$ (see fig. 3). We next wanted to extend these findings and show that trajectory directness was distinct from

Table 1. Distribution of Discounting Rate k across All Studies

	k		
	Arithmetic mean	Geometric mean	Standard deviation
Study 1	.012	.003	.028
Study 2	.029	.005	.059
Study 3	.034	.006	.073
Study 4	.026	.005	.050

reaction time (correlation between AUC and RT across studies: $r = 43$, .34, .44, and .45 for studies 1–4). As expected, all effects remained highly significant when controlling for reaction times, suggesting that curvature is not simply redundant with reaction time as a measure of conflict. Study 1: $b = -0.01$, SE $= .0008$, $t(32, 629.64) = -13.85$, $p < .001$. Study 2: $b = -0.006$, SE $= .0007$, $t(25, 782.12) = -9.69$, $p < .001$. Study 3: $b = -0.007$, SE $= 0.001$, $t(16, 826.72) = -6.22$, $p < .001$. Study 4: $b = -0.006$, SE $=$ .001, $t(21, 829.11) = -5.09$, $p < .001$. Together, these results suggest that mouse-tracking can be a sensitive metric for gauging conflict within a given decision and that the variance is distinct from reaction-time.

The Predictive Power of Conflict

We next wanted to demonstrate that conflict within decisions was predictive of participants' patience (or impatience) as indexed by their discount function. Specifically, we predicted that the amount of conflict (or lack thereof) when choosing larger-later over smaller-sooner, or vice versa, should predict participants' patience as quantified by discount rate.

To test this, for each participant, we divided their trials based on whether they selected the larger-later or the smaller-sooner option. We then calculated the average AUC within these two groups, yielding two metrics per participant—average conflict when choosing the larger-later option, and average conflict when choosing the smaller-sooner option—and used this to predict individuals' discount rate k. As k is often skewed, we followed established procedure (Kirby et al. 1999) and take the natural logarithm of k rather than predicting raw discount rates. We further note that our metrics of conflict are relatively uninformed (compared to metrics such as k) when it comes to details of the decisions themselves; they do not account for any information about the magnitudes or delays of the options and do not incorporate any of the details about how participants chose on a given trial. Therefore, if these relatively uninformed metrics of conflict can predict discount rates, it suggests that conflict may be particularly helpful in understanding self-control success and failure.

Consistent with our hypotheses, across all studies we find a strong relationship between both measures of conflict—conflict when choosing larger-later and conflict when choosing smaller-sooner—and log discount rates (see fig. 4). The greater the conflict that participants displayed when ultimately choosing the larger-later (i.e., delaying gratification), the higher their discount rates. Study 1: $b = 0.83$, SE $= 0.07$, $t(185) = 11.21$, $p < .001$. Study 2: $b = 0.98$,

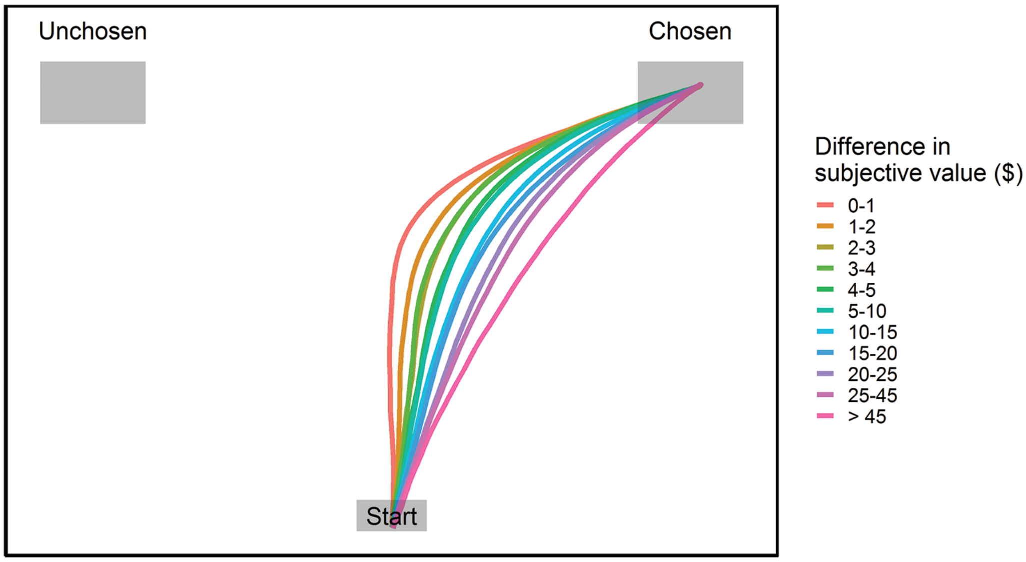

Figure 3. Average trajectory position as a function of the difference in subjective value. Figure was created by pooling across all studies, binning trajectories as a function of the difference in subjective value, and then taking the average *X*- and *Y*-location for each of the 101 time points.

SE = 0.13, $t(134) = 7.66$, $p < .001$. Study 3: $b = 0.81$, SE = 0.16, $t(87) = 4.97$, $p < .001$. Study 4: $b = 0.76$, SE = 0.13, $t(104) = 5.93$, $p < .001$. On the other hand, the greater the conflict that participants displayed when ultimately choosing the smaller-sooner (i.e., indulging), the lower their discount rates. Study 1: $b = -0.92$, SE = 0.07, $t(185) = -13.54$, $p < .001$. Study 2: $b = -1.49$, SE = 0.14, $t(134) = -10.93$, $p < .001$. Study 3: $b = -1.09$, SE = 0.17, $t(87) = -6.50$, $p < .001$. Study 4: $b = -1.03$, SE = 0.13, $t(104) = -8.06$, $p < .001$.

Our results are further notable given the strength with which our relatively uninformed metrics are able to predict discount rates. Indeed, we reach remarkably high R^2 values across all studies; study 1: $R^2 = .70$; study 2: $R^2 = .59$; study 3: $R^2 = .49$; study 4: $R^2 = .53$. It thus appears that the mouse-tracking metric of conflict confers a high degree of information, even in a relatively basic form.

Furthermore, with two exceptions, the above results remained significant when adding reaction times (specifically, average reaction time when choosing larger-later and average reaction time when choosing smaller-sooner) to the model. The two effects that drop to nonsignificant are the effect of average trajectories when choosing the smaller-sooner option in study 3: $b = -0.30$, SE = 0.25, $t(85) = -1.21$, $p = 0.23$; and study 4: $b = -0.26$, SE = 0.18, $t(102) = -1.43$, $p = 0.16$. If we collapse across our four studies and rerun these analyses, however, the average conflict in both larger-later and smaller-sooner still predicts the discount rate, even when controlling for reaction time; average conflict in the larger-later: $b = 0.41$, SE = 0.06, $t(517) =$

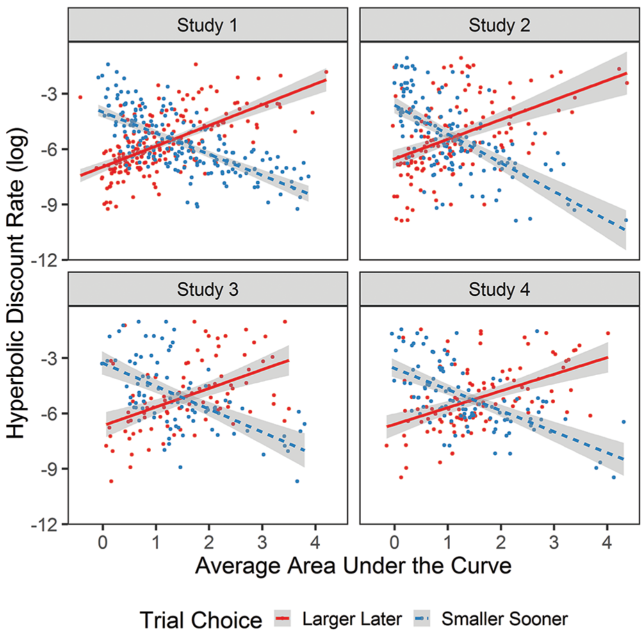

Figure 4. Predicting log discount rate from average conflict on trials in which participants chose the larger-later option (*solid red*) or the smaller-sooner option (*dashed blue*). Higher (log) discount rates correspond to greater discounting of delayed rewards (i.e., greater impatience).

6.37, $p < .001$; average conflict in the smaller-sooner: $b = -0.42$, SE $= 0.08$, $t(517) = -5.59$, $p < .001$. These results again suggest that the predictive power of conflict as measured by mouse-tracking is nonredundant with reaction time data.

Finally, one potential criticism with the present analysis is that, because the discount rates and average conflict metrics are both based on the same trials, our results may be a consequence of "double-dipping." To address this, we performed the above analyses again, except first we divided the trials in half (first-half trials and second-half trials) and then used average conflict (when choosing larger-later and smaller-sooner) in the first half of trials to predict discount rates on the second half of trials. Despite the reduction in trials (and therefore precision of the estimates for both conflict metrics as well as k), both metrics of first-half conflict significantly predicted second-half discount rate. Study 1: larger-later: $b = 0.82$, SE $= 0.09$, $t(182) = 9.31$, $p < .001$; smaller-sooner: $b = -0.80$, SE $= 0.083$, $t(182) = -9.65$, $p < .001$, $R^2 = .55$. Study 2: larger-later: $b = 0.80$, SE $= 0.24$, $t(131) = 3.30$, $p = .001$ smaller-sooner: $b = -1.11$, SE $= 0.23$, $t(131) = -4.75$, $p < .001$, $R^2 = .20$. Study 3: larger-later: $b = 0.59$, SE $=0.16$, $t(86) = 3.67$, $p < .001$; smaller-sooner: $b = -0.88$, SE $= 0.18$, $t(86) = -4.95$, $p < .001$, $R^2 = .31$. Study 4: larger-later: $b = 0.88$, SE $= 0.15$, $t(82) = 5.88$, $p < .001$; smaller-sooner: $b = -0.80$, SE $= 0.15$, $t(82) = -5.18$, $p < .001$, $R^2 = .44$.[2]

DISCUSSION

Although conflict plays an integral role in both the subjective experience and theoretical understanding of self-control, conflict itself is rarely studied in an online, real-time manner. In this article, we used mouse-tracking to more directly tap into conflict while participants decided between immediate gratification and delayed rewards in an intertemporal choice paradigm. Across four studies, we show that the difficulty of a self-control conflict, indexed via the difference in the subjective values of the smaller-sooner and larger-later options, strongly predicts conflict as measured by the degree to which mouse cursor movements deviated from a direct path toward the chosen option. These findings suggest that mouse-tracking is a sensitive measure of the conflict present in a given decision.

We further find that average conflict—both when electing the larger-later reward over the smaller-sooner reward, and vice versa—strongly and reliably predicts participants' patience as indexed by their discount function.[3] Notably, our metrics of conflict are relatively uninformed; they quantify only the average amount of conflict on decisions in which participants ultimately chose the larger-later or the smaller-sooner and do not account for information regarding the magnitudes or delay for a given trial. Even with this relatively blunt measure of conflict, we are able to account for a large proportion of the variance in discount rate, with R^2 ranging from .49 to .70. Together, these results demonstrate the predictive strength of direct measures of conflict for studying self-control and further suggest the usefulness of moving beyond a focus on choice to investigate how choice evolves.

Implications for Consumer Behavior

The present results demonstrate the predictive strength of tapping into conflict to predict consumers' patterns of behavioral tendencies (in this case, impatience), which may be particularly important when trying to predict repeated behaviors (e.g., food decisions). One implication is that, when available, conflict information may assist marketers in targeting consumers who may be most likely to be swayed by advertising, given that conflicted deciders may have more malleable attitudes and behavior than nonconflicted deciders (see Kleiman and Hassin 2011). Additionally, although we have focused on conflict that arises due to competing desires of short-term versus long-term, there are many other sources of conflict likely to be relevant to marketers. Harnessing conflict in these other decisions may be useful for understanding and predicting brand loyalty, choices that require trade-offs, and risky versus safe decisions, among many others.

Future Directions and Limitations

What Is Mouse-Tracking Measuring?. Throughout the article we have referred to "conflict" broadly to capture the competing desires of smaller immediate gratification versus

2. As with the previous analyses, some of these effects dropped to NS when controlling for reaction times. As above, however, conflict metrics significantly predicted discount rates when pooling across studies; larger later: $b = 0.24$, SE $= 0.11$, $t(488) = 2.17$, $p = 0.03$; smaller-sooner: $b = -0.60$, SE $= 0.12$, $t(488) = -5.12$, $p < .001$.

3. It is important to note that while certain conventions use "predict" to imply causal influence, here we simply mean that there is a reliable association between conflict and discount rate, not that AUC is causing differences in discount rates. Indeed, it is likely that the traits and value-construction processes associated with higher versus lower discount rates should determine how conflicted participants will be when electing larger-later or smaller-sooner.

greater delayed gratification. However, it is important to note two points: first, there are many factors that can contribute to conflict as measured by mouse-tracking beyond the conflict between short- and long-term considerations; second, "conflict" itself is a broad concept with many constituent subprocesses. Regarding the first point—many factors will contribute to conflict on a given decision (see also Kotabe and Hofmann 2015). For instance, contextual factors such as the difficulty of perceiving the options and participants' experience with the task might increase the directness of mouse trajectories even absent motivational conflict (indeed, across studies we find highly significant trial effects, such that earlier trials are more conflicting than later ones; all $p < .001$). Moreover, it is easy to envision other decisions that involve conflict that do not involve a temporal component (e.g., conflict between certain and risky outcomes). A reasonable question is thus whether conflict measured in alternative domains might also predict patience—in other words, might it simply be the ability to navigate conflict that is related to patience? Although we do not have the proper controls in the present study to rule this out, our past work (Stillman et al. 2017) with food choices found that whereas conflict when choosing between healthy and unhealthy foods predicted a real choice between an apple and a candy bar, conflict when choosing between healthy foods and inanimate objects did not. We thus believe that it may be the conflict specific to resolving dilemmas between short-term and long-term that is informative for understanding self-regulatory processes such as patience.

As noted above, conflict is an umbrella term that includes many distinct processes. Indeed, recent theories of conflict and cognitive control have attempted to disentangle the distinct processes and components involved in conflict and its resolution (Botvinick et al. 2001; Botvinick, Cohen, and Carter 2004; Myrseth and Fishbach 2009; Munakata et al. 2011; Shenhav, Botvinick, and Cohen 2013; Kotabe and Hofmann 2015; Erb et al. 2016). For instance, conflict monitoring and detection, control execution, and postdecisional attraction of the unchosen option (once a choice has been made but motor movement not yet completed; see Wirth et al. 2016) are all components of conflict that are likely to influence mouse trajectories. Although it is beyond the scope of the current article to fully disentangle these separate components of decisional conflict, we believe that our results showing that conflict is highly sensitive to subjective value, as well as the strength of our results in predicting discount functions, suggest that we are detecting meaningful conflict of how these decisions evolve.

The Resolution of Conflict. Although here we have focused on using mouse-tracking to measure the relative amount of conflict present on a given trial, the richness of mouse-tracking data allows for more nuanced predictions about when and how individuals will resolve conflict between two options and may allow researchers to reveal the underlying cognitive mechanisms supporting self-control. For instance, in our past work, we have shown that conflict between short-term temptations and long-term goals generally evolves dynamically (with input from both temptation and goal simultaneously) rather than sequentially (in which there is an initial impulse toward the temptation followed by controlled inhibition of that impulse; Stillman et al. 2017). Additionally, mouse-tracking can be used to investigate when in the processing stream different manipulations or individual differences influence the resolution of conflict (Sullivan et al. 2015). Overall, mouse-tracking offers a more nuanced view of the self-regulatory processes unfolding in real time as people decide between temptations and goals; we anticipate future research taking full advantage of these real-time measures of conflict.

Beyond Self-Control and the Limits of Mouse-Tracking. Although in our research we have focused exclusively on self-control, mouse-tracking may be useful to study other classes of decisions. Indeed, resolving conflict between decisions is a hallmark of many classes of choices, from moral dilemmas to risky gambles to prejudice. Although there have been some initial investigations in these domains (Koop and Johnson 2011; Koop 2013), they have yet to be fully explored using real-time metrics of conflict, and we look forward to future research in these areas.

One limitation of mouse-tracking is that it is not suitable for studying all decision contexts. Because individual trials can be noisy, it is necessary to have participants make many successive decisions, which can be infeasible in some domains. Additionally, domains that are difficult to instantly perceive (such as those that require reading vignettes or complex attribute tables) present challenges for the mouse-tracking paradigm, as it generally assumes that participants are instantly aware of both decision options, rather than sequentially comprehending them. Finally, the nature of the mouse-tracking makes it most suited for explicit decisions (i.e., participants know their task is to make decisions), which can carry very different psychological states compared with decisions that are often measured surreptitiously—for instance, decisions about prosocial behavior are often studied in ways that avoid drawing attention to the fact that researchers are studying their decisions. These limitations, however, are often manageable (e.g., in the present study we kept delay information constant within a block) and should not necessarily deter researchers from considering mouse-tracking to study decisional conflict in other domains.

Reaction Time. One unanswered question is the precise relationship between mouse curvature and reaction time. Our results were generally robust to controlling for reaction time, and when pooling across all studies, no analyses dropped to nonsignificant. Additionally, in previous work, we have found that reaction times are not influenced by self-control measures or manipulations in the same way that mouse-cursor conflict is (Wojnowicz et al. 2009; Stillman et al. 2017). Together, this suggests that the two metrics are tapping into distinct sources of variances. One possibility is that, whereas reaction time may be a more direct measure of "deliberation" (and therefore includes conflict but also can be influenced by things beyond conflict, such as accuracy motives), conflict as measured by mouse-tracking may be a better metric of the relative "pull" of the unchosen alternative; in other words, it is a more direct assessment of conflict between the choice options. Future research should test this possibility.

CONCLUSION

Conflict—whether consciously experienced or present below conscious awareness—is an inherent part of everyday life and permeates most decisions. By harnessing this conflict, researchers can reveal a clearer picture of individuals' decision making as they pursue their goals. A better understanding of this conflict should enable us to understand when, why, and how individuals are able to successfully pursue long-term goals in the face of short-term temptations.

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