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How Decisions Happen: Focal Points and Blind Spots in Interdependent Decision Making

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Decision makers often simplify decision problems by ignoring readily available information. The current multimethod research investigated which types of information about interdependence situations are psychologically prominent to decision makers and which tend to go unnoticed. Study 1 used eye-tracking measures to investigate how decision makers allocate their attention in interdependence situations and revealed that individuals fixated on mutual cooperation earlier and longer as compared with alternative combinations of strategies and outcomes. In addition, participants' behavioral cooperation was consistent with their attention allocation. Study 2 introduced a novel information-search paradigm: Participants exchanged yes/no questions and answers to discover which of 25 different games their counterpart chose. Analyzing the contents of participants' questions showed that, consistent with Study 1, participants focused primarily on desirable outcomes and symmetric behavioral choices. Study 3 revealed that outcome desirability is a robust basis of psychological prominence across different types of social relations; in contrast, the psychological prominence of symmetry was moderated by the nature of social relations. Study 4 revealed that whether different bases of psychological prominence directed individuals' attention to the same aspects of the decision-making task moderated the effect of information availability on decision latency and cooperation rates. Taken together, these findings contribute to the mapping of bounded rationality, demonstrate how people think about their interdependence, and enhance our understanding of how decisions happen.

Keywords: decision making, information processing, experimental games, psychological prominence, eye-tracking

Interdependent decision-making situations are complex. A quarterback in a football game, an executive in a deal-making negotiation, and an army commander in battle all have to quickly weigh different information and integrate it to make an informed decision. Research on bounded rationality (Simon, 1982) suggests that, in spite of decision makers' best intentions and efforts, they often simplify decision problems, for example, by ignoring readily available information (i.e., "bounded awareness"; Bazerman & Chugh, 2006; Chugh & Bazerman, 2007; Johnson, Camerer, Sen, & Rymon, 2002). As noted by March (1994), "studies of decision making in the real-world suggest that not all alternatives are known, that not all consequences are considered, and that not all preferences are evoked at the same time" (p. 8). Time pressure, information overload, and cognitive constraints (e.g., limited capabilities for attention, computation, and memory) often lead decision makers to edit and decompose complex decision problems and base their decisions on a subset of the available information.

Although the notion of bounded rationality is well established and widely accepted in psychology, economics, political science, and related fields, little is known about the ways in which decision makers cope with information constraints. Specifically, what information grabs decision makers' attention and what is overlooked in interdependent decision making? Discovering what types of information are psychologically prominent can greatly enhance our understanding of how decision makers mentally represent their interactions and act in them (Devetag & Warglien, 2008; Halevy & Katz, 2013; Kreps, 1990; Rubinstein, 1991). In the current research, we investigate this important question to enhance our knowledge of how decisions happen.

Our starting point in this endeavor is Schelling's (1960) seminal work on tacit coordination. Schelling observed that individuals often manage to coordinate their choices with those of interdependent others without communicating with them. Decision makers achieve tacit coordination by choosing psychologically prominent solutions, that is, ones that are salient to them and can reasonably be expected to also be salient to their counterparts. For example, people tend to choose heads over tails; the top-left box in a symmetric display of 16 identical boxes; and a 50:50 split of $100 (Schelling, 1960, p. 56). As these examples illustrate, prominence may result, among other things, from a social convention (heads over tails), spatial position (top-left box), or common norms of fairness (equal split).

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Schelling (1960) noted that "a prime characteristic of these. . . . focal points is some kind of prominence or conspicuousness. But it is a prominence that depends on time and place and who the people are" (pp. 57–58; Weber & Camerer, 2003). Thus, different information may serve as clues for decision makers who seek to coordinate their actions in different situations (e.g., social status: de Kwaadsteniet & van Dijk, 2010; property rights: Hoffman, McCabe, Shachat, & Smith, 1994). What is common across all of these examples is that, in any given decision problem, some information may be more prominent than others. These psychologically prominent pieces of information capture decision makers' attention and guide their subsequent choices (i.e., perceiving is for doing; S.T. Fiske, 1992, 1993; Orquin & Mueller Loose, 2013).

The prominence of a particular piece of information likely depends on bottom-up features of the stimulus (e.g., its uniqueness; Orquin & Mueller Loose, 2013; Schelling, 1960) as well as top-down person variables (e.g., decision makers' interaction goals; De Dreu & Boles, 1998; Levine, Resnick, & Higgins, 1993). Nonetheless, it stands to reason that some information-search and acquisition patterns generalize across situations and people. In the current research, we first sought to establish general patterns of information search across people and situations. We then explored how various aspects of the situation affect people's information search and use tendencies. As a final step, we linked psychological prominence to behavioral decisions in interdependence situations.

How Decisions Happen: Mapping Bounded Awareness

To investigate patterns of information search and use in social interactions, we build on game theory (Camerer, 2003a; Schelling, 1960). Game theory provides a formal and compelling language that defines an interdependence situation as a "game" in which each decision maker is a "player" who can choose one of several available strategies. The outcomes of the interaction are "payoffs," which are determined by the respective choices of the interdependent players. The simplest of all games are those that include exactly two players, each of whom can choose between two available strategies (Camerer, 2003a; Colman, 1995; Rapoport & Guyer, 1966).

The reliance on games as abstract representations of social interactions (e.g., Ames, Weber, & Zou, 2012; Camerer, 2003a, 2003b; Halevy, Chou, & Murnighan, 2012; Kelley et al., 2003) allows us to operationalize our fundamental theoretical question of what information is psychologically prominent in interdependence situations as what information is psychologically prominent in *strategic games*? Thus, in the current research, we investigate how people think about interdependence situations by investigating what information is more or less prominent to decision makers in 2×2 games (Studies 1 and 2). We also investigate when and why some information gain prominence in the eyes of decision makers (Study 3) and how the tendency to focus on certain information affects the process (i.e., decision latency) and outcomes (i.e., cooperation rates) of costly decision making (Study 4).

There are many different 2×2 games that can be distinguished along multiple dimensions (Kelley et al., 2003; Kelley & Thibaut, 1978; Rapoport & Guyer, 1966; Reis, 2008). However, one of the most salient characteristics in 2×2 games is that different combination of strategies (i.e., mutual cooperation, mutual competition, unilateral cooperation, and unilateral competition) can result in different outcomes in different games (see Figure 1 for an illustration). For example, in a game of Assurance (Stag-hunt), the worst outcome is to be a sucker (i.e., cooperate unilaterally), whereas in a game of Chicken, the worst outcome is mutual destruction (i.e., mutual competition; de Kwaadsteniet & van Dijk, 2010; Wolf, Insko, Kirchner, & Wildschut, 2008). As another example, whereas in Chicken the best outcome is to dominate one's counterpart (i.e., compete unilaterally), in the Assurance game, the best outcome is mutually beneficial cooperation (Halevy, Chou, & Murnighan, 2011; Skyrms, 2004). In the current research, we explored the possibility that certain levels of outcomes, as well as certain combinations of strategies, are more prominent to decision makers than others. The following sections elaborate on the rationale behind this proposition and articulate our hypotheses.

The Prominence of Desirable Outcomes

Information-search and acquisition tends to be goal directed (De Dreu & Boles, 1998; De Dreu & Carnevale, 2003). A recent review of the negotiation and group decision-making literatures concluded that "the individual's . . . motivation biases the type of information that someone looks for, generates, and processes" (De Dreu, Nijstad, & Van Knippenberg, 2008, p. 25). Because people prefer better outcomes to worse outcomes, and derive pleasure from anticipating positive outcomes (Loewenstein, 1987), we predicted that, faced with a 2×2 payoff matrix, decision makers would pay more attention to the combination of strategies that provides better outcomes than those providing worse outcomes. Thus, although negative information, once acquired, tends to be more impactful than equivalent positive information (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Kahneman & Tversky, 1979; Rozin & Royzman, 2001), we predicted that people's information-search patterns would show a preference for desirable outcomes (Orquin & Mueller Loose, 2013).

Research on interdependent decision making suggests that the logic of desirability in games is twofold (Bornstein, 2003; De Dreu et al., 2008). Individualistic goals (De Dreu & Carnevale, 2003; De Dreu et al., 2008) direct information search toward the best individual outcome (i.e., the most desirable outcome to the individual decision maker). In contrast, prosocial goals (Colman, 2003; Van Lange, 1999) direct information search toward Pareto optimality (i.e., the most desirable outcome for the collective). Individuals often consider both types of desirable outcomes, as explained by Crawford, Gneezy, and Rottenstreich (2008):

> In team reasoning, players begin by asking themselves, independently, if there is a decision rule that would be better for both than individualistic rules, if both players followed the better rule. . . . If there is such a better rule, players follow it; and if not, they follow their usual individualistic rule. (p. 1448)

Initial evidence from eye-tracking studies in which patterns of information acquisition in 2×2 games have been examined lends support to this view. The basic premise of these studies is that the frequency of gaze fixations in a given area of interest on the computer screen reflects the relative importance of the information presented in that area to the perceiver (Orquin & Mueller Loose, 2013). Consistent with the notion of bounded awareness in bar-

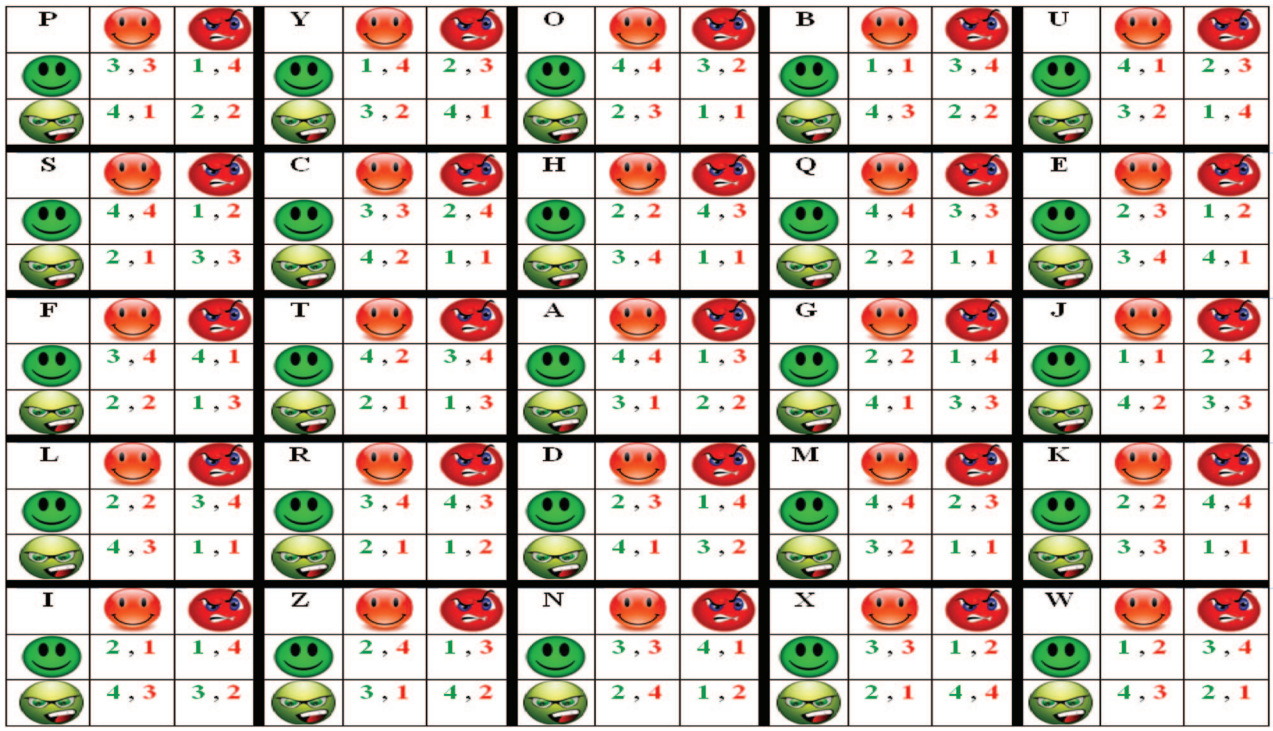

Figure 1. The game board used in the "perspective-taking challenge" task (Study 2). Each box represents a 2×2 game. Each game includes a green player and a red player; a smiley face represents cooperation, whereas an angry face represents competition. The four levels of possible outcomes are represented as follows: 4 = "best", 3 = "good", 2 = "bad," and 1 = "worst."

gaining (Bazerman & Chugh, 2006), and the idea that people compare the best individual outcome with maximization of joint outcomes (Colman, 2003; Crawford et al., 2008), researchers found that participants who played an iterated Prisoner's Dilemma game (captured by the Box labeled "P" in Figure 1) looked at the best individual outcome and best collective outcome twice more often than they did at the second-worst and worst outcomes. These findings were obtained across many game rounds that used different numerical values, all conforming to the structure of a Prisoner's Dilemma game. In addition, the transitions between fixating on the individually best and collectively best outcomes were the most frequent of any transitions, indicating that participants repeatedly compared these two payoffs (Hristova & Grinberg, 2005). On the basis of these ideas and findings, we predicted that information about desirable outcomes would be more psychologically prominent to decision makers than information about less desirable outcomes.

The Prominence of Symmetric Choices and Outcomes

Symmetry boosts perceptions of facial attractiveness (Rhodes, Proffitt, Grady, & Sumich, 1998), underlies artistic preferences (Humphry, 1997), and facilitates fluent information processing (Reber, Schwartz, & Winkielman, 2004). Consistent with these findings, we propose that people's strong preference for symmetry (e.g., Freyd & Tversky, 1984; Reber, 2002) may also guide their attention allocation as they search for and acquire information in interdependence situations.

In the context of interdependent decision making, Schelling (1960, p. 57) noted that symmetry may be an important situational clue in coordination situations, and others have observed that individuals find it easier to mentally represent symmetric interactions as compared with asymmetric ones (Camerer, 2003b, p. 229). Thinking about asymmetrical social interaction can introduce cognitive complexity (Devetag & Warglien, 2008; Halevy, 2008), which often leads to the breakdown of tacit coordination (Crawford et al., 2008) or misrepresentation of information in memory (Devetag & Warglien, 2008). Indeed, recent research revealed that individuals tend to create symmetric payoff structures when asked to represent their perceptions of outcome interdependence in negotiation in a matrix form (Halevy et al., 2012). Further supporting the psychological prominence of symmetry, developmental research documented expectations of symmetry (in particular, equality) in social interactions even among infants under the age of 2 years (Sloane, Baillargeon, & Premack, 2012). Thus, because symmetric information is consistent with both individuals' preferences and their expectations, we predicted that people's attention allocation and information search patterns will show a strong preference for symmetric information over asymmetric information.

In short, everything else being equal, we expected individuals to pay more attention to the mutual cooperation and mutual compe-

tition cells in 2×2 payoff matrices than to the asymmetric cells capturing unilateral cooperation and competition. Likewise, we expected individuals to pay more attention to cells that provide equal outcomes to both parties (which are often seen as more fair; Rabin, 1993) than to cells that provide unequal outcomes to the parties. By "everything else being equal," we mean that for the same level of outcome desirability, cells depicting symmetric behavioral choices are expected to be more psychologically prominent than cells depicting asymmetric behavioral choices.

Integrating the Two Research Hypotheses

Integrating our two hypotheses—about the prominence of desirable and symmetric information—suggests that individually and collectively desirable outcomes that are achieved via symmetric behavioral choices (i.e., mutual cooperation that results in the best possible outcomes to each player and to both together) should be most prominent to decision makers (for instance, see the top-left cell in the boxes labeled "A" and "M" in Figure 1). In contrast, undesirable outcomes should be less prominent, especially when they are achieved via asymmetric choices (e.g., unilateral cooperation that results in the second-worst outcome; see the bottom-left cell in the boxes labeled "U" and "Y" in Figure 1).[1] Put differently, the psychological prominence of information increases when different bases of prominence—individual desirability, collective desirability, symmetry of behavioral choices, and symmetry of outcomes—converge and jointly direct decision makers' attention to it (Crawford et al., 2008), and decreases when different bases of psychological prominence diverge and direct decision makers' attention in different directions.

A Process Model of Attention Allocation in Interdependent Decision Making

Figure 2 outlines our proposed process model of attention allocation in interdependent decision making. The starting point for our model is the observation that, although a given objective interdependence situation may include multiple features (in our example, four situational features, consistent with the four cells in a 2×2 payoff matrix), some situational features may receive significantly more attention than others. We refer to those situational features that receive relatively more attention as *psychologically prominent information* and to those situational features that are relatively neglected as *blind spots*.[2] In Studies 1 and 2, we directly tested this part of the model using two different process tracing tools: eye tracking (Study 1) and a novel, interactive information search and acquisition task (Study 2).

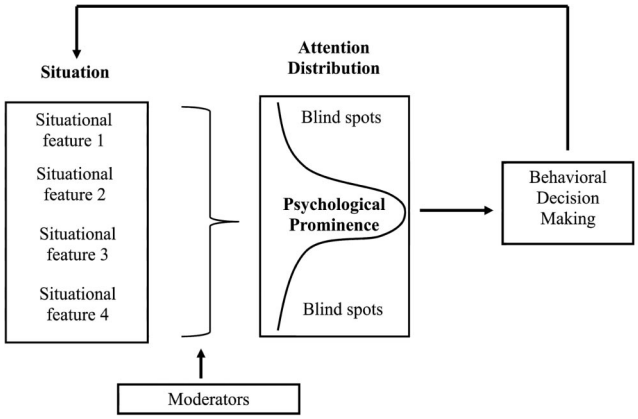

Figure 2. A process model of attention allocation in interdependent decision making.

As shown in our process model in Figure 2, we propose that how individuals allocate their attention over the different situational features may be moderated by context variables. These context variables include both bottom-up features of the stimulus, such as visual saliency due to color, size, or spatial position, and top-down influences, such as information-processing approach and individual differences in goals (Orquin & Mueller Loose, 2013). In the current research, we tested this component of our model by investigating how the relational context (A. P. Fiske, 1992) in which an interdependence situation is embedded moderates what information gains psychological prominence. Finally, our model includes a path from psychologically prominent information to behavioral decisions, indicating that information search and acquisition guides subsequent decision making (i.e., perceiving is for doing). In the current research, we tested this component of the model by investigating how the natural distribution of attention in interdependent decision-making tasks relate to behavioral decisions (Study 1) as well as by manipulating the availability of different information and exploring the effects of information availability on decision latency and cooperation rates (Study 4). For the sake of completeness, our process model also includes a feedback loop going from behavioral decisions to the features of the situation, to capture the fact that people's decisions in a given situation can alter the nature of their interdependence (e.g., Kelley, 1997). Modification of the interdependence situation may occur when a behavioral choice creates new objective circumstances (e.g., by changing power relations or introducing novel choice alternatives), changes individuals' construal of the situation (e.g., altering the game that people think they are playing), or both.

Study 1: Attention Allocation in Interdependent Decision Making

To investigate patterns of attention distribution in games, in Study 1 we used eye-tracking measures—a frequently used

[1] A Google Ngram Viewer search (conducted on September 13, 2012) in all English-language books published between the years 1800 and 2000 revealed that the term *good* is mentioned in literary works 400%–700% more frequently than the term *bad*. The discrepancy between the terms *best* and *worst* is even more remarkable, with the former being mentioned between 800% and 1,500% more frequently than the latter. Similarly, *mutual cooperation* trumps *mutual competition* (although the reverse is true for *competition* and *cooperation*). Likewise *symmetry* trumps *asymmetry* in frequency of mentions.

[2] We use the term *blind spots*, which is commonly used and readily understood, to indicate information that receives *relatively* less information. We neither suggest nor find (in our eye-tracking study) information that is completely overlooked. Importantly, consistent with prior research that used multiple process-tracing methods, eye-tracking measures in our research indicate greater information acquisition than more controlled and explicit measures of information acquisition (e.g., van Raaij, 1977, pp. 181–182). Thus, the amount of attention expanded on relative blind spots seems to depend, at least to some degree, also on the method used to assess information search and acquisition (Reisen et al., 2008).

method of process tracing in decision research (Orquin & Mueller Loose, 2013; Reisen, Hoffrage, & Mast, 2008; van Raaij, 1977)—as well as research on motivated perception (e.g., Balcetis & Dunning, 2006) and social interactions (e.g., DeWall, Maner, & Rouby, 2009). Specifically, we investigated attention allocation and decision making in two mixed-motive games: the game of Chicken and the game of Assurance (see Matrices C and A in Figure 1, respectively). These particular games were chosen for several reasons, including their archetypal status in individuals' thinking about interdependence situations (Halevy et al., 2012) and our desire to contribute to the literature on attention allocation in interdependent decision making, which to date, has focused primarily on the Prisoner's Dilemma (Hristova & Grinberg, 2005, 2010; Tanida & Yamagishi, 2010). In addition, the contrast between the Chicken and Assurance games, which has been used in previous research (e.g., Bornstein & Gilula, 2003), is particularly appealing in the context of the current research because different strategies are associated with obtaining one's best outcome in these two games. Unilateral competition, which is an asymmetric combination of strategies, produces the best outcome in Chicken, whereas mutual cooperation, which is a symmetric combination of strategies, produces the best outcome in Assurance. Thus, our hypothesized bases of psychological prominence (outcome desirability, symmetry) potentially direct attention to the same matrix cell in Assurance but may direct decision makers' attention to different matrix cells in Chicken.

A recent review of the literature on attention allocation in decision-making tasks revealed "that participants overwhelmingly attend to important or high utility information . . ." and concluded that "the utility effect is the most robust observation on eye movements in decision making" (Orquin & Mueller Loose, 2013, pp. 195–196). Specifically, previous research revealed that participants fixate on the alternative they eventually choose earlier in the process, more frequently, and for longer durations, as compared with the alternatives they do not choose. In Study 1, we used two process measures commonly employed in eye-tracking research on decision making: proportion of the overall fixation duration and the temporal sequence of fixations to the different areas of interest.

Method

Participants. We recruited 56 Stanford University students from a dedicated participant pool to participate in an experiment on interdependent decision making. Participants arrived at the laboratory in dyads. Effort was taken to make sure that participants in each dyad were unfamiliar to each other. Due to technical difficulties (i.e., inability to calibrate the eye tracker or malfunction in the recording apparatus), eye-tracking data for five participants was not recorded. Thus, the final sample for Study 1 consisted of 51 participants, of which demographic information was available for 50 (58% female; age: $M = 21.4$, $SD = 3.1$).

Procedure, stimuli, and apparatus. Upon arrival to the laboratory, each participant was ushered to a private breakout room, received written and oral explanations from the experimenter about the study, and signed a consent form that informed him or her that an eye tracker would record his or her gaze behavior during the decision-making task. Participants were seated approximately 20-in. across from a 24-in. computer monitor. The first screen the participants viewed included general information about the decision-making task (see Appendix A). Participants were told that they could spend as much time as they wanted on the instruction screen, and advanced using a key stroke when they were ready to view the payoff table. Upon pressing the key, a fixation cross appeared at the center of an otherwise white screen for 500 ms, followed by the payoff table screen (see Appendix A). The size of the payoff table on the screen was 9-in. tall × 7-in. wide. Half of the dyads were randomly assigned to play a game of Chicken, whereas the other half were randomly assigned to play a game of Assurance. Similar to the instruction screen, participants could spend as much time as they wanted viewing the payoff table screen, and advanced using a key stroke when they were ready to make their decision.

A manual calibration of eye fixations was conducted at the beginning of each session using a 5-point fixation procedure, as implemented in the Tobii Studio (Version 3.2) software, which served to present and control the stimuli in the experiment. Eye movements were recorded at a sampling rate of 60 Hz (i.e., 60 samples per second) with the Tobii T60 XL eye-tracker (Tobii Technology, Sweden). Both eyes for each participant were tracked, and input from both was averaged. Each of the four cells of the payoff was defined as a separate area of interest (AOI). For each participant, we calculated the proportion of time spent fixating on each of the four AOIs out of the total time they spent fixating on all four AOIs. We also recorded the mean number of fixations prior to the first fixation in each AOI to determine the temporal sequence of fixations to different AOIs.

The final instructions screen in the experiment asked participants to choose between cooperation and competition within the given game structure. We emphasized that their decisions had real monetary consequences. Participants' decisions allowed us to establish the link between psychological prominence and behavioral action. After participants made their decisions, they were debriefed and paid according to their decisions.

Results

Participants in the Chicken condition spent, on average, 26.02 seconds ($SD = 31.46$) fixating on the four matrix cells; participants in the Assurance condition spent, on average, 16.98 seconds ($SD = 11.21$) fixating on the four matrix cells.[3] These two means are not statistically different from each other, $t(49) = 1.36$, $p = .18$, although the direction of the difference potentially lends support to the idea that information processing is easier or more fluent when different bases of psychological prominence converge rather than diverge.

A repeated measures analysis of variance (ANOVA) on the proportion of gaze fixation duration in each of the four matrix cells (out of the total fixation duration across all four cells) revealed a significant effect of matrix cell on attention allocation in both Chicken, $F(3, 75) = 29.64$, $p < .001$, and Assurance, $F(3, 72) = 17.38$, $p < .001$. As shown in Figure 3, participants gazed at the mutual cooperation cell significantly longer than at any of the other three cells (all ps $< .001$). This result replicated for both

[3] These total gaze fixation durations capture only the total time participants fixated on the four matrix cells. Additional time spent gazing at the strategy labels, the player labels, and other parts of the screen were not included in the total gaze fixation durations (see Appendix A).

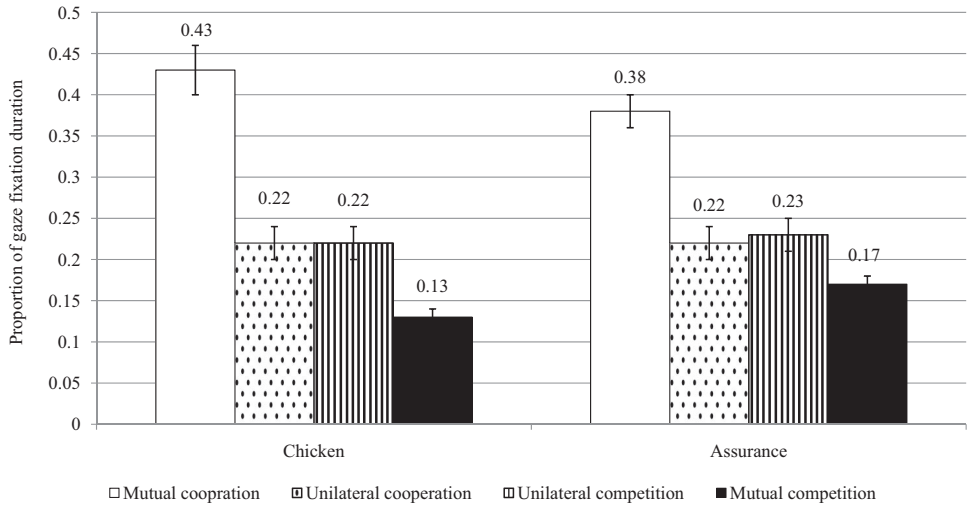

Figure 3. Proportion of gaze fixation duration for each of the four matrix cells in Chicken and Assurance (Study 1). Error bars represent standard errors.

Chicken and Assurance and lends support to our hypothesis that the juxtaposition of symmetry and outcome desirability underlies psychological prominence in interdependence situations.

The proportion of visual attention allocated to the mutual cooperation, unilateral cooperation, and unilateral competition matrix cells did not significantly differ between the Chicken and the Assurance condition, $t(49) < 1.5$, all $ps > .15$. Participants allocated more attention to the mutual competition cell in Assurance as compared with Chicken; this difference, although only marginally significant, $t(49) = -1.95$, $p = .057$, potentially lends support to the idea that outcome desirability underlies psychological prominence: Mutual competition results in worse outcomes for both parties in Chicken as compared with Assurance, and participants clearly allocated less visual attention to it.

Corroborating our findings using the fixation duration measure, our temporal sequence measure indicated that participants fixated on the mutual cooperation cell significantly earlier in the process compared with the other three matrix cells (see Table 1). This result replicated both in Chicken, $F(3, 75) = 27.97$, $p < .001$, and Assurance, $F(3, 72) = 43.91$, $p < .001$. These findings suggest that the juxtaposition of symmetry and desirability influences both gaze fixation duration and the temporal sequence of attention allocation in interdependent decision making.

Finally, consistent with the psychological prominence of mutual cooperation reported above, a large majority of the participants in Study 1 chose to cooperate (86%, 44/51, significantly above chance rate), $\chi^2(1) = 26.84$, $p < .001$, making mutual cooperation not only the most prominent matrix cell but also the most likely outcome of either game in our sample (cf. Halevy et al., 2012, Study 4). These results lend support to our theoretical model outlined in Figure 2, which links psychological prominence to behavioral action.

Discussion

The results of Study 1 provide compelling eye-tracking evidence that individuals pay significantly more attention to the symmetric cell that provides more desirable outcomes (mutual cooperation) than to either the asymmetric cells in the payoff matrix or to the symmetric cell that provides less desirable outcomes (mutual competition). They also fixate to this cell earlier in the process. These findings lend initial support to the idea that symmetry and outcome desirability are important bases of psychological prominence in interdependence situations. Study 1 also links gaze behavior—the distribution of visual attention across the four matrix cells—to social behavior in an interdependent decision-making task, suggesting that attention allocation plays an active functional role in decision making. These findings are consistent with previous results on eye movements in decision making, which documented positive associations between the expected value of an alternative and the amount of visual attention it receives, as well as between gaze allocation and choice likelihood (Orquin & Mueller Loose, 2013).

Table 1
Means (and Standard Deviations) of the Number of Fixations That Preceded the First Fixation to a Given Area of Interest (Study 1)

Game	Area of interest	*M* (*SD*)	*F*
Chicken	Mutual cooperation	0 (0)[a]	—
	Mutual competition	24.88 (17.46)	52.83**
	Unilateral cooperation	13.85 (8.13)	75.46**
	Unilateral competition	22.08 (14.39)	61.18**
Assurance	Mutual cooperation	0.68 (1.91)	—
	Mutual competition	32.72 (19.68)	67.83**
	Unilateral cooperation	14.36 (7.43)	85.49**
	Unilateral competition	29.56 (16.60)	72.71**

Note. *F* values are from planned contrasts in a repeated measures analysis of variance comparing mutual cooperation with each of the other three areas of interest. Degrees of freedom are $F(1, 25)$ and $F(1, 24)$ for Chicken and Assurance, respectively. Dashes indicate reference categories.
[a] All 26 participants in the Chicken condition fixated on the mutual cooperation cell first.
** $p < .001$.

Participants in Study 1 knew that their gaze patterns were being monitored, which potentially made them more diligent in reviewing information in all four matrix cells. The simplicity of the decision task and the relatively low demands on working memory potentially also led them to attend to all four cells, thus reducing the likelihood of nonattendance to certain information. These features make Study 1 a conservative test of our hypotheses.

One possible limitation of Study 1 concerns the fact that previous research has associated the spatial positioning of the mutual cooperation cell—the top-left corner of the payoff matrix—with heightened psychological prominence (Crawford et al., 2008; Schelling, 1960). To address this concern, we conducted a separate study that altered the spatial positioning of the mutual cooperation cell. In this follow-up study, we presented 108 Stanford University MBA students with the payoff matrix of either the game of Chicken or the game of Assurance and asked them to choose which one of the four matrix cells they would be most likely to describe to a stranger who could not see the payoff matrix (our measure of psychological prominence in this follow-up study). Thus, participants had insight into the nature of the situation that the hypothetical stranger did not have and were asked to choose what information about the situation they would like to communicate to the target. Importantly, we switched the spatial position of the mutual cooperation and mutual competition cells, such that the former now appeared in the bottom right-hand cell of the matrix, whereas the latter now appeared in the top left-hand cell of the matrix. Across the two games, an overwhelming majority of the participants chose the mutual cooperation cell even in its new location (85.2%, 92/108, significantly above chance rate of 25%), $\chi^2(3) = 208.82$, $p < .001$, suggesting that the combination of symmetry and desirable outcomes results in high psychological prominence across different possible spatial locations of the information and measures of psychological prominence.

Although the distribution of attention across the four matrix cells in Study 1 is consistent with our theorizing about the psychological prominence of desirable outcomes and symmetry, measuring visual behavior (i.e., gaze fixations) provides little insight into participants' thinking process while reviewing the payoff matrix and making their decisions. Thus, Study 1 provides unequivocal evidence concerning where people look but did not shed light on the reasoning processes underlying individuals' gaze behavior. In Study 2, we addressed this limitation by investigating more directly individuals' thinking while processing information about interdependence situations. By using different process-tracing techniques across different studies, we hope to triangulate on our research problem, approaching the answer from different angles (Reisen et al., 2008; van Raaij, 1977).

Study 2: Getting Inside the Negotiator's Mind

In Study 2, we used query theory to investigate what information is prominent to decision makers in 2×2 games (Johnson, Haubl, & Keinan, 2007). Query theory offers a process account of how decision makers think about their decision problems. The theory proposes that people decompose complex decision problems into a series of queries that they ask and answer for themselves sequentially. Furthermore, the theory posits that query order is important: "the first query results in a richer and more heavily weighted representation than the second" (Johnson et al., 2007, p. 462). In line with query theory, we propose that the questions people ask in the context of strategic games can reveal which elements of their interactions are most prominent to them.

We analyzed in Study 2 people's questions about 2×2 games. Specifically, we created a novel, interactive information-search task as a means to solicit questions about 2×2 games from participants. Consistent with the view that initial responses are most revealing of people's strategic thinking (Crawford et al., 2008, p. 1444; Johnson et al., 2007), we analyzed the contents of the first question in addition to the contents of the entire set of questions asked by each of our participants in this task.

Method

Participants and procedure. The participants were 110 MBA students (71.3% male) at Stanford University who participated as part of an elective course on negotiation. The participants represented 27 different countries, including Australia, Brazil, Canada, Chile, China, Colombia, Costa Rica, India, Iran, Israel, Japan, Mexico, Moldova, Nigeria, Pakistan, Palestine, Peru, Portugal, Qatar, Russia, Rwanda, Saudi Arabia, Taiwan, Turkey, United Kingdom, United States, and Vietnam. Participants were randomly assigned to dyads (i.e., two-person teams) for an exercise titled "The Perspective-taking Challenge." Each participant received a packet with instructions, including a game board that contained the payoff matrices of 25 different 2×2 games, each labeled with a letter (see Figure 1). Each payoff matrix on the game board included a red player and a green player; to reduce cognitive load, the two available strategies were represented using visual symbols rather than text: Participants were told explicitly that the smiling face denotes cooperation and the angry face denotes competition for the purposes of this task.

The exercise included three stages. In the first stage, each participant was instructed to privately and discretely review the game board and choose the payoff structure that best reflected their personal view of the nature of outcome interdependence in two-person negotiation situations. In the second stage, participants wrote down the game that they thought their counterpart chose as their mental representation of two-person negotiation situations. Finally, in the third stage, participants' task was to discover the game actually chosen by their counterpart using the smallest number of yes/no questions possible (similar to parlor games such as "20 questions" and "guess who"). In each dyad, the participants took turns asking questions and were encouraged to continue until they each discovered their counterpart's chosen game. Each dyad could decide who will ask the first question in the interaction. The specific instructions used in this exercise appear in Appendix B.

To motivate the participants to do well in this task (i.e., ask highly diagnostic questions), it was announced that the 10 participants who would discover their partner's chosen game using the fewest *legitimate* yes/no questions would win a negotiation book (copies of the prize book were brought to class

and displayed on the podium as incentive during the exercise).[4] Legitimate questions were defined as questions about the properties of the payoff structures; participants were explicitly forbidden from asking questions about the payoff structure's spatial position on the game-board or the range of letter codes. Participants were required to provide only truthful answers about their chosen payoff structure in response to their counterpart's questions (i.e., no deception was allowed). They were instructed to write down each question that they asked on a designated form included in the instructions packet. Two participants (from two different dyads) failed to submit their forms. Thus, the final sample included information collected from 108 individuals.

Participants within each dyad communicated with one another; therefore, their questions cannot be considered independent observations. Thus, once high interrater reliability was established, we averaged the frequency of each of the coded categories to the dyad level and divided the frequency by the overall number of legitimate questions asked to create a proportion measure for each category, within each dyad. All the analyses reported in Study 2 were done at the dyad level.

Coding of data. The average number of questions participants recorded on their forms was close to four ($M = 3.86$, $SD = 1.75$). Two independent coders coded the questions along multiple dimensions related to strategies (i.e., they counted how many questions mentioned mutual cooperation, mutual competition, unilateral cooperation/competition, making symmetric choices, and making asymmetric choices) as well as outcomes (i.e., how many questions mentioned the best possible outcome, second-best outcome, second-worst outcome, worst outcome, obtaining the same outcomes, and obtaining different outcomes). Table 2 lists all the coding categories, illustrates some of the questions participants asked, and reports the interrater reliability for each of these categories. Interrater reliability was high for all the coded categories (range: $r = .83$ to $r = 1.0$). To further explore the prominence of specific elements within games, the same coding scheme was applied also to the first question that each participant asked (i.e., consistent with Study 1, we operationalized prominence in two different ways: overall frequency and temporal primacy). Because most (although not all) legitimate questions referred both to strategies and outcomes, these different categories were not mutually exclusive.

Naturally, some of the questions were unusable for our purposes, either because participants' handwriting was incomprehensible, because the participants asked questions that violated the instructions by not referring to properties of the payoff structures (e.g., "Is your letter a vowel?" "Do you like winning?"), or because the questions fell beyond the scope of our coding categories (e.g., direct guesses of the counterpart's chosen game: "Is it Q?" "Are you A?" "Is your box M?").

Results

Because questions about strategy and questions about outcomes are not mutually exclusive (e.g., a single question could refer both to the best outcome and to mutual cooperation), we analyzed them separately. Within each domain, we conducted separate analyses for participants' first questions and the entire set of questions. Table 3 presents the relative frequencies of the different coded categories as well as the results of statistical tests.

As Table 3 shows, the findings lend support to our hypotheses about the psychological prominence of desirable outcomes and symmetry. Questions about the best outcome of the game were significantly more frequent than questions about any other level of outcome. Similarly, questions about symmetric choices and outcomes were significantly more frequent than questions about asymmetric choices and outcomes. This finding is particularly compelling because asking a yes/no question either about symmetry or asymmetry provides the same information. Table 3 also demonstrates that, in the entire set of questions, questions about extreme outcomes (i.e., the best and worst outcomes) are more frequent than questions about intermediate outcomes (i.e., the second-best and second-worst outcomes).

Discussion

The results of Study 2 lend support to our hypotheses that outcome desirability and strategic symmetry are psychologically prominent in interdependence situations. Information about the best outcome, symmetric choices, or symmetric outcomes grabbed participants' attention significantly more than information about other levels of outcomes, asymmetric choices, and asymmetric outcomes. This was indicated both by the higher overall frequency of questions about the former types of information compared with the latter types of information and by their temporal primacy (i.e., the higher frequency among participants' first questions). These findings are consistent with Study 1's results (mirroring the findings using the measures of overall proportion of gaze fixations and temporal sequence of attention allocation, respectively), substantiate the idea that some elements within 2×2 games are more psychologically prominent than others, and shed light on negotiators' mental representations of their strategic interactions.

Building on query theory (Johnson et al., 2007), we introduced a novel, interactive information-search paradigm in Study 2 to access what decision makers deem most prominent when thinking about interdependence situations (at least when those are represented using 2×2 games). This novel paradigm also controls for potential spatial effects on the psychological prominence of different types of outcomes by using a large and diverse set of games. Study 2's game board consisted of many different games; consequently, the spatial positions of desirable and undesirable outcomes, as well as those of symmetric and asymmetric outcomes, varied considerably. For example, the best individual outcome appeared in the top-left cell in 11 of the 25 games in the game board, whereas the second-worst individual outcome appeared in the top-left cell in 10 of the 25 games in the game board.

We used graphical icons (happy vs. angry face) rather than verbal text in Study 2 to communicate the available strategies of cooperation and competition in 2×2 games. In addition, we used only positive values (ranging from 1 to 4) to communicate the possible outcomes in 2×2 games. To explore the extent to which

[4] Arguably, the instructions introduced a strategic element into the "perspective-taking challenge" exercise, where each participant tried to outdo his or her counterpart as well as other classmates in guessing the counterpart's chosen payoff matrix. However, the fact that the same pattern of findings replicated using different methods in this research suggests that the strategic nature of the task used in Study 2 did not detract from our ability to identify bases of psychological prominence using this exercise.

Table 2
Coding Categories, Examples of Participants' Questions, and Interrater Reliability of Coded Categories (Study 2)

Coding category[a]	Examples from participants' questions	Interrater *r*[b]
Best outcome	"Can you generate a 4 by cooperating?"	.88/.96
Second-best outcome	"3–3 in dual cooperate?"	.92/1.0
Second-worst outcome	"Does your answer have a 2,3 or a 3,2?"	1.0/[c]
Worst outcome	"If both parties don't cooperate, do they get a 1?"	.88/1.0
Symmetric outcomes	"If made same decision, same outcome?"	.91/.87
Asymmetric outcomes	"When one is competitive and one is cooperative – the competitive gets a higher payout?"	.83/.90
Mutual cooperation	"If we both cooperate, do we both get the best outcome?"	.90/.98
Mutual competition	"If both parties being competitive the worst outcome for both?"	.92/.93
Unilateral cooperation/competition	"Is opposite strategy payoff symmetric?"	.87/.93
Symmetric choices	"If I were to reciprocate your action, would we get equal points?"	.91/.98
Asymmetric choices	"In the situation when one is competitive and the other cooperative, is the payoff higher for the person who is competitive?"	.85/.93

[a] Strategy categories, symmetry of strategy, outcome categories, and symmetry of outcomes were coded independently. [b] The number on the left indicates reliability for the entire set of questions. The number on the right indicates the reliability for participants' first question. [c] Coders A and B were in full agreement in this category; because there was no variance in this category (all zeros), a correlation could not be computed.

these aspects of the study materials influenced our outcomes, we conducted a follow-up study that manipulated the valence of outcomes (i.e., we used positive values ranging from 1 to 4 vs. negative values ranging from −1 to −4) and the availability of strategy labels (i.e., the red and green players' strategies were labeled *cooperation* and *competition* vs. *G* and *N* for the green player and *Q* and *S* for the red player). The pattern of findings in this study replicated Study 2's results in full, revealing that outcome desirability and symmetry are important bases of psychological prominence; interestingly, questions about the best outcome became even more frequent when we used negative values to indicate the possible outcomes of the game as compared with when we used positive values.[5]

Table 3
Relative Frequency of Coded Categories in Participants' First Questions and in the Entire Set of Questions (Study 2)

Variable	First questions		Entire set of questions	
	Proportion	*SD*	Proportion	*SD*
Best outcome	**32.73%**$_a$	34.32%	**35.73%**$_a$	27.96%
Second-best outcome	3.64%$_b$	13.10%	5.27%$_c$	12.36%
Second-worst outcome	0%$_b$	—	1.25%$_d$	5.21%
Worst outcome	6.36%$_b$	16.82%	17.88%$_b$	22.94%
F	30.49**		34.98**	
Symmetric outcomes	**32.73%**$_a$	33.64%	**38.08%**$_a$	30.87%
Asymmetric outcomes	8.64%$_b$	18.77%	18.46%$_b$	26.28%
F	20.00**		7.79*	
Mutual cooperation	**40.00%**$_a$	37.12%	**40.89%**$_a$	23.28%
Mutual competition	7.73%$_b$	20.34%	23.78%$_b$	22.45%
Unilateral cooperation/ competition	6.36%$_b$	16.82%	15.33%$_c$	18.81%
F	27.74**		18.29**	
Symmetric choices	**50.00%**$_a$	39.68%	**60.87%**$_a$	27.96%
Asymmetric choices	6.36%$_b$	16.82%	16.62%$_b$	21.49%
F	50.15**		72.18**	

Note. The most frequent category in each section appears in boldface type. In each section, proportions with different subscripts differ significantly ($p \leq .05$). Dash indicates zero standard deviation.
* $p < .05$. ** $p < .001$.

In Studies 1 and 2, we used payoff matrices to investigate bases of psychological prominence in interdependence situations. In Study 3, we used an alternative method to decouple our observed effects from our methods. Thus, we sought to demonstrate the robustness of outcome desirability and symmetry as bases of psychological prominence across different modes of thinking about interdependence situations. We also extended Studies 1 and 2 by exploring the possibility that relational models moderate information acquisition preferences in interdependence situations. Thus, Study 3 was designed as a direct test of the moderator component in our process model depicted in Figure 2.

Study 3: Relational Models Moderate Information-Acquisition Preferences

In Study 3, we extended Studies 1 and 2 both theoretically and methodologically. Theoretically, we explored the possibility that the nature of relationships between the parties in a given social interaction moderates the types of information that people wish to acquire. Relational models theory (A. P. Fiske, 1992) suggests that four relational models—communal sharing, authority ranking, equality matching, and market pricing—organize human social life. The four relational models differ in how resources and responsibilities are allocated. In communal sharing relationships,

[5] This study used a sample of Stanford University undergraduate students who arrived at the laboratory, learned about the rules of the "perspective-taking challenge" exercise used in Study 2, and were asked to write down what would be the first question they would ask their counterpart in the exercise if they were to participate in it (i.e., each participant provided a single question). Two independent coders coded the contents of participants' questions using the same coding categories used in Study 2. This sample generated a total of 68 usable questions. Of the 68 questions, 19 referred to the best outcome, with only four questions referring to the second-best, three referring to the second-worst, and four referring to the worst outcomes. A logistic regression showed that the likelihood of asking about the best outcome of the game was significantly lower in the positive values condition as compared with the negative values condition (OR = .49, $p = .027$). Questions about symmetric outcomes (28/68) were once again more frequent than questions about asymmetric outcomes (10/68); this advantage was not significantly moderated by our manipulated factors, demonstrating the robustness of our observed effects.

individuals share resources and responsibilities (e.g., family). In authority-ranking relationships, individuals' hierarchical position determines their access to resources and responsibilities (e.g., workplace hierarchy). In equality-matching relationships, individuals strive to maintain strict balance between their contributions and privileges in the relationship (e.g., taking turns carpooling). Finally, in market-pricing relationships, individuals exchange resources and responsibilities on the basis of ratio of their values (e.g., paying a plumber for their services).

To motivate this possible moderator, consider the following examples. Imagine that you are dating someone and that you would like to take him or her out on a surprise dinner on his or her birthday. Would you rather know the person's most favorite type of food or least favorite type of food? Now imagine that you wish to buy a used car that you found on craigslist. Would you rather know the seller's target price (i.e., what is the maximum they hope to get for the car) or their reservation price (i.e., what is the minimum they would be willing to accept for the car)? Most people would rather know their date's most favorite food and the car seller's minimally acceptable price.[6] Thus, in both cases, people would rather have the information that would give them their own best outcome. Whereas in the dating example, the actor's best outcome is aligned with the target's best outcome (i.e., their outcomes are symmetric); in the car buying example, the actor's best outcome is misaligned with the target's best outcome (i.e., their outcomes are asymmetric). Thus, we predicted that individuals will seek information about the best individual outcome across different types of social relations but that their preference for acquiring information about symmetric choices and outcomes will be lower in material exchange relationships (i.e., market pricing) as compared with close personal relationships (i.e., communal sharing).

Methodologically, Study 3 replaced the payoff matrices used in Studies 1 and 2 with verbal descriptions. The verbal descriptions used real-world contexts that were missing in Studies 1 and 2, and used context-specific descriptions of concrete social behavior instead of the more abstract labels of cooperation and competition. In addition to using verbal descriptions, we randomized the order in which different pieces of information, either about the parties' choices or about their outcomes, were presented to different participants. These methodological changes precluded the possibility that the spatial position or presentation order of different combinations of the players' strategies and their outcomes would function as a potential source of psychological prominence (Crawford et al., 2008; Schelling, 1960), and eliminated the reliance on specific numerical values. Finally, to reduce the dependence on judges' coding, Study 3 elicited explicit information-acquisition preferences from participants.

Method

Participants, design, and procedure. We recruited 194 participants from a nationwide online participant pool maintained by Stanford University (56% female; age: $M = 38.6$, $SD = 11.8$). The participants received a link to an online survey and were randomly assigned to one of four conditions. Participants in the communal sharing condition were instructed as follows:

> Imagine you just got married. Each of you can either stay faithful or cheat on the other person with other people. Your respective choices will determine your outcomes.

Participants in the authority ranking-condition were instructed as follows:

> Imagine that you have a new boss at work. You can work hard or be sloppy in your work; your new boss can be supportive or unsupportive. Your respective choices will determine your outcomes.

Participants in the equality-matching condition were instructed as follows:

> Imagine that your college professor assigned you to work on a course project with another student from your class. Each of you can work hard on this project or withhold effort (and invest your time in other things instead). Your respective choices will determine your outcomes.

Finally, participants in the market-pricing condition were instructed:

> Imagine that a mechanic you hired to fix your car charges you an impossibly high price for their services. Assume further that you are now negotiating over the price and that each of you can either take a conciliatory approach or an aggressive approach in this negotiation. Your respective choices will determine your outcomes.

Thus, consistent with the structure of 2×2 games, each condition verbally described a situation with two parties, each facing a choice between a cooperative strategy (e.g., being faithful, working hard) and a competitive strategy (e.g., cheating, taking an aggressive approach in negotiation).

Measures. Participants rated on 5-point scales (1 = *not at all*, 5 = *very much*) how much they would like to know which combination of parties' actions would give them their best outcome, their second-best outcome, their second-worst outcome, and their worst outcome. Presentation order of the four levels of outcomes was randomly determined for each participant.

Participants likewise rated, using the same 5-point scales, how much they would like to know their outcomes for each of the four choice combinations (i.e., mutual cooperation, mutual competition, unilateral cooperation, and unilateral competition). Presentation order of the four choice combinations was randomly determined for each participant.

Results

Outcome desirability. A mixed-design ANOVA with relational model as a between-subject factor and levels of outcomes as a within-subject factor revealed a significant effect of level of outcomes, $F(3, 570) = 86.70$, $p < .001$. There was no main effect of relational model, $F(3, 570) = 0.09$, $p = .97$, suggesting that the type of relationship did not affect how much individuals desired information overall. Relational models also did not moderate the desire to know which choices are associated with different levels of outcomes, $F(9, 570) = 1.10$, $p = .37$.

Table 4 presents the means and standard deviations of participants' information-acquisition preferences as a function of rela-

[6] All the participants in Study 3 actually responded to both questions after taking part in the main study. Over 94% of our participants said they would rather know their date's most favorite type of food; over 87% of our participants said they would rather know the seller's reservation price.

Table 4
Mean Ratings of Desires to Acquire Different Pieces of Information About Interdependence Situations as a Function of Relational Model (Study 3)

Variable	Communal sharing		Authority ranking		Equality matching		Market pricing		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Best outcome	4.49_{a}	0.78	4.65_{a}	0.62	4.51_{a}	0.90	4.72_{a}	.58	4.60_{a}	0.72
Second-best outcome	3.41_{b}	1.13	3.69_{b}	1.13	3.63_{b}	0.94	3.60_{b}	1.17	3.58_{b}	1.10
Second-worst outcome	3.14_{c}	1.30	3.16_{c}	1.37	3.10_{c}	1.26	2.94_{c}	1.29	3.09_{c}	1.30
Worst outcome	3.67_{b}	1.34	$3.36_{b,c}$	1.50	$3.29_{b,c}$	1.52	3.55_{b}	1.41	3.47_{b}	1.44
Mutual cooperation	4.24_{a}	1.24	4.45_{a}	0.81	3.95_{a}	1.45	4.00_{a}	1.18	4.18_{a}	1.18
Mutual competition	3.37_{b}	1.48	3.15_{c}	1.35	3.02_{b}	1.48	$3.74_{a,b}$	1.22	3.32_{c}	1.40
Unilateral cooperation	3.80_{a}	1.37	4.04_{b}	1.11	3.83_{a}	1.28	3.51_{b}	1.35	3.80_{b}	1.28
Unilateral competition	3.41_{b}	1.34	3.13_{c}	1.40	3.05_{b}	1.41	$3.57_{a,b}$	1.30	3.29_{c}	1.37

Note. Separate analyses were conducted for levels of outcomes and strategic choice. In each column, means with different subscripts differ significantly ($p < .05$).

tional model. As shown in Table 4, the desire to know which choices lead to the best outcome was significantly stronger than the desires to know the choices that lead to any other level of outcomes. These findings replicate Study 2's finding that the best outcome of the game is more psychologically prominent to individuals than other levels of outcomes. They extend Study 2's findings by showing that the preference for acquiring information about the best outcome replicates across different relational models.

Strategic choice. A mixed-design ANOVA with relational model as a between-subject factor and strategy as a within-subject factor revealed a significant effect of strategy, $F(3, 570) = 27.02$, $p < .001$, which was qualified by a significant Relational Model × Strategy interaction, $F(9, 570) = 2.72$, $p = .004$. There was no main effect of relational model, $F(3, 570) = 0.79$, $p = .50$, suggesting that the type of relationship did not affect how much individuals desired information overall.

Across the four relational models, the desire to know the consequences of mutual cooperation was significantly stronger than the desires to know the consequences of any other possible combination of strategies, $F(1, 190) = 39.19$, $p < .001$. These findings are consistent with the results of Study 1, which revealed that individuals allocated significantly more visual attention to the mutual cooperation cell in two different interdependent decision-making situations (i.e., the games of Chicken and Assurance). They extend Study 1 by showing that this preference manifests not only in gaze behavior, which is less controllable, but also in conscious, explicit choice.

At the same time, the magnitude of the difference between the desires to know the consequences of mutual cooperation and the desires to know the consequences of other combinations of strategies varied as a function of relational model (see Table 4 for complete results). For instance, the advantage of the desire to know the consequences of mutual cooperation over the desire to know the consequences of mutual competition emerged in communal sharing, authority-ranking, and equality-matching relationships, but not in market-pricing relationships.

Discussion

Study 3 replicated and extended the findings of Studies 1 and 2 in four important ways. First, it showed that outcome desirability is an important and robust basis of psychological prominence across fundamentally different types of social relationships. Second, it showed that the type of social relations in which a social interaction is embedded moderates the magnitude of the *relative preference* for information about mutual cooperation in a theoretically predictable way. Third, it showed that actual information search patterns in strategic interactions as assessed either using eye tracking (Study 1) or via an interactive thought-tracing tool (Study 2) closely correspond to explicit preferences for different types of information in strategic interactions (Study 3). Thus, people's information search patterns map well on what they wish to know. Finally, Study 3 showed that the results of Studies 1 and 2 replicate also when spatial prominence and specific numerical values are absent, and social context is present. Put differently, it demonstrated that the results of Studies 1 and 2 hold also when interdependence situations are not represented in abstract matrix form.

Consistent with our hypotheses, results from Studies 1 through 3 document the psychological prominence of the best possible outcome and mutual cooperation in people's information-search patterns and information-acquisition preferences. In Study 4, we took the current research a step further by investigating information use during costly decision making. Specifically, we compared costly decisions in strategic interactions with complete information versus incomplete information. Participants in the complete information conditions in Study 4 knew the outcomes associated with each possible combination of the players' choices; decision makers in the incomplete information conditions in Study 4 knew only the information that emerged as most prominent in our previous studies, that is, either which combination of the players' choices would provide them with their best outcome or what their outcomes would be under mutual cooperation. Thus, Study 4 provided a direct test of the link between psychological prominence and behavioral decisions in our theoretical process model (see Figure 2). Unlike Study 1, in which we assessed psychological prominence and behavioral decisions, in Study 4 we manipulated availability of information and assessed decision latency and content to allow causal inferences concerning the value of information in interdependent decision making.

Study 4: The Value of Information in Interdependent Decision Making

Studies 1 through 3 documented patterns of information-search and information-acquisition preferences in interdependence situations. In Study 4, we investigated how these documented tendencies to focus on particular information influence costly decision making in interdependence situations. Specifically, we investigated strategic decisions under three different conditions: when decision makers have perfect and complete information; when decision makers only know which combination of strategies provides them with their best possible outcome and all other information is hidden; and when decision makers only know their own outcome for mutual cooperation and all other information is hidden (see Figure 4). We investigated the effects of information availability in the same two prototypical games used in Study 1 (i.e., Chicken and Assurance) and measured one process variable and one outcome variable as our dependent measures: time spent on the decision-making task (Glöckner & Betsch, 2012; Rand, Greene, & Nowak, 2012) and cooperation rates across 10 rounds of the game (without feedback between rounds).

Recall that, in the game of Assurance, different bases of prominence converge (i.e., mutual cooperation, which is a symmetric combination of strategies) provides the best individual outcome and the best collective outcome. Because this game "is trivial, in the sense that the same outcome is most preferred by both players" (Rapoport, 1967, p. 81), we predicted that decision makers would make approximately the same decisions (i.e., cooperate in equivalently high rates) regardless of whether they see the entire payoff matrix, only their best possible outcome, or only their outcomes for mutual cooperation. Although seeing the entire payoff matrix means that individuals would have more information to review, process, and weigh, and may therefore take longer to reach a decision, we predicted that decision makers would make their decisions faster when they see the entire payoff matrix than just one eighth of the possible outcomes. This is because complete information in Assurance removes any doubts about a potential conflict of interest between the players. Put differently, the absence of information plausibly makes players contemplate more (e.g., Will I be harming the other person?) than the presence of information in Assurance. This idea is consistent with recent theory and findings showing that "an increase in information amount can yield a decrease in decision time if the added information increases coherence in the information set" (Glockner & Betsch, 2012, p. 532).

The logic in the game of Chicken is reversed. In the game of Chicken, different bases of prominence diverge (i.e., the best individual outcome is achieved through unilateral competition rather than through mutual cooperation). Therefore, we predicted that people who would only see which combination of strategies produces their best individual outcome in Chicken would cooperate less frequently than people who see the entire payoff structure and can appreciate also the risks associated with mutual competition (i.e., a disastrous head-on collision that results in the worst possible outcome to both players), as well as the relationship between their best outcome and the other player's outcome. Because the game of Chicken involves brinkmanship and competition for dominance (Halevy et al., 2011), we predicted that decision makers would actually make their decisions faster when they do not see the entire payoff matrix. Thus, we reasoned that complete information in Chicken facilitates contemplation and potentially introduces doubts about the desired course of action rather than removes them. Put differently, the absence of information in Chicken may simplify the decision problem as compared with perfect and complete information in Chicken.

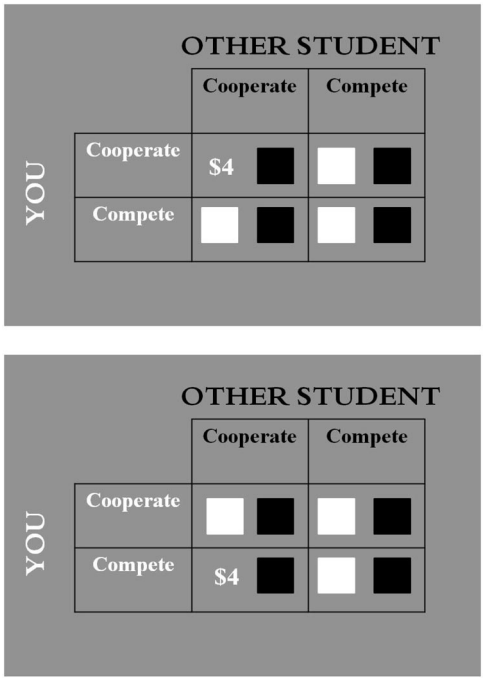

Figure 4. Examples of payoff matrices used in the incomplete information conditions for Assurance (top) and Chicken (bottom; Study 4).

Method

Participants. One hundred twenty-four Stanford University students and staff participated (59% female, age: $M = 21$, $SD = 2.6$).

Design and procedure. Participants arrived at the laboratory in large groups and were each seated in a private cubicle. They received written instructions and made all of their decisions using the computer. A 3 (information: complete vs. incomplete - mutual cooperation vs. incomplete - best outcome) × 2 (game: Assurance vs. Chicken) mixed design was used, with information as a between-subject factor and game as a within-subject factor. All the participants made decisions in two normal form games (see Figure 4); within each game, they made decisions in 10 rounds without receiving feedback between rounds. This provided a continuous measure of their cooperation rate in each game. The computer recorded the amount of time that participants spent making decisions in each of the two games.

The computer randomly assigned participants to one of three information conditions. Participants in the complete information condition first played 10 rounds of the Assurance game and then

played 10 rounds of the Chicken game.[7] We used the same payoffs presented in Figure 1 (Matrices A and C, respectively) and Appendix A. Thus, in each round of each of the two games, the participants could earn between \$1 and \$4 depending on their decisions and the decisions of their randomly assigned counterpart. It was announced that at the completion of the study, one pair of participants will be chosen to receive payment on the basis of all of their decisions. Thus, participants could earn up to \$80 on the basis of their decisions in Study 4.

Participants in the first of our two incomplete information conditions only received information about their profits in the case that both players would choose to cooperate (henceforth labeled *incomplete information – CC* condition). All other seven numbers were hidden behind boxes that matched each player's assigned color (i.e., either red or blue; see Figure 4). Participants first made 10 decisions in a game in which mutual cooperation provided them with the maximum possible payoff of \$4 (i.e., consistent with the payoff in Assurance, among other games; they were explicitly told that the possible range was \$1–\$4). Participants subsequently made 10 decisions in a game in which mutual cooperation provided them with a profit of \$3 per round (i.e., consistent with the payoff in Chicken, among other games; again, they were explicitly told that the possible range was \$1–\$4).

Participants in the second incomplete information condition only received information about the combination of strategies that results in the highest individual profit for them (henceforth labeled *incomplete information – best* condition). All other seven numbers were hidden behind boxes that matched each player's assigned color (i.e., either red or blue). Participants first made 10 decisions in a game in which mutual cooperation provided them with the best individual outcome of \$4 (i.e., consistent with the payoff in Assurance, among other games; participants knew that the possible range was \$1–\$4). Participants subsequently made 10 decisions in a game in which unilateral competition on their side provided them with the best individual outcome of \$4 per round (i.e., consistent with the payoff in Chicken, among other games; they knew that the possible range was \$1–\$4).

Results

Decision latency. A repeated measures ANOVA revealed significant effects of game, $F(1, 120) = 31.25$, $p < .001$, and information, $F(2, 120) = 23.27$, $p < .001$, on time spent on the task (i.e., decision latency). These main effects were qualified by a significant Game × Information interaction, $F(2, 120) = 144.00$, $p < .001$. As predicted, participants made their decisions in Assurance significantly *faster* when they had complete information as compared with incomplete information ($p < .001$ for both comparisons). The two incomplete information conditions did not significantly differ from each other, $t(120) = -0.75$, $p = .46$. In contrast, participants made their decisions in Chicken significantly *slower* when they had complete information as compared with incomplete information ($p < .001$ for both comparisons). The two incomplete information conditions did not significantly differ from each other, $t(120) = -0.38$, $p = .70$. Figure 5 presents these findings.

Cooperation rates. A repeated measures ANOVA revealed significant effects of game, $F(1, 120) = 13.30$, $p < .001$, and information, $F(2, 120) = 3.45$, $p = .04$, on cooperation rates (see Figure 6). The Game × Information interaction was not statistically significant, $F(2, 120) = 1.83$, $p = .16$. As predicted, consistent with the fact that different bases of psychological prominence converge in Assurance, participants cooperated at similar levels regardless of whether they received complete information or incomplete information ($p > .10$ for both comparisons). The two incomplete information conditions did not significantly differ from each other, $t(120) = -0.44$, $p = .66$.

In contrast, consistent with the fact that different bases of psychological prominence diverge in Chicken, participants cooperated significantly *more* when they received complete information (i.e., when they could appreciate the risks associated with competing in this situation as compared with when they received information only about their best outcome), $t(120) = 2.86$, $p = .005$. When participants received information only about the outcomes of mutual cooperation, cooperation rates were in between the other two conditions, and not significantly different from either, $t(120) < 1.6$, $p > .10$, for both comparisons.

Discussion

In Studies 1 through 3, we investigated patterns of information search and information-acquisition preferences in interdependence situations. In Study 4, we took a step further and explored the downstream consequences of individuals' focal points and blind spots (i.e., how the availability of different types of information influences costly decision making). The findings of Study 4 underscore important differences between coordination situations in which different bases of psychological prominence converge (i.e., Assurance) versus diverge (i.e., Chicken). In the former case, decision making is simplified and takes less time when participants have complete information, and individuals make the same behavioral decisions regardless of whether they have perfect and complete information or only focus on (or receive) psychologically prominent information. In the latter case, decision making is exacerbated and takes longer when participants have complete information, and individuals make different behavioral decisions when they have perfect and complete information than when they focus on (or receive information only about) the best individual outcome. These findings extend the results of Studies 1 through 3 by highlighting how different types of interdependence situations moderate the potential consequences of psychological prominence (and complementarily, blind spots) in interdependent decision making.

General Discussion

The current research proposed a general process model of attention allocation in interdependent decision making and tested its various components in four studies in which diverse methods were used to investigate what information captures decision makers' attention as well as how individuals' information-search and ac-

[7] Ideally, we would have liked to counterbalance the order of the two games for half our participants. Unfortunately, due to technical constraints, this was not done in Study 4. Nonetheless, the fact that we find a theoretically predictable interaction between game and information availability (rather than only main effects of game) on decision latency suggests that our findings go beyond simple order effects.

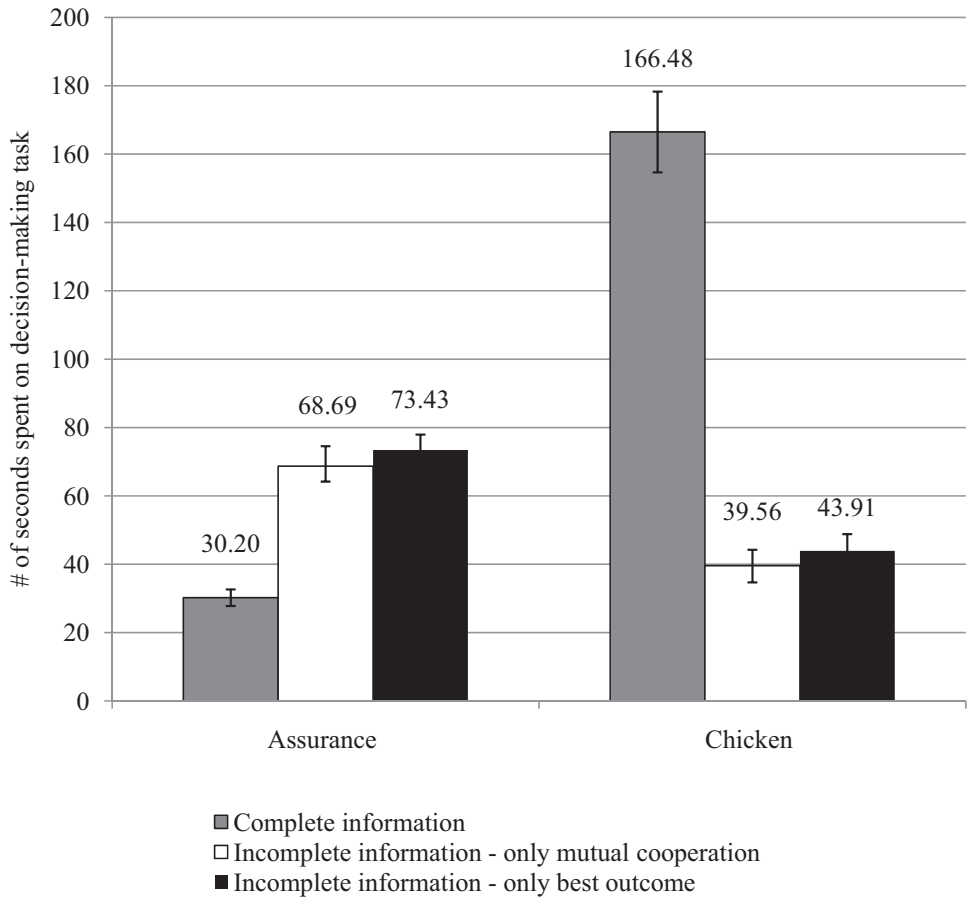

Figure 5. Time spent on decision-making task as a function of payoff structure and type of information available (Study 4). Error bars represent standard errors.

quisition tendencies might influence their decision making in interdependence situations. Specifically, we tested the hypotheses that outcome desirability and symmetry are important bases of psychological prominence in interdependence situations, that relational models moderate what information gains psychological prominence in interdependence situations, and that the information that people attend to and focus on in interdependence situations shapes their decision making.

In Studies 1 and 2, we tested our first two hypotheses (i.e., the attention distribution component of our model) using complementary process-tracing methods (Reisen et al., 2008). We used eye-tracking measures in Study 1 and found that individuals paid significantly more attention to the mutual cooperation cell (and fixated on it earlier) as compared with the two asymmetric cells (thus supporting the prominence of symmetry), or the mutual competition cell (thus supporting the prominence of outcome desirability). Consistent with the prominence of the mutual cooperation cell in this sample, a large majority of the participants in Study 1 chose to cooperate when making costly decisions in two types of interdependent decision-making tasks (Chicken and Assurance games). Study 2 introduced a novel experimental task that modeled important aspects related to information search and perspective taking in face-to-face negotiation (i.e., trying to get inside the head of one's counterpart; Ames et al., 2012; Galinsky, Maddux, Gilin, & White, 2008). Analyzing the contents of participants' questions in this interactive information-search task provided further support to the hypotheses that desirable outcomes and symmetric choices and outcomes are psychologically prominent in interdependence situations as modeled by 2×2 games. Individuals asked significantly more questions about the best possible outcome as compared with other levels of outcomes; they also asked significantly more questions about mutual cooperation than about other combinations of the player's choices. These findings replicated across two measures of psychological prominence used in Study 2: overall frequency and temporal primacy (i.e., mentions in participants' first questions). These findings were also replicated in two follow-up studies in which alternative methods and materials were used (see Footnote 6).

In Study 3, we investigated explicit information-acquisition preferences and found that outcome desirability is a robust basis of psychological prominence across four qualitatively different relational models: communal sharing, authority ranking, equality matching, and market pricing (A. P. Fiske, 1992). However, relational models moderated the prominence of different combinations of the parties' strategic choices, lending support to the idea that contextual variables moderate attention allocation in decision-

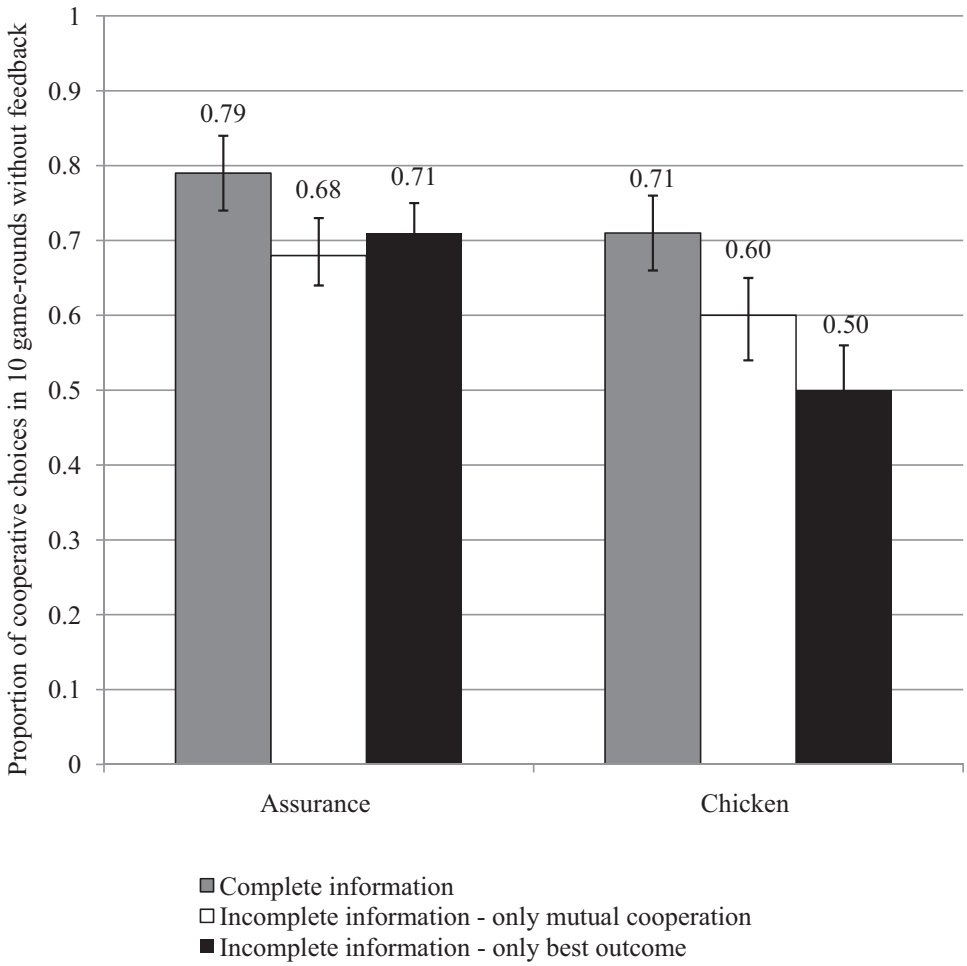

Figure 6. Proportion of cooperative choices as a function of payoff structure and type of information available (Study 4). Error bars represent standard errors.

making situations (see Figure 2; Orquin & Mueller Loose, 2013). In particular, in communal sharing, authority-ranking, and equality-matching relationships, individuals desired information about the outcomes associated with mutual cooperation (and unilateral cooperation) more than information about the outcomes associated with mutual competition and unilateral competition, whereas in market-pricing relationships, these different types of information were sought to similar degrees. Thus, Study 3 highlights an important boundary condition for the psychological prominence of mutual cooperation. The fact that these findings were obtained using a different methodology (that eliminated spatial position and specific numerical values as possible sources of psychological prominence, and randomly determined presentation order for each participant) contributes to the robustness and generalizability of our findings.

Finally, in Study 4 we investigated information use in interdependent decision making. Participants made costly decisions in interdependence situations in which different bases of psychological prominence either converged or diverged (i.e., called attention to the same or to different matrix cells), and with different types of information that was made available to them. When different bases of prominence converged, participants made the same decisions (cooperated at similar rates) regardless of whether they received complete information or only the information that emerged as psychologically prominent in Studies 1 through 3. In contrast, when different bases of prominence diverged, the type of information individuals received significantly influenced their decisions (i.e., information had decision value). We also found in Study 4 a significant Situation × Information interaction on the time participants took to make their decisions. Incomplete information resulted in longer decision latencies as compared with complete information when different bases of prominence converged (Glockner & Betsch, 2012), but in shorter decision latencies as compared with complete information when different bases of prominence diverged. These findings, in combination with the behavioral choice findings from Study 1, lend support to the hypothesized path from attention distribution to behavioral decision making in our theoretical model (see Figure 2).

Taken together, these findings help answer long-standing and fundamental research questions about the psychological prominence of different types of information in interdependence situations (March, 1994; Schelling, 1960) and enhance our understand-

ing of decision makers' mental representation of their interdependence (Camerer, 2003a; Halevy et al., 2012).

Theoretical Contributions

The current research advances research on bounded rationality (Gigerenzer & Goldstein, 1996), and more specifically on bounded awareness (Chugh & Bazerman, 2007), by mapping focal points and blind spots in interdependent decision making (Schelling, 1960). March (1994) proposed that,

> Decision makers do not consider all consequences of their alternatives. They focus on some and ignore others. Relevant information about consequences is not sought, and available information is not used. . . . Time and capabilities for attention are limited. Not everything can be attended to at once. Too many signals are received. Too many things are relevant to a decision. (pp. 9–10)

In the current research, we identified what information is sought and used and what is not. We showed, for example, that obtaining more information (i.e., beyond what is psychologically prominent) has decision value when different bases of prominence diverge, but not when different bases of prominence converge (in Assurance, acquiring more information did not affect choice, although it did shorten the time spent on the decision-making task). Complex decision problems often introduce information overload (Wiltermuth & Neale, 2011), and the allocation of attention determines what information is acquired, thereby influencing decisions. Specifically, attention allocation processes play an active role in decision making by limiting the decision to fixated stimuli and enhancing the influence of fixated information (Orquin & Mueller Loose, 2013). The current research enhances our understanding of the ways in which decision makers simplify their decision problems and how they organize their attention in interdependent decision-making situations.

The current research also contributes to a growing literature on the mental representation of conflict situations in particular and interdependence situations more generally. Recognizing that subjective perceptions of interdependence shape strategic choice in interdependence situations (Kelley et al., 2003; Kelley & Thibaut, 1978), this literature seeks to understand people's construal of their social interactions (i.e., what games people think they are playing; Camerer, 2003a, 2003b; Kreps, 1990; Rubinstein, 1991). Previous research focused on "perceptual gestalts," that is, on complete game representations (Ames et al., 2012; Devetag & Warglien, 2008; Halevy et al., 2011, 2012; Plous, 1985). We took a step further in the current research by investigating which elements are the "active ingredients" within these broader mental representations, that is, which elements of interdependence are the proximate causes of strategic behavior. Understanding how people decompose interdependence situations—which elements are attended to and which elements are relatively overlooked—sheds light on how people construe interdependence and think through their social interactions (Halevy & Katz, 2013).

Finally, the current research also broadens and enriches behavioral decision theory by integrating concepts and ideas from different theoretical frameworks, including query theory (Johnson et al., 2007), interdependence theory (Kelley et al., 2003; Kelley & Thibaut, 1978), behavioral game theory (Camerer, 2003a; Crawford et al., 2008; Schelling, 1960), and relational models theory (A. P. Fiske, 1992) to explain how decisions happen (March, 1994). It also introduces a novel, interactive experimental paradigm that can be used to investigate information-search patterns and perspective taking in various interdependent decision-making situations (e.g., deal-making negotiations, dispute resolution, coalition bargaining).

Practical Implications

Understanding which aspects of interdependence really matter also has important practical implications. For instance, Halevy, Cohen, Chou, Katz, and Panter (in press) surveyed thousands of employees across the United States about their interdependence beliefs. Specifically, they asked them whether mutual cooperation or unilateral exploitation of a cooperative counterpart leads to the best outcome in conflict and whether mutual competition or yielding to a competitive counterpart leads to the worst outcome in conflict. Consistent with the results of the current investigation, which show that the best outcome is more psychologically prominent than the worst outcome, employees' responses to the first question of the two mentioned above were highly predictive of their social relations in organizations, whereas their responses to the second question were uncorrelated with their social relations. In particular, people's beliefs about the best outcome in conflict predicted workplace conflict, workplace ostracism, and abusive supervision for up to 3 months after the assessment of interdependence beliefs. In contrast, beliefs about the worst outcome of conflict did not reliably predict social relations either with peers or with supervisors at work. Knowing which aspects of interdependence situations really matter not only affords better prediction of social relations; it also allows conflict managers to focus their efforts on changing dysfunctional social relations and resolving unnecessary conflicts.

The practical value of the current findings potentially increases as decision makers move away from simple and structured problems and confront complex problems in which they have to make high-stakes decisions under conditions of time pressure, information overload, and heightened uncertainty or risk. Knowing how decision makers tend to simplify their decision problems and construe their interdependence can help devise decision support systems to correct for possible oversights in complex interdependent decision-making situations. For example, sampling primarily information related to the best possible outcome may result in excess market entry (Camerer & Lovallo, 1999) or optimistic overconfidence during military disputes (Kahneman & Tversky, 2000); countering these tendencies may help entrepreneurs and generals make better informed decisions.

Strengths, Limitations, and Future Directions

Our multimethod investigation identified robust patterns of information search and use in interdependent decision-making situations. It also shed light on a relatively overlooked source of mutual cooperation among humans—the psychological prominence of symmetry and desirable outcomes. A natural extension of these findings concerns the possibility that different people differ in the extent to which they tend to focus on the whole rather than its parts. For example, epistemic motivations such as need for cognition (Cacioppo & Petty, 1982), need for cognitive closure (Kruglanski & Webster, 1996), and strategic sophistication (Camerer, Ho, & Chong, 2004), as well as situational

conditions that affect information processing (e.g., time pressure: De Dreu, 2003; process accountability: De Dreu et al., 2008; Lerner & Tetlock, 1999) may affect the tendency to focus only on psychologically prominent information rather than systematically acquire and process all the available information. In addition to the role of epistemic motivations, future investigations may also explore the role that social motives (e.g., De Dreu & Carnevale, 2003; Van Lange, Otten, De Bruin, & Joireman, 1997), discrete emotions (e.g., Forgas & George, 2001), culture (Elliot, Chirkov, Kim, & Sheldon, 2001), and self-construal (e.g., Lee, Aaker, & Gardner, 2000) play in determining which information decision makers seek and use in interdependent decision making.

Decision makers are influenced by both positive and negative information in interdependent decision making (cf. the "bad apple effect" in social dilemmas: Kerr et al., 2009; and the influence of "consistent contributors" in social dilemmas: Weber & Murnighan, 2008). Future research may seek to integrate the current findings, which show that the best possible outcome is a robust basis of psychological prominence (see also Hristova & Grinberg, 2005; Orquin & Mueller Loose, 2013), with findings showing that negative information, once acquired, tends to be weighted more heavily than equivalent positive information (Baumeister et al., 2001; Kahneman & Tversky, 1979; Rozin & Royzman, 2001). One possibility is that, because negative information is weighted heavily, people actively search for more instances of positive information to offset or balance the negative information. Thus, for example, consistent with the idea that motivational goals direct information search and processing, and the notion of confirmation bias (De Dreu et al., 2008), an entrepreneur who wishes to enter a new market may actively seek positive information about the prospects of success to offset negative information about the possible risks associated with market entry (Camerer & Lovallo, 1999). Future research may investigate this possibility directly.

The current set of studies used diverse methods to investigate our fundamental research questions. We have used eye tracking to assess the allocation of visual attention in decision-making situations, analyzed the contents of interactive questions and answers, elicited explicit information acquisition preferences, and experimentally manipulated the structure and information availability in interdependent decision-making situations, assessing their effects on both decision latency and strategic choice. Future research may extend these efforts further, for example, by using additional measures (e.g., willingness to pay for different types of information) to investigate the relative prominence of outcome desirability and symmetry in interdependent decision-making situations.

Conclusion

Information search and acquisition is a crucial first step in decision making. Decision makers tend to simplify decision problems, focus on some information while ignoring others, and base their choices on psychologically prominent information (March, 1994; Schelling, 1960; Simon, 1982). The current research mapped decision makers' bounded awareness in interdependence situations and identified desirability and symmetry as two important bases of psychological prominence. It also highlighted the role that relational models and convergence versus divergence of different bases of prominence play in shaping patterns of information search and use. The current findings address two fundamental, open research questions: What information is attended to in interdependent decision-making situations? and What do mental representations of interdependence situations look like? The results enhance our understanding of how people think about their interdependence and how they make decisions in strategic interactions.

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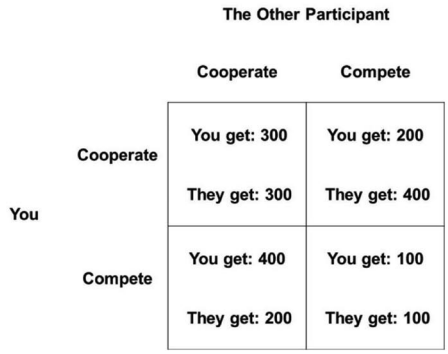
Appendix A

Instruction Screen and Stimuli Used in Study 1

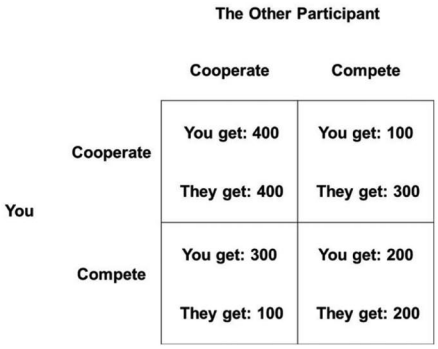
Decision-Making Task

In this task, you and another participant, who is currently seated in a different breakout room in the lab, will make simultaneous decisions, independently and without communicating with each other. Each of you will choose whether to cooperate or compete. Your choices will determine your payment in this task. The money will be paid to you at the end of the experiment, in cash, in addition to your payment for participating in today's experiment. On the next screen, you will see a payoff matrix with four cells. Each cell presents the payment to each of you (in cents) as a function of your choices. In each cell, the number on top represents the payment to you, and the number at the bottom represents the payment to the other person. Please go over the payoff matrix carefully. When you feel that you are ready to make your decision, press the space key to continue to the decision screen. If you have any questions about this task, please ask the experimenter now.

(*Appendices continue*)



Stimulus used in the Chicken condition



Stimulus used in the Assurance condition

Appendix B

Instructions Used in the "Perspective-Taking Challenge" Task in Study 2

In this exercise, you and your counterpart will each receive a game board with 25 different payoff structures. Each payoff structure includes a GREEN player and a RED player. Each player has two possible strategies: Cooperation, represented by the happy face, and Competition, represented by the angry face. The outcomes for each player range from "worst" = 1, to "poor" = 2, to "good" = 3, to "best" = 4. The outcomes for each player are represented in matching colors. In each cell, the green number on the left represents the outcome for the GREEN player and the red number on the right represents the outcome for the RED player.

The game has three steps.

1. In step one, each of you will choose the payoff structure *that best captures your view of a two-person negotiation*. Write the letter label of your chosen payoff structure on the Perspective-Taking Challenge form on the next page. Make sure not to show this to your counterpart.

2. In step two, write the letter label of the payoff structure that you think your counterpart has indicated on their Perspective-Taking Challenge form.

3. In step three, you and your counterpart will take turns asking each other "yes"/"no" questions about the chosen payoff structure (similar to many familiar children's games like "20 questions" and "guess who"). You must provide correct answers in response to your counterpart's questions. No deception is allowed! You can only ask questions about properties of the payoff structures (and not about their spatial position on the game board or the range of letter codes). Continue until both of you have discovered each other's chosen payoff tables.

Each of you should write down your questions to the other person as you ask them, in order, on the Perspective-Taking Challenge form. This record will be checked by our Teaching Assistant to determine the rightful class winners in this exercise. Your goal in this "mind reading" exercise is to discover your counterpart's chosen payoff structure using the smallest number of "yes"/"no" questions possible. As noted above the [number] of students with the lowest number of *legitimate* "yes"/"no" questions will win the book [name of negotiation book used as a prize]. A raffle will be used if more than [number] students are tied.

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