CHAPTER

9

Social and Emotional Factors in Decision-Making: Appraisal and Value

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OUTLINE

INTRODUCTION

In an effort to understand the basic processes that underlie decisions, scientists have typically exposed individual human participants as well as animals to choice situations in laboratory settings. As this volume and the larger literature demonstrates, this approach has yielded robust and exciting findings delineating the behavioral and neural mechanisms underlying simple choice and complex decisions. In spite of this success, to fully understand the complexity of human decisions, it is necessary to consider the range of factors that may be more prevalent in decisions outside the laboratory. In this chapter we discuss two of these factors: emotion and social interaction.

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We consider each of these factors independently, but there is significant overlap in that a primary means to elicit emotions is by introducing social interaction. For instance, it has been shown that members of different social groups elicit distinct emotional responses (Cuddy, Fiske & Glick, 2007; Harris & Fiske, 2007), which can impact subsequent decisions. In addition, as the discipline of social psychology has demonstrated repeatedly over the years, merely the presence of another may alter how we choose to act, one reason (of many) being the emotional discomfort of non-conformity (e.g., Asch, 1956). Importantly, both emotion and social interaction introduce factors that alter the determination of subjective value and, as a result, the decision.

A common mechanism through which this might occur is appraisal. Although economic studies of decision-making often refer to value as if it is a property of the object or choice being evaluated, an equally important component of the value computation is the appraisal by the evaluator. Both individual trait-like factors, such as risk sensitivity, and situational factors, such as satiation when assessing food rewards, can change the subjective value one assigns to a choice. In this chapter, we suggest that both emotion and social interaction can be situational factors that influence decisions, in addition to trait-like emotional dispositions. Furthermore, we suggest that a mechanism by which both emotion and social interaction influence decisions is to alter the appraisal of the choice options, thus influencing the value computation.

Below we review recent studies examining the impact of emotion and social interactions on economic and neuroeconomic decision tasks. We also highlight a few studies examining how these factors interact; for example, how a social stimulus elicits an emotional response that influences the decision. This review is not exhaustive, but rather highlights studies that demonstrate how emotional and social factors can influence the appraisal of the choice options in altering the decision and its underlying neural representation.

EMOTIONAL FACTORS

Emotion is a broad concept that is thought to represent a range of component affective processes (e.g., see Scherer, 2005 for a more detailed discussion). Although a review of component process models of emotion is beyond the scope of this chapter, a few basic definitions are useful in considering the role of emotion in decision-making. The term "emotion" is often used to describe a discrete, synchronized patterned response in reaction to an external or internal event which may include all or some of the following: subjective experience or feeling, bodily responses such as physiological arousal, expression in the face or body, and action

tendencies – i.e., the propensity to approach or withdraw. Emotion is often differentiated from mood, which is a more stable, long-lasting state primarily characterized by subjective experience that may or may not be elicited by an internal or external event. Finally in some theories of emotion, preference (and/or attitude) refers to the more enduring properties of people or objects resulting in an affective evaluation and a corresponding action tendency.

Although the relation between emotion and decision-making has long been a topic of philosophical debate (Aristotle, trans 1941), economic theories of judgment and decision-making (Kahneman, 2003) and neuroeconomic investigations (Cohen, 2005), surprisingly few studies of decision-making have explicitly measured or manipulated emotion variables. In our brief review of this literature, we only focus on studies that introduce emotion into the task and assess the impact on choice and/or measure a specific emotional response and link it to choice. We exclude studies that infer an emotional response from patterns of brain activation or brain injury (i.e. reverse inference), unless accompanied by an assessment of emotion.

One of the traditional techniques used in affective science to introduce an affective component into a task is mood induction. In a study designed to assess the impact of mood on a classic economic decision, Lerner, Small & Loewenstein (2004) presented participants with one of three film clips and assessed decisions with an endowment-effect scenario. The first two film clips elicited self-reported feelings of sadness and disgust respectively, and a third, neutral film clip, elicited no emotion in particular. Immediately afterwards, participants were either given a set of highlighters and asked for how much they would sell those highlighters, or they were shown the highlighters and asked several times to choose between different amounts of money and the highlighter set (eliciting a "choosing equivalent," or the amount of money at which point they would be indifferent between the money and the highlighters).

In the neutral condition, participants exhibited a classic endowment effect, in which selling prices for the highlighter set were higher than choosing equivalents (i.e., the prospect of "losing" the highlighters when selling them is worse than the prospect of "gaining" them at the same price). Interestingly, when participants decided on selling and choosing prices after watching the "sad" movie clip, they exhibited a reversal of the endowment effect – choosing prices were higher than selling prices. After the "disgust" clip, choosing and selling prices were both low, and equal.

To explain this striking reversal or elimination of the classic endowment effect with a simple mood manipulation, Lerner and colleagues (2004) suggested that moods can result in an appraisal tendency; that is, a tendency to appraise unrelated events in a manner consistent with that

mood. For instance, when sad, the tendency is to move away from the current circumstance to one that is less depressing. In the classic endowment effect, an individual values what he or she already possesses over something new. When sad, however, changing the current circumstance (i.e. what you possess) may be viewed as more valuable than the status quo, resulting in the reversal of the classic endowment effect.

A different approach to induce an emotional response is via a more direct, physiological intervention. Such an approach was used in a study on risk attitudes and stress, in which the researchers immersed participants' hands in near-freezing water before a choice task (Porcelli & Delgado, 2009). This procedure, called the "cold-pressor task," is known to reliably engage an acute stress response, which is capable of affecting behavior (Ishizuka, Hillier & Beversdorf, 2007). The choice task involved a series of simple risky gambles in either the loss domain or the gain domain. The choice was always between less money with higher probability (conservative), and more money with lower probability (risky). The classic finding in these situations is called the reflection effect, in which participants are risk averse in the gain domain (choosing the conservative option more often) and risk seeking in the loss domain (choosing the risky option more often). In this study, that risk attitude profile was exaggerated by acute stress – that is, after the cold-pressor task, participants were more conservative in the gain domain, and more risky in the loss domain. These results demonstrate that directly manipulating participants' levels of stress can contaminate later choices and significantly shift behavior. This result is particularly remarkable for the simplicity of the task, and the presence of feedback. If participants' choices were based on their knowledge and on previous results, then the stress induction should have had no effect – the fact that it did suggests that at least some of the components of the stress response may be integrated directly into the processes behind valuation and decision-making.

Instead of trying to induce a mood state or emotional response, another approach is to introduce stimuli that carry emotional information, such as facial expressions during the choice task. This approach was used in a study in which participants were subliminally shown angry, happy, or neutral facial expressions, before making a number of decisions about drinks (Winkielman, Berridge & Wilbarger, 2005). After completing a task nominally about gender classification (during which a set of one of the types of faces mentioned before was subliminally presented), participants poured, consumed, rated, and priced a drink. The authors found that, preceding the drink, decisions with angry faces reduced the amount poured, the amount consumed, the ratings, and the price participants would be willing to pay for the drink. Subliminal presentation of happy faces had the opposite effect. These results are particularly notable for the subliminal aspect of the experimental manipulation – participants were unaware

of the presence of the faces, and the emotional content of those faces was irrelevant to the task at hand. However, the subtle affective signal generated by these cues was sufficient to alter the appraisal of the choice options and change decisions.

By manipulating emotion, the studies described above can determine the causal role of emotion in influencing the computation of value. A second means to examine the role of emotion in decisions is to measure and quantify emotional reactions and relate those measurements to other observable aspects of the decision task. There are as many ways to measure emotion as there are components – one can assess subjective feelings by self-report, action tendencies with decisions and actions, facial expressions, or bodily responses with psychophysiology. Assessing physiological responses has several advantages in that they are quantifiable, objective, continuously graded, and easily measured alongside other variables. Though other components of emotion are no less important, many recent studies of emotion and decision-making have used the physiological arousal response as a measure of emotion, and as a result, we will focus mainly on this physiological assessment of emotion. As will shortly become clear, one reason for this is that physiological arousal is often closely associated with assessments of value – or more specifically, the representation of subjective values over which decisions are actually made.

One commonly used physiological response is the skin conductance response (SCR), an indication of autonomic nervous system arousal. Using SCR, one of the first studies to make the case for arousal as a component of subjective value examined patients with damage to the orbitofrontal cortex (OFC) in the performance of a risky gambling task (Bechara, Damasio, Tranel & Damasio, 1997). The task, called the "Iowa Gambling Task," consisted of repeated choices among four decks of cards. Two decks yielded high rewards quite often, but the occasional very high penalty as well, which in the long-run resulted in a net loss ("bad" decks). The other two decks yielded both smaller rewards and punishments, but led to a net gain over time ("good" decks). Over the course of the task, non-brain damaged controls began to generate anticipatory SCRs to the "bad" decks, shortly after which they began to avoid those decks; the brain damaged patients did neither. Bechara and colleagues suggested that the anticipatory arousal response serves as an important component of the decision process, essentially altering the value of the options and steering control participants away from the "bad" decks. Patients with OFC damage, who failed to generate these anticipatory arousal responses, also failed to incorporate their emotional response into their assessment of value. Though there were numerous methodological concerns with this study (e.g., Dunn, Dalgleish & Lawrence, 2005; Fellows & Farah, 2005; Maia & McClelland, 2004), it

remains the first to closely link arousal responses to behavioral decision patterns, and to suggest that arousal might be closely (or even necessarily) linked to assessments of subjective value.

Because of the non-invasive nature of most physiological measurements of arousal, a logical step is to assess arousal 'in the field." One study did exactly this, recording SCR, cardiovascular variables, respiration, and body temperature in professional traders over the course of a normal work day (Lo & Repin, 2002). It was found that SCRs were more frequent and cardiovascular responses were greater during both heightened periods of volatility in the market, as well as discrete market events. Perhaps most interestingly, however, this pattern of autonomic responses was exaggerated for traders with low to moderate experience, and attenuated for those of high experience. While all traders showed significant bodily arousal responses during the course of a normal workday, the connection to experience suggests that physiological arousal was an integral component of these professionals' decisions and reactions. It is possible that the most experienced traders had always had that profile of autonomic responses (and that's why they stuck around long enough to become experienced traders). But it is also possible that, as both their knowledge and skills developed (i.e. they gained experience), their assessment and appraisal of the market decisions changed, and the corresponding bodily responses during the performance of their job was also altered. In fact, one could argue, that shifts in arousal in response to market events is part and parcel of "gaining experience," just as much as growth in explicit knowledge or skills.

The results of Lo and Repin (2002) coincide with a recent study by Sokol-Hessner, Hsu, Curley et al. (2009), examining the impact of perspective shift that influences appraisal on the relation between arousal and choice. In this study, participants were presented with two sets of identical risky monetary choices. For one of the sets, participants were encouraged to "attend" to the individual choices at hand and their potential outcomes, while for the other set they were instructed to "regulate" each choice by considering it in its greater context, as one of many choices in a larger set, or portfolio. An econometric model of valuation and decision-making was used to estimate a number of aspects of participants' behavior including their degree of loss aversion (relative weighting of losses and gains) in that set.

In the "attend" condition, participants were on average more aroused per dollar to losses compared to gains, and this "over-arousal," which could be considered a physiological measure of loss aversion, correlated with the estimated degree of behavioral loss aversion. But perhaps most interestingly, only those participants for whom the portfolio regulation technique significantly affected their choices (in which case they became less loss averse), experienced significantly reduced "over-arousal" to

losses relative to gains. The participants in that study (undergraduates) were far from professional traders – yet by taking a perspective similar to that which an experienced trader might take, they showed not only changes in their choices that reflected a greater context, but also changes in SCR not unlike those observed in the experienced traders relative to the inexperienced ones in Lo and Repin (2002). The combination of these results makes a compelling case that at least part of the difference between novices and professionals may be a consequence of how their appraisal of the choice alters both the emotional response to the choice options and its impact on the assessment of value.

Altering the appraisal or interpretation of an event is a primary means of regulating emotional responses (see Ochsner & Gross, 2005). The studies described above demonstrate that influencing the appraisal of a choice through either specific instructions (Sokol-Hessner et al., 2009) or experience (Lo & Repin, 2002) changes arousal response and decisions. More recently, brain imaging studies have demonstrated that neural systems implicated in the representation of value are also influenced by manipulating appraisal. For instance, a study by Delgado, Gillis & Phelps (2008a) conditioned stimuli to be associated with monetary rewards. By introducing a simple emotion regulation instruction in this classical conditioning task, participants were able to reduce their physiological arousal response, as assessed with SCR, to the conditioned stimulus. Simultaneously, they reduced activation in the striatum, a region where the magnitude of the response generally increases with monetary value (Delgado et al., 2008a). The regulation task also led to increased blood oxygenation level dependent (BOLD) responses in dorsolateral prefrontal cortex (DLPFC) consistent with previous studies on the cognitive regulation of emotion (e.g., Ochsner & Gross, 2005), and the ventromedial prefrontal (VMPFC), a region thought to be involved in both emotion regulation (Hartley and Phelps, 2010) and the representation of value (Rangel, Camerer & Montague, 2008).

More recent investigations have demonstrated that introducing an emotion regulation technique to alter appraisal during a decision task has a similar impact on the representation of value in the brain. For example, Martin and Delgado (2011) found that using an imagery-based emotion regulation technique during a gambling task, reduced striatal activation during the decision, along with the tendency towards risky choices. Similarly, Sokol-Hessner and colleagues (submitted) examined the impact of introducing the portfolio perspective during a decision task. Replicating their behavioral results described above (Sokol-Hessner et al., 2009), they found the portfolio regulation technique diminished loss aversion. In addition, implementing the regulation technique reduced amygdala activation to losses, and led to an overall increase in BOLD responses in the striatum, VMPFC and DLPFC.

As the studies described above demonstrate, the components of emotion have undoubtedly complex relationships with the many processes that contribute to valuation and decision-making. Our understanding of those relationships can only be aided by increased specificity and measurement of emotion. The characterization of the precise impact of emotion on decision-making will vary depending on range factors, including the specific affective manipulation and corresponding state change, individual factors, the decision task and additional task demands, and the means of assessing the emotional response. However, across tasks and manipulations, it is clear that a primary impact of emotion on decisions is to temporarily shift the appraisal of the choice options, thus influencing the assessment of value.

SOCIAL FACTORS AND EMOTIONAL INFLUENCES

Given the complex social nature of everyday human life, it is not surprising that there are a range of means by which social information can influence decisions. In fact, the simple presence of social stimuli can be rewarding or punishing, thus altering choices. For example, in a clever series of study examining the rewarding properties of social interaction, Platt and colleagues showed that monkeys will "pay" (i.e. forego juice) to view socially relevant images of other monkeys, and that these social rewards engage the same reward circuitry as non-social decision-making tasks (Deaner, Khera & Platt, 2005; Klein, Deaner & Platt, 2008).

Economic decisions are, by their very nature, social transactions. However, in spite of the social dependence of economic decisions, literature examining how specific social features, such as the social quality of the interaction or the characteristics of the social partner, influence economic choices has only recently emerged. Although it is possible to study economic decision-making isolated from the larger societal context that imbues value in monetary reinforcement, there are some classic behavioral economic games that are completely dependent on social interaction. Below we highlight recent studies examining the influence of social factors on three such games: experimental economic auctions, the trust game and the ultimatum game.

One of the anomalies of experimental economics is the tendency for participants to overbid, or pay "too much" in auctions. In this case, just the mere presence of competition with another person alters decisions to pay. It has been proposed that one of the factors mediating overbidding is the "joy of winning" over a social partner (Goeree, Holt & Palfrey, 2003). In an effort to obtain support for this hypothesis by examining BOLD responses in the reward circuitry, Delgado, Schotter, Ozbay & Phelps (2008b) scanned participants while playing an auction game vs. a

lottery game. Winning or losing the lottery resulted in a predictable striatal response (Delgado, Locke, Stegner & Fiez, 2003) – that is an increase in BOLD signal to a monetary gain, but no difference from baseline when losing the lottery since there was no monetary loss. In contrast, the auction game showed the same predictable increased BOLD response to monetary gains, but a decrease in BOLD signal when losing the auction, even though there was no monetary loss. In contrast to the "joy of winning" hypothesis, it appeared the social loss experienced when losing the auction mirrored a monetary loss in the pattern of striatal response. Furthermore, the magnitude of the decrease in the striatal BOLD response to losing the auction correlated with amount of overbidding. There was no relationship between the striatal response to monetary gains and bids chosen. These results suggest that it was the anticipation or fear of losing the social competition that drove overbidding. To provide further evidence for this hypothesis, an additional behavioral economics experiment was conducted in which the choices were framed to emphasize losses, gains or neither. Emphasizing loss resulted in greater overbidding. There results indicate that just the presence of another person in an economic exchange can change subjective value and its underlying neural representation. Furthermore, these results demonstrate how an investigation of the impact of social factors on decisions can begin to isolate how specific factors, such as social loss, elicited by the social interaction may uniquely impact decisions, such as decisions bid.

This relationship between the presence of social others and decisions has also been investigated with the trust game. This game involves deciding whether to trust a social partner to maximize reward. In a typical version of this task, the investor is endowed with a sum of money that she or he can either keep or choose to share with a partner, the trustee. If the investor decides to share, the sum is multiplied so that the trustee receives, for instance, 3 or 4 times the sum invested. The trustee then has a choice, to either share the larger sum with the investor, in which case both investor and trustee profit, or keep the entire sum, in which case the investor's trust is violated resulting in a monetary loss, along with a relatively larger gain for the trustee.

In the first neuroeconomic study to examine the impact of social interaction on the neural systems mediating the trust game, King-Casas, Tomlin, Anen et al. (2005) simultaneously scanned two partners playing repeated rounds of this game. In the early rounds, they observed the same pattern of BOLD responses to monetary reinforcement in the striatum one might expect in a non-social task (e.g., Delgado et al., 2003) – that is, an increase in BOLD signal when the investor is rewarded and receives a profit and a decrease in BOLD signal when the trust is violated and there is a monetary loss. However, as the partners played repeated rounds with each other, this pattern shifted. Once a "reputation" was

acquired, there was no longer a striatal response to monetary outcome, instead the striatal response was now shifted to the presentation of the partner whose past actions may have led to monetary gain or loss. King-Casas and colleagues (2005) suggest that this pattern is similar to that observed with learning the value of non-social cues through prediction errors, in which reward responses in the striatum serve to update the value of a predictive cue while learning is ongoing, but once the cue value is acquired the striatal response shifts to the cue and striatal activation to the reward outcome is diminished (McClure, Berns & Montague, 2003).

It is not surprising that interacting repeatedly with a social partner might alter the appraisal of the value of that interaction. As King-Casas et al. (2005) suggest, in this case the pattern of brain response indicates that we learn about the predictive nature of social cues much like we learn about the predictive nature of non-social cues. However, social reputations are not only acquired by a history of repeated interactions. Social reputations can be linked to a number of factors, including knowledge of previous, unrelated social interactions and social group membership. Two studies examining how other types of social information can influence trust decisions explored the impact of moral character (Delgado, Frank & Phelps, 2005) and race (Stanley, Sokol-Hessner, Banaji & Phelps, 2011) of the trustee.

In a study by Delgado and colleagues (2005), moral character of the trustee partners was manipulated by introducing short vignettes about their life path and previous actions suggesting "good," "bad," or "neutral" moral character. Importantly, none of these vignettes mentioned previous economic transactions. After this introduction, participants played several rounds of the trust game with each partner. Each trustee partner was equally likely to reward the participant investor (i.e. share profits) across rounds. In spite of this equal pattern of reinforcement, the participant investor was more likely to choose to trust the "good" partner, than the "bad" or "neutral" partner, even after several rounds of the game when the participant could verbally report that the likelihood of each partner sharing profits was equivalent. In other words, the outcomes of previous trust decisions did not seem to update future trust decisions to the same degree when interacting with partners of "good" or "bad" moral character. An examination of the neural systems mediating the influence of moral character on trust decisions provides insight into why actions may not be updated based on previous outcomes as one might expect. Specifically, an examination of BOLD responses in the striatum to the outcome of trust decisions revealed diminished responses overall when interacting with the "good" partner relative to the "neutral" partner. A weaker, but similar pattern was observed with the "bad" partner. As mentioned above, the striatal response to

outcomes is proposed to update knowledge about the predictive nature of the cue (McClure et al., 2003). If this striatal signal is diminished, one might expect that previous outcomes may not influence future decisions to the same degree. In other words, the moral character of the partner may have taken this feedback learning mechanism "offline," resulting in choices driven by social factors as much as, or more than, previous interactions and reward history.

Finally, a recent study explored the interaction of social factors and emotion in decision-making by assessing whether the implicit affective response to members of different race groups can be linked to decisions to trust (Stanley et al., 2011). The automatic affective response to race groups was assessed with the implicit association test (IAT), which is a Stroop-like task that measures differences in reaction time when pairing affective judgments (e.g, good or bad) with categorization judgments of race (e.g., Black or White). Unlike explicit measures of race attitudes, which are thought to assess the cognitive component corresponding to beliefs, this version of IAT is thought to assess the affective component of attitudes. For many stimuli, such as consumer goods, implicit and explicit assessments of attitudes align. However, when assessing attitudes towards stimuli where intention and beliefs may be at odds with affective responses, such as race groups in the United States, implicit (IAT) and explicit assessments of attitudes often do not correspond (Greenwald, Poehlman, Uhlmann & Banaji, 2009). This pattern was also observed in the decisions to trust. Stanley et al. (2011) found that the relative amount the participant investor chose to invest in White or Black trustee partners was correlated with IAT scores, but not explicit measures of race attitudes. In other words, a participant investor whose IAT score indicated a pro-White bias invested relatively more with White trustees than Black trustees and vice versa. Importantly, there was no overall difference in the average amount invested with Black and White trustees, but rather individual variability in implicit race attitudes correlated with variability in decisions to invest with Black or White trustee partners.

The examination of the influence of social factors in the trust game demonstrates that we can update our value representation of social others much like we learn the value of other environmental cues, and that social factors which one might expect to be independent of assessments of economic value can nevertheless be incorporated into the value computation and influence decisions. Another behavioral economic game that critically depends on social interaction, and has been shown to be modulated by specific social factors, is the "ultimatum game." In this game there is a sum of money to be divided between two partners. The proposer has the option to divide the money however she or he sees fit. The proposer can keep the entire sum, give all of it to the partner,

or anything in between. However, the partner also has a choice. The responder can reject the offer. If this happens, both the proposer and the responder receive nothing. One of the puzzling aspects of the ultimatum game from an economic perspective is that the responder will often reject offers they deem to be unfair. For example, if the proposer chooses to offer the responder $20 out of $100 and keep $80, this offer has about a 50% chance of being rejected (Roth, 1995; Thaler, 1988) in spite of the fact the responder will lose $20 in this transaction.

In the first published neuroeconomic study of the ultimatum game, Sanfey, Rilling, Aronson et al. (2003), showed that the social aspect of this transaction is critical. Participants (playing the responder role) were much more likely to reject a low or unfair offer (i.e. an 8/2 split of $10), if the proposer was another person as opposed to a computer. In other words, the appraisal of the value of $2 shifted dramatically depending on the social nature of the task. Furthermore, Sanfey and colleagues showed that greater BOLD responses in the anterior insular cortex were correlated with a higher rate of rejection for unfair offers from social others. The insular cortex is a region implicated in a broad range of mental processes, including affective responses in a social context. These results led the authors to conclude that emotion might play a role in the rejection of unfair offers. Furthermore, the authors suggested that the relative BOLD response in the insular cortex and DLPFC, a region thought to be involved in the control of emotion, might be linked to whether an unfair offer is accepted or rejected.

This modulation of the insular cortex by unfair offers in the Sanfey et al. (2003) study, and the involvement of the DLPFC, has been replicated and extended in other studies examining the relationship between social factors and decisions in the ultimatum game. For example, a recent study by Güroğlu, van den Bos, Rombouts & Crone (2010) manipulated whether the proposer had a choice in offering a fair option. If the proposer had no choice to offer anything other than an unfair split, the responder was much more likely to accept the offer. The insular cortex response was modulated by this constrained choice set, and the perceived intention of the proposer, however activation of the DLPFC primarily reflected acceptance or rejection of the unfair offers regardless of constraints on the proposer.

Another recent study examined how the social context of the offer might alter the perception of fairness and decisions to reject. Wright, Symmonds, Fleming & Dolan (2011) presented participants with a range of ultimatum game offers within the larger social context of a group of proposers. One of the groups proposed a standard range of potential offers. The other two groups proposed the same range of offers, but these were interleaved with offers that were either “more fair” or “less fair.” This allowed the researcher to compare responses to the same offers, but

in varying social contexts. The results suggest that the social context of the group mattered in determinations of fairness. The same offer was more likely to be accepted when presented in the context of the "less fair" group, relative to the standard group, and less likely to be accepted in context of the "more fair" group. They also observed that the modulation of assessments of fairness or inequality by the social context was integrated into the insular cortex response. In addition, increased DLPFC activation reflected the rejections of offers perceived as more fair, which was modulated by the social context.

Across these neuroeconomic studies of the ultimatum game, there is a suggestion that the right DLPFC plays a role in the decision to accept or reject unfair offers, even when this judgment incorporates social context. In an effort to determine if the right DLPFC plays a causal role on decisions to accept or reject, Knoch, Pascual-Leone, Meyer et al. (2006) used transcranial magnetic stimulation (TMS) to temporarily disrupt neural processing in this region. They found that when TMS was applied to the right DLPFC, participants were more likely to accept unfair offers. Interestingly, the participants still rated the offers as unfair, suggesting that the DLPFC plays a role in implementing the rejection of offers.

As mentioned in the discussion of emotion above, the DLPFC is a region that has been linked to the control of emotional responses through altering the appraisal of the emotional event. Studies on the neural basis of the ultimatum game suggest that unfair offers elicit an emotional response (as represented in the insular cortex) that requires regulatory control by DLPFC, which in turn modulates decisions to accept or reject. Although the involvement of this neural circuitry implies a role for emotion in the ultimatum game, these studies do not assess or manipulate emotion. To address this issue, Sanfey and colleagues (2003) have conducted a series of studies exploring the relationship between emotion and decisions in the ultimatum game.

In the first study in this series van't Wout, Kahn, Sanfey and Aleman (2006) assessed SCR while participants played the ultimatum game (in the role of the responder) with either another person or a computer. They found that SCRs were greatest to unfair offers relative to fair offers, but only when playing against a human being – no difference was observed when the opponent was a computer. Furthermore, the size of the SCR was positively correlated, across participants, with rejection rate, suggesting a parallel to Bechara et al. (1997). Rather than "bad" decks, SCRs indicated "bad" offers, but in both cases, the action of rejection was the same. Importantly, the human/computer dimension of van't Wout et al. (2006) argues that value (and arousal) in their study was not simply a reflection of money, but also a reflection of the appraisal of the social value inherent in such a task.

In a second study, Harlé and Sanfey (2007) examined the impact of a mood induction procedure on performance in the ultimatum game. Participants viewed movie clips that elicited sadness, amusement or neutral mood. After viewing the movie clip, they played a series of ultimatum games with different partners. The induction of amusement had no effect on decisions, but participants who responded particularly intensely to the sad movie clip rejected even more of the unfair offers. Much like the Lerner et al. (2004) study described earlier, the underlying mood state altered the appraisal of the decision options, resulting in a shift in the pattern of choices. Finally, in a recent study, van't Wout, Chang and Sanfey (2010) explicitly instructed participants to use an emotion regulation technique to alter the appraisal of the emotional meaning of the offers. When utilizing this technique, participants were more likely to accept unfair offers. These findings explicitly assessing, manipulating and regulating emotion during the social interaction of the ultimatum game demonstrate a strong link between the influence of social stimuli and emotion on decision-making.

Given the necessity for social interaction in many economic decisions, whether it is the interaction with an institution, a social group, or another individual, it is surprising how little is known about the impact of specific social factors on decisions. The studies above represent a subset of an emerging literature that is beginning to explore this complex relationship. This research suggests the range of social factors that alter decisions is immense. By delineating the impact of specific factors, such as race, social group context, or simply the presence of another, on specific components of the decision process, we are starting to uncover the commonalities and differences among social and emotional influences on choice behavior.

CONCLUSIONS

The emerging research on the psychological and neural processes underlying decision-making has provided a foundation for understanding decisions in an emotional and social context. What is abundantly apparent in the current literature is that transient emotional and social factors can significantly alter judgments of subjective value, and as a result, choices. Less apparent is how, precisely, this occurs.

In this chapter we have highlighted the overlap and commonalities in the impact of emotional and social factors on decisions. One overlap is the fact that social stimuli may influence decisions by virtue of the emotional responses they elicit. Research on emotion has demonstrated a variety of means by which emotions can alter choice. For instance, some studies have shown a link between physiological arousal and decisions. Manipulations that regulate arousal responses by altering appraisal also alter choices. Interestingly, some judgments of social decisions mirror

this pattern demonstrating that arousal, and its control, may also be driving social influences on choice behavior. The overlap in the neural circuitry mediating emotional and social influences on decision-making provides further support for this link.

It is also clear that there are unique contributions of emotional and social factors to the decision process. Non-social stimuli can elicit emotional responses, and social stimuli engage distinct processes such as mentalizing about others and judgments of intent. In addition, as the review of the impact of the specific emotional and social factors highlights, they each may contribute distinctly to different decision variables. However, a common mechanism across the range of social and emotional factors that change decisions is that they alter the interpretation or appraisal of the significance of the choice. We suggest that appraisal is an important, and perhaps underappreciated, aspect of the determination of subjective value. The social and emotional context in which the choice options are encountered is likely to be expressed in the appraisal of the options, which may be a critical component of the value computation.

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