

# Social Rewards: From Basic Social Building Blocks to Complex Social Behavior

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**Diana I. Tamir<sup>1</sup> and Brent L. Hughes<sup>2</sup>**

<sup>1</sup>Department of Psychology and Princeton Neuroscience Institute, Princeton University, and <sup>2</sup>Department of Psychology, University of California, Riverside

## Abstract

Humans are social creatures, engaging almost constantly in social behaviors that serve ultimate social goals, such as forming strong bonds with one another. However, most social behaviors provide only incremental progress toward an ultimate goal. Instead, the drive to engage in any individual social act may derive from its proximal value rather than its ultimate goal. Thus, this proximal value forms the foundation on which the complexities of human sociality are built. We describe two complementary approaches for using proximal social rewards to understand social behaviors and their ultimate goals: (a) *decontextualizing* social rewards—paring down complex social interactions can help identify which basic building blocks remain valuable even in minimalistic contexts—and (b) *recontextualizing* social rewards—reintroducing motivational and contextual factors into the study of social experience can help identify how proximal rewards serve their ultimate function. We discuss how this dual-approach framework can inform future research by bridging basic social building blocks and real-world social goals.

## Keywords

social cognition, neuroscience, motivation, goals, reward

Human beings are among the most social creatures on the planet. People spend most of their daily lives engaging with the social world—thinking about, perceiving, and interacting with others. Americans spend, on average, 45% of their waking lives in the presence of another person, and 20% directly interacting with others (U.S. Bureau of Labor Statistics, 2016). Rare is the individual who isolates him- or herself completely from society. Indeed, the judicial system uses social isolation as an extreme and highly aversive punishment (Haney, 2003, 2006). Instead, from infancy to old age, people consistently seek opportunities to be social (Charles & Carstensen, 2010; Pascalis & Kelly, 2009; Warneken & Tomasello, 2009). Social behaviors take many forms, from the simple to the complex: People express preferences for social over nonsocial content, choose social presence over social absence, engage in direct social interaction, groom their social reputation and relationships, and serve others' needs (Baumeister & Leary, 1995; Chartrand & Bargh, 1999; Fantz, 1963; Jolly, Tamir, Burum, & Mitchell, 2018; Morelli, Lieberman, & Zaki, 2015). From expressing simple preferences to actively

pursuing costly behaviors, people's behaviors reveal a pervasive predisposition toward the social.

What drives people's pervasive sociality? Researchers have tried to answer this question by explaining *why* people engage in social behaviors. These kinds of answers provide an ultimate reason for their existence by identifying their adaptive functions. Researchers have also tried to answer this question by explaining *how* low-level mechanisms promote social behaviors. These kinds of answers identify proximal (i.e., immediate) causes, such as the behavioral or neural processes that underlie a social behavior (Tinbergen, 1963). Here, we propose complementary methodological approaches to link these two levels of analyses: *decontextualizing*

## Corresponding Authors:

Diana I. Tamir, Department of Psychology, Princeton University, Princeton, NJ 08544  
E-mail: dtamir@princeton.edu

Brent L. Hughes, Department of Psychology, 900 University Ave., Riverside, CA 92521  
E-mail: bhughes@ucr.edu

and *recontextualizing* social rewards. Both approaches rely on studying what people value in the social world. Together, these complementary approaches shed new light on social rewards and how they drive people toward the social behaviors that help fulfill their ultimate social goals. We first review social goals and social rewards and then introduce each approach in turn.

### ***Ultimate goals of social behavior***

Why are people so deeply motivated to be social? One explanation is that people's pervasive social tendencies serve adaptive goals. Much like the drive to satisfy basic needs such as food and shelter, the drive to be social offers significant adaptive benefits (Tomasello, 1999). Social connection increases the likelihood that people's basic needs are met by providing safety from predators, increasing access to potential mates, and promoting reciprocated and efficient cooperation (Axelrod & Hamilton, 1981; Deming, 2017; Rand & Nowak, 2013; West, Griffin, & Gardner, 2007). Socially connected individuals have better physical and mental health and live longer than socially isolated individuals (Cacioppo, Hawkley, & Thisted, 2010; Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Eisenberger & Cole, 2012; Helliwell & Putnam, 2004; Holt-Lunstad, Smith, & Layton, 2010; Miller, Chen, & Cole, 2009). Thus, the pervasive human tendency to seek out social presence, social interactions, and strong interpersonal relationships may stem from the adaptive benefits of these behaviors. Indeed, researchers have suggested that high-level social goals, such as a need to belong, a need to align with others, and a need to maintain a good reputation, are as fundamental to human survival as nonsocial needs (Baumeister & Leary, 1995; Romano, Balliet, Yamagishi, & Liu, 2017; Ryan & Deci, 2000). In this way, social goals provide an *ultimate* explanation for why people engage in social behaviors: Social success has adaptive consequences.

### ***Proximal signals that drive social behavior***

People do not engage in most social behaviors mindful of their social goals or their adaptive success (Nisbett & Wilson, 1977; Pronin, Lin, & Ross, 2002). Instead, social behaviors arise, in the moment, because of *proximal* causes (Brosnan & de Waal, 2002)—the immediate psychological or neural mechanisms that underlie behaviors. One important proximal motivator for social behavior is the value or subjective reward associated with it. Although these terms are often used interchangeably, the term *value* (here and in the literature) refers specifically to the utility associated with a stimulus or behavior, and the term *reward* refers to the positive

feeling on receipt of a subjectively valued outcome (Berkman, Livingston, & Kahn, 2017; Rangel, Camerer, & Montague, 2008). For example, you might be motivated to keep framed pictures of loved ones in your office not because viewing them increases your chances of survival, but simply because it feels good to do so (e.g., Aron et al., 2005). In this example, family pictures have value, and viewing them is subjectively rewarding. Value motivates people to engage in behaviors that increase the likelihood of receiving the rewarding outcomes that those behaviors predict (Delgado, Nystrom, Fissell, Noll, & Fiez, 2000; Knutson, Adams, Fong, & Hommer, 2001; McClure, Berns, & Montague, 2003; Rangel et al., 2008; Schultz, Dayan, & Montague, 1997).

Social stimuli and behaviors can acquire value as people learn that engaging with them leads to rewarding outcomes (e.g., Behrens, Hunt, Woolrich, & Rushworth, 2008; Burke, Tobler, Baddeley, & Schultz, 2010; Hackel, Doll, & Amodio, 2015; King-Casas et al., 2005; Rilling et al., 2002). For example, after people learn that a smiling person treats them more kindly than an angry one, or that a prosocial act earns them a new friend, smiling faces and prosocial behaviors might themselves acquire value. Feeling subjective reward in response to a stimulus or behavior reinforces the value associated with that stimulus or behavior, thereby increasing the likelihood of future attempts to achieve those same subjective rewards (Rangel et al., 2008; Rescorla & Wagner, 1972; Schultz et al., 1997). People can learn to value even very simple cues that signify only incremental progress toward a rewarding outcome (e.g., a smiling face; Leotti & Delgado, 2011; O'Doherty, Winston, et al., 2003; Spreckelmeyer, Rademacher, Paulus, & Gründer, 2013; Tamir, Zaki, & Mitchell, 2015). By identifying the simple signals that people value, researchers can learn which elements of the social world serve as proximal motivators of humans' pervasive social behavior.

How can researchers identify what social signals people value? Value can be measured using both neural and behavioral methods. Decades of work in behavioral neuroscience and human functional neuroimaging has characterized the neural and computational underpinnings of value and reward. A set of dopamine-rich midbrain structures (e.g., substantia nigra, ventral tegmental area) with connections to the striatum (e.g., nucleus accumbens, caudate), and areas of cortex (e.g., ventral medial prefrontal cortex; Alexander, DeLong, & Strick, 1986; Berridge, 1996; Haber & Knutson, 2010) reliably respond both when people anticipate or experience rewarding outcomes (e.g., seeing and then eating delicious cake; Delgado et al., 2000; Tobler, Fiorillo, & Schultz, 2005); each structure in the circuit computes relevant components of reward processing (e.g., common value signal, reward learning). This system provides a value signal across a wide variety of stimuli, including

primary rewards (e.g., food) and secondary rewards (e.g., money). Consequently, activation of these neural regions serves as a reliable marker of whether individuals assign value to stimuli. In this way, the brain offers researchers one informative signal of value.

Value can also be measured using behavioral methods. Researchers in behavioral economics have used measures such as “willingness to pay,” in which participants explicitly report the amount of money they would be willing to pay for a stimulus (e.g., a snack, a movie). In these tasks, participants are incentivized to report a monetary value commensurate with the value of the item, lest they miss out on buying an item they wanted because they bid too low or get stuck purchasing an item for a price far exceeding its utility (Ariely & Berns, 2010; Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007; Plassman, O’Doherty, & Rangel, 2007). Researchers can also measure value more implicitly using the logic of revealed preferences, by assessing how people make choices to trade one valued stimulus for another (Deaner, Khera, & Platt, 2005; Hayden, Parikh, Deaner, & Platt, 2007). Over many such choices, researchers can measure how much of one primary reward (e.g., juice) people will forgo to view social stimuli (e.g., high-status group members; Deaner et al., 2005).

Researchers can also assess value by examining how much effort a person is willing to exert to achieve a stimulus (Arkes & Blumer, 1985; Bem, 1976; Clement, Feltus, Kaiser, & Zentall, 2000; Inzlicht, Shenhav, & Olivola, 2018; Lydall, Gilmour, & Dwyer, 2010; Thaler, 1980). Like money, effort is costly; it requires physical or mental exertion and is generally experienced as unpleasant (Kurzban, 2016). People are willing to exert effort only when the value associated with an outcome outweighs the cost of effort (Hernandez Lallement et al., 2013; Kool, McGuire, Rosen, & Botvinick, 2010; Ma, Meng, Wang, & Shen, 2013). In this way, researchers can assess the value of a stimulus using behavioral paradigms that measure how much a person is willing to pay, willing to forgo, or willing to exert in order to attain it.

Both behavioral and neural measures have shown that people value social stimuli. Social stimuli range from cues that represent the real or implied presence of other people (e.g., pictures of faces, interpersonal feedback) to behavioral exchanges with other people (e.g., communicating with others, helping others). Using behavioral assessments, such as those described above, researchers have demonstrated that people are willing to pay or forgo significant amounts of money, or exert significant amounts of effort, to see social stimuli (Hayden et al., 2007; Prévost, Pessiglione, Météreau, Cléry-Melin, & Dreher, 2010; Smith et al., 2010) and to have opportunities to engage in social behaviors (Bartal, Decety, & Mason, 2011; Tamir & Mitchell, 2012; Tamir

et al., 2015). Likewise, neuroimaging studies have demonstrated that perceiving and engaging with such social content recruits the neural reward system (Aron et al., 2005; Bhanji & Delgado, 2014; Chib, Rangel, Shimojo, & O’Doherty, 2009; Cloutier, Heatherton, Whalen, & Kelley, 2008; Harbaugh, Mayr, & Burghart, 2007; Hughes & Beer, 2012; D. J. Levy & Glimcher, 2012; Moll et al., 2006; Morelli, Sacchet, & Zaki, 2015; O’Doherty, Dayan, Friston, Critchley, & Dolan, 2003; Ruff & Fehr, 2014; Spreckelmeyer et al., 2013; Tricomi, Rangel, Camerer, & O’Doherty, 2010; Zaki, Schirmer, & Mitchell, 2011). Researchers that directly compared monetary reward with social reward found that both classes of stimuli evoke similar neural responses (Ethridge et al., 2017; Izuma, Saito, & Sadato, 2008; Wake & Izuma, 2017; cf. Clithero et al., 2011). Although it is not possible to infer the presence of reward on the basis of neural activation alone (Poldrack, 2006), findings from behavioral and neural measures in both human and nonhuman animals provide strong, convergent evidence that people value social stimuli.

The reward system does more than just label social cues as subjectively valuable: It also motivates behavior to acquire valued stimuli (Saunders, Richard, Margolis, & Janak, 2017). The reward system can do so because it can learn to respond to cues that merely predict a reward (e.g., seeing a delicious cake; Hull, 1943; Kable & Glimcher, 2007; Knutson et al., 2001; McClure et al., 2003; O’Doherty, Dayan, et al., 2003; Pavlov, 1927; Schultz et al., 1997; Skinner, 1938; Sutton & Barto, 1998; Thorndike, 1911). That is, over the course of learning about reward outcomes, reward activity can shift from encoding the outcome of a decision or behavior to the moment at which a person first views the decision options or views the cue that will prompt a behavior. This anticipatory value signal serves as a “sneak peek” into the reward to come. If one fails to attain an anticipated reward, the reward system will instead respond with depressed activation during the outcome (McClure et al., 2003; Schultz et al., 1997). In this way, anticipatory value signals precipitate the behaviors that will help one attain the valued goal and avoid the disappointment of failing to do so.

Neural reward activity can thus be used as an index of the motivation that drives actual decisions or behavior (Saunders et al., 2017). For example, reward activity when viewing prosocial decision options predicts subsequent decisions to cooperate (King-Casas et al., 2005; Rilling et al., 2002). Neural reward activity also predicts real-world behaviors. Neural reward activity while viewing persuasive health messages predicts real-world behavior change (e.g., smoking cessation, exercise; N. Cooper, Bassett, & Falk, 2017; Falk et al., 2015); reward activity while viewing consumer goods predicts subsequent purchasing decisions (Berns & Moore, 2012;

I. Levy, Lazzaro, Rutledge, & Glimcher, 2011; Tusche, Bode, & Haynes, 2010); and reward activity while viewing crowd-funding campaigns predicts subsequent donations (Genevsky & Knutson, 2015; Genevsky, Yoon, & Knutson, 2017). The more people value a cue, as indexed by neural reward activity, the more they are motivated to act on it. In fact, recent work demonstrates that neural reward activity is critical for value-based decision making: Patients with damage to the ventromedial prefrontal cortex exhibit impaired consistency in their value-based preferences (Fellows & Farah, 2007; Henri-Bhargava, Simioni, & Fellows, 2012). Together, these findings suggest that the reward system, and its responses to simple stimuli, underlies our behavioral drives (Atzil et al., 2017; Preston, 2017).

People's drive to engage in behaviors that satisfy social goals is supported by the same reward system that supports the pursuit of other basic physiological needs (Fliessbach et al., 2007; Izuma et al., 2008; Montague & Berns, 2002). Thus, the domain-general work on valuation and reward provides a framework to understand the proximal drivers of social behaviors.

### ***From basic building blocks to ultimate motives***

The pursuit of social goals is often not as clear-cut as the pursuit of more basic physiological goals such as food. Many social goals are abstract and multifaceted. People can easily tell when hunger drives them to search for cake and whether they were successful in their pursuit of that goal. However, it is less clear how to search for a social connection, and whether someone has succeeded in achieving it is ambiguous. Social goals, unlike cake, do not tend to smell delicious, nor do they leave crumbs and smeared chocolate in their wake. How can researchers link proximal reward signals to the ultimate goals that they serve?

We propose that researchers must solve two challenges to understand how proximal motives help people achieve their ultimate social goals. First, researchers should identify the basic social values and rewards that drive everyday social behavior. What are the basic building blocks that underlie social behaviors? Second, researchers should identify how social behaviors bring people closer to the ultimate social goals that they so desire. What shapes the extent to which a behavior can accomplish those goals? We offer two complementary approaches for solving each of these challenges (Fig. 1).

First, to understand how proximal components (i.e., social rewards) drive social behaviors, we recommend *decontextualizing* social rewards by paring down complex social experiences to their most basic ingredients. Measuring the value of each basic ingredient can provide

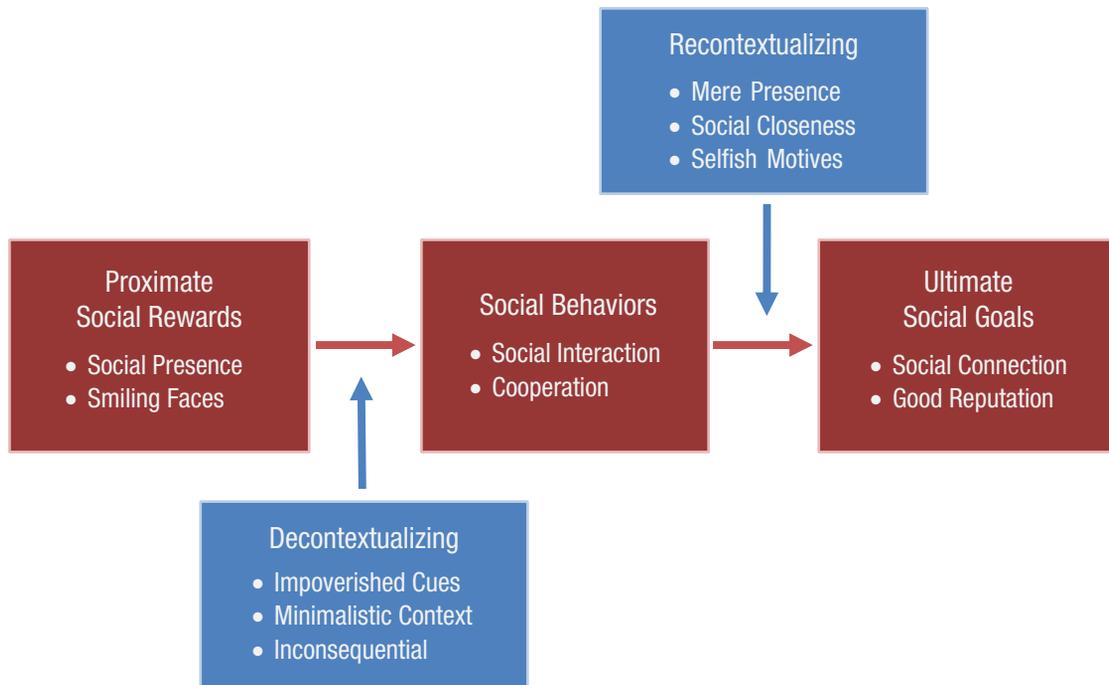
insight into the strength with which that ingredient is likely to drive social behavior. The most robust drivers, or core drivers, of social behaviors are those ingredients that remain valuable even when isolated from the rewarding outcomes they are supposed to predict. For example, if people value the presence of other people strongly enough, then they might seek out opportunities to see others (e.g., view pictures of their faces) even when it is not possible to connect with them. That is, people's basic motives should retain measurable value independent of fulfilling their ultimate goal. Decontextualizing allows researchers to identify this set of basic social values that drive social behaviors.

Second, to understand how social behaviors serve their ultimate goals, we recommend *recontextualizing* social rewards by reintroducing motivation and context into the study of social behavior. Contextual features of the social situation and individual motivations can dramatically shift the likelihood that a particular behavior will achieve its ultimate goal: Approaching a smiling friend should increase social connection, whereas approaching a smiling enemy might threaten one's safety. Contexts modulate not only the likelihood of behaviors such as approaching a smiling person but also the value of basic social ingredients: The value of a smile might diminish when it comes from an enemy rather than a friend. This revaluation sheds light on the ultimate social goals toward which the social value of a smile is leading.

These complementary approaches offer insight into the basic building blocks of social behaviors and their ultimate social functions. Both approaches rely on studying what people value in the social world and the factors that can and cannot shape those values. That is, examining how the brain's reward system supports social behaviors can provide insight into the structure of social rewards as well as the higher-level goals that give rise to them. We discuss each approach in turn and then discuss the implications of this framework on our understanding of the building blocks of social rewards, their development, and their impact on real-world outcomes.

### **Decontextualizing Social Rewards**

People love eating cake, but this does not mean that people are fundamentally motivated to eat cake. To understand why people might be driven to eat cake, we can learn a lot by breaking down "cake," a single entity, into its individual ingredients. In doing so, we might find that people have a strong drive to eat sugars and fats, but not flour. Because people are motivated to eat sugar, even when the sugar is isolated from the rest of the cake ingredients, this offers a strong argument that



**Fig. 1.** Two approaches to studying social rewards. Decontextualizing social rewards reveals the core components (e.g., social presence and smiling faces) that drive social behavior (e.g., social interaction and cooperation). The core components retain their value even in experimental designs with minimalistic cues, contexts, and consequences. Recontextualizing reshapes the value of these core components by introducing contextual and motivational factors (e.g., social closeness, motives to maximize self-interest). The change in value can be linked to changes in the likelihood that the recontextualized social behavior can bring one closer to an ultimate social goal (e.g., social connection and a good reputation).

sugar is a basic ingredient on which some more complex eating drives depend.

In the same way, researchers interested in understanding the social motives that drive social behavior can break down those behaviors into their simpler ingredients. This *decontextualizing* approach allows researchers to identify basic building blocks of human social motives by determining which social ingredients remain valuable even when isolated from their social milieu. The persistent value of each ingredient allows researchers to determine the strength with which that ingredient drives the social behavior that might help to fulfill distal goals. In this section, we describe three complementary routes to creating minimalistic, decontextualized social experiences. Although many social goals motivate social behavior, this section focuses, in particular, on the ultimate goal of social connection. We demonstrate how decontextualization can uncover some of the basic ingredients that underlie this ultimate social goal.

### ***Impoverished stimuli***

One simple way to break a social experience into its independent ingredients is to present social stimuli as impoverished, minimalistic versions of their usual form.

A stimulus that one is prepared to perceive should retain its salience even when it is impoverished. For decades, researchers have capitalized on this approach both inside and outside of the social domain. In studies on fear responses, participants might see pictures of snakes on computer screens within the safety of a laboratory room. This highly impoverished version of a fear-relevant stimulus still elicits robust arousal responses despite its pared-down nature (Öhman & Mineka, 2001). Impoverished fear-relevant stimuli have been incredibly productive in helping researchers understand the dynamics of fear. Indeed, results from studies using impoverished stimuli dovetail with those studies that use more naturalistic fear stimuli (e.g., Mobbs et al., 2010).

Research in the social domain has likewise used impoverished social stimuli. In fact, this approach may work especially well in the social domain, because people are particularly attuned to social stimuli and highly prepared to perceive them (Dunbar, 1998; Dunbar & Shultz, 2007; Fantz, 1963; Hornstein, Fanselow, & Eisenberger, 2016; Reid et al., 2017). Humans' preparedness to be social leads them to see sociality in minimally social stimuli: People see faces in their toast, endow simple animated shapes with rich mental lives, and tell their cats about their day

(Epley, Akalis, Waytz, & Cacioppo, 2008; Heider & Simmel, 1944; Waytz, Gray, Epley, & Wegner, 2010). Impoverished stimuli depicting cartoons throwing a cartoon ball are sufficient to elicit robust feelings of social exclusion (Eisenberger, Lieberman, & Williams, 2003). Our knee-jerk response—like a social heuristic (Rand, 2016)—is to see stimuli as social even when given only minimal cues to their sociality.

Impoverished cues of social connection have been shown to elicit reward responses. For example, static pictures of faces, especially attractive or smiling faces, elicit neural reward activity (Cloutier et al., 2008; Deaner et al., 2005; O'Doherty, Winston, et al., 2003; Spreckelmeyer et al., 2013), much like naturalistic smiling faces serve as a robustly rewarding stimulus. Faces are rich sources of information that both motivate social connection and signal successful social connection. Likewise, researchers have found that receiving social approval, even in the minimalistic form of a number on a scale on a computer screen, can elicit reward activity (Hughes, Leong, Shiv, & Zaki, 2018; Korn, Prehn, Park, Walter, & Heekeren, 2012; Somerville, Kelley, & Heatherton, 2010), much like receiving richer forms of feedback (e.g., empathic messages from another person; Morelli, Torre, & Eisenberger, 2014).

Though the goals of social connection can seem abstract, simple proxies for social connection—the cues that might arise en route to that goal—can be sufficient for driving reward activity. People value social connection so strongly that impoverished signals of acceptance are experienced as rewarding.

### ***Removed from typical contexts***

If the first approach to identifying basic social ingredients is to strip down stimuli to their minimalistic forms, then a second approach is to strip away the context within which a social stimulus is typically embedded. We can test the strength of a learned association by taking it out of one context and demonstrating that the association generalizes in a new one. This approach to decontextualization allows researchers to identify potent social *inputs*, or stimuli, but also social *outputs*, or behaviors, that people continue to pursue in minimalistic contexts. For example, in research on fear, rats respond to highly significant stimuli (e.g., another rat's distress squeals) across contexts but fail to do so for less significant stimuli (Evans & Hammond, 1983). Likewise, humans are more likely to generalize their fear response when they have more robust fear associations (e.g., in anxiety disorders; Dunsmoor, Otto, & Phelps, 2017; Grillon, 2002). Thus, minimalistic contexts provide a powerful means to test for the doggedness with which people might pursue social stimuli or behaviors.

In the social domain, one of the most complex behaviors that one can observe is two or more people conversing with each other. A closer look at what people actually talk about reveals a striking simplicity: People mostly talk about themselves. Self-disclosure—the act of sharing information about oneself with others—is one of the most pervasive social behaviors. Researchers have estimated that 30% to 40% of conversations consist primarily of reciprocal self-disclosure. Self-disclosure does not merely persist in decontextualized settings, it flourishes: Self-disclosure constitutes up to 80% of online social behavior (Dunbar, 1998; Emler, 1990, 1994; Landis & Burt, 1924; Naaman, Boase, & Lai, 2010). How can we use the decontextualizing approach to identify which basic ingredients motivate people to pursue this social behavior?

Researchers have tested why people find self-disclosure rewarding by using simplified tasks that remove the act of self-disclosure from its typical context of naturalistic face-to-face conversation (Tamir & Mitchell, 2012). In this research, participants were given opportunities to share information with others: They answered questions about themselves and about other people. Participants answered these questions using a keypad while alone in a room. On half of the trials, participants' answers were shared with another person; on the other half, the answers were kept private. Despite the highly minimalistic context, participants reliably chose to self-disclose, and both behavioral and neural measures indicated that people valued opportunities to do so: Participants were willing to forgo money to self-disclose, and doing so engaged neural reward regions. Moreover, there were two independent sources of this value: Participants valued opportunities to answer questions about the self (both shared and private) *and* opportunities to share information (both about the self and others) with another person (Tamir & Mitchell, 2012). These findings suggest that self-disclosure is motivated by at least two basic ingredients: a selfish motive to think about oneself and a social motive to disclose information to other people.

Decontextualizing conversations using simplified computer tasks has allowed researchers to establish the strength of people's motives to share information. These tasks lack the typical contexts of naturalistic conversations and thereby demonstrate the reliability with which people will opt to self-disclose, as well as the value they place on doing so.

### ***Untethered from consequences***

Social behaviors have consequences. Indeed, the predicted outcome of a social behavior is one of its most important associations; it is the outcome that often

reinforces the value of the behavior in the first place. When a stimulus is strongly associated with its typical consequences, it is difficult to untether that stimulus from its predicted outcomes (Odling-Smee, 1978). This may be especially true for stimulus associations that are innate or that people are prepared to learn. For example, in the domain of fear, researchers have found that prepared fear stimuli, such as snakes, are readily associated with their negative consequences. People quickly and robustly learn to fear snakes, and when they do, those conditioned responses are especially difficult to unlearn (Cook, Hodes, & Lang, 1986; Öhman & Mineka, 2001; Seligman, 1971). People continue to show automatic startle responses to harmless snake-like objects, such as a garden hose or rope coiled on the ground (Schaller, Faulkner, Park, Neuberg, & Kenrick, 2004). When a stimulus is strongly associated with its consequences, it should be more difficult to untether that stimulus from its learned associations.

The act of disclosure is strongly associated with multiple positive consequences that likely promote its prevalence. Self-disclosure can facilitate social bonding and allow for positive self-presentation (Ellison, Heino, & Gibbs, 2006; Toma, Hancock, & Ellison, 2008); sharing information can have positive reputational or prosocial benefits when such information might help others (Feinberg, Willer, Stellar, & Keltner, 2012). If people continue to value disclosure even when the act of disclosure is untethered from these positive consequences, this would provide strong evidence for the rootedness of this behavior. Researchers have tested whether people continue to find disclosure rewarding even in highly minimalistic paradigms that prevent any consequences (Tamir et al., 2015). In this research, participants were given opportunities to send useless packets of information—the number 1, 2, 3, or 4—to a study partner. The experimental design precluded most of the typical consequences of disclosure: Neither participants nor their study partners stood to gain any added benefit from this information. The study partners did not know where this packet of information came from, so there was no opportunity for reputational benefits. Finally, the information was not personally relevant, so there was no opportunity for positive self-presentation. Nevertheless, participants continued to choose to inform, and both behavioral and neural measures indicated that people valued opportunities to do so.

Even when people are precluded from experiencing the usual consequences of informing, they retain their long-standing association of informing with its positive consequences. Decontextualizing a conversation has thus helped to identify the act of informing as one potential basic ingredient driving human sociality (Baumeister, Maranges, & Vohs, 2018).

### ***Decontextualized, but still externally valid***

To what extent do experiments with impoverished stimuli, minimalistic contexts, and inconsequential outcomes reveal something meaningful about human social behavior? This question has plagued psychological inquiry since its earliest attempts to rigorously quantify fuzzy psychological concepts with controlled yet contrived empirical tests (Mook, 1983; Zaki & Ochsner, 2009). We suggest that these inquiries have much to gain, particularly by using social rewards as a primary dependent variable. Researchers across psychological science and behavioral economics have endeavored to understand the proximate mechanisms that underlie vision, attention, memory, fear, and decision making by paring down complex multisensory and naturalistic stimuli into their component parts. We suggest that systematically breaking down complex social behavior into basic ingredients is particularly informative because it can reveal which social ingredients retain their value in the absence of naturalistic stimulus features, relevant contexts, and predicted consequences. When a social stimulus or behavior is so stubbornly rewarding that it persists in even the most minimalistic conditions, we have learned something deep about its role as a basic ingredient of human sociality.

That said, decontextualizing social rewards is only one approach to understand human sociality. People are embedded in rich, dynamic social contexts. These contexts can elicit complementary or competing goals that have the potential to shape the value of the basic social ingredients that drive human behavior. By recontextualizing social rewards, we can get a different set of insights into social behaviors and the ultimate goals they serve.

### **Recontextualizing Social Rewards**

People may love eating cake, but cake-eating behavior changes after a person has filled up on a heavy meal (e.g., Balleine & Dickinson, 1998; Gottfried, O'Doherty, & Dolan, 2003; Kringelbach, O'Doherty, Rolls, & Andrews, 2003), while a person is pursuing health motives (e.g., Hare, Camerer, & Rangel, 2009; Nook & Zaki, 2015), or if a person believes the cake to be an award-winning delicacy (e.g., Campbell-Meiklejohn, Bach, Roepstorff, Dolan, & Frith, 2010; Klucharev, Smidts, & Fernández, 2008; Plassmann, O'Doherty, Shiv, & Rangel, 2008). Just as the value of cake can change, so can the value of social stimuli. Social experiences do not occur in a vacuum (Hughes & Zaki, 2015; Redcay & Warnell, 2017). Instead, social rewards are powerfully shaped by interpersonal contexts—the social situations

in which people are embedded—as well as individual motives. These factors can activate additional goals that align or compete with social goals and, in doing so, can shift the likelihood that pursuing a social reward will help people achieve their ultimate social goal. Researchers interested in deriving a complete picture of human sociality can thus benefit from *recontextualizing* social rewards within the contexts and motivations in which they are embedded. This approach allows researchers to understand how social contexts interact with ultimate social goals and how the value of basic social ingredients pivots on these intersections. In this section, we describe three ways in which contexts and motives can impinge on basic social rewards.

In particular, this section focuses on the effect of context on prosocial rewards. Both prosocial outcomes and prosocial behaviors reliably elicit reward activity (Braams, Peters, Peper, Güroğlu, & Crone, 2014; Harbaugh et al., 2007; Mobbs et al., 2009; Morelli, Sacchet, & Zaki, 2015; Tricomi et al., 2010; Varnum, Shi, Chen, Qiu, & Han, 2014; Zaki & Mitchell, 2011). Moreover, prosociality serves ultimate social goals (Hare, 2017) by facilitating social connection and improving one's reputation (Axelrod & Hamilton, 1981; Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007; West et al., 2007). We show how recontextualization can reveal the extent to which a behavior can serve that goal.

### ***Social versus private contexts***

Since its inception, the field of social psychology has investigated the impact of social presence on people's thoughts, feelings, and behaviors (Allport, 1985). People are highly attuned to the presence of others (Zajonc, 1965). The mere presence of others can affect both cognition and behavior and is thus central to the study of complex social behaviors (Michaels, Blommel, Brocato, Linkous, & Rowe, 1982; Zajonc, Heingartner, & Herman, 1969). Being alone as opposed to being in the presence of others is also one of the simplest ways in which context can change a basic social value. For example, in a social context, people experience more self-conscious emotion. This experience is accompanied by greater activation in neural regions associated with the self (i.e., medial prefrontal cortex) and in greater connectivity between these regions and reward regions (i.e., striatum; Somerville et al., 2013). Self-awareness, heightened by social presence, can influence value processing. Values changed by social context can influence associated behaviors. For example, when adolescents make risky decisions in the presence of peers, this is accompanied by increased striatal activity (Chein, Albert, O'Brien, Uckert, & Steinberg, 2011). Social presence amplifies the value of a risky option,

which leads adolescents to make riskier decisions (e.g., risky driving) when they are with peers than when they are alone.

Social contexts can change value and behavior because context changes the likelihood that people will achieve their ultimate social goals. This is because social contexts introduce *additional* goals that interact with the fundamental goal of social connection. Public contexts, for example, activate ultimate social goals such as maintaining a favorable reputation. Consequently, public contexts may be especially likely to elicit prosocial behaviors, which in turn increase the likelihood of both social connection and a positive reputation. This increase in social behavior should depend on an increase in the value of prosocial behaviors. Indeed, people make more altruistic choices (e.g., donating money to charity) when they believe that other people are watching their choices, and such choices are accompanied by amplified reward activity (Izuma, Saito, & Sadato, 2010; Moll et al., 2006). Likewise, winning a reward by cooperating with a partner results in greater striatal activity than winning an equivalent reward alone (e.g., Rilling et al., 2002; van den Bos, van Dijk, Westenberg, Rombouts, & Crone, 2009). In these public contexts, the motivation to gain a good reputation amplifies the basic value associated with prosocial behaviors (Harbaugh et al., 2007).

By comparing the value of prosocial behaviors in public and private contexts, we see that reward activity does not represent only the basic value of prosocial behavior. Instead, when public contexts enhance the potential ultimate affiliative benefits by capitalizing on the activation of complementary ultimate goals, we see a parallel enhancement of reward activity.

### ***Close versus far contexts***

The mere presence of other people in a context is not the only factor that affects behavior. The identity of those people can differentially activate motives that tip the scales of what is valuable (Hughes & Zaki, 2015). One dimension that meaningfully affects social rewards is social closeness. Close others are much more motivationally salient as social targets than are distant others (Hughes & Beer, 2012; Hughes, Zaki, & Ambady, 2017; Ratner, Dotsch, Wigboldus, van Knippenberg, & Amodio, 2014; Van Bavel, Packer, & Cunningham, 2008); people generally wish to affiliate with and feel good about close others—including family, friends, romantic partners, and in-group members—to a significantly greater extent than they want to affiliate with and feel good about more distant others—including acquaintances, strangers, disliked individuals, and out-group members. As a result, the value people place on

social opportunities with close others should be greater than the value of social opportunities with distant others.

**Dyads.** Social closeness shapes the basic value that people place on prosociality (Rand & Nowak, 2013; Zaki & Mitchell, 2013) and vicarious reward (Morelli, Sacchet, & Zaki, 2015). People experience more pleasure and exhibit greater reward activity in response to vicarious reward for close versus distant others (Braams et al., 2014; Mobbs et al., 2009; Varnum et al., 2014). Likewise, the amount of money people will forgo to give money to another person increases as a function of social closeness (Jones & Rachlin, 2006). Social closeness also shapes the value of rewards gained collaboratively (e.g., Rilling et al., 2002): People experience more pleasure from winning, and they exhibit greater reward responses when rewards are shared with friends than with strangers (Fareri, Niznikiewicz, Lee, & Delgado, 2012). Together, these findings suggest that the value that people extract from social interactions pivots on the social closeness of interaction partners. Note that these changes in value are accompanied by levels of trust and cooperation that are greater between friends than between strangers. That is, the change in value of prosociality can be linked to a change in the likelihood of achieving the ultimate goal of social connection (Fareri, Chang, & Delgado, 2015).

**Groups.** As in dyadic interactions, social closeness modulates the value of group interactions. The value of intergroup interactions often directly hinges on one's attitudes toward the group (Hackel, Zaki, & Van Bavel, 2017; Stanley, Sokol-Hessner, Banaji, & Phelps, 2011). As with dyads, this translates into changes in prosocial behaviors (Hein, Silani, Preuschoff, Batson, & Singer, 2010). People choose to cooperate more frequently and more equitably with in-group members than with out-group members, and they exhibit greater reward responses during such interactions (Hughes, Ambady, & Zaki, 2017). In fact, the value people place on prosocial behaviors can disappear entirely when individuals are required to interact with members of out-groups (Hughes, Ambady, & Zaki, 2017; Levine, Prosser, Evans, & Reicher, 2005; Stallen, Smidts, & Sanfey, 2013). Social closeness similarly influences vicarious responses toward others' experiences, such that the value of positive experiences is amplified for in-group members (Cikara, Bruneau, Van Bavel, & Saxe, 2014; Hackel et al., 2017; Morelli, Sacchet, & Zaki, 2015).

Social closeness may render shared positive experiences particularly rewarding, but they can just as easily redefine *negative* outcomes as rewarding when they occur to out-groups: Reward activity increases when people observe out-group members experiencing negative outcomes (Cikara, Botvinick, & Fiske, 2011; Hein

et al., 2010). This revaluation may contribute to well-documented empathy gaps between groups (Cikara et al., 2011; Gutsell & Inzlicht, 2012; Hein et al., 2010; Xu, Zuo, Wang, & Han, 2009). Thus, the basic social value of vicarious rewards is not context-invariant; rather, it is flexibly modulated by the motivational significance of these shared outcomes.

Together, the modulation of the basic social value of prosociality by intergroup contexts suggests powerful motivational mechanisms that both are driven by and perpetuate parochialism. Social closeness changes the value of prosocial behaviors as well as the likelihood that those behaviors will lead to the ultimate goals generally associated with them. In particular, social closeness amplifies the value of prosocial behaviors that will bring individuals closer to their ultimate goal of social connection (i.e., with socially close targets) and diminishes or negates the value of prosocial behaviors with unlikely social connections (i.e., socially distant targets).

### ***Selfish vs. social motives***

Prosocial motives are not the only force driving behavior. Selfish motives are similarly powerful and pervasive. People are motivated to maximize their own self-interest (e.g., profit, pleasure, well-being) and self-esteem and to maintain a positive self-image (Dunning, Heath, & Suls, 2004; Kunda, 1990; Morewedge, Shu, Gilbert, & Wilson, 2009; Taylor & Brown, 1988). This tendency toward self-positivity is so powerful that some have suggested that the self likewise serves as its own source of basic value (Sedikides & Gregg, 2008). Indeed, the self is associated with activity in neural reward regions (Berkman et al., 2017; Chavez, Heatherton, & Wagner, 2017; Hughes & Beer, 2013; Northoff & Hayes, 2011; Tamir & Mitchell, 2012). Researchers have shown robust reward signals when people evaluate, exaggerate, update, and receive feedback from peers about their own positive characteristics (Beer & Hughes, 2010; J. C. Cooper, Dunne, Furey, & O'Doherty, 2013; Hughes & Beer, 2013; Hughes et al., 2018; Izuma et al., 2008; Korn et al., 2012; Morelli et al., 2014; Somerville, Kelley, & Heatherton, 2010; Zink et al., 2008). This selfish motive to feel good about the self, to look good in the eyes of others, and to maximize self-interest can interact with ultimate social motives and, in doing so, shape *both* basic social and self-related value signals.

When selfish motives align with prosocial motives, they increase the value of prosocial behaviors. As seen above, when public contexts allow for prosocial behavior to enhance one's personal reputation, this increases the value of prosocial behaviors (e.g., Izuma et al., 2010; Moll et al., 2006). Likewise, the prevalence of

self-disclosure can be attributed to both the social value of sharing information with others and *also* the selfish value of thinking about oneself (Tamir & Mitchell, 2012). When this selfish motive aligns with the social motive to share information, this boosts the value of self-disclosure. Thus, the presence of selfish motives can at times amplify the basic value associated with social behaviors.

Selfish motives can interact with social connection goals in a positive feedback loop. For example, the value people place on positive feedback from others can shift depending on the source of that feedback (Guyer et al., 2008; Hughes et al., 2018; Izuma et al., 2008; Korn et al., 2012; Somerville, Kelley, & Heatherton, 2010). In one study, participants received feedback about their attractiveness (Hughes et al., 2018). Reward activity increased in response to positive feedback, but only when such feedback came from well-liked targets. These heightened reward responses then predicted a further increase in subsequent attraction to the well-liked social targets. Accordingly, the desire for social connection shaped the value of positive feedback, which in turn shaped the desire to connect with the social targets.

In contrast, when selfish motives clash with social motives, this diminishes the value of prosocial behaviors. Research using economic games has specifically pit selfishness against prosociality to assess prosocial behavior (e.g., prisoner's dilemma, public good game). Participants in these games are asked to decide between cooperating by contributing to a communal fund or behaving selfishly by not contributing to the communal fund while still benefiting from the contributions of others. In these contexts, participants weigh the benefits of selfish decisions over prosocial ones (e.g., Rand, Greene, & Nowak, 2012; Rand & Nowak, 2013). When participants take time to deliberate, the selfish motives are more likely to win out (cf. Krajbich, Bartling, Hare, & Fehr, 2015): Greater deliberation reduces contributions to a public pool and increases self-interest gains from others' contributions. When people demonstrate a preference for selfish over prosocial decisions (Rand, Brecoll, Everett, Capraro, & Barcelo, 2016; Sul et al., 2015), this tendency is reflected by greater selfish neural reward activity (Soutschek et al., 2017; Sul et al., 2015). Moreover, pharmacologically increasing reward activity in these selfish individuals can then further increase selfish versus prosocial decisions (Pedroni, Eisenegger, Hartmann, Fischbacher, & Knoch, 2014). So, when selfish goals are pitted directly against prosocial ones, individuals pit the value of each goal against the value of the other and make a decision in line with the stronger value.

By examining the value of selfish and social motives as they meet in different contexts, we can make

predictions about which behaviors people will enact and which ultimate goals they will prioritize. At times, selfish motives align with social goals. This increases both the basic value of such behaviors and the likelihood of performing them. At other times, selfish motives clash with social goals. This forces individuals to select the behavior associated with the more valued outcome and prioritize one ultimate goal over another. In this way, recontextualization can shed light on the goals that guide social behavior by allowing different motives to align or compete for priority.

### ***Recontextualized rewards reveal ultimate functions***

Although people experience basic, decontextualized units of social interaction as subjectively valuable, contextual features can change the extent to which pursuing a basic social reward will actually bring them closer to their ultimate social goals. That is, social contexts and internal motives shape the ultimate functionality of basic social ingredients, which in turn can amplify, diminish, or even negate their value. Though people generally value prosocial behaviors because they facilitate social connection (Axelrod & Hamilton, 1981; Hare, 2017; West et al., 2007), social closeness can change the value of prosocial behaviors because it changes the likelihood that those behaviors will beget the ultimate goal of social connection (e.g., Cikara et al., 2011; Fareri et al., 2015; Hackel et al., 2017; Hughes, Ambady, & Zaki, 2017; Jones & Rachlin, 2006; Mobbs et al., 2009). The value of social behaviors is thus defined by the extent to which these experiences bring people closer to the people they care about (e.g., socially close others). Whereas decontextualizing social rewards provides important insights into the basic ingredients of human sociality, recontextualizing social rewards highlights how the value of these basic ingredients still pivots on their ultimate functions.

### **Implications**

There are several important implications of studying social rewards from the two proposed angles—to decontextualize from the bottom up and to recontextualize from the top down. Whereas decontextualizing social stimuli can uncover *what* people value in the social world, recontextualizing those stimuli helps explain *why* people ultimately value them. Decontextualizing social rewards into their component parts helps to isolate the core units of a constellation of social behaviors by pinpointing the basic rewards that persist even in the absence of their everyday contexts. In contrast, recontextualizing social rewards takes advantage of the multitude of motives elicited by contexts. In

doing so, recontextualizing pinpoints how context reshapes the consequences of social behaviors and, as a result, the value of basic units of reward. Both approaches work in concert to uncover the structure of social values—both their intractable core and the ultimate social goals they serve. These complementary approaches provide a conceptual lens through which to understand and make predictions about human sociality. We highlight a few such implications below.

Researchers can test new hypotheses about real-world human social behavior by extrapolating from work on decontextualized social reward. For example, self-disclosure, a highly valued behavior, offers a prime example of a pervasive social behavior that can be decomposed into more basic ingredients: People are highly motivated to self-disclose, even when self-disclosure is pared down to its barest bones and un tethered from its typical consequences. Thus, one should predict that people will continue to share information with others at any opportunity to do so. People should do so even in atypical environments that offer only minimalistic versions of face-to-face sharing and preclude the typical rich social benefits people have come to expect from these disclosures—environments such as online social media. Indeed, self-disclosure behavior has exploded online; self-referential content accounts for more than 80% of missives on Twitter (Naaman et al., 2010). The strong but simple value of sharing information might help explain this explosion (Meshi, Tamir, & Heekeren, 2015; Tamir & Ward, 2015). The social reward offered by social media is just one consequence of a *supernormal stimulus*—an environment that causes an exaggeration of an otherwise normal behavior (Tamir & Ward, 2015; Ward, 2013). As people advance in their ability to shape their own environment (e.g., online or virtual spaces), humanity will have more and more opportunities to capitalize on the basic social drives identified by ongoing research. However, platforms that offer quick and easy access to basic rewards might not always pave the path to ultimate goals. Just as our current environment's overabundance of sugary and fatty cakes has not served the ultimate goal of being healthy humans, so too might an overreliance on easy socializing not lead to meaningfully connected humans.

Researchers can use what they know about contextual effects on social motives to predict how people will behave across new contexts. For example, we know that people value some behaviors (e.g., fairness, cooperation) and yet they are influenced by social group contexts (e.g., parochialism; Hackel et al., 2017; Hughes, Ambady, & Zaki, 2017). Researchers do not have to test these behaviors across every single group boundary to determine whether they change with

context (Cikara & Van Bavel, 2014; Cikara, Van Bavel, Ingbreetsen, & Lau, 2017). If these behaviors break down when people interact across one group boundary (e.g., one based on political beliefs), we can generate a strong prediction that they will likely also do so across other group boundaries (e.g., one based on sports teams). That said, by identifying cases in which observed changes in behavior across group boundaries do *not* generalize (e.g., when individuals without implicit racial biases interact with members of another race; Stanley et al., 2011) and comparing them with cases in which generalization does occur, researchers can learn how people represent group contexts and the dimensions that might scaffold our understanding of social contexts more generally.

This dual approach can help identify the source of social deficits in clinical populations. The extent to which clinical deficits arise because of distortions in processing basic social values versus distortions in incorporating context into those value calculations offers a meaningful dissociation to test for in clinical populations. For example, social dysfunction in autism may arise as a result of devalued basic social values (Chakrabarti, Haffey, Canzano, Taylor, & McSorley, 2017; Chevallier, Kohls, Troiani, Brodtkin, & Schultz, 2012; Hsu, Neufeld, & Chakrabarti, 2017; Williams & Cross, 2018). From this perspective, individuals with autism may exhibit abnormal social interactions because of reduced subjective value typically associated with social connection. Alternatively, social deficits in autism may arise because of difficulties with processing personal motives or complex social contexts (Happé, 1997; Lopez & Leekam, 2003) or by disordered communication between the two systems (Sims, Neufeld, Johnstone, & Chakrabarti, 2014). In contrast, social dysfunctions in people with Williams syndrome may arise from a failure to modify the value of social rewards in contexts that change the contingency between social rewards and their high-level social goals. Individuals with Williams syndrome are overly gregarious and overly empathic, even toward people who are unknown or objectively unapproachable (Meyer-Lindenberg, Mervis, & Berman, 2006). By delineating when each system is affected in clinical populations, we can get greater insight into the nature of the disorder, the neural systems implicated, and the most effective cognitive targets of intervention.

Finally, this approach offers leverage in understanding the trajectory of social development. All of the basic social values discussed thus far were tested in adults or adolescents. Would infants or children demonstrate similar social values? In most cases, what we have referred to as a “basic social value” can be interpreted in two possible ways: (a) It is innately rewarding, such

that it is intrinsically valued from birth and is part of humans' core social cognitive processes; or (b) it is overlearned, such that the contingencies between a particular social stimulus or behavior and positive response is so reliable over the course of development that people automatically encode the relation between the two.

This distinction reveals deep questions about the nature of people's social lives: Is humans' social core a result of overlearned contingencies (Rand, 2016) or an innate predisposition toward social signals (Fantz, 1963; Reid et al., 2017; Tomasello, Carpenter, Call, Behne, & Moll, 2004)? Our framework suggests that we might be able to tease these possibilities apart by testing reward values across multiple ages, species, contexts, and cultures (Heine, Lehman, Markus, & Kitayama, 1999; Hung et al., 2017; Kwak, Kwon, Yun, Jeong, & Huettel, 2018; Markus & Kitayama, 1991; Nisbett, Peng, Choi, & Norenzayan, 2001). In doing so, we could reveal the social rewards that serve as the very basic social building blocks for the more complex social behaviors to come. Moreover, we can learn how children develop the ability to incorporate social contexts, and their impact on higher-level social goals, into their value computations (Somerville & Casey, 2010; Somerville, Jones, & Casey, 2010). Whereas children might seek cake *always*, as adults, adults (try to) abide by health goals or social norms of not overindulging. In the domain of social rewards, children might value positive social feedback regardless of the source, but over time, kids might learn to value certain kinds of positive feedback more than others (e.g., popular cliques vs. freaks and geeks in school). When basic reward processing can be dissociated from contextualized reward processing, this offers leverage for making predictions about when children will and will not respond to social cues and environments.

Decontextualizing and recontextualizing social reward provides a conceptual lens through which to understand social behavior and its consequences in the real world. Both approaches work in concert to uncover the structure of social values—their intractable core and the ultimate social goals they serve. We hope to encourage researchers to harness these approaches for insight into our sociality, and its neural, developmental, and evolutionary roots.

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### References

- Alexander, G. E., DeLong, M. R., & Strick, P. L. (1986). Parallel organization of functionally segregated circuits linking basal ganglia and cortex. *Annual Review of Neuroscience*, *9*, 357–381.
- Allport, G. W. (1985). The historical background of social psychology. In G. Lindzey & E. Aronson (Eds.), *The handbook of social psychology* (3rd ed., Vol. 1, pp. 1–46). New York, NY: McGraw-Hill.
- Ariely, D., & Berns, G. S. (2010). Neuromarketing: The hope and hype of neuroimaging in business. *Nature Reviews Neuroscience*, *11*, 284–292.
- Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes*, *35*, 124–140.
- Aron, A., Fisher, H., Mashek, D. J., Strong, G., Li, H., & Brown, L. L. (2005). Reward, motivation, and emotion systems associated with early-stage intense romantic love. *Journal of Neurophysiology*, *94*, 327–337.
- Atzil, S., Touroutoglou, A., Rudy, T., Salcedo, S., Feldman, R., Hooker, J. M., . . . Barrett, L. F. (2017). Dopamine in the medial amygdala network mediates human bonding. *Proceedings of the National Academy of Sciences, USA*, *114*, 2361–2366.
- Axelrod, R., & Hamilton, W. D. (1981). The evolution of cooperation. *Science*, *211*, 1390–1396.
- Balleine, B. W., & Dickinson, A. (1998). Goal-directed instrumental action: Contingency and incentive learning and their cortical substrates. *Neuropharmacology*, *37*, 407–419.
- Bartal, I. B. A., Decety, J., & Mason, P. (2011). Empathy and pro-social behavior in rats. *Science*, *334*, 1427–1430.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529.
- Baumeister, R. F., Maranges, H. M., & Vohs, K. D. (2018). Human self as information agent: Functioning in a social environment based on shared meanings. *Review of General Psychology*, *22*, 36–47.
- Beer, J. S., & Hughes, B. L. (2010). Neural systems of social comparison and the “above-average” effect. *NeuroImage*, *49*, 2671–2679.
- Behrens, T. E., Hunt, L. T., Woolrich, M. W., & Rushworth, M. F. (2008). Associative learning of social value. *Nature*, *456*, 245–249.
- Bem, D. J. (1976). Self-perception: An alternative interpretation of cognitive dissonance phenomena. *Psychological Review*, *74*, 183–200.
- Berkman, E. T., Livingston, J. L., & Kahn, L. E. (2017). Finding the “self” in self-regulation: The identity-value model. *Psychological Inquiry*, *28*, 77–98.

- Berns, G. S., & Moore, S. E. (2012). A neural predictor of cultural popularity. *Journal of Consumer Psychology, 22*, 154–160.
- Berridge, K. C. (1996). Food reward: Brain substrates of wanting and liking. *Neuroscience & Biobehavioral Reviews, 20*, 1–25.
- Bhanji, J. P., & Delgado, M. R. (2014). The social brain and reward: Social information processing in the human striatum. *Wiley Interdisciplinary Reviews: Cognitive Science, 5*, 61–73.
- Braams, B. R., Peters, S., Peper, J. S., Güroğlu, B., & Crone, E. A. (2014). Gambling for self, friends, and antagonists: Differential contributions of affective and social brain regions on adolescent reward processing. *NeuroImage, 100*, 281–289.
- Brosnan, S. F., & de Waal, F. B. (2002). A proximate perspective on reciprocal altruism. *Human Nature, 13*, 129–152.
- Burke, C. J., Tobler, P. N., Baddeley, M., & Schultz, W. (2010). Neural mechanisms of observational learning. *Proceedings of the National Academy of Sciences, USA, 107*, 14431–14436.
- Cacioppo, J. T., Hawkey, L. C., & Thisted, R. A. (2010). Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychology and Aging, 25*, 453–463.
- Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkey, L. C., & Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. *Psychology and Aging, 21*, 140–151.
- Campbell-Meiklejohn, D. K., Bach, D. R., Roepstorff, A., Dolan, R. J., & Frith, C. D. (2010). How the opinion of others affects our valuation of objects. *Current Biology, 20*, 1165–1170.
- Chakrabarti, B., Haffey, A., Canzano, L., Taylor, C. P., & McSorley, E. (2017). Individual differences in responsivity to social rewards: Insights from two eye-tracking tasks. *PLOS ONE, 12*(10): Article e0185146. doi:10.1371/journal.pone.0185146.
- Charles, S. T., & Carstensen, L. L. (2010). Social and emotional aging. *Annual Review of Psychology, 61*, 383–409.
- Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893–910.
- Chavez, R. S., Heatherton, T. F., & Wagner, D. D. (2017). Neural population decoding reveals the intrinsic positivity of the self. *Cerebral Cortex, 27*, 5222–5229.
- Chein, J., Albert, D., O'Brien, L., Uckert, K., & Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain's reward circuitry. *Developmental Science, 14*(2), F1–F10.
- Chevallier, C., Kohls, G., Troiani, V., Brodtkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in Cognitive Sciences, 16*, 231–239.
- Chib, V. S., Rangel, A., Shimojo, S., & O'Doherty, J. P. (2009). Evidence for a common representation of decision values for dissimilar goods in human ventromedial prefrontal cortex. *Journal of Neuroscience, 29*, 12315–12320.
- Cikara, M., Botvinick, M. M., & Fiske, S. T. (2011). Us versus them: Social identity shapes neural responses to intergroup competition and harm. *Psychological Science, 22*, 306–313.
- Cikara, M., Bruneau, E., Van Bavel, J. J., & Saxe, R. (2014). Their pain gives us pleasure: How intergroup dynamics shape empathic failures and counter-empathic responses. *Journal of Experimental Social Psychology, 55*, 110–125.
- Cikara, M., & Van Bavel, J. J. (2014). The neuroscience of intergroup relations: An integrative review. *Perspectives on Psychological Science, 9*, 245–274.
- Cikara, M., Van Bavel, J. J., Ingbreten, Z. A., & Lau, T. (2017). Decoding “us” and “them”: Neural representations of generalized group concepts. *Journal of Experimental Psychology: General, 146*, 621–631.
- Clement, T. S., Feltus, J. R., Kaiser, D. H., & Zentall, T. R. (2000). “Work ethic” in pigeons: Reward value is directly related to the effort or time required to obtain the reward. *Psychonomic Bulletin & Review, 7*, 100–106.
- Clithero, J. A., Smith, D. V., Carter, R. M., & Huettel, S. A. (2011). Within- and cross-participant classifiers reveal different neural coding of information. *NeuroImage, 56*, 699–708.
- Cloutier, J., Heatherton, T. F., Whalen, P. J., & Kelley, W. M. (2008). Are attractive people rewarding? Sex differences in the neural substrates of facial attractiveness. *Journal of Cognitive Neuroscience, 20*, 941–951.
- Cook, E. W., Hodes, R. L., & Lang, P. J. (1986). Preparedness and phobia: Effects of stimulus content on human visceral conditioning. *Journal of Abnormal Psychology, 95*, 195–207.
- Cooper, J. C., Dunne, S., Furey, T., & O'Doherty, J. P. (2013). The role of the posterior temporal and medial prefrontal cortices in mediating learning from romantic interest and rejection. *Cerebral Cortex, 24*, 2502–2511.
- Cooper, N., Bassett, D. S., & Falk, E. B. (2017). Coherent activity between brain regions that code for value is linked to the malleability of human behavior. *Scientific Reports, 7*, Article 43250. doi:10.1038/srep43250
- Deaner, R. O., Khera, A. V., & Platt, M. L. (2005). Monkeys pay per view: Adaptive valuation of social images by rhesus macaques. *Current Biology, 15*, 543–548.
- Delgado, M. R., Nystrom, L. E., Fissell, C., Noll, D. C., & Fiez, J. A. (2000). Tracking the hemodynamic responses to reward and punishment in the striatum. *Journal of Neurophysiology, 84*, 3072–3077.
- Deming, D. J. (2017). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics, 132*, 1593–1640.
- Dunbar, R. I. (1998). The social brain hypothesis. *Brain, 9*, 178–190.
- Dunbar, R. I., & Shultz, S. (2007). Evolution in the social brain. *Science, 317*, 1344–1347.
- Dunning, D., Heath, C., & Suls, J. M. (2004). Flawed self-assessment: Implications for health, education, and the workplace. *Psychological Science in the Public Interest, 5*, 69–106.
- Dunsmoor, J. E., Otto, A. R., & Phelps, E. A. (2017). Stress promotes generalization of older but not recent threat memories. *Proceedings of the National Academy of Sciences, USA, 114*, 9218–9223.
- Eisenberger, N. I., & Cole, S. W. (2012). Social neuroscience and health: Neurophysiological mechanisms linking

- social ties with physical health. *Nature Neuroscience*, *15*, 669–674.
- Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Science*, *302*, 290–292.
- Ellison, N., Heino, R., & Gibbs, J. (2006). Managing impressions online: Self-presentation processes in the online dating environment. *Journal of Computer-Mediated Communication*, *11*, 415–441.
- Emler, N. (1990). A social psychology of reputation. *European Review of Social Psychology*, *1*, 171–193.
- Emler, N. (1994). Gossip, reputation, and social adaptation. In R. F. Goodman & A. Ben-Ze'ev (Eds.), *Good gossip* (pp. 117–133). Lawrence: University Press of Kansas.
- Epley, N., Akalis, S., Waytz, A., & Cacioppo, J. T. (2008). Creating social connection through inferential reproduction: Loneliness and perceived agency in gadgets, gods, and greyhounds. *Psychological Science*, *19*, 114–120.
- Ethridge, P., Kujawa, A., Dirks, M. A., Arfer, K. B., Kessel, E. M., Klein, D. N., & Weinberg, A. (2017). Neural responses to social and monetary reward in early adolescence and emerging adulthood. *Psychophysiology*, *54*, 1786–1799.
- Evans, J. G., & Hammond, G. R. (1983). Differential generalization of habituation across contexts as a function of stimulus significance. *Animal Learning & Behavior*, *11*, 431–434.
- Falk, E. B., O'Donnell, M. B., Cascio, C. N., Tinney, F., Kang, Y., Lieberman, M. D., . . . Strecher, V. J. (2015). Self-affirmation alters the brain's response to health messages and subsequent behavior change. *Proceedings of the National Academy of Sciences, USA*, *112*, 1977–1982.
- Fantz, R. L. (1963). Pattern vision in newborn infants. *Science*, *140*, 296–297.
- Fareri, D. S., Chang, L. J., & Delgado, M. R. (2015). Computational substrates of social value in interpersonal collaboration. *Journal of Neuroscience*, *35*, 8170–8180.
- Fareri, D. S., Niznikiewicz, M. A., Lee, V. K., & Delgado, M. R. (2012). Social network modulation of reward-related signals. *Journal of Neuroscience*, *32*, 9045–9052.
- Feinberg, M., Willer, R., Stellar, J., & Keltner, D. (2012). The virtues of gossip: Reputational information sharing as prosocial behavior. *Journal of Personality and Social Psychology*, *102*, 1015–1030.
- Fellows, L. K., & Farah, M. J. (2007). The role of ventromedial prefrontal cortex in decision making: Judgment under uncertainty or judgment per se? *Cerebral Cortex*, *17*, 2669–2674.
- Fliessbach, K., Weber, B., Trautner, P., Dohmen, T., Sunde, U., Elger, C. E., & Falk, A. (2007). Social comparison affects reward-related brain activity in the human ventral striatum. *Science*, *318*, 1305–1308.
- Genevsky, A., & Knutson, B. (2015). Neural affective mechanisms predict market-level microlending. *Psychological Science*, *26*, 1411–1422.
- Genevsky, A., Yoon, C., & Knutson, B. (2017). When brain beats behavior: Neuroforecasting crowdfunding outcomes. *Journal of Neuroscience*, *37*, 8625–8634.
- Gottfried, J. A., O'Doherty, J., & Dolan, R. J. (2003). Encoding predictive reward value in human amygdala and orbitofrontal cortex. *Science*, *301*, 1104–1107.
- Grillon, C. (2002). Startle reactivity and anxiety disorders: Aversive conditioning, context, and neurobiology. *Biological Psychiatry*, *52*, 958–975.
- Gutsell, J. N., & Inzlicht, M. (2012). Intergroup differences in the sharing of emotive states: Neural evidence of an empathy gap. *Social Cognitive and Affective Neuroscience*, *7*, 596–603.
- Guyer, A. E., Lau, J. Y., McClure-Tone, E. B., Parrish, J., Shiffrin, N. D., Reynolds, R. C., & Ernst, M. (2008). Amygdala and ventrolateral prefrontal cortex function during anticipated peer evaluation in pediatric social anxiety. *Archives of General Psychiatry*, *65*, 1303–1312.
- Haber, S. N., & Knutson, B. (2010). The reward circuit: Linking primate anatomy and human imaging. *Neuropsychopharmacology*, *35*, 4–26.
- Hackel, L. M., Doll, B. B., & Amodio, D. M. (2015). Instrumental learning of traits versus rewards: Dissociable neural correlates and effects on choice. *Nature Neuroscience*, *18*, 1233–1235.
- Hackel, L. M., Zaki, J., & Van Bavel, J. J. (2017). Social identity shapes social valuation: Evidence from prosocial behavior and vicarious reward. *Social Cognitive and Affective Neuroscience*, *12*, 1219–1228.
- Haney, C. (2003). Mental health issues in long-term solitary and “supermax” confinement. *NCCD News*, *49*, 124–156.
- Haney, C. (2006). *Reforming punishment: Psychological limits to the pains of imprisonment*. Washington, DC: American Psychological Association.
- Happé, F. G. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology*, *15*, 1–12.
- Harbaugh, W. T., Mayr, U., & Burghart, D. R. (2007). Neural responses to taxation and voluntary giving reveal motives for charitable donations. *Science*, *316*, 1622–1625.
- Hare, B. (2017). Survival of the friendliest: Homo sapiens evolved via selection for prosociality. *Annual Review of Psychology*, *68*, 155–186.
- Hare, T. A., Camerer, C. F., & Rangel, A. (2009). Self-control in decision-making involves modulation of the vmPFC valuation system. *Science*, *324*, 646–648.
- Hayden, B. Y., Parikh, P. C., Deaner, R. O., & Platt, M. L. (2007). Economic principles motivating social attention in humans. *Proceedings of the Royal Society B: Biological Sciences*, *274*, 1751–1756.
- Heider, F., & Simmel, M. (1944). An experimental study of apparent behavior. *The American Journal of Psychology*, *57*, 243–259.
- Hein, G., Silani, G., Preuschhoff, K., Batson, C. D., & Singer, T. (2010). Neural responses to ingroup and outgroup members' suffering predict individual differences in costly helping. *Neuron*, *68*, 149–160.
- Heine, S. J., Lehman, D. R., Markus, H. R., & Kitayama, S. (1999). Is there a universal need for positive self-regard? *Psychological Review*, *106*, 766–794.
- Helliwell, J. F., & Putnam, R. D. (2004). The social context of well-being. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *359*, 1435–1446.
- Henri-Bhargava, A., Simioni, A., & Fellows, L. K. (2012). Ventromedial frontal lobe damage disrupts the accuracy,

- but not the speed, of value-based preference judgments. *Neuropsychologia*, *50*, 1536–1542.
- Hernandez Lallement, J., Kuss, K., Trautner, P., Weber, B., Falk, A., & Fliessbach, K. (2013). Effort increases sensitivity to reward and loss magnitude in the human brain. *Social Cognitive and Affective Neuroscience*, *9*, 342–349.
- Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLOS Medicine*, *7*(7), Article e1000316. doi:10.1371/journal.pmed.1000316
- Hornstein, E. A., Fanselow, M. S., & Eisenberger, N. I. (2016). A safe haven: Investigating social-support figures as prepared safety stimuli. *Psychological Science*, *27*, 1051–1060.
- Hsu, C. T., Neufeld, J., & Chakrabarti, B. (2017). Reduced reward related neural response to mimicry in individuals with autism. *European Journal of Neuroscience*, *47*, 610–618.
- Hughes, B. L., Ambady, N., & Zaki, J. (2017). Trusting outgroup, but not ingroup members, requires control: Neural and behavioral evidence. *Social Cognitive and Affective Neuroscience*, *12*, 372–381.
- Hughes, B. L., & Beer, J. S. (2012). Orbitofrontal cortex and anterior cingulate cortex are modulated by motivated social cognition. *Cerebral Cortex*, *22*, 1372–1381.
- Hughes, B. L., & Beer, J. S. (2013). Protecting the self: The effect of social-evaluative threat on neural representations of self. *Journal of Cognitive Neuroscience*, *25*, 613–622.
- Hughes, B. L., Leong, J. K., Shiv, B., & Zaki, J. (2018). Wanting to like: Motivation influences behavioral and neural responses to social feedback. *bioRxiv*, Article 300657. doi:10.1101/300657
- Hughes, B. L., & Zaki, J. (2015). The neuroscience of motivated cognition. *Trends in Cognitive Sciences*, *19*, 62–64.
- Hughes, B. L., Zaki, J., & Ambady, N. (2017). Motivation alters impression formation and related neural systems. *Social Cognitive and Affective Neuroscience*, *12*, 49–60.
- Hull, C. L. (1943). *Principles of behavior*. New York, NY: Appleton-Century.
- Hung, L. W., Neuner, S., Polepalli, J. S., Beier, K. T., Wright, M., Walsh, J. J., . . . Malenka, R. C. (2017). Gating of social reward by oxytocin in the ventral tegmental area. *Science*, *357*, 1406–1411.
- Inzlicht, M., Shenhav, A., & Olivola, C. Y. (2018). The effort paradox: Effort is both costly and valued. *Trends in Cognitive Sciences*, *22*, 337–349.
- Izuma, K., Saito, D. N., & Sadato, N. (2008). Processing of social and monetary rewards in the human striatum. *Neuron*, *58*, 284–294.
- Izuma, K., Saito, D. N., & Sadato, N. (2010). Processing of the incentive for social approval in the ventral striatum during charitable donation. *Journal of Cognitive Neuroscience*, *22*, 621–631.
- Jolly, E. P., Tamir, D. I., Burum, B., & Mitchell, J. P. (2018). Wanting without enjoying: The social value of sharing experiences. *PsyArXiv*. doi:10.17605/osf.io/b3zju
- Jones, B., & Rachlin, H. (2006). Social discounting. *Psychological Science*, *17*, 283–286.
- Kable, J. W., & Glimcher, P. W. (2007). The neural correlates of subjective value during intertemporal choice. *Nature Neuroscience*, *10*, 1625–1633.
- King-Casas, B., Tomlin, D., Anen, C., Camerer, C. F., Quartz, S. R., & Montague, P. R. (2005). Getting to know you: Reputation and trust in a two-person economic exchange. *Science*, *308*, 78–83.
- Klucharev, V., Smidts, A., & Fernández, G. (2008). Brain mechanisms of persuasion: How ‘expert power’ modulates memory and attitudes. *Social Cognitive and Affective Neuroscience*, *3*, 353–366.
- Knutson, B., Adams, C. M., Fong, G. W., & Hommer, D. (2001). Anticipation of increasing monetary reward selectively recruits nucleus accumbens. *Journal of Neuroscience*, *21*(16), Article RC159. doi:10.1523/JNEUROSCI.21-16-j0002.2001
- Knutson, B., Rick, S., Wimmer, G. E., Prelec, D., & Loewenstein, G. (2007). Neural predictors of purchases. *Neuron*, *53*, 147–156.
- Kool, W., McGuire, J. T., Rosen, Z. B., & Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand. *Journal of Experimental Psychology: General*, *139*, 665–882.
- Korn, C. W., Prehn, K., Park, S. Q., Walter, H., & Heekeren, H. R. (2012). Positively biased processing of self-relevant social feedback. *Journal of Neuroscience*, *32*, 16832–16844.
- Krajbich, I., Bartling, B., Hare, T., & Fehr, E. (2015). Rethinking fast and slow based on a critique of reaction-time reverse inference. *Nature Communications*, *6*, Article 8455. doi:10.1038/ncomms8455.
- Kringelbach, M. L., O’Doherty, J., Rolls, E. T., & Andrews, C. (2003). Activation of the human orbitofrontal cortex to a liquid food stimulus is correlated with its subjective pleasantness. *Cerebral Cortex*, *13*, 1064–1071.
- Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, *108*, 480–498.
- Kurzban, R. (2016). The sense of effort. *Current Opinion in Psychology*, *7*, 67–70.
- Kwak, Y., Kwon, J., Yun, K., Jeong, J., & Huettel, S. (2018). Money for us versus money for them: Cross-cultural differences in sensitivity to rewards for ingroup and outgroup. *Culture and Brain*, *6*, 36–52.
- Landis, M. H., & Burt, H. E. (1924). A study of conversations. *Journal of Comparative Psychology*, *4*, 81–89.
- Leotti, L. A., & Delgado, M. R. (2011). The inherent reward of choice. *Psychological Science*, *22*, 1310–1318.
- Levine, M., Prosser, A., Evans, D., & Reicher, S. (2005). Identity and emergency intervention: How social group membership and inclusiveness of group boundaries shape helping behavior. *Personality and Social Psychology Bulletin*, *31*, 443–453.
- Levy, D. J., & Glimcher, P. W. (2012). The root of all value: A neural common currency for choice. *Current Opinion in Neurobiology*, *22*, 1027–1038.
- Levy, I., Lazzaro, S. C., Rutledge, R. B., & Glimcher, P. W. (2011). Choice from non-choice: Predicting consumer preferences from blood oxygenation level-dependent signals obtained during passive viewing. *Journal of Neuroscience*, *31*, 118–125.
- Lopez, B., & Leekam, S. R. (2003). Do children with autism fail to process information in context? *Journal of Child Psychology and Psychiatry*, *44*, 285–300.

- Lydall, E. S., Gilmour, G., & Dwyer, D. M. (2010). Rats place greater value on rewards produced by high effort: An animal analogue of the "effort justification" effect. *Journal of Experimental Social Psychology, 46*, 1134–1137.
- Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*, 224–253.
- McClure, S. M., Berns, G. S., & Montague, P. R. (2003). Temporal prediction errors in a passive learning task activate human striatum. *Neuron, 38*, 339–346.
- Meshi, D., Tamir, D. I., & Heekeren, H. R. (2015). The emerging neuroscience of social media. *Trends in Cognitive Sciences, 19*, 771–782.
- Meyer-Lindenberg, A., Mervis, C. B., & Berman, K. F. (2006). Neural mechanisms in Williams syndrome: A unique window to genetic influences on cognition and behavior. *Nature Reviews Neuroscience, 7*, 380–393.
- Michaels, J. W., Blommel, J. M., Brocato, R. M., Linkous, R. A., & Rowe, J. S. (1982). Social facilitation and inhibition in a natural setting. *Replications in Social Psychology, 2*, 21–24.
- Miller, G., Chen, E., & Cole, S. W. (2009). Health psychology: Developing biologically plausible models linking the social world and physical health. *Annual Review of Psychology, 60*, 501–524.
- Mobbs, D., Yu, R., Meyer, M., Passamonti, L., Seymour, B., Calder, A. J., . . . Dalgleish, T. (2009). A key role for similarity in vicarious reward. *Science, 324*, 900.
- Mobbs, D., Yu, R., Rowe, J. B., Eich, H., FeldmanHall, O., & Dalgleish, T. (2010). Neural activity associated with monitoring the oscillating threat value of a tarantula. *Proceedings of the National Academy of Sciences, USA, 107*, 20582–20586.
- Moll, J., Krueger, F., Zahn, R., Pardini, M., de Oliveira-Souza, R., & Grafman, J. (2006). Human fronto-mesolimbic networks guide decisions about charitable donation. *Proceedings of the National Academy of Sciences, USA, 103*, 15623–15628.
- Montague, P. R., & Berns, G. S. (2002). Neural economics and the biological substrates of valuation. *Neuron, 36*, 265–284.
- Mook, D. G. (1983). In defense of external invalidity. *American Psychologist, 38*, 379–387.
- Morelli, S. A., Lieberman, M. D., & Zaki, J. (2015). The emerging study of positive empathy. *Social & Personality Psychology Compass, 9*, 57–68.
- Morelli, S. A., Sacchet, M. D., & Zaki, J. (2015). Common and distinct neural correlates of personal and vicarious reward: A quantitative meta-analysis. *NeuroImage, 112*, 244–253.
- Morelli, S. A., Torre, J. B., & Eisenberger, N. I. (2014). The neural bases of feeling understood and not understood. *Social Cognitive and Affective Neuroscience, 9*, 1890–1896.
- Morewedge, C. K., Shu, L. L., Gilbert, D. T., & Wilson, T. D. (2009). Bad riddance or good rubbish? Ownership and not loss aversion causes the endowment effect. *Journal of Experimental Social Psychology, 45*, 947–951.
- Naaman, M., Boase, J., & Lai, C. H. (2010). Is it really about me?: Message content in social awareness streams. In S. Whittaker & E. F. Churchill (Eds.), *CSCW '10: Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work* (pp. 189–192). doi:10.1145/1718918.1718953
- Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review, 108*, 291–310.
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review, 84*, 231–259.
- Nook, E. C., & Zaki, J. (2015). Social norms shift behavioral and neural responses to foods. *Journal of Cognitive Neuroscience, 27*, 1412–1426.
- Northoff, G., & Hayes, D. J. (2011). Is our self nothing but reward? *Biological Psychiatry, 69*, 1019–1025.
- Odling-Smee, F. J. (1978). The overshadowing of background stimuli by an informative CS in aversive Pavlovian conditioning with rats. *Learning & Behavior, 6*, 43–51.
- O'Doherty, J. P., Dayan, P., Friston, K., Critchley, H., & Dolan, R. J. (2003). Temporal difference models and reward-related learning in the human brain. *Neuron, 38*, 329–337.
- O'Doherty, J., Winston, J., Critchley, H., Perrett, D., Burt, D. M., & Dolan, R. J. (2003). Beauty in a smile: The role of medial orbitofrontal cortex in facial attractiveness. *Neuropsychologia, 41*, 147–155.
- Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108*, 483–522.
- Pascalis, O., & Kelly, D. J. (2009). The origins of face processing in humans: Phylogeny and ontogeny. *Perspectives on Psychological Science, 4*, 200–209.
- Pavlov, P. I. (1927). *Conditioned reflexes*. London, England: Oxford University Press.
- Pedroni, A., Eisenegger, C., Hartmann, M. N., Fischbacher, U., & Knoch, D. (2014). Dopaminergic stimulation increases selfish behavior in the absence of punishment threat. *Psychopharmacology, 231*, 135–141.
- Plassman, H., O'Doherty, J., & Rangel, A. (2007). Orbitofrontal cortex encodes willingness to pay in everyday economic transactions. *Journal of Neuroscience, 27*, 9984–9988.
- Plassmann, H., O'Doherty, J., Shiv, B., & Rangel, A. (2008). Marketing actions can modulate neural representations of experienced pleasantness. *Proceedings of the National Academy of Sciences, USA, 105*, 1050–1054.
- Poldrack, R. A. (2006). Can cognitive processes be inferred from neuroimaging data? *Trends in Cognitive Sciences, 10*, 59–63.
- Preston, S. D. (2017). The rewarding nature of social contact. *Science, 357*, 1353–1354.
- Prévost, C., Pessiglione, M., Météreau, E., Cléry-Melin, M. L., & Dreher, J. C. (2010). Separate valuation subsystems for delay and effort decision costs. *Journal of Neuroscience, 30*, 14080–14090.
- Pronin, E., Lin, D. Y., & Ross, L. (2002). The bias blind spot: Perceptions of bias in self versus others. *Personality and Social Psychology Bulletin, 28*, 369–381.
- Rand, D. G. (2016). Cooperation, fast and slow: Meta-analytic evidence for a theory of social heuristics and self-interested deliberation. *Psychological Science, 27*, 1192–1206.

- Rand, D. G., Brescoll, V. L., Everett, J. A., Capraro, V., & Barcelo, H. (2016). Social heuristics and social roles: Intuition favors altruism for women but not for men. *Journal of Experimental Psychology: General, 145*, 389–396.
- Rand, D. G., Greene, J. D., & Nowak, M. A. (2012). Spontaneous giving and calculated greed. *Nature, 489*, 427–430.
- Rand, D. G., & Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences, 17*, 413–425.
- Rangel, A., Camerer, C., & Montague, P. R. (2008). A framework for studying the neurobiology of value-based decision making. *Nature Reviews: Neuroscience, 9*, 545–556.
- Ratner, K. G., Dotsch, R., Wigboldus, D. H., van Knippenberg, A., & Amodio, D. M. (2014). Visualizing minimal ingroup and outgroup faces: Implications for impressions, attitudes, and behavior. *Journal of Personality and Social Psychology, 106*, 897–911.
- Redcay, E., & Warnell, K. R. (2017). A social-interactive neuroscience approach to understanding the developing brain. *Advances in Child Development and Behavior, 27*, 1825–1828.
- Reid, V. M., Dunn, K., Young, R. J., Amu, J., Donovan, T., & Reissland, N. (2017). The human fetus preferentially engages with face-like visual stimuli. *Current Biology, 27*, 1825–1828.
- Rescorla, R. A., & Wagner, A. R. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In A. H. Black & W. F. Prokasy (Eds.), *Classical conditioning II: Current research and theory* (Vol. 2, pp. 64–99). New York, NY: Appleton-Century-Crofts.
- Rilling, J. K., Gutman, D. A., Zeh, T. R., Pagnoni, G., Berns, G. S., & Kilts, C. D. (2002). A neural basis for social cooperation. *Neuron, 35*, 395–405.
- Romano, A., Balliet, D., Yamagishi, T., & Liu, J. H. (2017). Parochial trust and cooperation across 17 societies. *Proceedings of the National Academy of Sciences, USA, 114*, 12702–12707.
- Ruff, C. C., & Fehr, E. (2014). The neurobiology of rewards and values in social decision making. *Nature Reviews Neuroscience, 15*, 549–562.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68–78.
- Saunders, B., Richard, J., Margolis, E., & Janak, P. (2017). Instantiation of incentive value and movement invigoration by distinct midbrain dopamine circuits. *bioRxiv*, Article 186502. doi:10.1101/186502
- Schaller, M., Faulkner, J., Park, H. J., Neuberg, L. S., & Kenrick, T. D. (2004). Impressions of danger influence impressions of people: An evolutionary perspective on individual and collective cognition. *Journal of Cultural and Evolutionary Psychology, 2*, 231–247.
- Schultz, W., Dayan, P., & Montague, P. R. (1997). A neural substrate of prediction and reward. *Science, 275*, 1593–1599.
- Sedikides, C., & Gregg, A. P. (2008). Self-enhancement: Food for thought. *Perspectives on Psychological Science, 3*, 102–116.
- Seligman, M. E. (1971). Phobias and preparedness. *Behavior Therapy, 2*, 307–320.
- Sims, T. B., Neufeld, J., Johnstone, T., & Chakrabarti, B. (2014). Autistic traits modulate frontostriatal connectivity during processing of rewarding faces. *Social Cognitive and Affective Neuroscience, 9*, 2010–2016.
- Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. New York, NY: Appleton-Century.
- Smith, D. V., Hayden, B. Y., Truong, T. K., Song, A. W., Platt, M. L., & Huettel, S. A. (2010). Distinct value signals in anterior and posterior ventromedial prefrontal cortex. *Journal of Neuroscience, 30*, 2490–2495.
- Somerville, L. H., & Casey, B. J. (2010). Developmental neurobiology of cognitive control and motivational systems. *Current Opinion in Neurobiology, 20*, 236–241.
- Somerville, L. H., Jones, R. M., & Casey, B. J. (2010). A time of change: Behavioral and neural correlates of adolescent sensitivity to appetitive and aversive environmental cues. *Brain and Cognition, 72*, 124–133.
- Somerville, L. H., Jones, R. M., Ruberry, E. J., Dyke, J. P., Glover, G., & Casey, B. J. (2013). The medial prefrontal cortex and the emergence of self-conscious emotion in adolescence. *Psychological Science, 24*, 1554–1562.
- Somerville, L. H., Kelley, W. M., & Heatherton, T. F. (2010). Self-esteem modulates medial prefrontal cortical responses to evaluative social feedback. *Cerebral Cortex, 20*, 3005–3013.
- Soutschek, A., Burke, C. J., Beharelle, A. R., Schreiber, R., Weber, S. C., Karipidis, I. I., . . . Tobler, P. N. (2017). The dopaminergic reward system underpins gender differences in social preferences. *Nature Human Behaviour, 1*, 819–827.
- Spreckelmeyer, K. N., Rademacher, L., Paulus, F. M., & Gründer, G. (2013). Neural activation during anticipation of opposite-sex and same-sex faces in heterosexual men and women. *NeuroImage, 66*, 223–231.
- Stallen, M., Smidts, A., & Sanfey, A. G. (2013). Peer influence: Neural mechanisms underlying in-group conformity. *Frontiers in Human Neuroscience, 7*, Article 50. doi:10.3389/fnhum.2013.00050
- Stanley, D. A., Sokol-Hessner, P., Banaji, M. R., & Phelps, E. A. (2011). Implicit race attitudes predict trustworthiness judgments and economic trust decisions. *Proceedings of the National Academy of Sciences, 108*, 7710–7715.
- Sul, S., Tobler, P. N., Hein, G., Leiberg, S., Jung, D., Fehr, E., & Kim, H. (2015). Spatial gradient in value representation along the medial prefrontal cortex reflects individual differences in prosociality. *Proceedings of the National Academy of Sciences, USA, 112*, 7851–7856.
- Sutton, R. S., & Barto, A. G. (1998). *Reinforcement learning: An introduction*. Cambridge, MA: MIT Press.
- Tamir, D. I., & Mitchell, J. P. (2012). Disclosing information about the self is intrinsically rewarding. *Proceedings of the National Academy of Sciences, USA, 109*, 8038–8043.
- Tamir, D. I., & Ward, A. F. (2015). Old desires, new media. In W. Hofmann & L. F. Nordgren (Eds.), *The psychology of desire* (pp. 432–455). New York, NY: Guilford Press.
- Tamir, D. I., Zaki, J., & Mitchell, J. P. (2015). Informing others is associated with behavioral and neural signatures

- of value. *Journal of Experimental Psychology: General*, *144*, 1114–1123.
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin*, *103*, 193–210.
- Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior & Organization*, *1*, 39–60.
- Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. New York, NY: Macmillan.
- Tinbergen, N. (1963). On aims and methods of ethology. *Ethology*, *20*, 410–433.
- Tobler, P. N., Fiorillo, C. D., & Schultz, W. (2005). Adaptive coding of reward value by dopamine neurons. *Science*, *307*, 1642–1645.
- Toma, C. L., Hancock, J. T., & Ellison, N. B. (2008). Separating fact from fiction: An examination of deceptive self-presentation in online dating profiles. *Personality and Social Psychology Bulletin*, *34*, 1023–1036.
- Tomasello, M. (1999). The human adaptation for culture. *Annual Review of Anthropology*, *28*, 509–529.
- Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2004). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral & Brain Sciences*, *28*, 675–691.
- Tricomi, E., Rangel, A., Camerer, C. F., & O'Doherty, J. P. (2010). Neural evidence for inequality-averse social preferences. *Nature*, *463*, 1089–1091.
- Tusche, A., Bode, S., & Haynes, J. D. (2010). Neural responses to unattended products predict later consumer choices. *Journal of Neuroscience*, *30*, 8024–8031.
- Twenge, J. M., Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Bartels, J. M. (2007). Social exclusion decreases prosocial behavior. *Journal of Personality and Social Psychology*, *92*, 56–66.
- U.S. Bureau of Labor Statistics. (2016). *American time use survey (2003–2016)*. Washington, DC: U.S. Department of Labor. Retrieved from [https://www.bls.gov/tus/data/files\\_0316.htm](https://www.bls.gov/tus/data/files_0316.htm)
- Van Bavel, J. J., Packer, D. J., & Cunningham, W. A. (2008). The neural substrates of in-group bias: A functional magnetic resonance imaging investigation. *Psychological Science*, *19*, 1131–1139.
- Van den Bos, W., van Dijk, E., Westenberg, M., Rombouts, S. A. R. B., & Crone, E. A. (2009). What motivates repayment? Neural correlates of reciprocity in the Trust Game. *Social Cognitive and Affective Neuroscience*, *4*, 294–304.
- Varnum, M. E., Shi, Z., Chen, A., Qiu, J., & Han, S. (2014). When “Your” reward is the same as “My” reward: Self-construal priming shifts neural responses to own vs. friends’ rewards. *NeuroImage*, *87*, 164–169.
- Wake, S. J., & Izuma, K. (2017). A common neural code for social and monetary rewards in the human striatum. *Social Cognitive and Affective Neuroscience*, *12*, 1558–1564.
- Ward, A. F. (2013). Supernormal: How the Internet is changing our memories and our minds. *Psychological Inquiry*, *24*, 341–348.
- Warneken, F., & Tomasello, M. (2009). Varieties of altruism in children and chimpanzees. *Trends in Cognitive Sciences*, *13*, 397–402.
- Waytz, A., Gray, K., Epley, N., & Wegner, D. M. (2010). Causes and consequences of mind perception. *Trends in Cognitive Sciences*, *14*, 383–388.
- West, S. A., Griffin, A. S., & Gardner, A. (2007). Social semantics: Altruism, cooperation, mutualism, strong reciprocity and group selection. *Journal of Evolutionary Biology*, *20*, 415–432.
- Williams, E. H., & Cross, E. S. (2018). Decreased reward value of biological motion among individuals with autistic traits. *Cognition*, *171*, 1–9.
- Xu, X., Zuo, X., Wang, X., & Han, S. (2009). Do you feel my pain? Racial group membership modulates empathic neural responses. *Journal of Neuroscience*, *29*, 8525–8529.
- Zajonc, R. B. (1965). Social facilitation. *Science*, *149*, 269–274.
- Zajonc, R. B., Heingartner, A., & Herman, E. M. (1969). Social enhancement and impairment of performance in the cockroach. *Journal of Personality and Social Psychology*, *13*, 83–92.
- Zaki, J., & Mitchell, J. (2011). Equitable decision making is associated with neural markers of subjective value. *Proceedings of the National Academy of Sciences, USA*, *108*, 19761–19766.
- Zaki, J., & Mitchell, J. (2013). Intuitive prosociality. *Current Directions in Psychological Science*, *22*, 466–470.
- Zaki, J., & Ochsner, K. (2009). The need for a cognitive neuroscience of naturalistic social cognition. *Annals of the New York Academy of Sciences*, *1167*, 16–30.
- Zaki, J., Schirmer, J., & Mitchell, J. P. (2011). Social influence modulates the neural computation of value. *Psychological Science*, *22*, 894–900.
- Zink, C. F., Tong, Y., Chen, Q., Bassett, D. S., Stein, J. L., & Meyer-Lindenberg, A. (2008). Know your place: Neural processing of social hierarchy in humans. *Neuron*, *58*, 273–283.