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Functional Interdependence Theory: An Evolutionary Account of Social Situations

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Abstract

Social interactions are characterized by distinct forms of interdependence, each of which has unique effects on how behavior unfolds within the interaction. Despite this, little is known about the psychological mechanisms that allow people to detect and respond to the nature of interdependence in any given interaction. We propose that interdependence theory provides clues regarding the structure of interdependence in the human ancestral past. In turn, evolutionary psychology offers a framework for understanding the types of information processing mechanisms that could have been shaped under these recurring conditions. We synthesize and extend these two perspectives to introduce a new theory: functional interdependence theory (FIT). FIT can generate testable hypotheses about the function and structure of the psychological mechanisms for inferring interdependence. This new perspective offers insight into how people initiate and maintain cooperative relationships, select social partners and allies, and identify opportunities to signal social motives.

Keywords

interdependence, power, conflict, cooperation, evolution

> Interdependence is the greatest challenge to the maturity of individual and group functioning.
>
> —K. Lewin; Marrow (1969, p. 226)[1]

> The demands of interdependent social life that "select" for certain behavior tendencies in the course of an individual's life may also have selected genetically for humans with those tendencies or, at least, with the aptitude for readily learning them.
>
> —Kelley and Thibaut (1978, p. 181)

> We operate in a world where the inferred costs and benefits of actions are relevant to our understanding of our exchange relations.
>
> —Tooby, Cosmides, and Price (2006, p. 118)

Interdependence provides significant opportunities and challenges to any organism. This is especially the case for humans, given the richness of our social lives. Indeed, Lewin, a pioneer of social psychology, suggested that navigating the landscape of interdependence is a foundational challenge to group and individual functioning (Marrow, 1969). Seventy years later, Lewin's observation seems prescient given the volume of biological and social science work dedicated to understanding how interdependence shapes human behavior (e.g., Emerson, 1976; Kelley et al., 2003; Maynard-Smith, 1974; Montgomery, 1998; Olson, 1965).

Recent biological perspectives on social behavior suggest that interdependence—the manner in which each individual's behavior affects their own and others' outcomes—can provide key insights into how organisms are adapted to the social environment (e.g., Roberts, 2006; Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012; Tooby & Cosmides, 1996). To illustrate, evolutionary biologists argue that corresponding versus conflicting fitness outcomes between individuals can determine whether cooperation evolves in a species (e.g., Hamilton, 1964; Trivers, 1971). Although this work has not always focused on humans, it implies that different forms of human interdependence in the ancestral environment would have produced psychological adaptations for navigating interdependence (Doebeli & Hauert, 2005; Skyrms, 2004; Tomasello et al., 2012). Hence, understanding how humans deal with Lewin's great challenge of interdependence requires a consideration of not only contemporary social environments but also the ancestral past and the types of adaptations that underlie our psychology of interdependence.

But what was the form of interdependence in the ancestral past? And what adaptations might have evolved in response to these types of interdependence? Here, we answer both of these questions by detailing the fundamental structures of interdependence proposed by Kelley and Thibaut (1978) and the types of information processing systems these structures

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should have produced using Tooby and Cosmides's (1992) approach to understanding psychological adaptations. This integration can be used to generate novel hypotheses regarding the function and structure of psychological mechanisms for detecting and responding to the specific types of interdependence within social situations. We argue that this approach advances evolutionary social psychology by unifying several research topics (e.g., cooperation, coordination, power, nonverbal behavior, and emotional expressions) under a common theoretical framework. Before outlining our theory, though, we briefly describe the theoretical foundations of evolutionary psychology and interdependence theory.

Evolutionary Psychology: Adaptations for Interdependence and Cooperation

Evolutionary theory forms the foundation of scientific investigations of interdependence, social interaction, and cooperation across disciplines (Alcock, 2001). Population biologists use evolutionary game theory models to understand how the structure of organisms' interdependence can select for cooperative tendencies (West, El Mouden, & Gardner, 2011); ethologists study how different social environments and ecologies give rise to varied cooperative strategies across taxa (Wilson, 2012); human behavioral ecologists examine how humans cooperate to solve various interdependent problems, including hunting, coalitional aggression, and child care (Alvard & Nolin, 2002; Hrdy, 2007; Mathew & Boyd, 2011); and social psychologists use evolutionary theory to understand the psychological mechanisms underlying social interactions (DeScioli & Kurzban, 2013; Kenrick, Li, & Butner, 2003; Neuberg & Schaller, 2014; Simpson & Gangestad, 2001).

Each approach aims to understand a fundamental question about interdependent biological organisms: How would selection favor adaptations that motivate organisms to cooperate, and so incur costs to provide benefits to others? And, especially importantly for psychologists, how would these (psychological) adaptations be executed? The evolutionary psychology paradigm articulated by Tooby, Cosmides, and others provides a framework for understanding how psychological adaptations have been shaped by natural selection to promote cooperation (Buss, 1995; Symons, 1990; Tooby & Cosmides, 1992). We discuss two theoretical principles of evolutionary psychology that are pertinent to our theory: the concept of *functional specialization* and the concept of the *environment of evolutionary adaptedness* (EEA).

The ease with which organisms behave in seemingly adaptive manners can belie the engineering difficulties inherent in shaping brains that can process information in a fitness-promoting fashion. Given the varied nature of barriers to reproducing before death (e.g., detecting and avoiding snakes vs. detecting and acquiring a reproductively viable romantic partner vs. detecting and avoiding pathogens; Kenrick, Griskevicius, Neuberg, & Schaller, 2010), it is implausible that the mind has evolved for the general function of "engage in fitness-promoting behavior" (or, pertinent to this article, "navigate interdependence"; Cosmides & Tooby, 1994a; Kurzban, 2010). One of the key contributions of evolutionary psychology concerns the emphasis on *functional specialization* of psychological mechanisms (frequently referred to as "modularity"; Barrett & Kurzban, 2006; Cosmides & Tooby, 1994b). The varied nature of adaptive problems favors the evolution of specialized psychological mechanisms, each of which processes specific information in a functional manner.

But what are these environmental barriers to ultimately reproducing that have shaped psychological mechanisms? Evolutionary psychologists, following Bowlby (1969), suggest that psychological adaptations (i.e., functionally specialized mechanisms) were shaped by conditions in their EEAs (Tooby & Cosmides, 1990, 2005). Each specialized psychological mechanism can, theoretically, be shaped in and by a different EEA. The EEA for mechanisms underlying snake detection and avoidance, for example, concerns the environmental conditions in which snakes threatened our hominid ancestors (Öhman & Mineka, 2001), whereas the EEA for mechanisms underlying anticuckoldry adaptations involves environments of paternal investment mixed with extra-pair sex (Buss, 2006). Based on knowledge of the ancestral past, evolutionary psychologists often generate and test hypotheses about the ultimate, fitness-relevant function and proximate, information processing structure of modern psychology.

Although these principles have led to novel predictions and new information regarding the nature of prejudice (Schaller & Neuberg, 2008), emotion (Tybur, Lieberman, Kurzban, & DeScioli, 2013), visual perception (Jackson & Cormack, 2007), morality (DeScioli & Kurzban, 2013), cooperation (Delton, Cosmides, Guemo, Robertson, & Tooby, 2012), and aggression (Sell, Tooby, & Cosmides, 2009), they have also been criticized on theoretical and empirical grounds. Criticisms regarding functional specialization have highlighted that "domain general" mechanisms (e.g., working memory) can be used in a fitness-promoting fashion (Laland & Brown, 2011). However, the evidence for functionally specialized mechanisms is strong (see Kurzban, 2010; Pinker, 1997, for overviews), and mechanisms need not be applied to only one adaptive problem to be functionally specialized (e.g., Barrett & Kurzban, 2006).

Other criticisms have highlighted the difficulties in inferring functional design based on incomplete knowledge of the past environments that would have shaped psychological adaptations. Naturally, we do have plenty of knowledge regarding the ancestral environment. As one example, we know that there were infectious microorganisms, and we know that their presence likely shaped the evolution of a number of adaptations that function to neutralize their fitness-negating effects (e.g., the emotion disgust; see Tybur & Lieberman, 2016; Tybur et al., 2013).

Nevertheless, there are gaps in our knowledge about our ancestral past. Consider the precise structure of the social environment in the EEA that shaped the psychological adaptations for cooperation. There were certainly some invariants in the past, including problems posed by cheaters and free riders—that is, people who tended to receive benefits from others but not contribute to public goods or reciprocate. Not surprisingly, some of the key evolutionary psychology research programs investigating cooperation have focused on free riders (e.g., Cosmides, 1989; Delton et al., 2012). However, cooperative tasks and collective decisions were exceptionally diverse in ancestral environments; they included hunting, food sharing, migration, trade, protection from predators, child care, and warfare. Furthermore, the nature of each of these tasks varied across ecologies (e.g., jungle vs. savannah vs. coastal). This diversity poses challenges for understanding environmental invariants that could have shaped psychological adaptations for cooperation (Henrich & Henrich, 2007). One feature of social interactions is invariant across ecologies, though: the social dilemma.

The EEA, Social Dilemmas, and the Variety of Interdependence

In social dilemmas, it is in no single individual's best interest to help another because helping incurs a personal cost. If all individuals behave according to their own interests, though, then the collective (i.e., the average of each person's outcomes) is worse off compared with when everyone cooperated (Van Lange, Balliet et al., 2014). Hence, social dilemmas are characterized by conflicts of interests, where the best outcome for each individual is actually worse for all individuals. Social dilemmas occur across myriad types of social interactions, each of which poses distinct challenges and opportunities, including interactions relevant to self-protection, mate retention, status striving, and coalition formation (Kenrick et al., 2003). As a consequence, we can safely assume that social dilemmas were an enduring feature of the EEA that shaped our social psychology (Axelrod, 1984; Delton, Krasnow, Cosmides, & Tooby, 2011; Nowak, 2006).

Not all social dilemmas are created equal, though. Some situations, like deciding to join a coalition for raiding a neighboring tribe, can be characterized by great conflict between individual and collective interests (Bowles, 2009). However, other situations, like joining a coalition to protect one's kin or social allies from a violent outgroup, can involve little conflict between individual and collective interests (Rusch, 2014). Conflicts of interest also vary across individuals within the same situation, if some individuals' interests are more or less aligned with collective interests, or some individuals' behavior more strongly affects others' outcomes (Kelley et al., 2003). Variations in interdependence during social dilemmas (e.g., more or less conflict/power) were likely also an enduring feature of the ancestral past.

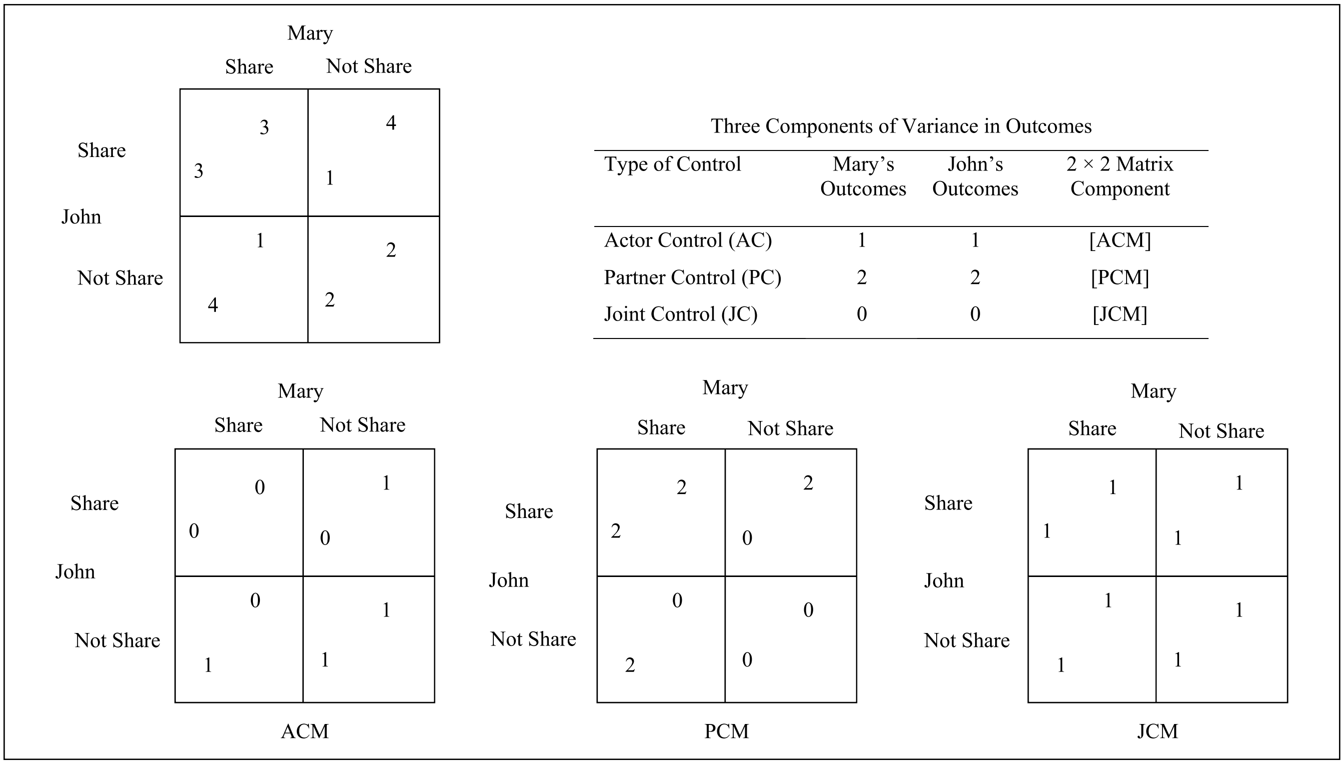
These considerations suggest that understanding the evolved psychology of interdependence requires knowledge of the dimensions of interdependence that psychological mechanisms could operate to detect and navigate. Such information is provided by a social-psychological framework that preceded evolutionary psychology: interdependence theory.

Variation Across Interdependent Situations

Interdependence theory (Kelley & Thibaut, 1978) describes variation in outcomes in any single interdependent interaction. Using a matrix approach initially developed for game theory, Kelley and Thibaut analyzed variation in outcomes in situations described as two-person, two-option (i.e., 2 × 2) matrices (see Kelley et al., 2003). To illustrate, consider the different possible outcomes in a food sharing situation, portrayed in Figure 1. Both individuals in this situation—John and Mary—have two options: share food or do not share food. Each person can experience variable outcomes. John could receive 1, 2, 3, or 4 units, and Mary could also receive 1, 2, 3, or 4 units. The number of units John and Mary receive depends on (a) their own behavior, (b) their interaction partner's behavior, and/or (c) some mutual actions taken together (e.g., coordination). Kelley and Thibaut (1978) used these three components to describe the variance in each person's outcomes in dyadic interactions. To do so, they analyzed each interdependent situation by first considering each person's outcomes separately. We illustrate this approach by first focusing on John's outcomes.

In the situation displayed in Figure 1, one component of variance in John's outcomes is captured by how John's decision to share or not share food influences his own outcomes, independent of what Mary decides to do. This component is labeled *Actor Control*.[2] John's Actor Control can be calculated by averaging across his outcomes when he shares food ([3 + 1] / 2 = 2), then averaging across his outcomes when he does not share food ([4 + 2] / 2 = 3), and finally taking the difference score between those average outcomes (3 − 2 = 1). John's Actor Control here (1) reveals that John receives 1 unit more when he does not share relative to when he does share, independent of Mary's behavior. The same calculations can be done for Mary, whose Actor Control is also (1) in this situation—that is, Mary receives 1 unit more when she does not share than when she does share, independent of John's behavior. Finally, the absolute value of Actor Control (1) can then be imputed in an Actor Control Matrix displayed in Figure 1, where the calculated magnitude is inserted for John's and Mary's outcomes for their behavior that results in the relatively better outcome (in this case, when they do not share food).

John's outcomes are also influenced by whether Mary shares food, independent of how John behaves. This



Three Components of Variance in Outcomes

Type of Control	Mary's Outcomes	John's Outcomes	2 × 2 Matrix Component
Actor Control (AC)	1	1	[ACM]
Partner Control (PC)	2	2	[PCM]
Joint Control (JC)	0	0	[JCM]

Figure 1. Decomposing the variance in outcomes in a food sharing situation into three components: Actor Control, Partner Control, and Joint Control.
Note. Across all the matrices, Mary's outcomes are represented in the upper right-hand corner of each cell, whereas John's outcomes are represented in the lower left-hand corner of each cell. ACM = Actor Control Matrix; PCM = Partner Control Matrix; JCM = Joint Control Matrix.

component of variance in John's outcomes is labeled *Partner Control*. In this situation, John's Partner Control is calculated by averaging across John's outcomes when Mary shares food ([3 + 4] / 2 = 3.5), then averaging across John's outcomes when Mary does not share food ([1 + 2] / 2 = 1.5), and finally creating a difference score between those average outcomes (3.5 − 1.5 = 2). John's Partner Control here (2; see Figure 1) indicates that he receives 2 units more when Mary shares food than when she does not share food, independent of John's behavior. Here, Mary's Partner Control is the same value (2). Next, the absolute value of Partner Control (2) can be imputed in a Partner Control Matrix, where the calculated magnitude is inserted for John's and Mary's outcomes according to when their partner's behavior mainly improves their own outcomes (i.e., when their partner decides to share food).

The final component of variance in John's outcomes is determined by how both Mary and John behave together, referred to as *Joint Control*. John's Joint Control is calculated by first constructing a Joint Control Matrix for John's outcomes and then using the values in that Joint Control Matrix to calculate John's Joint Control. John's Joint Control Matrix is formed by comparing the values in each cell of the Actor Control Matrix and Partner Control Matrix with the original values in the overall matrix. For example, John's overall outcome when both John and Mary share food is (3), subtract from this value the same outcome from the Actor Control Matrix (0) and Partner Control Matrix (2), and then the outcome of this comparison is placed in the Joint Control Matrix (3 − [0 + 2] = 1). John's Joint Control Matrix is formed by doing this calculation for each of John's four possible outcomes. Finally, the magnitude of Joint Control is calculated across all of John's outcomes in the Joint Control Matrix by comparing the outcomes in the two diagonals—upper left to lower right and upper right to lower left (1 − 1 = 0). John's outcomes are influenced by (1) for all possible combinations of how his own behavior combines with Mary's behavior and, hence, his Joint Control value is (0). In this case, no variance in John's outcomes is captured by Joint Control. As shown in Figure 1, the same value of Joint Control (0) describes Mary's outcomes in this situation.[3]

This example describes only one type of interdependence, and the pattern of outcomes described above can vary substantially across situations. After examining hundreds of situations like the one described above, Kelley and Thibaut (1978) found that the ratio between the magnitudes of Actor Control, Partner Control, and Joint Control could be used to describe differences and similarities across interdependent situations. They found that the variation in interdependence *across* situations can be described by four dimensions:

degree of interdependence, degree of correspondence, basis of interdependence, and asymmetric dependence. Below, we (a) describe each dimension of interdependence, (b) provide matrix examples of each dimension, and (c) illustrate each dimension via concrete situations thought to have been ubiquitous in the lives of our hunter-gatherer ancestors.

Degree of Interdependence

One end of this dimension is characterized by bilateral actor control—meaning that each person determines their own outcomes, and their behavior has no effect on their partner's outcomes. That is, people in these situations are *in*dependent. The other end of this dimension is characterized by total *inter*dependence. In this context, both individuals are mutually (and symmetrically) dependent on their partner's behavior—that is, each individual's outcomes are entirely dependent on how their own behavior combines with their partner's behavior. The degree of interdependence is calculated for each person in an interdependent situation, say John ($_j$), as the amount of variance in John's outcomes accounted for by Partner Control (PC) and Joint Control (JC) (both squared), divided by the sum of all three variance components, including Actor Control (AC) (each squared) (see Kelley & Thibaut, 1978, for further details).

$$\text{Degree of interdependence} = \frac{PCj^2 + JCj^2}{ACj^2 + PCj^2 + JCj^2}.$$

Figure 2 displays three matrices, each of which characterizes an interdependent situation at a different position on this dimension. In the situation characterized by total *independence*, John (and Mary) can choose either Option A (+5) or Option B (+0). Importantly, John's choice has no consequence on Mary's outcome. In contrast, in a situation of complete *interdependence*, John can benefit (+5) by choosing Option A or Option B, but whether or not he benefits is completely determined by Mary's behavior (Option A vs. Option B). The matrix in the middle characterizes such a situation, whereby both John and Mary have a clear choice for a benefit (Option A), but their choice affects both their own outcome and their partner's outcome.

To illustrate a situation of *independence*, imagine John and Mary deciding to drink water from a large lake. Each person can choose whether or not to drink water. Given the volume of water in the lake, John's decision to drink has no effect on Mary's outcome (and vice versa). This can be contrasted with a situation of *interdependence*, such as when dangerous animals are introduced into the situation. If there are potential predators nearby, then John can only safely drink from the lake if Mary looks out for predators while he is vulnerable, with his back to the land. The same goes for Mary; she can only safely benefit from the water if John looks out for her while she drinks. Here, both John and Mary benefit from drinking water only when their partner watches for predators.

Degree of Correspondence

On one end of this dimension, outcomes correspond perfectly. That is, both individuals can achieve their best outcome within a situation. On the opposite end of the dimension, outcomes conflict completely, and the behavior that results in the best outcome for one individual results in the worst outcome for the other individual. The degree of correspondence is calculated using the three variance components, Actor Control (AC), Partner Control (PC), and Joint Control (JC), for John ($_j$) and Mary ($_m$), respectively. Possible values range from +1 (completely corresponding outcomes) to −1 (completely conflicting outcomes).

$$\text{Degree of correspondence} = 2\times \left(\frac{\left(AC_j \times PC_m\right) + \left(AC_m \times PC_j\right) + \left(JC_j \times JC_m\right)}{\left(AC_j^2 + PC_j^2 + JC_j^2 + AC_m^2 + PC_m^2 + JC_m^2\right)} \right).$$

As displayed in Figure 2, an example of a situation with completely corresponding outcomes includes John benefiting by choosing Option A (+5), but only if Mary also chooses Option A. Importantly, Mary benefits (+5) from choosing the same option that benefits John. In a situation with conflicting interests, John can benefit (+5) by choosing Option A, and only when Mary also chooses Option A. Mary, though, receives nothing if she chooses Option A; she achieves her best outcome when choosing Option B, but only when John also chooses Option B. Thus, in this situation, one member of the dyad must receive nothing for either individual to receive anything. If John and Mary both behave in a way to achieve their best outcome, then they both receive nothing. Intermediate situations can arise that contain a mixture of corresponding versus conflicting outcomes. To illustrate, the middle matrix in Figure 2 displays a situation with zero corresponding or conflicting outcomes. Such situations are characterized by mutual Partner Control, whereby each person's behavior completely determines their partner's outcome, without any consequence on their own outcomes.

As a further illustration, consider a situation with highly corresponding interests: John and Mary carrying large prey back to the safety of camp—a large prey that is too heavy for a single person to carry alone. Here, both individuals benefit from helping the other carry the prey. The other end of this dimension involves zero-sum (or win–lose) situations, such as when there is only a small amount of food available (enough to feed one person). Here, the only way for John to benefit is for Mary to receive nothing, and the only way for Mary to benefit is for John to receive nothing.

Basis of Interdependence

In some situations, people must coordinate to achieve their best outcomes. That is, each person can improve their outcome by adjusting their behavior based on what their partner is doing. In other situations, coordination has no effect on

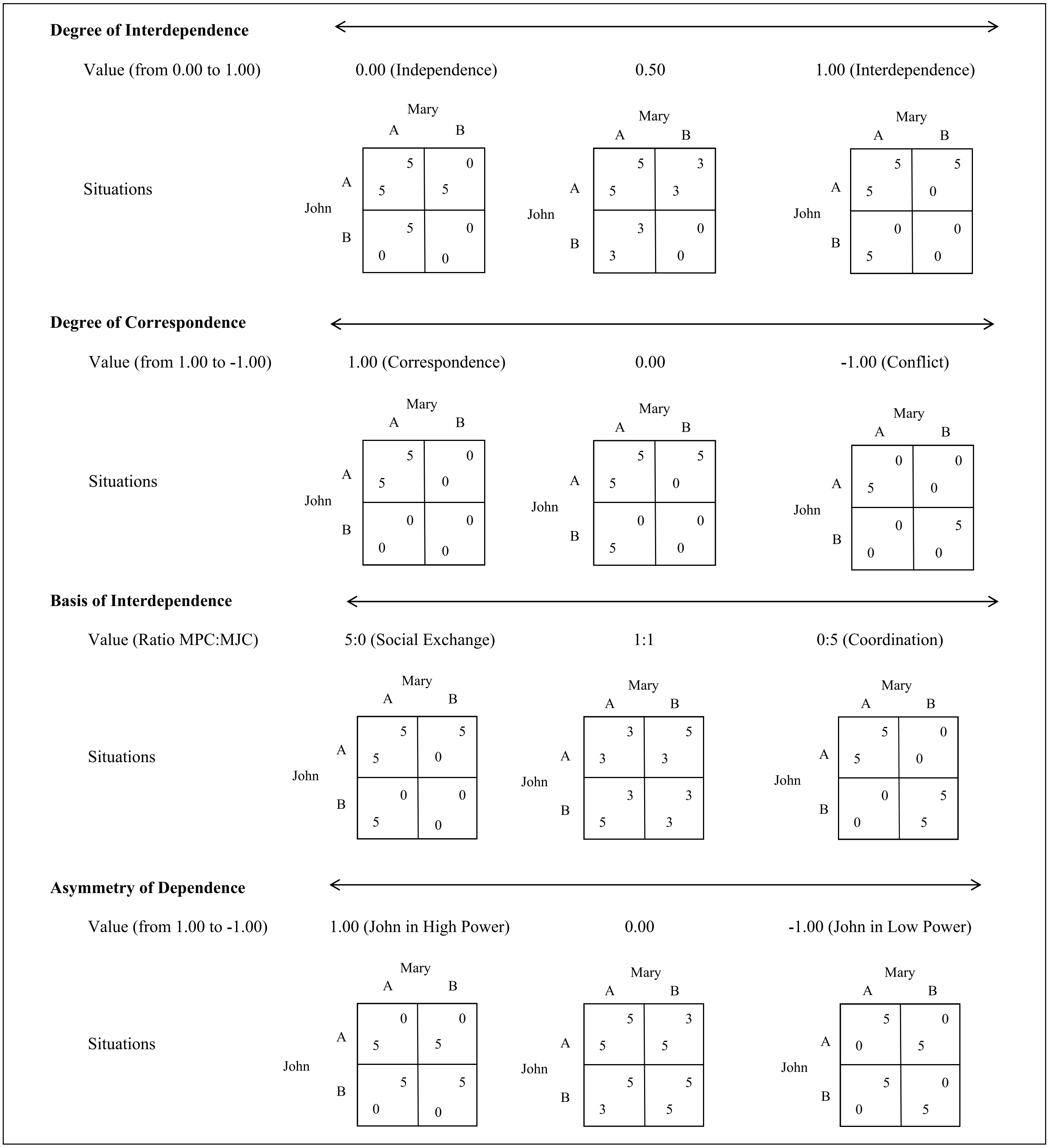


Figure 2. Four dimensions of interdependence and prototypical situations that illustrate the ends and middle of each dimension. MPC = Mutual Partner Control; MJC = Mutual Joint Control.

outcomes. Nonetheless, each person's outcomes can still be influenced by others' behaviors, independent of what they decide to do. The degree to which an individual's behavior can influence how a partner's behavior determines that individual's outcomes is described by the *basis of interdependence*. One end of this dimension is characterized by Mutual Joint Control (i.e., coordination); the other end is characterized by Mutual Partner Control (what Kelley & colleagues, 2003, refer to as "exchange" relations). In situations of Mutual Partner Control, each person's outcome is completely determined by their partner's behavior. In contrast, Partner Control is zero in situations of complete Joint Control; each person's outcome is determined by how their own behavior combines with their partner's behavior. As displayed in the equation below, the basis of interdependence for an individual in an interaction, say John ($_j$), is calculated by the ratio of two variance components of John's outcomes: Partner Control and Joint Control.

$$\text{Basis of interdependence} = \frac{PC_j}{JC_j}.$$

Figure 2 illustrates situations that vary in terms of the basis of interdependence. One end of this dimension contains exchange situations, which are completely characterized by (mutual) *Partner* Control. In a situation of mutual Partner Control, John has two options, each of which could result in a benefit (+5), but whether they do benefit John is completely determined by Mary's behavior. In contrast, the other end of this dimension is characterized by mutual *Joint* Control. In Figure 2, a coordination situation involves both John and Mary engaging in complementary behaviors to achieve some benefit (+5). Situations often lie between these two extremes and involve a mixture of both Partner Control and Joint Control.

Cooperative child rearing can serve as an example of social exchange (mutual Partner Control). Imagine that John and Mary are brother and sister. John can provide care for Mary's child (or not). Mary would benefit from child care, but whether or not she benefits is completely determined by John's behavior. Similarly, Mary can spend that time away from the child gathering tubers for dinner (or not), which could benefit John later that evening. Conversely, other situations may be relatively more determined by mutual Joint Control. For example, John and Mary might engage in distinct behaviors to start a fire in camp (e.g., John might gather wood and Mary might gather tinder). The best outcome in this situation (starting a fire) can be achieved by adjusting one's own behavior to a partner's behavior.

Asymmetric Dependence

At one end of this dimension, an individual is unilaterally dependent on their partner. At the other extreme, an individual completely determines their own and their partner's outcomes. In fact, asymmetric dependence has been offered as a definition of social power (Fiske, 2010; Keltner, Gruenfeld, & Anderson, 2003; Magee & Smith, 2013). The equation below shows that the degree of asymmetric dependence can be calculated by comparing the degree of interdependence for each person, say John ($_j$) and Mary ($_m$). The values can range from +1 to −1. A negative value indicates that John's outcome is less dependent on Mary's behavior than Mary's outcome is dependent on John's behavior (i.e., John has more power than Mary). Conversely, a positive value indicates that Mary has relatively more power than John.

$$\text{Asymmetric dependence} = \left(\frac{PC_j^2 + JC_j^2}{AC_j^2 + PC_j^2 + JC_j^2}\right) - \left(\frac{PC_m^2 + JC_m^2}{AC_m^2 + PC_m^2 + JC_m^2}\right).$$

Figure 2 displays situations that vary in asymmetric dependence. We can consider each of these situations from the perspective of John. In the situation on the left, John benefits by choosing Option A (+5), while Option B results in no benefit. John's outcome is not at all influenced by Mary's behavior. However, Mary only benefits if John chooses Option B, and so Mary is unilaterally dependent on John. Alternatively, as the situation on the right suggests, the roles could change, and John could be unilaterally dependent on Mary. The matrix in the middle displays a situation with symmetric dependence, where both individuals equally influence each other's outcomes.

Consider migratory periods for hunter-gatherers. In these situations, physical strength may determine how much weight people can carry while migrating. Imagine that John is injured and Mary is healthy. Here, John might not be able to carry much on the journey, and he would benefit from Mary's willingness to carry his provisions. Thus, John is unilaterally dependent on Mary during migration. On the contrary, Mary is not reliant on John—Her best outcomes are not at all influenced by John's behavior. That is, Mary is unilaterally independent from John.

Kelley and Thibaut's (1978) rigorous and systematic analysis of interdependent situations in the form of matrices led to a derivation of components and dimensions of interdependence that transcend time and location. Although Kelley and Thibaut focused on how different contemporary situations varied along these dimensions, we propose that the many various interdependent situations encountered by our hunter-gatherer ancestors (e.g., hunting, trade, child care, and warfare; Simpson, 1999) likely also varied along these same dimensions (Proposition 1). In fact, these dimensions should describe variation of interdependence deep into our phylogenetic history. For example, there is evidence that suggests chimpanzees experience situations of variable interdependence (e.g., grooming; Gomes, Mundry, & Boesch, 2009), conflict (e.g., food sharing; Muller & Mitani, 2005), coordination (e.g., hunting; Boesch, 1994), and power (e.g., sexual access; De Waal & Waal, 2007), and such variation in interdependence was likely experienced across the lifetime of a common ancestor between chimpanzees and humans. Hence, interdependence theory provides critical information regarding the nature of variation in interdependence across situations in the ancestral past.

Variations in Interdependence in the Ancestral Past

Evolutionary and social scientists endorse the fact that interdependence in the ancestral past has shaped the evolution of human social psychology, yet most evolutionary models have examined how interdependence strategies would evolve in the face of one type of interdependence in isolation. Hence, researchers have overlooked the important variation in interdependence individuals have experienced within a lifetime for millennia. For example, evolutionary models of social behavior often assume that a specific type of interdependence describes social interactions in the ancestral environment (e.g., a social dilemma). Most models assume that (a) specific behavioral strategies vary in a population (e.g., tit-for-tat vs. always defect), (b) strategies interact with each other in only one specific type of interdependent situation, (c) the outcomes of interactions affect reproductive success of individuals (and, hence, their strategies), and (d) certain strategies become more prevalent across generations (see Rand & Nowak, 2013). Two examples illustrate these evolutionary models of social behavior: (a) how social dilemmas can inform cooperation and (b) how the war of attrition can inform negotiating conflict over scarce resources.

Social Dilemmas and the Adaptive Problem of Cooperation

Many evolutionary game theory models of cooperation assume that a social dilemma (e.g., the Prisoner's Dilemma) characterized the form of interdependence among our ancestors (Boyd & Richerson, 1992; Nowak & May, 1992). As we have seen above, though, the type of interdependence (e.g., degree of corresponding interests, unilateral dependence) contained within any specific social dilemma would have varied dramatically across situations.

Consider food sharing as an example of an interdependent situation. Although food sharing can be generally described as a social dilemma (Gurven, 2004), the nature of the dilemma varies wildly across circumstances. For example, food division can vary in conflict of interests depending on the amount of resources available at any given time (Smaldino, Schank, & McElreath, 2013). Moreover, an adult hunter-gatherer's outcomes for food sharing can be characterized by relatively high power when sharing food with a child, or relatively low power when sharing food with a high-status adult. Other types of ubiquitous ancestral social interactions, including decisions to hunt, migrate, divide parental care, defend against predators, and trade, were also characterized by myriad forms of interdependence.

Yet, most evolutionary game theory models of social interactions model a fixed pattern of interdependence across an individual's lifetime. For example, the 30 years of modeling work that have revealed that the "tit-for-tat" strategy outperforms other strategies across generations have assumed a single, fixed type of social dilemma (e.g., Axelrod, 1984).[4] Nonetheless, recent simulations that have modeled dynamic, more realistic interdependence structures reveal that tit-for-tat is outperformed by other strategies that are sensitive to variation in interdependence (e.g., Cheng, Zuckerman, Nau, & Golbeck, 2011; Dawkins, 2010; Fischer et al., 2013). For example, Fischer and colleagues (2013) find that conditional cooperation based on the perceived similarity of another individual outperform tit-for-tat, especially in a social ecology that involves interdependent situations with variable amounts of corresponding interests.

Other examples suggest that strategies that are sensitive to asymmetric dependence—and adjust decisions based on this dimension of interdependence—are more likely to evolve than a fixed tit-for-tat strategy (Dawkins, 2010), as long as organisms can detect the interdependence within a situation under conditions of uncertainty (Delton et al., 2011).

War of Attrition and the Adaptive Problem of Competition Over Scarce Resources

In modeling how animals, including humans, resolve costly conflicts over scarce resources, biologists have analyzed an interdependent situation in which two individuals compete over a finite resource, such as mates, food, or territory (Haccou & Glaizot, 2002; Hammerstein & Parker, 1982). In such so-called war of attrition situations, costs and benefits for the individuals within the interaction are asymmetric. That is, the situation is characterized by asymmetric dependence, with the cost/benefit ratio being larger for one individual than for the other. In the war of attrition, individuals decide to either compete for resources or withdraw from competition. Presumably, the cost/benefit ratio changes across the interaction, and individuals make decisions to withdraw when costs exceed the benefits. Individuals are thought to assess the asymmetric dependence in these situations prior to competing, and then update those estimates based on the outcome of interactions during the competition.

War of attrition models have provided direct evidence for the functional benefit of making accurate inferences about interdependence in these conflict situations—specifically, by avoiding the costs of making inaccurate inferences about the cost/benefit structure (Haccou & Glaizot, 2002). Theory on the war of attrition suggests that two features of the situation influence each individual's estimated power in the situation: (a) partner cost infliction potential (e.g., formidability; Sell et al., 2009) and (b) the value of the resource being contested (e.g., ownership; Pietraszewski & Shaw, 2015). Consistent with this theory, recent evidence finds that children use specific cues, including physical size, number of alliances, and ownership to infer who is more likely to win a competitive situation (Pietraszewski & Shaw, 2015). In fact, infants as young as 10 months old use physical size to form expectations about who is likely to prevail in situations that contain a conflict of interests (Thomsen, Frankenhuis, Ingold-Smith, & Carey, 2011).

The cues used to infer interdependence in a war of attrition situation may provide clues as to how people infer interdependence in other social dilemmas. That said, existing analyses of the war of attrition do not distinguish between two dimensions of interdependence: degree of correspondence and asymmetric dependence. Moreover, the war of attrition overlooks two other potentially relevant dimensions of interdependence—the degree of interdependence and the basis of interdependence. Also, making inferences of interdependence is a problem that occurs not only in situations involving conflict over resources but also in situations involving coalition formation, social exchange, child rearing, and food sharing, to name a few. Nevertheless, work on the war of attrition offers insights into how psychological mechanisms might function to navigate the uncertainty inherent to interdependent situations. This work is embedded within recent developments in evolutionary psychology—developments that provide a framework for understanding how people infer conspecific characteristics relevant to the nature of interdependent situations.

Functional Specialization for Interdependence Inferences

Others' abilities to impose costs and provide benefits can critically influence the degree of interdependence in a situation, the extent to which interests conflict, whether the situation involves coordination, and whether dependence is asymmetric. How do people infer this information? Evolutionary psychologists have recently proposed that humans possess functionally specialized psychological mechanisms for estimating others' ability to impose costs (a Formidability Index) and provide benefits (a Conferral Index; Sell et al., 2009). Additional adaptations might estimate one's own ability to provide benefits to and impose costs on others. Such estimates, which can inform how each person's behavior can affect their own and others' outcomes across many situations, should be computed based on stable aspects of an individual. For example, upper body strength is used to estimate a person's Formidability Index, and attractiveness is used to estimate a person's Conferral Index (Sell et al., 2010; Sell et al., 2009).

Although traits such as strength and attractiveness are stable across situations, they are not equally relevant across situations. Partner physical strength and attractiveness can inform interdependence in some situations, but might be less important (and, perhaps, irrelevant) in other situations (e.g., when the allocation of pooled resources is based on status rather than strength and attractiveness). If accurately inferring the nature of interdependence within situations was beneficial in the ancestral past, and features of situations reliably covaried with the nature of interdependence (e.g., the degree of interdependence, degree of correspondence, basis of interdependence, and asymmetric dependence), then aspects of human social psychology might have evolved to respond to cues that would dynamically and systematically change depending on the type of interdependence in a social interaction.

Adaptations for Interdependence

Existing work suggests that (a) variation in the structure of outcomes during interdependent situations in the ancestral past can shape how organisms (including people) think about interdependence, (b) the dimensions of interdependence articulated by interdependence theory are relevant to delineating differing social situations, (c) specific cues reliably covary with different forms of interdependence, (d) detecting and responding to the nature of interdependence within a situation is beneficial, and (e) human psychology does indeed have content-rich adaptations that could inform the nature of interdependence within a situation. This existing work can set the foundation for a new, integrative framework for understanding why and how people infer interdependence in a situation. Armed with a descriptive model of the variation in interdependence across social interactions in the EEA, we forward a theory about the evolved psychological mechanisms that function to make interdependence inferences.

Functions of Interdependence Inferences

Much experimental research on human social behavior studies how people behave in situations in which people are provided objective information about their interdependence with others. In contrast with assumptions guiding most of this work, individuals in real-life contexts do not have direct, objective knowledge about how their own and others' actions affect their own and others' outcomes. Instead, people must infer their interdependence under conditions of considerable uncertainty. We propose that even an imperfect ability to infer and respond to interdependence in social situations would afford myriad benefits relative to a position of complete lack of knowledge regarding interdependence (Proposition 2).[5]

Predicting others' behavior. Correctly anticipating a partner's actions allows an individual to select a strategy that is beneficial given anticipated partner behavior (Balliet & Van Lange, 2013; Camerer, 2003; Maynard-Smith, 1976). For example, in social dilemmas, accurately predicting others' behavior allows individuals to avoid interacting with likely free riders (see C. Aktipis, 2004). And, of course, interaction partners can only coordinate if they are able to anticipate each other's actions. Moreover, accurately assessing interdependence within a situation can also inform what type of information will predict others' behavior. For example, an individual's concern for their interaction partner's outcomes predicts behavior in situations that involve a conflict of interests, but in situations of corresponding interests, then partner competence, experience, and common knowledge may better predict partner behavior (Balliet & Van Lange, 2013; Thomas, DeScioli, Haque, & Pinker, 2014).

Influencing others' behavior. Except in situations of pure bilateral actor control (i.e., complete independence), an individual's outcomes are always influenced by their partner's behavior. Hence, the ability to not only predict but also influence a partner's behavior is beneficial in most situations. Strategies to influence a partner's behavior can include making threats and promises, communicating strategies of turn-taking (e.g., in situations requiring coordination), and sharing or concealing information about one's own preferences (Kelley, 1979; Smith, 1982). The tactics employed to influence others' behavior may depend in part on the interdependence in the situation. In situations containing a conflict of interests, investing in verbal communication can enhance trust in others (Cohen, Wildschut, & Insko, 2010), commitment to cooperate (e.g., a norm of promise keeping; Bicchieri, 2002), and ultimately cooperation (Balliet, 2009). In situations containing asymmetric dependence, powerful individuals can use different tactics to strategically influence partner behavior (e.g., via threats), but identical tactics would be less successful when deployed by the low-power individual (Fiske, 2010; Keltner et al., 2003).

Partner selection. Depending on the type of interdependence within a situation, others' behaviors are differentially predicted by personality traits (e.g., assertiveness, dominance, kindness), social motives (e.g., cooperative, competitive, and aggressive), and rules (e.g., punish cheaters, keep promises, and return favors; Kelley et al., 2003; Nakamura & Ohtsuki, 2014). Accurately inferring the type of interdependence can allow individuals to select interaction partners with the qualities that are advantageous in that situation. This occurs regularly. For example, when individuals find themselves in situations that require a sacrifice from an interaction partner, they usually select interaction partners who "owe them a favor" (e.g., family or friends) or who have a prosocial personality (e.g., individuals who are agreeable). Indeed, people are much more likely to help family and friends, rather than mere acquaintances, in high conflict of interests situations, but the difference in helping is much smaller when there is a low conflict of interests (Stewart-Williams, 2007).

Detecting and signaling motives. Existing theory suggests that individuals can benefit from signaling motives (e.g., Gintis, Smith, & Bowles, 2001), detecting others' motives, and then sharing information about others' motives (theory of indirect reciprocity; Nowak & Sigmund, 2005). Accurately inferring interdependence can facilitate efficient signals of cooperative motives because costly cooperation can signal a cooperative motive (Balliet, Mulder, & Van Lange 2011). For instance, to attenuate costs while gleaning reputational benefits, individuals might engage in more cooperation in situations with conflicting interests if an audience is present (Smith & Bird, 2000). Understanding interdependence within situations can also increase the accuracy of inferences regarding others' social motives. This can in turn (a) enable individuals to better predict potential partners' behavior in subsequent situations (Kelley et al., 2003), (b) help them select or avoid interaction partners in subsequent situations (Gintis et al., 2001), and (c) enable them to share more accurate information about others' motives (N. H. Hess & Hagen, 2006). Indeed, prior research finds that people can accurately infer a friend's social motive (Bem & Lord, 1979), that people do evaluate others' behavior differently depending on the type of interdependence in a situation (Joireman, Kuhlman, Van Lange, & Shelley, 2003), and that the type of interdependence in a situation can be used to make inferences of other's social motives (Kelley et al., 2003).

Detecting changes within and across situations. Interdependence can change within a situation, and situations can change even when an interaction partner remains constant. The ability to detect such changes in interdependence would allow individuals to enter or exit situations (or relationships) that are characterized by undesirable interdependence. Alternatively, people can make decisions to increase interdependence to enable them to signal specific traits to partners, or they may decide to reduce interdependence to avoid harm from others (Yamagishi, 2011).

Interdependence inferences can also be monitored over the course of a relationship with a specific partner, and can in turn be integrated to understand the types of situations frequently encountered with specific others. For example, knowing whether previous interactions with a specific person contained mostly corresponding or conflicting interests can guide partner selection and decisions in subsequent situations. In fact, the ability to monitor the types of interdependent situations experienced with a specific person could underlie the phenomenon of felt closeness with others and/or increased commitment to relationships (Aron, Aron, & Smollan, 1992; Rusbult & Buunk, 1993).

In sum, the benefits of detecting and responding to the type of interdependence in a situation are clear. Given the ubiquity of content domains that involve interdependence (e.g., Kenrick et al., 2010; Simpson, 1999), adaptations for making interdependence inferences might gather and store information that can then be deployed across multiple domains of social interaction. The concept of internal regulatory variables (IRVs; Tooby, Cosmides, Sell, Lieberman, & Sznycer, 2008) can provide clues regarding how the mind might do this.

Structure of Interdependence Inferences: Four IRVs

Evolutionary psychologists have argued that motivational systems are computational by nature, and that they have evolved to incorporate functionally specific information from the environment to output adaptive behavior (Tooby & Cosmides, 1992). This idea of computation and integration is similar to Brunswik's (1955) Lens Model, which suggests that the mind tracks and integrates domain-specific cues to arrive at an estimate of probabilistic features of the environment. Consider how a Lens Model can elucidate mate choice. Miller and Todd (1998) suggest that the mind integrates cues to a potential mate's health, intelligence, resources, and cooperativeness into a single index, which is outputted as a proximally experienced value of mate attractiveness, which in turn motivates courtship (or a lack thereof). Tooby et al. (2008) argue that myriad motivational systems act in a similar manner, by tracking, integrating, and storing domain-specific information that can be encoded into a value, which can then be used for a variety of other psychological mechanisms.

Consider the Kinship Index proposed by Lieberman, Tooby, and Cosmides (2007) as another example of an IRV. Knowing the degree of genetic relatedness with conspecifics is important for directing several different types of behavior. Even so, humans, like other animals, do not have infallible knowledge of their relatedness with conspecifics. Instead, they must estimate relatedness by extracting information from the environment. The Kinship Index is proposed as an IRV that extracts and encodes features of the environment (e.g., how much time you spent with another individual during development; whether you witnessed your mother breastfeeding another individual) as information regarding relatedness. This information can then be applied to discrete adaptive problems, including "whom do I behave prosocially toward" and "whom do I avoid as a sexual partner." Other IRVs (e.g., the Welfare Tradeoff Ratio) can similarly be deployed across numerous adaptive problems (Delton & Robertson, 2016; Tooby et al., 2008).

Given the ubiquity of the dimensions of interdependence discussed above—and the putative benefits to detecting and acting upon interdependence within a situation—we propose that adaptations for navigating the four dimensions of interdependence act like IRVs (Proposition 3). These indices, like the Kinship Index and Mate Attractiveness Index, can be used to guide adaptive behavior across several distinct adaptive problems (e.g., parenting, mate search, coalition formation, social exchange; see Kenrick et al., 2010). Just as motivational states outputted from the Kinship Index can vary between mating and cooperative contexts (e.g., with greater values corresponding with disgust and empathy, respectively), outputted behavior arising from the same interdependence index could also vary across adaptive problems. While most previous work has focused on IRVs that estimate important "hidden" properties of *people* (e.g., shared genes, ability to inflict costs or confer benefits, prosocial motivation), functional interdependence theory (FIT) describes IRVs that function to estimate properties of *situations* that are not directly observable. Moreover, similar to the perspective that variation in people cannot be described by a single dimension (or IRV), variation across multidimensional situations requires multiple IRVs to estimate interdependent properties of the situation.

The output from any of the four IRVs estimating the four dimensions of interdependence could be used by different programs regulating behavior in response to a distinct adaptive problem. Consider how a Correspondence Index that estimates the degree of corresponding versus conflicting outcomes would feed into several programs regulating cooperation in different situations. For example, in a situation that involves forming a coalition, detecting high conflict of interests among potential partners could direct a person to condition behavior on trust and previous experience with others. In contrast, detecting high conflict of interests during an interaction with an intrasexual competitor could direct a person to preemptively communicate threats and physical aggression. Alternatively, detecting corresponding interests could lead to similar cooperative behaviors with kin, intrasexual competitors, and even individuals who have a poor reputation for cooperation.

Any adaptation for social behavior should contain a domain-specific logic for how output from interdependence IRVs is used (if it is used at all), and some adaptations might take input from multiple interdependence IRVs. Consider an adaptation for cheater detection (Cosmides & Tooby, 2005). Because a greater degree of interdependence often means that a cheater's behavior has more impact on others' outcomes, detecting a higher degree of interdependence should lead to greater vigilance in detecting cheaters, lower thresholds for detecting cheating, and more aggression toward cheaters. Because low conflict indicates that a cheater could have paid a small cost to provide a substantial benefit to others, detecting a low degree of conflict should lead people to be more likely to punish cheaters. Furthermore, high-power individuals should be less vigilant in detecting cheaters because other's behavior by definition has less impact on their outcomes. Nonetheless, high-power individuals should punish cheaters more severely when cheaters are detected (e.g., via direct aggression) because they pay fewer costs for punishment. In contrast, low-power individuals might fail to punish high-powerful individuals who cheat because counter-punishment would be especially damaging. Cheating can be more prevalent in situations characterized by Partner Control as opposed to situations of Joint Control (i.e., coordination). Therefore, in social exchange situations, people may spend more effort and time monitoring other's actions in relation to certain rules. Moreover, cheating detected in a coordination task should be more readily forgiven and interpreted as a failure of ability as opposed to a lack of concern for other's outcomes.

Like other IRVs, the four interdependence IRVs would each take domain-specific cues as input. Furthermore, each should work in such a way that people enter a situation with an initial estimate on each IRV and then, based on how the situation unfolds, each IRV would be dynamically updated. We discuss input that can be used to estimate initial properties of interdependence in a situation and the cues used to update estimates within a situation. We consider the types of behaviors that should covary with each dimension of interdependence, and we use these considerations to generate hypotheses about how each IRV is computed.[6]

Interdependence Index. People often enter situations with some initial estimate of their degree of interdependence with other individuals within that situation. Such estimates may be based on features of an anticipated interaction partner, including the likely duration of a relationship and potential for future interactions (e.g., relationship commitment; Axelrod, 1984; Rusbult, 1980), the partner's Relationship Value (McCullough, Kurzban, & Tabak, 2013), and estimates of the partner's kinship (Lieberman et al., 2007). Greater likelihood of future interactions, higher relationship value, and higher kinship estimates would each increase the Interdependence Index.

While an Interdependence Index could estimate initial degrees of interdependence in a situation, it should respond to cues within the situation—cues that can be used to dynamically update estimates of interdependence. The most diagnostic cue of where a situation lies on the dimension of interdependence is the presence of others. Especially in the ancestral past, behaviors that influenced others' outcomes would have occurred when others were physically present. When others are present, their eye contact and head–body orientation (e.g., facing a person vs. back turned and looking away from a person) can further inform the degree of interdependence in the situation. Indeed, people tend to direct their gaze toward their interdependent partners, but not necessarily toward individuals they are independent of (Emery, 2000). Partner emotional response to one's own presence or actions (e.g., surprise, disappointment) can also be used to infer interdependence. Others would express emotion more intensely after one's actions if those actions affected the other individual—that is, if the situation is interdependent rather than independent. Critically, different partner emotional expressions could inform different dimensions of interdependence—We address this issue in discussing the Correspondence Index, Coordination Index, and Power Index, below. Verbal behavior may also provide cues to interdependence. Another's speech directed at oneself can also be a cue of interdependence. People often "call the attention" of others by name, and the speaker may expect a response if they are in an interdependent situation.

Prior research supports the idea that these hypothesized cues to interdependence affect whether people behave in ways that display concern for others' outcomes. For example, cues to being observed by others influence whether people behave in relatively more self-interested versus prosocial manners (Bateson, Nettle, & Roberts, 2006). Each of these types of cues could be integrated into a single index tracking the degree of interdependence within a situation.

Correspondence Index. People may be able to form initial estimates of whether a situation contains conflicting or corresponding outcomes by using information about another individual in that situation. For example, the Kinship Index should inform that a situation involves corresponding interests. Similarly, a high Welfare Tradeoff Ratio for another person in that situation should lead to greater estimates of corresponding interests (Delton & Robertson, 2016), as should inferences that another person has a high welfare tradeoff for oneself (Yamagishi, 2011). Conversely, high values of an Exploitation Index, which estimates how likely another person is to transgress during future interactions, should inform that a situation contains greater amounts of conflicting interests (McCullough et al., 2013). An initial Correspondence Index should then be updated based on how the situation unfolds.

Partner emotional cues, for example, should update the Correspondence Index. Because anger is more frequently expressed in situations that contain conflicting interests (especially when a partner follows a strategy favoring their own outcomes; Balliet, Li, & Joireman, 2011; McCullough et al., 2013), and anger expressions can encourage a partner to recalibrate their investment in themselves versus the expresser (Sell et al., 2009), detecting anger in a partner should shift a Correspondence Index away from corresponding and toward conflicting interests. In contrast, as happiness is expressed in social interactions containing corresponding interests (Reed, Zeglen, & Schmidt, 2012; Van Kleef, De Dreu, & Manstead, 2010), a partner's expressed happiness should update the Correspondence Index away from conflicting and toward corresponding interests. Evidence indeed suggests that a partner's smile influences perceptions of cooperative intentions in situations that contain conflicting interests (Reed et al., 2012), and that individuals evaluate situations as containing greater amounts of corresponding interests when a partner smiles or expresses happiness (Van Doorn, Heerdink, & Van Kleef, 2012). When a partner expresses anger, though, individuals rate situations as having greater conflicting interests (Pietroni, Van Kleef, De Dreu, & Pagliaro, 2008).

Nonverbal gestures that are not necessarily associated with any specific emotion should also reliably covary with the degree of corresponding interests. In situations that contain conflict, people may have a tense body posture (e.g., clenched fists and arms crossed), and they may breathe heavily. Conversely, people in situations with corresponding interests might have a relaxed body posture (e.g., open hands and arms hanging loose); they might touch their partner, laugh, and speak with a higher voice pitch. Previous research indeed finds that specific nonverbal behaviors relate to how warm people perceive others, social interactions, and relationships (DePaulo & Friedman, 1998). For example, people infer that a situation contains corresponding interests when others nod their heads (Heintzman, Leathers, Parrott, & Cairns, 1993), lean forward (Reece & Whitman, 1962), and engage in affective touching (McCann & McKenna, 1993). Conversely, gestures such as arm crossing and leaning away increase perceptions of vulnerability (and so conflict) in a situation (DeSteno et al., 2012).

Coordination Index. A Coordination Index should draw mostly on dynamic cues in a situation to estimate the degree of coordination, but not necessarily cues from stable properties of a partner. For example, anticipating that the situation will involve a task requiring synchronous or asynchronous actions (e.g., rowing a canoe, starting a fire, carrying a heavy object) should inform value on the Coordination Index. This anticipation can be updated based on whether an interaction partner is engaging in similar or complementary behaviors (Newtson, 1993, 1994). Such synchrony of actions occurs less frequently in situations involving mutual Partner Control (i.e., social exchange) versus mutual Joint Control (i.e., coordination; Manson, Bryant, Gervais, & Kline, 2013). In addition, decades of research have shown that people unconsciously mimic each other, especially when they share a goal (see Lakin, Jefferis, Cheng, & Chartrand, 2003; Lanzetta & Englis, 1989). Mimicry involves engaging in similar forms of nonverbal behavior (e.g., arm and leg crossing, rate of speech) as others in a social interaction (Argyle, 1988; DePaulo & Friedman, 1998). Hence, the degree to which a partner is mimicking should inform the degree of coordination in a situation.

Importantly, prior theory has claimed that mimicry *communicates* shared goals in a situation (Argyle, 1990; Bavelas, Black, Chovil, Lemery, & Mullett, 1988; Manson et al., 2013) and that mimicry functions to promote perceived similarity, affiliation, and rapport (e.g., Lakin et al., 2003). Furthermore, researchers have speculated that behavioral synchrony can lead people to perceive a social exchange situation as a coordination situation (Manson et al., 2013). Indeed, when people are told that they need to "work together" with a partner, they are more likely to mimic that partner (Lakin & Chartrand, 2003). Moreover, behavioral synchrony and mimicry tend to increase perceptions of a coordinated social unit (Campbell, 1958; Lakens, 2010; Van Baaren, Holland, Steenaert, & van Knippenberg, 2003); importantly, this can result in enhanced coordination and more prosocial behaviors (Manson et al., 2013; Valdesolo, Ouyang, & DeSteno, 2010; Van Baaren, Holland, Kawakami, & van Knippenberg, 2004).

Similarity in partner emotional expression (e.g., wincing at another's expression of pain, two or more individuals expressing fear or anger) can also be used to update the degree to which goals are shared within a situation (e.g., U. Hess & Fischer, 2014). Moreover, people tend to mimic others' emotional expressions, but individuals primed to compete in an interaction mimic others' emotions less (Weyers, Mühlberger, Kund, Hess, & Pauli, 2009). In sum, the degree to which the Coordination Index outputs Partner Control versus Join Control should be influenced less by who a partner is, and more by the dynamic feedback from a partner's synchrony, mimicry, and similarity of emotional expressions.

Power Index. Given that asymmetric dependence is often referred to as "power" in the social psychology literature (e.g., Fiske, 2010), we refer to this IRV as a Power Index.[7] Before entering into an interaction, the Power Index should be informed by an integration of one's own and one's partner's (a) Formidability Index and (b) Conferral Index (Sell et al., 2009). When a partner can deliver substantial benefits/costs compared with oneself, then people should estimate that their partner has greater power.

Initial Power Index estimates are imperfect, though, and these estimates should be dynamically adjusted given a partner's behavior within a situation. Extensive research on power offers clues to the verbal and nonverbal cues that could be used to update the Power Index (Hall, Coats, & LeBeau, 2005; Keating, 1985). For example, during aggressive interactions, more vulnerable individuals position the body in such a manner to protect the vital organs (ten Brinke, Gruenfeld, & Carney, 2014), and these positions should serve as a cue to power asymmetries in a situation (Carney, Cuddy, & Yap, 2010). In fact, research has found that the manipulation of a relaxed, open, and expansive bodily posture compared with a tense, closed, and compressed bodily posture can influence perceived power in a situation (Carney et al., 2010; Tiedens & Fragale, 2003). People in high-power positions display relaxed facial expressions, greater facial expressiveness, and direct eye contact, and they maintain close interpersonal distance, pay less overall attention to others, and display greater amounts of hand/arm gestures (Aguinis, Simonsen, & Pierce, 1998; Carney, Hall, & LeBeau, 2005; Hall et al., 2005).

Emotions and emotional expression should also feed into a Power Index. For example, people in low-power positions are more likely to display fear (Langner & Keltner, 2008), which can stem from a potential threat of physical harm (e.g., relative size or strength). An interaction partner's fear expression might reveal information about their own power estimate, which can in turn inform the observer's Power Index. Conversely, an interaction partner's pride expression might suggest that this person has high power in a situation (Tangney, 1999).

Verbal behavior may also provide cues about asymmetric dependence in a situation. Higher power individuals tend to speak more loudly and interrupt others' speech (Hall et al., 2005), whereas lower power individuals tend to intersperse speech (Carney et al., 2005; Hall et al., 2005). In sum, although the Power Index should be largely determined by an integration of a Formidability Index and a Conferral Index, it should also be updated dynamically based on cues to an interaction partner's perception of their own power within a situation.

FIT proposes that functionally specialized psychological mechanisms track four dimensions of interdependence because (a) features of situations reliably covary with the four dimensions of interdependence, (b) there are benefits to inferring interdependence and adjusting behavior based on the output of these inferences, and (c) psychological mechanisms are functionally specialized for using these features to infer interdependence. FIT hypothesizes that people are able to use specific information to form initial estimates of interdependence prior to entering a situation. As suggested above, these estimates can be based on properties of partners in the interaction (e.g., kinship, relationship value, and social motives). People may also have an ability to recall past similar situations with estimated properties of interdependence, and the prior estimates of interdependence in a situation may inform initial estimates in the current situation. Subsequent partner verbal and nonverbal behaviors in an interaction could be used to update those initial estimates of interdependence. Accurate inferences of interdependence are beneficial insofar as they enable individuals to navigate social interactions in a fitness-promoting fashion. To illustrate the utility of this perspective, we use FIT to examine a specific type of behavior: cooperation.

Interdependence Inferences and Cooperation

Individuals can benefit from cooperative interactions, but they can also be exploited. Natural selection can favor adaptations to encourage selective cooperation that increases benefits and attenuates costs (i.e., conditional cooperation), such as when interacting with kin (Hamilton, 1964), with an individual with anticipated future interactions (Trivers, 1971), or with an individual who is known to have a cooperative reputation (Boyd & Richerson, 1989). To date, though, most adaptationist theories of conditional cooperation have not considered how people execute cooperative strategies depending on variable interdependent contexts—that is, previous work has mostly examined how cooperation evolved in response to a single type of interdependence, often characterized by some degree of conflicting interests *and* symmetric dependence. This assumption pales in comparison with the rich variety of interdependence encountered across the lifetime. In the face of variable interdependence, adaptations for conditional cooperation that could estimate key properties of interdependence would outperform those that do not. We expect that the four IRVs discussed above facilitate conditional cooperation via direct reciprocity, indirect reciprocity, and partner selection.

Direct Reciprocity

Cooperation can evolve through direct reciprocity if cooperation is restricted to partners with whom an individual will interact in the future (Axelrod, 1984; Trivers, 1971). Direct reciprocity involves individuals paying immediate costs to cooperate with a partner, but later receiving benefits from that partner during a future interaction. A large body of research indicates that humans engage in this type of direct reciprocity (Berg, Dickhaut, & McCabe, 1995; Gouldner, 1960; Van Lange, 1999). Yet, research is only beginning to understand the proximate information processing structures that support direct reciprocity (Cosmides & Tooby, 1989).

Any psychological mechanisms specialized for regulating reciprocal exchange should condition behavior on (a) estimated properties of the exchange and (b) subsequent partner behavior. Critically, mechanisms utilizing information regarding the interdependence structure of an interaction would outperform those that do not. For example, higher values on the Interdependence Index would upregulate cooperation because people in these situations often depend on their partner to acquire benefits. Furthermore, the type of interdependence may also matter for initial levels of cooperation with potential future interaction partners. If the Coordination Index indicates that a situation contains mutual joint control, then people should attend to one's partner, adjust their behavior according to one's partner, and cooperate together for mutual benefit. Also, when the Correspondence Index indicates that a situation contains a conflict of interests, people should be initially less cooperative (or require a greater number of expected future interactions to cooperate). Conversely, if the Correspondence Index indicates that a situation involves corresponding interests, then people should upregulate cooperation because their partner values the same outcome and is likely to cooperate. In addition, when the Power Index indicates that a person is in a position of high power, he or she should be less cooperative, and vice versa, because of the asymmetric benefits of cooperation and the potential cost of retaliation for non-cooperation.

The four interdependence IRVs discussed above should also influence the type of information people use to adjust their initial levels of cooperation. For example, when the Correspondence Index indicates that a situation contains conflicting interests, people should condition their behavior on perceived similarity, group membership, and trust that their partner is concerned about their own outcomes (Balliet & Van Lange, 2013; Balliet, Wu, & De Dreu, 2014; Fischer, 2009). In contrast, if the Correspondence Index or the Coordination Index suggests that a situation involves corresponding outcomes or mutual joint control, then people should condition their cooperation on cues that indicate partner ability, partner experience, and common knowledge (Thomas et al., 2014).

Existing research supports these hypotheses, with people who perceive lower corresponding interests behaving less cooperatively within a negotiation (e.g., Liu, Liu, & Zhang, 2016; Thompson, Valley, & Kramer, 1995). Recent work has also found that strategies that take into account the degree of corresponding interests in a situation are more successful at initiating and maintaining reciprocal relations relative to other strategies (Fischer et al., 2013). Specifically, using agent-based modeling, Fischer and colleagues (2013) found that initial cooperation based on cues of similarity promoted cooperation better than other traditional strategies of direct reciprocity (e.g., tit-for-tat and win-stay–lose-shift). This model assumed that the amount of perceived similarity is always compared with knowledge about the degree of conflict within a situation. According to the successful similarity strategy, cooperation requires greater amounts of perceived similarity in situations that involve greater amounts of conflict.

Mechanisms that regulate responses to a partner's prior cooperation (or non-cooperation) would also be enriched by IRVs that monitor the interdependence structure of a situation. For example, people who tend to reciprocate in more symmetrically dependent interactions might adjust this strategy based on output from the Power Index. When the Power Index indicates that a person is in a low-power situation, for instance, that individual could benefit from more readily forgiving their partner's non-cooperation; in contrast, when in a high-power situation, the same individual could benefit from being unforgiving (see Aquino, Tripp, & Bies, 2006). Surprisingly, as far as we know, no research has yet examined how reciprocation strategies covary with actual or perceived power. This dearth of research contrasts with theory suggesting that reciprocity fails to support cooperation in situations characterized by varying degrees of asymmetric dependence (see Dawkins, 2010).

Moreover, people may be more forgiving of a partner's non-cooperation when the Correspondence Index indicates that a situation contains a strong conflict of interests, and less forgiving when a partner defects in a situation that contains corresponding interests. Punishing and avoiding individuals who fail to cooperate in high conflict of interests situations may damage otherwise mutually beneficial relationships because these individuals could still be reliable and trustworthy partners in situations that contain less conflict of interests. In contrast, expressing anger in response to a partner who defects in a low conflict of interests situation may promote that individual to recalibrate their concern for one's outcomes in subsequent social interactions (Delton & Robertson, 2016; Sell et al., 2009). Indeed, feelings of anger and a desire for revenge are stronger when a partner defects in a low, compared with high, conflict of interests situation (Balliet, Li, & Joireman, 2011). Thus, the psychological mechanisms that promote conditional cooperation based on expected future interaction and partner's past behavior can potentially reap even greater fitness benefits by taking into account the output from the four IRVs that monitor the type of interdependence in a situation.

Indirect Reciprocity

Indirect reciprocity occurs when people cooperate (or not) with others, and then information about their behavior is shared with others in a social network, and then people subsequently choose to cooperate with others who have a cooperative reputation. In a system of indirect reciprocity, a cooperator benefits individuals apart from the person with whom they initially cooperated (Boyd & Richerson, 1989). To date, a wealth of research confirms that people engage in indirect reciprocity and that indirect reciprocity can support cooperation in social networks (Feinberg, Willer, & Schultz, 2014). As with direct reciprocity, strategies for indirect reciprocity informed by the interdependence within situations should outperform those that are not.

For indirect reciprocity to support the evolution of cooperation, people must be able to accurately assess and spread reputational information about others' behavior and motives. Knowledge about interdependence in a situation critically informs the social motives that underlie behavior (Holmes, 2002; Kelley et al., 2003), and the four IRVs that monitor the type of interdependence can provide this information. Consider situations in which the Correspondence Index suggests that a situation contains conflicting versus corresponding interests. Observing cooperation from an individual in the former versus the latter situation should imply relatively more cooperative motives (i.e., a high Welfare Tradeoff Ratio; Delton & Robertson, 2016). Consistent with this hypothesis, people who sacrifice self-interest to punish non-cooperators are perceived as caring more about group outcomes and valuing cooperation more relative to people who engage in less costly punishment of non-cooperators (Balliet, Mulder, & Van Lange, 2011; Nelissen, 2008). Moreover, inferences of others' cooperative motives can be shared with others via gossip, which can impact others' reputation (Barclay, 2013; Wu, Balliet, & Van Lange, 2015).

Furthermore, which rules should people use to assign good versus bad reputations to others? For example, should people be evaluated poorly for defecting against another person who cooperates, even if that person has a bad reputation? Answers to such questions may depend on the type of interdependence in that situation. Using computer simulations, Nakamura and Ohtsuki (2014) found that different rules for assigning good versus bad reputations evolved in different types of interdependent situations. A decision rule that assigns a good reputation to individuals who cooperate with partners who have a known cooperative reputation, regardless of their partner's current behavior, promoted cooperation in some types of interdependent situations (e.g., the Prisoner's Dilemma and Chicken). In contrast, a decision rule that assigns a good reputation to individuals who defect with a partner who currently cooperates but has a bad reputation was more successful in promoting cooperation in other types of interdependent situations (e.g., the assurance situation). If selection engineers psychological mechanisms for inferring interdependence, then people can glean greater benefits in systems of indirect reciprocity by adjusting the rules used to evaluate others' behavior.

Partner Selection

Evolutionary models of human cooperation demonstrate that cooperation can evolve if cooperators are able to identify and interact with cooperative partners while avoiding selfish partners (Nesse, 2007; Noë & Hammerstein, 1994). Moreover, existing models suggest that individuals who signal cooperative motives are selected as an interaction partner in future social exchange contexts (Barclay, 2004, 2013; Bliege Bird & Smith, 2005). We suggest that making interdependence inferences may be useful in choosing, attracting, and retaining valuable partners. For example, the Correspondence Index might allow people to enter situations with some degree of conflicting interests to test a potential long-term partner's concern for one's outcomes (Simpson, 2007). Similar benefits should arise from the Power Index, which would allow people to detect and enter low-power situations to test whether their partner displays concern for their outcome—a type of screening mechanism to choose cooperative partners (see Archetti et al., 2011).

The four interdependence IRVs should also inform the traits on which individuals should select potential partners (e.g., dominant, submissive, cooperative, and assertive). To illustrate, when the Coordination Index indicates that a situation contains mutual joint control, then partner choice strategies selecting for skill, experience, and common knowledge should outperform strategies selecting for cooperative reputation and honesty. When the Correspondence Index indicates that a situation contains conflicting interests, strategies selecting for honest and cooperative partners (e.g., via perceived Welfare Tradeoff Ratio) should outperform those selecting for ability.

The four IRVs could also enable people to establish (and maintain) relationships with partners who possess valuable characteristics relative to others, such as desirable traits, a large number of alliances, and high centrality in a social network (Noë & Hammerstein, 1994). Perceived partner value on a specific characteristic may influence what types of interdependent situations people enter with others. People may be motivated to enter social interactions with high value partners in situations characterized by low power, high conflicting interests, and high interdependence, but to exit or avoid such situations with a comparably low value partner. Basically, interdependence inferences from the four IRVs can inform when to enter, avoid, or exit a specific interaction with high and low value partners in a way that promotes cooperative relationships with high value partners.

Of course, people are not unconstrained in their partner selection; they must attract and retain valuable partners in competitive biological markets (Barclay, 2016), often by signaling cooperative motives (Barclay, 2013). Signals can be more efficient and effective if signalers can assess the interdependence within a situation. Previous research suggests that people should be more motivated to broadcast cooperative motives in front of larger, compared with smaller, audiences (Griskevicius, Tybur, & Van den Bergh, 2010; Smith & Bird, 2000). However, FIT implies that audience size should only be relevant if the Correspondence Index indicates that a situation contains conflicting (vs. corresponding) interests because choosing to cooperate when interests correspond should do little to attract future interaction partners. Moreover, the Correspondence Index may enable people to efficiently adjust the cost of sending a cooperative signal depending on the value of a possible future partner.

Finally, after identifying and attracting partners and allies, people should also maintain such valued social relationships. Some individuals' social value is based on their physical formidability and ability to protect against aggressive conspecifics rather than their cooperative tendencies. It can be beneficial to maintain ties with such individuals while limiting the costs of those non-cooperative tendencies. People can thus benefit from selectively avoiding interdependent situations that involve a conflict of interests and/or unilateral dependence with such non-cooperative individuals, rather than choosing to avoid these individuals across all interdependent situations. Thus, the Correspondence Index and Power Index may enable strategies to efficiently maintain relationships with non-cooperative individuals by selectively entering situations with these persons. In addition, the Interdependence Index would enable people to detect changes in interdependence across situations (e.g., monitor when a partner decreases interdependence), which could allow for estimates of a partner's relationship commitment or inclusion by a group.

FIT: Summary of Propositions and Hypotheses

Bridging evolutionary psychology (Tooby & Cosmides, 1992, 2005) and interdependence theory (Kelley et al., 2003; Kelley & Thibaut, 1978) provides psychologists with a powerful new theoretical perspective: FIT. FIT advances three key, novel propositions not yet incorporated into evolutionary social psychology (see Table 1). The first proposition is that four dimensions of interdependence characterized interdependence across social interactions in the EEA, and thus are likely candidates for shaping psychological adaptations for assessing interdependence. The second proposition is that accurately inferring and responding to the type of interdependence in a specific situation is beneficial in many ways, including predicting and influencing others' behavior, selecting partners, communicating social motives, and detecting changes across situations. People do not possess objective knowledge of interdependence structures, as is typically assumed in experimental research, and so people must infer interdependence based on cues within situations (e.g., about partner identity and behavior). The third proposition is that psychological adaptations function to estimate the different dimensions of interdependence. These adaptations function as IRVs that integrate, track, and store information about interdependence—information that can be deployed to other functionally specialized psychological mechanisms. Table 2 provides an overview of some of the testable hypotheses we have discussed above.

How people infer interdependence in a situation may be a fundamental and primary process in directing much of social cognition and behavior (A. Aktipis, 2015; Bazerman, Curhan, Moore, & Valley, 2000; De Dreu, 2010; Deutsch, 1973; Holmes, 2002; Kelley & Thibaut, 1978; March, 1995;

Table 1. Three Propositions of Functional Interdependence Theory.

1	Four dimensions of interdependent outcomes describe the similarities among and differences between many reliably recurring types of social exchange contexts in both the ancestral and contemporary social context (Kelley et al., 2003).
2	Humans have benefited from detecting and responding to the type of interdependence in a situation. Benefits include predicting others' behavior, influencing others' behavior, selecting partners, communicating social motives, and detecting changes in interdependence.
3	These dimensions of interdependence provide a key framework for understanding some of the (likely) adaptations for dealing with social exchange. Variation across these dimensions of interdependence identifies threats and affordances posed across different social exchange contexts and can provide insights into the function and structure of key social-psychological adaptations.

Messick, 1999; Montgomery, 1998; Rusbult & Van Lange, 2003). The propositions discussed above highlight the utility of research programs that (a) elucidate features (cues) that systematically vary across the four dimensions of interdependence, (b) generate hypotheses about how variation in these cues allows people to infer interdependence, and (c) test hypotheses about how these cues affect cognitive and motivational processes of behavior.

Broader Implications and Future Directions

In this section, we discuss how FIT can advance fundamental theoretical issues of evolutionary social psychology, address how FIT answers recent calls for psychological perspectives on how people think about situations, and specify methodological innovations necessary to test hypotheses generated by FIT.

FIT and Modeling Evolutionary Processes

Much evolutionary research on interdependence has focused on how reproductive fitness was interdependent among our ancestors (Roberts, 2006). This work—most of which is modeling work—has largely assumed that social interactions are characterized by a single type of interdependence across generations, such as a social dilemma, assurance situation, or chicken situation. Model outcomes are examined to determine what behavioral strategies evolve under certain interdependent conditions. Models using different types of interdependence structures (e.g., when fitness interdependence is characterized by more or less corresponding interests) are sometimes compared (Nowak & Sigmund, 1992, 1993; Smaldino et al., 2013). Although informative, this work is limited by not systematically varying the type of interdependence that individuals face across generations. Given cross-generational differences in resource availability, sex ratios, disease prevalence, social structures, and so on, it is unlikely that a single type of interdependence characterized a population across generations. Moreover, models that do address variability in interdependence assume that fitness interdependence varies along a single dimension—the degree of corresponding interests (Roberts, 2006). FIT offers modelers four parameters on which interdependence can vary—parameters that can be used to test what cooperation strategies emerge under variable, cross-generational conditions.

Interdependence also varies *within* generations. FIT addresses how variation in interdependence across an individual's lifetime can pose selective pressure on adaptations for social behavior. Only recently have evolutionary game theorists attempted to relax assumptions of a fixed type of interdependence across an individual's lifetime (see Cheng et al., 2011). Work that has modeled different interdependent situations shows that behavioral strategies successful in ecologies with a single interdependence structure are easily outcompeted under more complex, ecologically valid assumptions. Nevertheless, work varying interdependence structures in agent-based models has not yet been informed by theory specifying how interdependence varies across the lifetime. FIT can be instrumental in advancing this area of inquiry. At the same time, the models employed in evolutionary game theory can be used to test key assumptions of FIT that we have communicated in this article. Preliminary evidence is consistent with FIT (e.g., Fischer et al., 2013), but many more tests can support, refute, or refine our arguments.

Phylogeny and Comparative Psychology

All social species experience interdependence with conspecifics (and other species, for example, mutualisms). FIT can be applied to understanding variation in interdependence within a variety of species. Descriptions of interdependence in other species might inform when, phylogenetically, adaptations for navigating interdependence emerged. The degree of interdependence may be the most ancient dimension described by FIT. Indeed, even single-celled organisms can experience variable forms of interdependence with other conspecifics (and across species) in a lifetime (see Kessin, 2001; Werner et al., 2014). Once adaptations for detecting and responding to degrees of interdependence evolved, subsequent adaptations for, say, asymmetric dependence might have evolved, if social interactions within a species were characterized by power differences.

Any adaptations for assessing interdependence could vary across species, depending on what cues covary with the four dimensions of interdependence (e.g., antler size in deer vs.

Table 2. Hypotheses of FIT on the Internal and External Input for Each IRV and How Each IRV Regulates Cooperation.

IRV	Internal input	External input	Output
Interdependence Index	Kinship Index (+) Future interactions (+) Relationship value (+) Closeness (+) Commitment (+)	Presence of others (+) Eye contact (+) Head–body orientation (+) Partner emotion after behavior (+) Vocalize name (+)	Initial cooperation (+) Monitor for cheating (+) Anger in response to defection (+) Select high WTR partner (+)
Correspondence Index	Kinship Index (+) Other Welfare Tradeoff Ratio (+) Own Welfare Tradeoff Ratio (+) Exploitation Index (−)	Partner anger (−) Partner happiness (+) Affective touching (+) Laughing (+) Partner tense body posture (−)	Initial cooperation (+) Condition behavior on trust (−) Condition behavior on similarity (−) Anger in response to defection (+) Punish cheaters (+)
Coordination Index		Mimicry (+) Synchrony (+) Similar emotion (+)	Monitor for cheating (−) Condition behavior on trust (−) Condition behavior on experience (+) Condition behavior on common knowledge (+)
Power Index	Other Formidability Index (−) Other Conferral Index (−) Own Formidability Index (+) Own Conferral Index (+)	Partner fear (+) Partner pride (−) Partner expansive bodily posture (−) Interrupt speech (−) Partner loud speech (−)	Initial cooperation (−) Anger in response to partner defection (+) Punish cheaters (+)

Note. FIT = functional interdependence theory; IRV = internal regulatory variable; Interdependence Index = positive value equals greater degrees of interdependence; (+) = a positive correlation between the IRV index and the specified variable; WTR = Welfare Tradeoff Ratio; Correspondence Index = higher value equals greater corresponding interests; (−) = a negative correlation between the IRV index and the specified variable; Coordination Index = higher value equals greater degree of mutual joint control; Power Index = higher value equals higher power position of a person relative to one's partner in a social interaction.

upper body strength in humans as cues to asymmetric dependence). We suspect, however, that primate species use similar cues to infer interdependence (e.g., head–body orientation, eye gaze, and emotional gestures). Previous work suggests that a common ancestor had a capacity to infer asymmetric dependence. Indeed, a wealth of research suggests that similar vocal communication and nonverbal behaviors observed across the great apes (including humans) tend to provide information about dominance and submission during social interactions (e.g., Darwin, 1871; Keating, 1985). However, prior theory and research are silent about potential commonalities in how humans and other species infer other dimensions of interdependence.

Although nonhuman primates may experience situations with varying degrees of conflicting interests (e.g., food sharing) and coordination (e.g., hunting), they tend not to differentiate behavior across these different types of interdependence. For example, nonhuman primates may not have adaptations for estimating the degree of conflicting interests in a situation and/or an ability to detect the amount of coordination. This could be because a common ancestor (a) did not have reliably recurring cues across situations that varied according to the degree of conflicting interests and/or (b) lacked some critical cognitive ability that provides input to an adaptation to infer the degree of conflict in a situation (e.g., theory of mind; Baron-Cohen, 1997). Comparative research can incorporate insights from FIT to examine whether mechanisms to infer interdependence are characterized by different EEAs.

Building Evolutionary Psychology From Social Psychology

To date, evolutionary psychology has fruitfully informed how social psychologists think about myriad phenomena, including widely studied topics such as prejudice (Schaller & Neuberg, 2008), the self (Kurzban & Aktipis, 2007), and romantic relationships (Simpson, 1999). FIT highlights an opportunity for theory developed in social psychology to reciprocate and enrich evolutionary psychology. Specifically, the dimensions of interdependence described in interdependence theory are ubiquitous across the types of adaptive problems often considered by evolutionary psychologists when trying to understand psychological adaptations (e.g., avoiding cuckoldry, assessing mate value, forming coalitions; see Buss, 1999). By offering a theory of interdependent situations, social psychology can aid evolutionary psychologists in understanding how specific information processing systems may (or may not) be more effective problem solvers in the face of variably interdependent situations. Indeed, as illustrated by our approach, FIT can be extended from understanding adaptations for navigating interdependence to elucidating the adaptations for more domain-specific problems, such as conditional cooperation. Perhaps more ambitiously, FIT might serve as an umbrella under which to categorize and integrate work by evolutionary psychologists on Welfare Tradeoff Ratios, Formidability Indices, Conferral Indices, Relative Bargaining Power (RBP) Indices, Kinship Indices, and so on (see Cosmides & Tooby, 2013).

FIT and Other Models of Situational Inferences

Several social psychologists have suggested that humans have an ability to associate situations with prototypes of interdependence, such as a social dilemma, assurance, chicken, or one of the many possible types of interdependence (Halevy & Katz, 2013; Messick, 1999). Rapoport and Guyer (1966), for example, considered all the possible types of interdependence in the simplest forms of dyadic interactions—the 2 × 2 matrix—whereby two individuals each have two behavioral options, and each individual has rank-ordered preferences of the different possible outcomes. After determining that only 78 (of the resulting 576) interdependent situations were nonequivalent, Rapoport and Guyer further concluded that only four situations were truly unique—the Prisoner's Dilemma, Chicken Game, Assurance Game, and Maximizing Difference Game. Subsequent research has shown that people behave differently when they perceive a situation as characterized by one of these prototypes (Halevy, Chou, & Murnighan, 2012).

Great variability in interdependence exists, though, within the interdependent prototype situations, such as the social dilemma (e.g., variable conflicting interests vs. variable asymmetric dependence). Assuming that preferences for each specific outcome in a situation can vary continuously, then an infinite number of possible interdependent situations could exist even in a simple 2 × 2 matrix. Given the vast number of candidate situations, categorizing situations into one of a limited number of prototypes would lead to errors in anticipating others' behavior in many situations.[8] This variation in interdependence can continue to have important implications for own and others' behavior. Indeed, people behave more versus less cooperatively in a social dilemma with less versus more conflict of interests, respectively (Komorita, Sweeney, & Kravitz, 1980; Murnighan & Roth, 1983). People also tend to adjust their own cooperation depending on the degree of asymmetric dependence in a social dilemma (Dawkins, 2010; Righetti et al., 2015). For this reason, detecting and responding to different degrees of conflict and asymmetric dependence, even within one of the situations suggested by Rapoport and Guyer (1966), could more efficiently guide behavior relative to associating a specific situation to a prototypical type of interdependence. Finally, FIT also extends the prototype model by generating unique predictions of how people use cues from the social context to make inferences of interdependence.

Personality and social psychologists have long lamented the lack of theories or taxonomies of situations (see Funder, 2009; Kenrick & Funder, 1988; Reis, 2008). Recently, Rauthmann and colleagues (2014) empirically derived eight dimensions that describe how people evaluate situations (Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception, Sociality, that is, DIAMONDS) by examining how people describe situations using the Riverside Situational Q-sort (RSQ). Three of these eight dimensions differentiate social situations: sociality, adversity, and deception. *Sociality* describes if a social interaction is present or not—and so this dimension may relate to the degree of interdependence. *Adversity* describes if a situation contains conflict. *Deception* describes if a situation involves issues related to trust. Both of the latter dimensions may relate to the degree of corresponding interests in a situation (see Balliet & Van Lange, 2013). Hence, while there is some overlap between FIT and DIAMONDS, the eight DIAMONDS dimensions do not clearly map onto the four dimensions of interdependence. For example, asymmetric dependence and basis of interdependence are not represented within the eight DIAMONDS dimensions, despite that these dimensions are essential properties of situations (Fiske, 2010). Insights from FIT could supplement DIAMONDS, perhaps by expanding the situational content included in the RSQ.

Computational Adaptations and Learning Processes

The sharpest contrast between interdependence theory and FIT concerns the psychological mechanisms used to navigate interdependence. According to Kelley and Thibaut (1978), people learn over time to understand the type of interdependence in a situation by experiencing the consequences of their own and other's behavior. Once people experience many of the different possible outcomes over time, only then are they able to understand their interdependence with others. In other words, people adapt to all interdependent situations by the same general learning mechanisms (e.g., operant conditioning), with no domain specificity across the dimensions of interdependence. More recent conceptions of interdependence theory have continued to assume that only domain-general learning mechanisms guide behavior across the four dimensions of interdependence (Rusbult & Van Lange, 2003). Recent investigations have continued to operate under these assumptions, with researchers assuming that the same factors (e.g., objective information about interdependence) influence assessments of each dimension of interdependence, and in turn influence cooperation (Gonzalez, Ben-Asher, Martin, & Dutt, 2015; Martin, Gonzalez, Juvina, & Lebiere, 2014). These assumptions sit uneasily with research demonstrating that different cues influence different dimensions of interdependence, and empirical work providing objective information about situations (e.g., matrix payouts) does not represent the natural contexts in which people must infer interdependence under conditions of uncertainty.

In contrast with interdependence theory, FIT suggests that different, functionally specialized mechanisms make inferences about each dimension of interdependence. This proposition is consistent with evidence that people—indeed, even infants—use domain-specific cues to infer dimensions of interdependence (e.g., Pietraszewski & Shaw, 2015; Pietroni et al., 2008; Sell et al., 2009; Thomsen et al., 2011; Van Doorn et al., 2012). FIT is also consistent with the speed and accuracy advantages of domain-specific processes and, hence, plausible evolvability of a functionally specialized interdependence psychology (Cosmides & Tooby, 1994b). For example, a domain-specific approach implies that people can accurately infer their interdependence with others in novel, first-time-encountered situations, and so would not require experience of outcomes to acquire knowledge of their interdependence with others. Naturally, though, learning processes do not conflict with evolutionary approaches to behavior (see Tooby & Cosmides, 1992, 2005). And, as Kelley and Thibaut (1978) note themselves, adaptation within situations could take the form of a type of learning bias. Future research can more exhaustively examine the degree of functional specialization across each interdependence dimension, including the degree to which learning is distinct across the dimensions.[9]

Future Theoretical Issues

The four dimensions of interdependence theory were developed analyzing dyadic interactions, and Kelley and Thibaut (1978) noted that the complexity of interdependence explodes while even scaling up from a dyad to triad. Nonetheless, four dimensions can still characterize important differences in interdependence within larger groups. Future research can examine whether and how people infer their interdependence in a situation with a group (e.g., number of people, cues of group membership, position in hierarchy). The IRVs that function to infer interdependence within dyads might be applied to infer interdependence in larger groups, or other IRVs might be tailored especially for situations encountered in group settings.

In line with mainstream evolutionary psychological perspectives (Barrett & Kurzban, 2006; Cosmides & Tooby, 1994b; Pinker, 1997), FIT adopts a computational perspective to understanding situations. This means that cues are perceived, weighted, and integrated to form a value on a specific dimension. Here, we have focused on generally sketching out the input to the mechanisms that perform these computations and their relation to functional outputs. We do not wish for this account to belie the possible complexity of these computations (e.g., the weighting and integration of different inputs). Many aspects of our interdependence psychology await elucidation, including (a) which cues are given more weight in updating inferences; (b) are there biases to avoid making specific errors; and (c) is there a serial ordering in which specific cues are processed to infer interdependence? Work on kin detection can serve as a model for understanding some of these computational processes. Lieberman et al. (2007) proposed that both childhood coresidence duration and maternal perinatal association (MPA) should act as inputs into mechanisms estimating kinship. However, they suggested that coresidence duration should only be considered if MPA was absent because MPA gives more reliable information regarding relatedness. Data supported this prediction. Future work on FIT could similarly examine whether specific cues more reliably predict a feature of interdependence and whether such cues are prioritized in the process of inferring interdependence.

Methodological Implications of FIT

Across fields, empirical research on interdependence typically (a) observes behavior in only a few types of interdependent situations, (b) provides participants with objective information about their interdependence with others, and/or (c) observes outcomes without measuring how people think about their interdependence with others (e.g., how they think about the situation). For example, psychologists have rich data informing how people behave in social dilemmas, but we know much less about how people behave in response to changes in that type of interdependence. Moreover, inside the laboratory, people are presented objective information about how their own and others' behavior affect their own and others' outcomes. In contrast, people outside the laboratory must infer their interdependence based on information available in a specific situation. Researchers can benefit from developing (a) methods that systematically vary the types of interdependence people experience (see Kelley, 1983, 1984), (b) measurements for how people think about interdependence (see Halevy et al., 2012; Rauthmann et al., 2014), and (c) methods that enable researchers to relate objective and subjective interdependence, to test hypotheses about factors that give rise to accuracy and biases in the perception of interdependent situations (see Funder, 2009; Rauthmann, Sherman, & Funder, 2015). FIT can enable theory-directed efforts to develop methods to study how variation in interdependence, including the ways people think about interdependence, shapes human cognition, motivation, and behavior.

Concluding Remarks

Researchers across the biological and social sciences agree that interdependence shapes how organisms behave. Despite this consensus, most theoretical modeling and experimental research across fields have neglected the problem of how people detect the type of interdependence in a situation—or if they can even detect their interdependence at all. This lacuna has been occasionally recognized across disciplines (A. Aktipis, 2015; Bazerman et al., 2000; Deutsch, 1973; Halevy & Katz, 2013; Kelley & Thibaut, 1978; March, 1995; Messick, 1999; Montgomery, 1998). For example, in economics, Camerer (2003) has suggested that a leading open research question for understanding social behavior is, "What games do people think they are playing?" (p. 474). Social psychology is uniquely positioned to advance our understanding of this phenomenon, but it can do so most fruitfully through bridging with other disciplines.

As captured by Kurt Lewin's quote at the beginning of this article, the early history of social psychology prioritized understanding how people deal with the challenges and opportunities of interdependence. In fact, Kelley (2000)—who was a student of Lewin—stated that "the proper study of social psychology is the study of interaction and its immediate consequences," and that any theory of interaction should be "anchored" in situations of interdependence (p. 11). Kelley and Thibaut (1978) developed a taxonomic model of interdependent situations that could provide a foundation for theorizing about cognitive and motivational processes underlying social behavior. However, this model has remained insulated within social psychology and isolated from the broader discussions across the biological and social sciences about the role of interdependence in shaping human behavior. This isolation is surprising given Kelley's (2000) view that "dealing with exchange and coordination problems of outcome interdependence is crucial to human adaptational and evolutionary processes" (p. 13).

A marriage between Kelley's work and the broader evolutionary sciences highlights the fact that interdependence cannot be easily described along a single dimension, and that the psychological mechanisms regulating behavior across interdependent situations are similarly multifaceted. Indeed, logical analyses using a simple conceptual tool (the matrix) illuminate key properties of interdependence that can describe both interactions in contemporary society *and* interactions among our ancestors deep in our ancestral past. We applied this approach to generate predictions regarding four psychological mechanisms that function to make interdependence inferences and that regulate much of social cognition, motivation, and behavior. FIT can unite different programs of research that have focused on how people respond to a single property of interdependence—such as the degree of interdependence (e.g., Kumar, Scheer, & Steenkamp, 1995; Wageman & Baker, 1996), conflict (e.g., Deutsch, 1949; Rapoport, 1967; Thompson & Hastie, 1990), coordination (e.g., Kelley et al., 2003; Oullier, De Guzman, Jantzen, Lagarde, & Scott Kelso, 2008), and power (e.g., Fiske, 2010; French & Raven, 1959)—under a common framework. This framework, in turn, can inform fundamental aspects of our psychology that determine behavior across a variety of social interaction situations that pose challenges and opportunities to relationships, groups, and even societies.

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Notes

1. This statement by Kurt Lewin was made during a conversation with Ronald Lippett (a student of Lewin) just hours before he died of a heart attack, February 12, 1947.
2. In our analysis, we focus on the classic writings of Kelley and Thibaut (1978) but use the labels of the concepts in the most recent formulation of interdependence theory (Kelley et al., 2003). Specifically, we use the labels of the components of Actor Control, Partner Control, and Joint Control (rather than Reflexive Control, Fate Control, and Behavior Control, respectively). These labels of the different variance components do not imply that people have conscious control over their own and other's outcomes or that people understand how their own behavior influences other's outcomes. These terms simply describe how variance in an individual's outcomes is determined by their own and other's behavior.
3. At this point, the reader might make the connection between this approach to describing variance in outcomes and ANOVA used in statistics. In fact, the logic is the same in both approaches. The Kelley and Thibaut (1978) approach is essentially two ANOVAs conducted on the outcomes in a situation, one ANOVA for each person in the matrix. For example, in Figure 1, the sums of squares can be calculated for John's outcomes by squaring the calculated values for Actor Control ($1^2 = 1$), Partner Control ($2^2 = 4$), and Joint Control ($0^2 = 0$), which can then be combined to create the total sums of squares ($1 + 4 + 0 = 5$). The total amount of variance in John's outcomes accounted for by each variance component can be calculated by a ratio of that variance component to the total variance. For example, 80% of John's outcomes are determined by Partner Control ($4 / 5 = .80$).
4. Although early research supported the success of tit-for-tat as a strategy to promote the evolution of cooperation during repeated interactions, more recent research suggests that tit-for-tat +2 (a more forgiving version of tit-for-tat) and the strategy of win-stay–lose-shift can be relatively more successful than a tit-for-tat strategy (see Nowak, 2006). Here, we focus on tit-for-tat because of the historical precedence, because of knowledge of the strategy across disciplines, and, most importantly, because all of our conclusions about tit-for-tat extend to these other strategies.
5. Our perspective is aligned with an approach to social perception that attempts to anchor social perception in objective features of the social environment (see Funder, 2009; Gibson, 1979; Jussim, 1991; McArthur & Baron, 1983; Rauthmann et al., 2014). Specifically, we assume that interdependence characterizes social interactions, four dimensions describe properties of any single interaction, and that inferences of

interdependent situations may operate to estimate those properties of a situation. While these inferences of interdependence can contain error, the inferences would reduce uncertainty and reflect the actual interdependence in a situation.

6. In our approach, we focus on various forms of verbal and nonverbal behaviors, with a relatively stronger emphasis on the latter. We agree that "nonverbal behavior is crucial . . . for defining the social psychological situation" (Ambady & Weisbuch, 2010, p. 473), and that "many of the key parameters of our social life are quickly and efficiently negotiated through nonverbal communication" (DePaulo & Friedman, 1998, p. 27). Yet, to date, most work on nonverbal behavior has focused on person perception (i.e., person inferences), as opposed to interpersonal situation perception (i.e., interdependence inferences).
7. The Power Index is similar to the Relative Bargaining Power (RBP) Index proposed by Lukaszewski (2013). Here, we extend RBP to use cues to estimate the amount of power asymmetry in a specific situation with others.
8. Halevy, Chou, and Murnighan (2012) suggest that people perceive situations according to four prototypes of symmetric interdependent situations because (a) the prototypes simplify the interdependent problem and (b) people prefer symmetry. We agree that any psychological mechanism for making interdependent inferences should likely provide a relatively less complex representation of the type of interdependence of any single interaction. That said, the four prototypes overlook the four fundamental dimensions of interdependence that vary across situations. For example, the prototypes do not consider variation in asymmetric dependence across situations. However, there are substantial benefits to accurately detecting asymmetries in dependence in an interaction, and there can be substantial costs imposed on people who misrepresent a situation as containing equal dependence. Thus, the four prototypes of interdependence may result in costly inferential errors.
9. Most interdependent situations in the ancestral environment occurred in the presence of interdependent partners. Therefore, functional interdependence theory (FIT) emphasizes cues from others who are present in a situation. While we believe that these cues should continue to reliably covary across situations that vary on the dimensions of interdependence, in contemporary society people often behave in ways that affect the lives of others when those others are not physically present (e.g., on the computer). How do individuals make sense of their interdependence when their interaction partners are not physically present? One possibility is that people estimate initial properties of an interdependent situation based on properties of their expected interaction partners and/or estimations of interdependence in past situations. In addition, people may imagine and simulate others' behavior during an interaction, which could provide input to infer interdependence (e.g., How would a person respond if I do not cooperate?).

References

Aguinis, H., Simonsen, M. M., & Pierce, C. A. (1998). Effects of nonverbal behavior on perceptions of power bases. *The Journal of Social Psychology*, *138*, 455-469. doi:10.1080/00224549809600400

Aktipis, A. (2015). Principles of cooperation across systems: From human sharing to multicellularity and cancer. *Evolutionary Applications*, *9*, 17-36.

Aktipis, C. (2004). Know when to walk away: Contingent movement and the evolution of cooperation. *Journal of Theoretical Biology*, *231*, 249-260. doi:10.1016/j.jtbi.2004.06.020

Alcock, J. (2001). *The triumph of sociobiology*. Oxford, UK: Oxford University Press.

Alvard, M. S., & Nolin, D. A. (2002). Rousseau's whale hunt? Coordination among big-game hunters. *Current Anthropology*, *43*, 533-559. doi:10.1086/341653

Ambady, N., & Weisbuch, M. (2010). Nonverbal behavior. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (pp. 464-497). Hoboken, NJ: John Wiley & Sons.

Aquino, K., Tripp, T. M., & Bies, R. J. (2006). Getting even or moving on? Power, procedural justice, and types of offense as predictors of revenge, forgiveness, reconciliation, and avoidance in organizations. *Journal of Applied Psychology*, *91*, 653-668. doi:10.1037/0021-9010.91.3.653

Archetti, M., Ubeda, F., Fundenberg, D., Green, J., Pierce, N. E., & Yu, D. W. (2011). Let the right one in: A microeconomic approach to partner choice in mutualisms. *The American Naturalist*, *177*, 75-85. doi:10.1086/657622

Argyle, M. (1988). *Bodily communication* (2nd ed.). London, England: Methuen.

Argyle, M. (1990). The biological basis of rapport. *Psychological Inquiry*, *1*, 297-300. doi:10.1207/s15327965pli0104_3

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, *63*, 596-612. doi:10.1037/0022-3514.63.4.596

Axelrod, R. (1984). *The evolution of cooperation*. New York, NY: Basic Books.

Balliet, D. (2009). Communication and cooperation in social dilemmas: A meta-analytic review. *Journal of Conflict Resolution*, *54*, 39-57. doi:10.1177/0022002709352443

Balliet, D., Li, N. P., & Joireman, J. (2011). Relating trait self-control and forgiveness among prosocials and proselfs: A test of compensatory and synergistic models. *Journal of Personality and Social Psychology*, *101*, 1090-1109. doi:10.1037/a0024967

Balliet, D., Mulder, L. B., & Van Lange, P. A. M. (2011). Reward, punishment, and cooperation: A meta-analysis. *Psychological Bulletin*, *137*, 594-615. doi:10.1037/a0023489

Balliet, D., & Van Lange, P. A. M. (2013). Trust, conflict, and cooperation: A meta-analysis. *Psychological Bulletin*, *139*, 1090-1112. doi:10.1037/a0030939

Balliet, D., Wu, J., & De Dreu, C. K. W. (2014). In-group favoritism in cooperative decision making: A meta-analysis. *Psychological Bulletin*, *140*, 1556-1581. doi:10.1037/a0037737

Barclay, P. (2004). Trustworthiness and competitive altruism can also solve the "tragedy of the commons." *Evolution & Human Behavior*, *25*, 209-220. doi:10.1016/j.evolhumbehav.2004.04.002

Barclay, P. (2013). Strategies for cooperation in biological markets, especially for humans. *Evolution & Human Behavior*, *34*, 164-175. doi:10.1016/j.evolhumbehav.2013.02.002

Barclay, P. (2016). Biological markets and the effects of partner choice on cooperation and friendship. *Current Opinion in Psychology*, *7*, 33-38. doi:10.1016/j.copsyc.2015.07.012

Baron-Cohen, S. (1997). *Mindblindness: An essay on autism and theory of mind*. New York, NY: The MIT Press.

Barrett, H. C., & Kurzban, R. (2006). Modularity in cognition: Framing the debate. *Psychological Review*, *113*, 628-647. doi:10.1037/0033-295X.113.3.628

Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology Letters*, *2*, 412-414. doi:10.1098/rsbl.2006.0509

Bavelas, J. B., Black, A., Chovil, N., Lemery, C. R., & Mullett, J. (1988). Form and function of motor mimicry: Topographic evidence that the primary function is communicative. *Human Communication Research*, *14*, 275-299. doi:10.1111/j.1468-2958.1988.tb00158.x

Bazerman, M. H., Curhan, J. R., Moore, D. A., & Valley, K. L. (2000). Negotiation. *Annual Review of Psychology*, *51*, 279-314. doi:10.1146/annurev.psych.51.1.279

Bem, D. J., & Lord, C. G. (1979). Template matching: A proposal for probing the ecological validity of experimental settings in social psychology. *Journal of Personality and Social Psychology*, *37*, 833-846. doi:10.1037/0022-3514.37.6.833

Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior*, *10*, 122-142. doi:10.1006/game.1995.1027

Bicchieri, C. (2002). Covenants without swords: Group identity, norms, and communication in social dilemmas. *Rationality and Society*, *14*, 192-228. doi:10.1177/1043463102014002003

Bliege Bird, R., & Smith, E. A. (2005). Signaling theory, strategic interaction, and symbolic capital. *Current Anthropology*, *46*, 221-248. doi:10.1086/427115

Boesch, C. (1994). Cooperative hunting in wild chimpanzees. *Animal Behaviour*, *48*, 653-667. doi:10.1006/anbe.1994.1285

Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment*. New York, NY: Basic Books.

Bowles, S. (2009). Did warfare among ancestral hunter-gatherers affect the evolution of human social behaviors? *Science*, *324*, 1293-1298. doi:10.1126/science.1168112

Boyd, R., & Richerson, P. J. (1989). The evolution of indirect reciprocity. *Social Networks*, *11*, 213-236. doi:10.1016/0378-8733(89)90003-8

Boyd, R., & Richerson, P. J. (1992). Punishment allows the evolution of cooperation (or anything else) in sizable groups. *Ethology and Sociobiology*, *13*, 171-195. doi:10.1016/0162-3095(92)90032-Y

Brunswik, E. (1955). Representative design and probabilistic theory in a functional psychology. *Psychological Review*, *62*(3), 193.

Buss, D. M. (1995). Psychological sex differences: Origins through sexual selection. *American Psychologist*, *50*, 164-168. doi:10.1037/0003-066X.50.3.164

Buss, D. M. (1999). *Evolutionary psychology: The new science of the mind*. New York, NY: Allyn & Bacon.

Buss, D. M. (2006). Strategies of human mating. *Psychological Topics*, *15*, 239-260.

Camerer, C. F. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton, NJ: Princeton University Press.

Campbell, D. T. (1958). Common fate, similarity, and other indices of the status of aggregates of persons as social entities. *Behavioral Science*, *3*, 14-25. doi:10.1002/bs.3830030103

Carney, D. R., Cuddy, A. J., & Yap, A. J. (2010). Power posing brief nonverbal displays affect neuroendocrine levels and risk tolerance. *Psychological Science*, *21*, 1363-1368. doi:10.1177/0956797610383437

Carney, D. R., Hall, J. A., & LeBeau, L. S. (2005). Beliefs about the nonverbal expression of social power. *Journal of Nonverbal Behavior*, *29*, 105-123. doi:10.1007/s10919-005-2743-z

Cheng, K.-L., Zuckerman, I., Nau, D., & Golbeck, J. (2011). The life game: Cognitive strategies for repeated stochastic games. Proceedings of the International Conference on Privacy, Security, Risk and Trust, 95-102. doi:10.1109/PASSAT/SocialCom.2011.62

Cohen, T. R., Wildschut, T., & Insko, C. A. (2010). How communication increases interpersonal cooperation in mixed-motive situations. *Journal of Experimental Social Psychology*, *46*, 39-50. doi:10.1016/j.jesp.2009.09.009

Cosmides, L. (1989). The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task. *Cognition*, *31*, 187-276. doi:10.1016/0010-0277(89)90023-1

Cosmides, L., & Tooby, J. (1989). Evolutionary psychology and the generation of culture, part II. Case study: A computational theory of social exchange. *Ethology and Sociobiology*, *10*, 51-97.

Cosmides, L., & Tooby, J. (1994a). Better than rational: Evolutionary psychology and the invisible hand. *The American Economic Review*, *84*, 327-332.

Cosmides, L., & Tooby, J. (1994b). Origins of domain specificity: The evolution of functional organization. In L. Hirschfeld & S. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 85-116). New York, NY: Cambridge University Press. doi:10.1017/CBO9780511752902.005

Cosmides, L., & Tooby, J. (2005). Neurocognitive adaptations designed for social exchange. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 584-627). Hoboken, NJ: John Wiley.

Cosmides, L., & Tooby, J. (2013). Evolutionary psychology: New perspectives on cognition and motivation. *Annual Review of Psychology*, *64*, 201-229. doi:10.1146/annurev.psych.121208.131628

Darwin, C. (1871). *The descent of man, and selection in relation to sex*. New York, NY: Appleton.

Dawkins, M. S. (2010). Do asymmetries destabilize the Prisoner's Dilemma and make reciprocal altruism unlikely? *Animal Behavior*, *80*, 339-341. doi:10.1016/j.anbehav.2010.05.005

De Dreu, C. K. (2010). Social conflict: The emergence and consequences of struggle and negotiation. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (5th ed., pp. 983-1023). Hoboken, NJ: Wiley. doi:10.1002/9780470561119.socpsy002027

Delton, A. W., Cosmides, L., Guemo, M., Robertson, T. E., & Tooby, J. (2012). The psychosemantics of free riding: Dissecting the architecture of a moral concept. *Journal of Personality and Social Psychology*, *102*, 1252-1270. doi:10.1037/a0027026

Delton, A. W., Krasnow, M. M., Cosmides, L., & Tooby, J. (2011). Evolution of direct reciprocity under uncertainty can explain human generosity in one-shot encounters. *Proceedings of the National Academy of Sciences*, *108*, 13335-13340. doi:10.1073/pnas.1102131108

Delton, A. W., & Robertson, T. E. (2016). How the mind makes welfare tradeoffs: Evolution, computation, and emotion. *Current Opinion in Psychology*, *7*, 12-16. doi:10.1016/j.copsyc.2015.06.006

DePaulo, B. M., & Friedman, H. S. (1998). Nonverbal communication. In S. T. Fiske, D. Gilbert, & G. Lindzey (Eds.), *The handbook of social psychology* (3rd ed., Vol. *2*, pp. 3-40). Boston, MA: McGraw-Hill.

DeScioli, P., & Kurzban, R. (2013). A solution to the mysteries of morality. *Psychological Bulletin*, *139*, 477-496. doi:10.1037/a0029065

DeSteno, D., Breazeal, C., Frank, R. H., Pizarro, D., Baumann, J., Dickens, L., & Lee, J. J. (2012). Detecting the trustworthiness of novel partners in economic exchange. *Psychological Science*, *23*, 1549-1556. doi:10.1177/0956797612448793

Deutsch, M. (1949). A theory of co-operation and competition. *Human Relations*, *2*, 129-152. doi:10.1177/001872674900200204

Deutsch, M. (1973). *The resolution of conflict*. New Haven, CT: Yale University Press.

De Waal, F., & Waal, F. B. (2007). *Chimpanzee politics: Power and sex among apes*. Baltimore, MD: Johns Hopkins University Press.

Doebeli, M., & Hauert, C. (2005). Models of cooperation based on the Prisoner's Dilemma and the Snowdrift game. *Ecology Letters*, *8*, 748-766. doi:10.1111/j.1461-0248.2005.00773.x

Emerson, R. M. (1976). Social exchange theory. *Annual Review of Sociology*, *2*, 335-362. doi:10.1146/annurev.so.02.080176.002003

Emery, N. J. (2000). The eyes have it: The neuroethology, function and evolution of social gaze. *Neuroscience & Biobehavioral Reviews*, *24*, 581-604. doi:10.1016/S0149-7634(00)00025-7

Feinberg, M., Willer, R., & Schultz, M. (2014). Gossip and ostracism promote cooperation in groups. *Psychological Science*, *25*, 656-664. doi:10.1177/0956797613510184

Fischer, I. (2009). Friend or foe: Subjective expected relative similarity as a determinant of cooperation. *Journal of Experimental Psychology: General*, *138*, 341-350. doi:10.1037/a0016073

Fischer, I., Frid, A., Goerg, S. J., Levin, S. A., Rubenstein, D. I., & Selten, R. (2013). Fusing enacted and expected mimicry generates a winning strategy that promotes the evolution of cooperation. *Proceedings of the National Academy of Sciences*, *110*, 10229-10233. doi:10.1073/pnas.1308221110

Fiske, S. T. (2010). Interpersonal stratification: Status, power, and subordination. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (pp. 941-982). Hoboken, NJ: John Wiley. doi:10.1002/9780470561119

French, J. R. P., & Raven, B. (1959). The bases of social power. In D. Cartwright (Ed.), *Studies in social power* (pp. 150-167). Ann Arbor, MI: Institute for Social Research.

Funder, D. C. (2009). Persons, behaviors and situations: An agenda for personality psychology in the postwar era. *Journal of Research in Personality*, *43*, 120-126. doi:10.1016/j.jrp.2008.12.041

Gintis, H., Smith, E. A., & Bowles, S. (2001). Costly signaling and cooperation. *Journal of Theoretical Biology*, *213*, 103-119. doi:10.1006/jtbi.2001.2406

Gomes, C. M., Mundry, R., & Boesch, C. (2009). Long-term reciprocation of grooming in wild West African chimpanzees. *Proceedings of the Royal Society B: Biological Sciences*, *276*, 699-706. doi:10.1098/rspb.2008.1324

Gonzalez, C., Ben-Asher, N., Martin, J. M., & Dutt, V. (2015). A cognitive model of dynamic cooperation with varied interdependency information. *Cognitive Science*, *39*, 457-495. doi:10.1111/cogs.12170

Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review*, *25*, 161-178. doi:10.2307/2092623

Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going green to be seen: Status, reputation, and conspicuous conservation. *Journal of Personality and Social Psychology*, *98*, 392-404.

Gurven, M. (2004). To give and to give not: The behavioral ecology of human food transfers. *Behavioral and Brain Sciences*, *27*, 543-583. doi:10.1017/S0140525X04000123

Haccou, P., & Glaizot, O. (2002). The ESS in an asymmetric generalized war of attrition with mistakes in role perception. *Journal of Theoretical Biology*, *214*, 329-349. doi:10.1006/jtbi.2001.2454

Halevy, N., Chou, E. Y., & Murnighan, K. (2012). Mind games: The mental representation of conflict. *Journal of Personality and Social Psychology*, *102*, 132-148. doi:10.1037/a0025389

Halevy, N., & Katz, J. J. (2013). Conflict templates: Thinking through interdependence. *Current Directions in Psychological Science*, *22*, 217-224. doi:10.1177/0963721412474296

Hall, J. A., Coats, E. J., & LeBeau, L. S. (2005). Nonverbal behavior and the vertical dimension of social relations: A meta-analysis. *Psychological Bulletin*, *131*, 898-924. doi:10.1037/0033-2909.131.6.898

Hamilton, W. D. (1964). The genetical evolution of social behavior. *Journal of Theoretical Biology*, *7*, 1-16. doi:10.1016/0022-5193(64)90038-4

Hammerstein, P., & Parker, G. A. (1982). The asymmetric war of attrition. *Journal of Theoretical Biology*, *96*, 647-682. doi:10.1016/0022-5193(82)90235-1

Heintzman, M., Leathers, D. G., Parrott, R. L., & Cairns, A. B. (1993). Nonverbal rapport-building behaviors' effects on perceptions of a supervisor. *Management Communication Quarterly*, *7*, 181-208. doi:10.1177/0893318993007002003

Henrich, J., & Henrich, N. (2007). *Why humans cooperate: A cultural and evolutionary explanation*. New York, NY: Oxford University Press.

Hess, N. H., & Hagen, E. H. (2006). Sex differences in indirect aggression: Psychological evidence from young adults. *Evolution & Human Behavior*, *27*, 231-245. doi:10.1016/j.evolhumbehav.2005.11.001

Hess, U., & Fischer, A. (2014). Emotional mimicry: Why and when we mimic emotions. *Social & Personality Psychology Compass*, *8*, 45-57. doi:10.1111/spc3.12083

Holmes, J. G. (2002). Interpersonal expectations as the building blocks of social cognition: An interdependence theory perspective. *Personal Relationships*, *9*, 1-26. doi:10.1111/1475-6811.00001

Hrdy, S. B. (2007). Evolutionary context of human development: The cooperative breeding model. In C. A. Salmon & T. K. Shackelford (Eds.), *Family relationships: An evolutionary perspective* (pp. 39-68). New York, NY: Oxford University Press. doi:10.1093/acprof:oso/9780195320510.003.0003

Jackson, R. E., & Cormack, L. K. (2007). Evolved navigation theory and the descent illusion. *Perception & Psychophysics*, *69*, 353-362. doi:10.3758/BF03193756

Joireman, J. A., Kuhlman, D. M., Van Lange, P. A., & Shelley, G. P. (2003). Perceived rationality, morality, and power of social choice as a function of interdependence structure and social value orientation. *European Journal of Social Psychology*, *33*, 413-437. doi:10.1002/ejsp.155

Jussim, L. (1991). Social perception and social reality: A reflection-construction model. *Psychological Review*, *98*, 54-73. doi:10.1037/0033-295X.98.1.54

Keating, C. F. (1985). Human dominance signals: The primate in us. In S. L. Ellyson & J. F. Dovidio (Eds.), *Power, dominance, and nonverbal behavior* (pp. 89-108). New York, NY: Springer. doi:10.1007/978-1-4612-5106-4_5

Kelley, H. H. (1979). *Personal relationships: Their structure and prophecies*. Hillsdale, NJ: Princeton University Press.

Kelley, H. H. (1983). Situational origins of human tendencies: A further reason for the formal analysis of structures. *Personality and Social Psychology Bulletin*, *9*, 8-30. doi:10.1177/0146167283091003

Kelley, H. H. (1984). The theoretical description of interdependence by means of transition lists. *Journal of Personality and Social Psychology*, *47*, 956-982. doi:10.1037/0022-3514.47.5.956

Kelley, H. H. (2000). The proper study of social psychology. *Social Psychology Quarterly*, *63*, 3-15. doi:10.2307/2695877

Kelley, H. H., Holmes, J. G., Kerr, N. L., Reis, H. T., Rusbult, C. E., & Van Lange, P. A. M. (2003). *An atlas of interpersonal situations*. Cambridge, UK: Cambridge University Press.

Kelley, H. H., & Thibaut, J. W. (1978). *Interpersonal relations: A theory of interdependence*. New York, NY: John Wiley.

Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review*, *110*, 265-284. doi:10.1037/0033-295X.110.2.265

Kenrick, D. T., & Funder, D. C. (1988). Profiting from controversy: Lessons from the person-situation debate. *American Psychologist*, *43*, 23-34. doi:10.1037/0003-066X.43.1.23

Kenrick, D. T., Griskevicius, V., Neuberg, S. L., & Schaller, M. (2010). Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations. *Perspectives on Psychological Science*, *5*, 292-314. doi:10.1177/1745691610369469

Kenrick, D. T., Li, N. P., & Butner, J. (2003). Dynamical evolutionary psychology: Individual decision rules and emergent social norms. *Psychological Review*, *110*, 3-28. doi:10.1037/0033-295X.110.1.3

Kessin, R. H. (2001). *Dictyostelium: Evolution, cell biology, and the development of multicellularity*. Cambridge, UK: Cambridge University Press.

Komorita, S. S., Sweeney, J., & Kravitz, D. A. (1980). Cooperative choice in *N*-person dilemma situation. *Journal of Personality and Social Psychology*, *38*, 504-516. doi:10.1037/0022-3514.38.3.504

Kumar, N., Scheer, L. K., & Steenkamp, J. B. E. (1995). The effects of perceived interdependence on dealer attitudes. *Journal of Marketing Research*, *32*, 348-356. doi:10.2307/3151986

Kurzban, R. (2001). The social psychophysics of cooperation: Nonverbal communication in a public goods game. *Journal of Nonverbal Behavior*, *25*, 241-259. doi:10.1023/A:1012563421824

Kurzban, R. (2010). *Why everyone (else) is a hypocrite: Evolutionary psychology and the modular mind*. New York, NY: Princeton University Press.

Kurzban, R., & Aktipis, C. A. (2007). Modularity and the social mind: Are Psychologists too self-ish? *Personality and Social Psychology Review*, *11*, 131-149. doi:10.1177/1088868306294906

Lakens, D. (2010). Movement synchrony and perceived entitativity. *Journal of Experimental Social Psychology*, *46*, 701-708. doi:10.1016/j.jesp.2010.03.015

Lakin, J. L., & Chartrand, T. L. (2003). Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychological Science*, *14*, 334-339. doi:10.1111/1467-9280.14481

Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of Nonverbal Behavior*, *27*, 145-162. doi:10.1023/A:1025389814290

Laland, K. N., & Brown, G. (2011). *Sense and nonsense: Evolutionary perspectives on human behaviour*. Oxford, UK: Oxford University Press.

Langner, C. A., & Keltner, D. (2008). Social power and emotional experience: Actor and partner effects within dyadic interactions. *Journal of Experimental Social Psychology*, *44*, 848-856. doi:10.1016/j.jesp.2007.08.002

Lanzetta, J. T., & Englis, B. G. (1989). Expectations of cooperation and competition and their effects on observers' vicarious emotional responses. *Journal of Personality and Social Psychology*, *33*, 354-370. doi:10.1037/0022-3514.33.3.354

Lieberman, D., Tooby, J., & Cosmides, L. (2007). The architecture of human kin detection. *Nature*, *445*, 727-731. doi:10.1038/nature05510

Liu, W., Liu, L. A., & Zhang, J. D. (2016). How to dissolve fixed-pie bias in negotiation? Social antecedents and the mediating effect of mental-model adjustment. *Journal of Organizational Behavior*, *37*, 85-107. doi:10.1002/job.2025

Lukaszewski, A. (2013). Testing an adaptationist theory of trait covariation: Relative bargaining power as a common calibrator of an interpersonal syndrome. *European Journal of Personality*, *27*, 328-345. doi:10.1002/per.1908

Magee, J. C., & Smith, P. K. (2013). The social distance theory of power. *Personality and Social Psychology Review*, *17*, 158-186. doi:10.1177/1088868312472732

Manson, J. H., Bryant, G. A., Gervais, M. M., & Kline, M. A. (2013). Convergence of speech rate in conversation predicts cooperation. *Evolution & Human Behavior*, *34*, 419-426. doi:10.1016/j.evolhumbehav.2013.08.001

March, J. G. (1995). *A primer on decision making: How decisions happen*. New York, NY: Free Press.

Marrow, A. J. (1969). *The practical theorist*. New York, NY: Basic Books.

Martin, J. M., Gonzalez, C., Juvina, I., & Lebiere, C. (2014). A description–experience gap in social interactions: Information about interdependence and its effects on cooperation. *Journal of Behavioral Decision Making*, *27*, 349-362.

Mathew, S., & Boyd, R. (2011). Punishment sustains large-scale cooperation in prestate warfare. *Proceedings of the National Academy of Sciences*, *108*, 11375-11380. doi:10.1073/pnas.1105604108

Maynard-Smith, J. (1974). The theory of games and the evolution of animal conflicts. *Theoretical Journal of Biology*, *47*, 209-221. doi:10.1016/0022-5193(74)90110-6

Maynard-Smith, J. (1976). Evolution and the theory of games: In situations characterized by conflict of interest, the best strategy to adopt depends on what others are doing. *American Scientist*, *64*, 41-45.

McArthur, L. Z., & Baron, R. M. (1983). Toward an ecological theory of social perception. *Psychological Review*, *90*, 215-238. doi:10.1037/0033-295X.90.3.215

McCann, K., & McKenna, H. P. (1993). An examination of touch between nurses and elderly patients in a continuing care setting in Northern Ireland. *Journal of Advanced Nursing*, *18*, 838-846. doi:10.1046/j.1365-2648.1993.18050838.x

McCullough, M. E., Kurzban, R., & Tabak, B. A. (2013). Cognitive systems for revenge and forgiveness. *Behavioral and Brain Sciences*, *36*, 1-15. doi:10.1017/S0140525X11002160

Messick, D. M. (1999). Alternative logics for decision making in social settings. *Journal of Economic Behavior & Organization*, *39*, 11-28. doi:10.1016/S0167-2681(99)00023-2

Miller, G. F., & Todd, P. M. (1998). Mate choice turns cognitive. *Trends in Cognitive Sciences*, *2*(5), 190-198.

Montgomery, J. D. (1998). Toward a role-theoretic conception of embeddedness. *American Journal of Sociology*, *104*, 92-125. doi:10.1086/210003

Muller, M. N., & Mitani, J. C. (2005). Conflict and cooperation in wild chimpanzees. *Advances in the Study of Behavior*, *35*, 275-331. doi:10.1016/S0065-3454(05)35007-8

Murnighan, J. K., & Roth, A. E. (1983). Expecting continued play in Prisoner's Dilemma games: A test of several models. *Journal of Conflict Resolution*, *27*, 279-300. doi:10.1177/0022002783027002004

Nakamura, M., & Ohtsuki, H. (2014). Indirect reciprocity in three types of social dilemmas. *Journal of Theoretical Biology*, *355*, 117-127. doi:10.1016/j.jtbi.2014.03.035

Nelissen, R. (2008). The price you pay: Cost-dependent reputation effects of altruistic punishment. *Evolution & Human Behavior*, *29*, 242-248. doi:10.1016/j.evolhumbehav.2008.01.001

Nesse, R. M. (2007). Runaway social selection for displays of partner value and altruism. *Biological Theory*, *2*, 143-155. doi:10.1162/biot.2007.2.2.143

Neuberg, S. L., & Schaller, M. (2014). Evolutionary social cognition. In M. Mikulincer, & P. R. Shaver (Eds.), E. Borgida, & J. A. Bargh (Assoc. Eds.), *APA handbook of personality and social psychology: Vol. 1. Attitudes and social cognition* (pp. 3-45). Washington, DC: American Psychological Association.

Newtson, D. (1993). The dynamics of action and interaction. In L. B. Smith & E. Thelen (Eds.), *A dynamic systems approach to development: Applications* (pp. 241-264). Cambridge, MA: The MIT Press.

Newtson, D. (1994). The perception and coupling of behavior waves. In R. Vallacher & A. Nowak (Eds.), *Dynamical systems in social psychology* (pp. 139-167). San Diego, CA: Academic Press.

Noë, R., & Hammerstein, P. (1994). Biological markets: Supply and demand determine the effect of partner choice in cooperation, mutualism and mating. *Behavioral Ecology and Sociobiology*, *35*, 1-11. doi:10.1007/BF00167053

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, *314*, 1560-1563.

Nowak, M. A., & May, R. M. (1992). Evolutionary games and spatial chaos. *Nature*, *359*, 826-829. doi:10.1126/science.1133755

Nowak, M. A., & Sigmund, K. (1992). Tit-for-tat in heterogeneous populations. *Nature*, *355*, 250-253. doi:10.1038/359826a0

Nowak, M. A., & Sigmund, K. (1993). A strategy of win-stay, lose-shift that outperforms tit-for-tat in the Prisoner's Dilemma game. *Nature*, *364*, 56-58. doi:10.1038/355250a0

Nowak, M. A., & Sigmund, K. (2005). Evolution of indirect reciprocity. *Nature*, *437*, 1291-1298. doi:10.1038/364056a0

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: toward an evolved module of fear and fear learning. *Psychological Review*, *108*(3), 483-522.

Olson, M. (1965). *The logic of collective action: Public goods and the theory of groups*. Cambridge, MA: Harvard University Press.

Oullier, O., De Guzman, G. C., Jantzen, K. J., Lagarde, J., & Scott Kelso, J. A. (2008). Social coordination dynamics: Measuring human bonding. *Social Neuroscience*, *3*, 178-192. doi:10.1080/17470910701563392

Pietraszewski, D., & Shaw, A. (2015). Not by strength alone. *Human Nature*, *26*, 44-72. doi:10.1007/s12110-015-9220-0

Pietroni, D., Van Kleef, G. A., De Dreu, C. K. W., & Pagliaro, S. (2008). Emotions as strategic information: Effects of other's emotional expressions on fixed-pie perception, demands, and integrative behavior in negotiation. *Journal of Experimental Social Psychology*, *44*, 1444-1454. doi:10.1016/j.jesp.2008.06.007

Pinker, S. (1997). *How the mind works*. New York, NY: W.W. Norton.

Rand, D. G., & Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences*, *17*, 413-425. doi:10.1016/j.tics.2013.06.003

Rapoport, A. (1967). A note on the "index of cooperation" for Prisoner's Dilemma. *Journal of Conflict Resolution*, *11*, 101-103. doi:10.1177/002200276701100108

Rapoport, A., & Guyer, M. (1966). A taxonomy of 2 × 2 games. *General Systems*, *11*, 203-214.

Rauthmann, J. F., Gallardo-Pujol, D., Guillaume, E. M., Todd, E., Nave, C. S., Sherman, R. A., & Funder, D. C. (2014). The Situational Eight DIAMONDS: A taxonomy of major dimensions of situation characteristics. *Journal of Personality and Social Psychology*, *107*, 677-718. doi:10.1037/a0037250

Rauthmann, J. F., Sherman, R. A., & Funder, D. C. (2015). Principles of situation research: Towards a better understanding of psychological situations. *European Journal of Personality*, *29*(3), 363-381.

Reece, M. M., & Whitman, R. N. (1962). Expressive movements, warmth, and verbal reinforcement. *The Journal of Abnormal and Social Psychology*, *64*, 234-236. doi:10.1037/h0039792

Reed, L. I., Zeglen, K. N., & Schmidt, K. L. (2012). Facial expressions as honest signals of cooperative intent in a one-shot anonymous Prisoner's Dilemma game. *Evolution & Human Behavior*, *33*, 200-209. doi:10.1016/j.evolhumbehav.2011.09.003

Reis, H. T. (2008). Reinvigorating the concept of situation in social psychology. *Personality and Social Psychology Review*, *12*, 311-329. doi:10.1177/1088868308321721

Righetti, F., Luchies, L. B., van Gils, S., Slotter, E. B., Witcher, B., & Kumashiro, M. (2015). The prosocial versus proself power holder: How power influences sacrifice in romantic relationships. *Personality and Social Psychology Bulletin*, *41*, 779-790. doi:10.1177/0146167215579054

Roberts, G. (2006). Cooperation through interdependence. *Animal Behavior*, *70*, 901-908. doi:10.1016/j.anbehav.2005.02.006

Rusbult, C. E. (1980). Commitment and satisfaction in romantic associations: A test of the investment model. *Journal of Experimental Social Psychology*, *16*, 172-186. doi:10.1016/0022-1031(80)90007-4

Rusbult, C. E., & Buunk, B. P. (1993). Commitment processes in close relationships: An interdependence analysis. *Journal of Social and Personal Relationships*, *10*, 175-204. doi:10.1177/026540759301000202

Rusbult, C. E., & Van Lange, P. A. M. (2003). Interdependence, interaction, and relationships. *Annual Review of Psychology*, *54*, 351-375. doi:10.1146/annurev.psych.54.101601.145059

Rusch, H. (2014). The two sides of warfare. *Human Nature*, *25*, 359-377. doi:10.1007/s12110-014-9199-y

Schaller, M., & Neuberg, S. L. (2008). Intergroup prejudices and intergroup conflicts. In C. Crawford & D. L. Krebs (Eds.), *Foundations of evolutionary psychology* (pp. 399-412). Mahwah, NJ: Lawrence Erlbaum.

Sell, A., Bryant, G., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C., & Gurven, M. (2010). Adaptations in humans for assessing physical strength and fighting ability from the voice. *Proceedings of the Royal Society B: Biological Sciences*, *277*, 3509-3518. doi:10.1098/rspb.2010.0769

Sell, A., Tooby, J., & Cosmides, L. (2009). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences*, *106*, 15073-15078. doi:10.1073/pnas.0904312106

Simpson, J. A. (1999). Attachment theory in modern evolutionary perspective. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (pp. 115-140). New York, NY: Guilford Press.

Simpson, J. A. (2007). Psychological foundations of trust. *Current Directions in Psychological Science*, *16*, 264-268. doi:10.1111/j.1467-8721.2007.00517.x

Simpson, J. A., & Gangestad, S. W. (2001). Evolution and relationships: A call for integration. *Personal Relationships*, *8*, 341-355. doi:10.1111/j.1475-6811.2001.tb00044.x

Skyrms, B. (2004). *The stag hunt and the evolution of social structure*. Cambridge, UK: Cambridge University Press.

Smaldino, P. E., Schank, J. C., & McElreath, R. (2013). Increased costs of cooperation help cooperators in the long run. *The American Naturalist*, *181*, 451-463. doi:10.1086/669615

Smith, J. M. (1982). *Evolution and the theory of games*. Cambridge, UK: Cambridge University Press.

Smith, E. A., & Bird, R. L. B. (2000). Turtle hunting and tombstone opening: Public generosity as costly signaling. *Evolution & Human Behavior*, *21*, 245-261. doi:10.1016/S1090-5138(00)00031-3

Stewart-Williams, S. (2007). Altruism among kin vs. nonkin: Effects of cost of help and reciprocal exchange. *Evolution & Human Behavior*, *28*, 193-198. doi:10.1016/j.evolhumbehav.2007.01.002

Symons, D. (1990). Adaptiveness and adaptation. *Ethology and Sociobiology*, *11*, 427-444. doi:10.1016/0162-3095(90)90019-3

Tangney, J. P. (1999). The self-conscious emotions: Shame, guilt, embarrassment and pride. In T. Dalgleish & M. J. Power (Eds.), *Handbook of cognition and emotion* (pp. 541-568). New York, NY: John Wiley.

ten Brinke, L., Gruenfeld, D., & Carney, D. (2014, July). *Vulnerable and vigilant: Powerless posture increases threat detection accuracy*. Paper presented at the 2014 Annual Meeting of the Association of Social Psychology, *Amsterdam, The Netherlands*.

Thomas, K. A., DeScioli, P., Haque, O. S., & Pinker, S. (2014). The psychology of coordination and common knowledge. *Journal of Personality and Social Psychology*, *107*, 657-676. doi:10.1037/a0037037

Thompson, L., & Hastie, R. (1990). Social perception in negotiation. *Organizational Behavior and Human Decision Processes*, *47*(1), 98-123.

Thompson, L., Valley, K. L., & Kramer, R. M. (1995). The bittersweet feeling of success: An examination of social perception in negotiation. *Journal of Experimental Social Psychology*, *31*, 467-492. doi:10.1006/jesp.1995.1021

Thomsen, L., Frankenhuis, W. E., Ingold-Smith, M., & Carey, S. (2011). Big and mighty: Preverbal infants mentally represent social dominance. *Science*, *331*, 477-480.

Tiedens, L. Z., & Fragale, A. R. (2003). Power moves: Complementarity in dominant and submissive nonverbal behavior. *Journal of Personality and Social Psychology*, *84*, 558-568. doi:10.1037/0022-3514.84.3.558

Tomasello, M., Melis, A. P., Tennie, C., Wyman, E., & Herrmann, E. (2012). Two key steps in the evolution of human cooperation: The interdependence hypothesis. *Current Anthropology*, *53*, 673-692. doi:10.1086/668207

Tooby, J., & Cosmides, L. (1990). The past explains the present: Emotional adaptations and the structure of ancestral environments. *Ethology and Sociobiology*, *11*, 375-424. doi:10.1016/0162-3095(90)90017-Z

Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19-136). New York, NY: Oxford University Press.

Tooby, J., & Cosmides, L. (1996). Friendship and the banker's paradox: Other pathways to the evolution of adaptations for altruism. In W. G. Runciman, J. Maynard Smith, & R. I. M. Dunbar (Eds.), *Evolution of social behavior patterns in primates and man* (pp. 119-143). Oxford, UK: Oxford University Press.

Tooby, J., & Cosmides, L. (2005). Conceptual foundations of evolutionary psychology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 5-67). Hoboken, NJ: John Wiley.

Tooby, J., Cosmides, L., & Price, M. E. (2006). Cognitive adaptations for n-person exchange: The evolutionary roots of organizational behavior. *Managerial and Decision Making Economics*, *27*, 103-129. doi:10.1002/mde.1287

Tooby, J., Cosmides, L., Sell, A., Lieberman, D., & Sznycer, D. (2008). Internal regulatory variables and the design of human motivation: A computational and evolutionary approach. In A. J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 251-271). Mahwah, NJ: Lawrence Erlbaum.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, *46*, 35-57.

Tybur, J. M., & Lieberman, D. (2016). Human pathogen avoidance adaptations. *Current Opinion in Psychology*, *7*, 6-11.

Tybur, J. M., Lieberman, D., Kurzban, R., & DeScioli, P. (2013). Disgust: Evolved function and structure. *Psychological Review*, *120*, 65-84. doi:10.1037/a0030778

Valdesolo, P., Ouyang, J., & DeSteno, D. (2010). The rhythm of joint action: Synchrony promotes cooperative ability. *Journal of Experimental Social Psychology*, *46*, 693-695. doi:10.1016/j.jesp.2010.03.004

Van Baaren, R. B., Holland, R. W., Kawakami, K., & van Knippenberg, A. (2004). Mimicry and prosocial behavior. *Psychological Science*, *15*, 71-74.

Van Baaren, R. B., Holland, R. W., Steenaert, B., & van Knippenberg, A. (2003). Mimicry for money: Behavioral consequences of imitation. *Journal of Experimental Social Psychology*, *39*, 393-398. doi:10.1016/S0022-1031(03)00014-3

Van Doorn, E. A., Heerdink, M. W., & Van Kleef, G. A. (2012). Emotion and the construal of social situations: Inferences of cooperation versus competition from expressions of anger, happiness, and disappointment. *Cognition & Emotion*, *26*, 442-461. doi:10.1080/02699931.2011.648174

Van Kleef, G. A., De Dreu, C. K. W., & Manstead, A. S. R. (2010). An interpersonal approach to emotion in social decision making: The emotions as social information model. *Advances in Experimental Social Psychology*, *42*, 45-96.

Van Lange, P. A. M. (1999). The pursuit of joint outcomes and equality in outcomes: An integrative model of social value orientation. *Journal of Personality and Social Psychology*, *77*, 337-349.

Van Lange, P. A. M., Balliet, D., Parks, C., & Van Vugt, M. (2014). *Social dilemmas: Understanding the psychology of human cooperation*. New York, NY: Oxford University Press.

Van Lange, P. A. M., Rockenbach, B., & Yamagishi, T. (Eds.). (2014). *Reward and punishment in social dilemmas*. Oxford, UK: Oxford University Press.

Wageman, R., & Baker, G. P., III. (1996). Incentives and cooperation: The joint effects of task and reward interdependence on group performance. *Journal of Organizational Behavior*, *18*, 139-158.

Werner, G. D., Strassmann, J. E., Ivens, A. B., Engelmoer, D. J., Verbruggen, E., Queller, D. C., & Kiers, E. T. (2014). Evolution of microbial markets. *Proceedings of the National Academy of Sciences*, *111*, 1237-1244. doi:10.1073/pnas.1315980111

West, S. A., El Mouden, C., & Gardner, A. (2011). Sixteen common misconceptions about the evolution of cooperation in humans. *Evolution & Human Behavior*, *32*, 231-262.

Weyers, P., Mühlberger, A., Kund, A., Hess, U., & Pauli, P. (2009). Modulation of facial reactions to avatar emotional faces by nonconscious competition priming. *Psychophysiology*, *46*, 328-335. doi:10.1111/j.1469-8986.2008.00771.x

Wilson, E. O. (2012). *The social conquest of earth*. New York, NY: W.W. Norton.

Wu., J., Balliet, D., & Van Lange, P. A. M. (2015). When does gossip promote generosity? Indirect reciprocity under the shadow of the future. *Social Psychological and Personality Science*, *6*, 923-330.

Yamagishi, T. (2011). *Trust: The evolutionary game of mind and society*. New York, NY: Springer.