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## Abstract and Keywords

Interdependence is a fundamental characteristic of social situations. Yet, in everyday life, people rarely have direct knowledge about how their own and others' decisions influence desired outcomes. The chapter discusses two models of objective differences in interdependent situations and then outlines three theoretical approaches to understanding how people form interdependence perceptions: an experiential learning approach, a mental templates approach, and functional interdependence theory. It then reviews recent innovations in the measurement of interdependence perceptions across situationsIt describes how these theoretical approaches and measures can be used to investigate (a) the cues that people use to infer interdependence, (b) the common forms of interdependence people experience in their daily lives, (c) the importance of future interdependence and biased inferences, and (d) the role of personality in shaping interdependence perceptions. It concludes with discussing how recent research on interdependence perceptions can be integrated with existing empirical findings on taxonomies of psychological situations.

Keywords: interdependence, situations, conflict, power, cooperation

Interdependent situations are omnipresent in our daily lives. More often than not, our outcomes depend on our own as well as others' actions; similarly, our choices have an impact not only on ourselves, but also on others around us. A father playing hide-and-seek with his daughter, a couple deciding to buy a home, an employee having a meeting with her boss, citizens paying taxes—each of these diverse situations contains a specific type of outcome interdependence. While some of these situations are undoubtedly benign, involving common interests or a need to achieve coordination, others contain conflicting interests or stark differences in power. Such variations in interdependence can have

important consequences for individual cognition, affect, motivation, and behavior in a given situation (Holmes, 2002; Kelley et al., 2003; Reis, 2008).

Indeed, an abundance of experimental research has shown that participants in laboratory social interactions adjust their behavior when facing different interdependent situations. For example, people cooperate more often in coordination games (e.g., the Assurance game) than in social dilemmas (e.g., the Prisoner's Dilemma; Halevy, Chou, & Murnighan, 2012), but cooperation rates in social dilemmas tend to increase when these situations arise within a series of coordination games (Rusch & Luetge, 2016). Similarly, individuals contribute more to public goods when there is less conflict of interests (Weimann et al., 2014)—that is, when cooperating with others to generate or conserve common resources also benefits themselves. People also tend to be less cooperative in situations when they feel less dependent on their partners (e.g., De Cremer & Van Dijk, 2005; Righetti et al., 2015). As this research clearly illustrates, cooperative behaviors vary across different types of interdependent situations. The same applies to other forms of social behavior, such as aggressive and competitive behaviors.

In most previous experimental research participants have been provided with objective information about their interdependence with others. However, in real life, individuals rarely possess objective knowledge regarding the consequences of their own and others' behavior (Balliet, Tybur, & Van Lange, 2016; Halevy & Katz, 2013; Messick, 1999). As such, they have to infer this information based on past experience, environmental cues, and/or a partner's characteristics (Balliet et al., 2016). Indeed, inferring the type of interdependence that characterizes a situation is a challenging task. This is because each situation can be characterized by a unique form of interdependence and there are multiple dimensions that characterize differences and similarities between unique situations (Kelley & Thibaut, 1978).

Importantly, there are considerable benefits to individuals who are able to infer their interdependence with others in a situation, such as an enhanced ability to predict and/or influence others' behavior (Balliet et al., 2016). For example, understanding that a situation contains a conflict of interests (a type of interdependence) can be useful in predicting others' behavior in that situation and then responding in a way that results in desirable outcomes. This is because certain types of information—such as, an interaction partner's prosocial motivations—can be used to predict that partner's behavior in conflict-of-interests situations (Simpson, 2007; Shallcross & Simpson, 2012), whereas the same information is less relevant to predicting behavior in situations that involve corresponding interests. In the latter type of situations, other information—such as an interaction partner's competence and prior experience—should be more relevant to predict a partner's behavior.

Similarly, inferring one's own relative power in a situation can guide strategies to influence others' behavior. While some strategies, like the threat of punishment, may be particularly effective to deter cheating when employed by the powerful, the powerless might opt for other strategies to influence a powerful partner's behavior, such as gossip

and coalitional punishment (Boehm, 1993; Cummins, 1999, 2005; Molho & Balliet, 2016a). Importantly, the benefits of adjusting behavior based on the type of interdependence in a situation can only be realized if people are able to make inferences about their interdependence in a situation.

Despite the fact that several programs of research have studied the implications of different forms of interdependence—such as conflict (De Dreu, Koole, & Steinel, 2000; Halevy & Katz, 2013; Thompson & Hrebec, 1996), coordination (Halevy et al., 2012; Rusch & Luetge, 2016), and asymmetric power (Fiske, 2010; Galinsky, Rucker, & Magee, 2015; Sturm & Antonakis, 2015)—for social behavior, there has been surprisingly little work on developing and testing theory about how people make inferences regarding these situational characteristics. Here, we provide a brief outline of different theoretical approaches to understanding how people think about their interdependence with others. We subsequently review the instruments that have been developed to measure perceptions of interdependence. Finally, we close this chapter by discussing topics for future research.

# Variations in Objective Interdependence

One core proposition of several theoretical approaches to interdependence is that perceptions of interdependence are tied to the *objective* realities that people experience on a daily basis (Reis, 2008; see also, Rauthmann, Sherman, & Funder, 2015). That is, people's subjective experience of interdependence should correlate with the actual interdependence that describes a situation. Thus, a model of objective variation in interdependence is necessary to understand subjective interdependence. Much prior theorizing about objective interdependence has used matrices as a useful conceptual tool to reduce the complexity of social situations and to analyze variation across interdependent situations (see Balliet et al., 2016; Kelley & Thibaut, 1978; Rapoport & Guyer, 1966). Next we elaborate on two models that have used game-theoretic payoff matrices to understand the similarities and differences across interdependent situations: prototypical interdependence and interdependence theory.

## Prototypical Interdependence

The first model—prototypical interdependence—was developed to describe variation in objective interdependence across situations and identify "archetypal" interdependent situations—that is, payoff structures that model different strategic considerations and give rise to specific fundamental motivations (e.g., fear and greed). To identify these situations, the prototypical interdependence model used game-theoretic analyses of 2 × 2 matrices (Rapoport, 1967; Rapoport & Guyer, 1966)—dyadic interactions in which each person has two behavioral options and a rank ordered preference of different possible

outcomes. Outcomes, here, can be material (e.g., money and resources), symbolic (e.g., reputation and relative social standing), emotional (e.g., happy, sad, angry, or grateful), and so on.

Rapoport and Guyer (1966; Rapoport, 1967) considered all possible combinations of ordinal outcomes in such two-person, two-option interactions (i.e., 2 × 2 matrices)—an analysis that produced 78 non-equivalent games. From these games, some are asymmetric ($N = 66$) and others contain no conflict of interests (i.e., the same outcome is preferred by both persons; $N = 8$). Rapoport (1967) provided a detailed analysis of archetypal interdependent situations—that is, of the remaining four games that involved both symmetric preferences and conflicting interests. Some of these archetypal situations, such as the Prisoner's Dilemma (Rapoport & Chammah, 1965) and the Stag Hunt game (Skyrms, 2004), have been studied extensively by behavioral economists and psychologists alike, and they are considered to activate different psychological and strategic considerations (Thielmann, Böhm, & Hilbig, 2015).

However, the prototypical interdependence model assumes that individuals have rank ordered preferences for different outcomes in a situation (i.e., outcomes are defined on an ordinal rather than on a continuous scale; see Halevy et al., 2012; Rapoport, 1967)—an assumption that unnecessarily constrains variation within game types. Further, the prototypical interdependence model has largely ignored situations that involve corresponding interests, as they are considered trivial from a game-theoretic perspective (Rapoport, 1967), or situations that contain asymmetric preferences and payoffs. Yet these situation types are often encountered by people in daily life and, as such, research would benefit from examining social behavior in such situations. Moreover, as we discuss later, the prevalence of daily life situations that contain corresponding interests and asymmetric dependence can contain important consequences for understanding how people think about interdependent situations.

## Interdependence Theory

Similar to the game-theoretic, prototypical interdependence model, Interdependence Theory has used two-person, two-option (i.e., 2 × 2) matrices as a method for understanding variation across social situations (Kelley & Thibaut, 1978). However, in contrast to the model just described, Kelley and Thibaut assumed that values across the different possible outcomes in a situation could vary on a continuous scale. This change led to a dramatically different vantage point on variation across situations. Specifically, this theory suggests that most experimental games and real-life social interactions can be described using four fundamental dimensions of interdependence (for greater details, see Kelley & Thibaut, 1978; Kelley et al., 2003): degree of interdependence, covariation of interests, basis of interdependence (i.e., coordination), and asymmetric dependence (i.e., power).

## Degree of interdependence.

This is the most basic dimension of interdependence, describing the extent to which each person's outcomes in a dyadic interaction are influenced by how the other person behaves. On the one end of this dimension, situations are characterized by complete independence, whereby each actor's behavior only influences outcomes for oneself but has no impact whatsoever on the other person. On the other end of this dimension, situations are characterized by complete interdependence, whereby each person's outcomes are influenced by the combination of their own and the other's behavior.
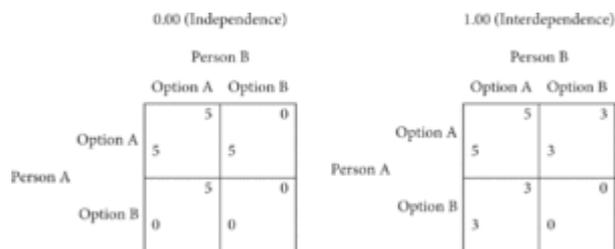


*Click to view larger*

*Figure 1.* Examples of matrices characterized by complete independence (left panel) versus complete interdependence (right panel).

To illustrate this point, consider the examples of matrices in Figure 1. In these matrices, the numbers represent the value of specific outcomes, with larger positive values indicating better outcomes —material, symbolic, and/ or emotional—for an individual. In a situation of complete independence (see the left panel of Figure 1), each person can make a choice that leads to the best outcome *irrespective* of what the other person does. That is, Person A can achieve his/her most desired outcome in this situation by always choosing Option A, and the same is true for Person B. Moving to a situation of complete interdependence (see the right panel of Figure 1), each person now needs to consider the combination of his/her own and the other's behavior. Person A can achieve the best outcome by choosing Option A, but only to the extent that Person B chooses the same option, and the same is true for Person B.

## Covariation of interests.

The latter situation described involves strong interdependence, and it also represents a relatively benign interaction—a win-win situation—in which both individuals can achieve their best outcome. The second dimension of interdependence refers to this characteristic of situations, that is, the extent to which they involve corresponding versus conflicting interests (Balliet & Van Lange, 2013; Rapoport, 1967). As indicated before, on one end of this dimension, individuals' interests correspond completely, such that each individual can achieve his/her most desired outcome. On the other end of this dimension, there is complete conflict of interests, such that the best outcome for one individual results in the worst outcome for the other (i.e., a zero-sum game; De Dreu et al., 2000; Halevy et al., 2012). Daily life situations rarely take the form of win-win or zero-sum games; instead, they often contain a mixture of corresponding and conflicting interests.

## Basis of interdependence.

The basis of interdependence describes the extent to which an individual needs to adjust his/her behavior to what the other person is doing in order to achieve the best outcome in a situation. Some situations require exactly this—coordinating with others by conditioning one's own behavior on a partner's (expected) behavior. Yet in other situations, there is nothing a person can do to influence how another person's behavior affects his/her own outcomes. Kelley and colleagues (2003) refer to this latter type of situations as "exchange" relations.

## Asymmetry of dependence.

The fourth dimension of interdependence describes the extent to which an individual depends on an interaction partner to achieve good outcomes—a common conceptualization of power (Fiske, 2010; Kelley et al., 2003; Keltner, Gruenfeld, & Anderson, 2003). On the one end of this dimension, an individual is completely and unilaterally dependent upon someone else to achieve desired outcomes—that is, he/she has relatively low power in the situation. On the other end of this dimension, an individual has complete control over own and others' outcomes—that is, he/she possesses relatively high power in the situation. Of course, as with all dimensions of interdependence, there are situations in between these two extremes, in which individuals have more or less power.

# How Do People Think about Interdependence in a Situation?

Previous research across various disciplines—including evolutionary biology, anthropology, behavioral economics, and psychology—has shown that variations in objective interdependence can have important implications for individual behavior (Kelley et al., 2003; Roberts, 2006; Tomasello, Melis, Tennie, Wyman, & Herrmann, 2012; Weimann et al., 2014). However, this research has been conducted under the implicit assumption that people have knowledge of their objective interdependence with others in daily life. Here, we explicitly acknowledge that people rarely possess such information and so they must somehow infer interdependence. While inferences of interdependence are likely to correspond with the objective interdependence in a situation (see Balliet et al., 2016; Rauthmann, Sherman, & Funder, 2015; Reis, 2008), previous research has found that people often form markedly different perceptions of interdependence in the same situation (Halevy, Sagiv, Roccas, & Bornstein, 2006; Tenbrunsel & Northcraft, 2010; Van Vugt, Meertens, & Van Lange, 1995; Yamagishi et al., 2013).

So far, research has shown that such *subjective* perceptions of interdependence influence cooperative behavior in conflicts (Halevy et al., 2006, 2012; Kiyonari, Tanida, & Yamagishi, 2000), negotiations (De Dreu et al., 2000; Halevy & Phillips, 2015; Plous, 1985), and during environmental social dilemmas (Van Vugt et al., 1995). Yet while there have been various approaches to understanding how people think about interdependence, there is little empirical work directed by them. Here, we outline three theoretical approaches and relevant empirical evidence: an *experiential learning* approach, a *mental templates* approach, and *functional interdependence theory*.

## Experiential Learning

Interdependence theorists have typically used a learning-based approach to explain how people form perceptions of interdependence in a situation (Kelley & Thibaut, 1978; Rusbult & Van Lange, 2003). According to this approach, individuals use their repeated experience of different outcomes over time to understand the type of interdependence that characterizes their interactions with another person. Rusbult and Van Lange (2003) state: "In a novel situation, John may systematically analyze the situation. … If his reaction yields poor outcomes, John will behave differently in future situations with parallel [interdependence] structure; if his reaction yields good outcomes, he will react similarly in future, parallel situations. Repeated experience in situations with similar [interdependence] structure gives rise to habitual response patterns … that on average yield good outcomes" (p. 367). Thus, individuals will engage in behaviors that have resulted in positive outcomes and avoid behaviors that have resulted in negative outcomes in the past.

Recently, research on cognitive models of decision making has provided a test of this approach, by investigating how individuals make decisions in interdependence with others when they have incomplete information regarding how their own and others' behaviors influence each person's outcomes (Gonzalez & Martin, 2011). Specifically, this work has focused on how individuals make decisions based on previous experience in situations that are similar to the current situation. Further, this approach has assumed that there are different levels of social information available in a situation, ranging from *no information* to *complete information* about interdependence. Martin, Gonzalez, Juvina, and Lebiere (2014) found that giving individuals greater amounts of information regarding their objective interdependence increases cooperation, especially when moving from minimal information (i.e., mere knowledge that they are interacting with another person) to information regarding their own and others' actions and outcomes as they happen (i.e., *experiential* information). Further, they have found that higher levels of information are associated with increased satisfaction and joint performance in social dilemma tasks.

The experiential learning approach, however, has some potential limitations. First, it remains unclear whether people perceive and respond to (a) their own outcomes in a situation, (b) the other person's outcomes, or (c) a combination of both. Moreover, this approach does not address if people can accurately represent their interdependence in situations that are more complex than the typical two-person, two-option matrices used in previous research. Second, experiential learning does not specify which types of information should be more or less relevant to infer different aspects of outcome interdependence. Previous research suggests that certain types of social information may covary across situations with corresponding versus conflicting interests (e.g., expressions of happiness versus anger; Reed, DeScioli, & Pinker, 2014; Van Dijk, Van Kleef, Steinel, & Van Beest, 2008; Van Kleef, De Dreu, & Manstead, 2004), while other types of social information may be associated with asymmetric power (e.g., own and others' fighting ability; Sell, Eisner, & Ribeaud, 2015; Sell et al., 2009). In fact, this is the crux of the problem of inferring interdependence: how people use information to understand similarities in interdependence between what would otherwise be disparate situations.

## Mental Templates

The mental templates approach, proposed by Halevy and colleagues (2006, 2012), suggests that individuals mentally represent various situations—including conflicts, negotiations, and workplace interactions—using a constrained number of prototypical situation types or *templates*. The template approach is based on Rapoport and Guyer's (1966; Rapoport, 1967) game-theoretic analysis of prototypical interdependent situations. Starting from the 78 non-equivalent games identified by Rapoport and Guyer (1966), Halevy and colleagues (2006, 2012) further assumed that, when mentally representing interdependence, people strongly favor (a) symmetric compared to asymmetric matrices and (b) cooperative compared to non-cooperative partners. This resulted in six games, out

of which four have received considerable attention in previous research: the Prisoner's Dilemma, the Chicken game, the Assurance game (or Stag Hunt; Skyrms, 2004), and the Maximizing Difference game (for an overview of their outcome structures, see Figure 2).



*Click to view larger*

*Figure 2.* Outcome structures for the four archetypal game templates.

According to the mental templates approach, these four games "have psychological prominence in individuals' minds as they think about outcome interdependence" (Halevy et al., 2012, p. 134). Importantly, they are characterized by different dominant strategies, equilibria (i.e., a set of strategies for which no decision maker can achieve better outcomes by unilaterally switching strategy; Osborne & Rubinstein, 1994), and motivations underlying behavior (for more detailed analyses, see Bornstein & Gilula, 2003; Halevy, Chou, & Murnighan, 2011, 2012; Kelley et al., 2003; Skyrms, 2004; Thielmann et al., 2015). For example, the optimal strategy in a Prisoner's Dilemma game is to defect irrespective of what the other person does—and the only equilibrium is mutual defection—whereas in a Maximizing Difference game, the best strategy is to cooperate irrespective of the other person's behavior—and the game equilibrium is mutual cooperation. In a Chicken game, the optimal strategy is to do the opposite of one's interaction partner, whereas in an Assurance game it is best to do the same as one's partner (i.e., both games have two equilibria). As might be evident, therefore, these games also differ according to the degree of conflicting interests they contain, with Prisoner's Dilemmas involving the highest degree of conflict, the Chicken and Assurance games containing moderate correspondence, and Maximizing Difference games containing highly corresponding interests (see Figure 2).

Various studies have provided evidence for the importance of individuals' mental representations of interdependence in negotiations. Specifically, Halevy and colleagues (2012) have found that, when asked to represent negotiation situations using outcome matrices, more than 70% of their participants created one of the four archetypal games described above. Endorsement of different games predictably correlates with fixed-pie perceptions in negotiations (De Dreu et al., 2000), such that participants who endorse Prisoner's Dilemma or Chicken games as most representative of a negotiation also perceive the situation as containing more conflict, whereas those who endorse other games do not (Halevy et al., 2012). Similarly, individuals endorsed Prisoner's Dilemmas as more descriptive—and Maximizing Difference games as less descriptive—of deal-making negotiations (which are presumably harsher and strongly oriented toward financial

gains), compared to situations of dispute resolution, joint decision making, and their daily life interactions (Halevy & Phillips, 2015). Importantly, situational perceptions in terms of different games also influence cooperative behavior. Individuals show less cooperation in Prisoner's Dilemmas, followed by Chicken, Assurance, and Maximizing Difference games (Halevy et al., 2012). Furthermore, people are more deceptive with negotiation counterparts when they perceive the situation as a game of Chicken (Halevy et al., 2012).

While these findings are compelling, the mental templates approach is limited in a number of ways. First, it is unclear how the prototypes can be applied to situations involving multiple parties, who have different rankings and preferences regarding available outcomes. Second, while the four experimental games identified as prototypical templates seem to capture differences in conflict across situations, they overlook another fundamental characteristic of interdependent social interactions, namely, the presence of power differences. Hierarchical differentiations and power asymmetries are ubiquitous across social interactions (Fiske, 1992) and, thus, power should represent a core aspect of how people think about interdependent situations. Third, although people seem able to categorize interdependent situations in terms of different game templates when they are prompted to do so, it is unclear whether they would spontaneously think about their daily life situations using abstract games. This latter issue is particularly problematic, given that the mental templates model—like the experiential learning approach—remains silent regarding the types of information that individuals would use to mentally categorize a situation as one or the other prototypical game.

## Functional Interdependence Theory

Functional Independence Theory (FIT) applies an evolutionary psychology approach to understanding how people think about interdependence (see Balliet et al., 2016; Cosmides & Tooby, 2013) and recognizes that humans faced variable interdependent situations in the past ancestral environment (e.g., hunting, food sharing, child care, protection from predators, and trade). However, humans did not have direct, objective knowledge of their interdependence with others in any specific situation. Nonetheless, there were benefits to individuals making inferences about their interdependence in a situation, relative to a complete ignorance of their interdependence with others. These benefits include being better able to predict others' behavior, influencing others' behavior, selecting social partners for specific situations, and communicating social motives to others. Thus, a reliably reoccurring adaptive problem in the ancestral environment was making inferences about the types of interdependence that characterize any situation.

To understand the possible adaptations that could be selected to solve the problem of inferring interdependence, then, researchers must understand how interdependence varied across situations in the ancestral past. FIT proposes that the four dimensions of interdependence outlined by Interdependence Theory (and described earlier; Kelley et al., 2003) characterized how interdependent situations varied in the past: the degree of

interdependence, covariation of interests, basis of interdependence (i.e., coordination), and asymmetry of dependence (i.e., power). If social information, such as partner non-verbal behavior, emotional expressions, and vocal communication, varied across situations in the past along these four dimensions of interdependence, then this would provide a basis for evolution to select for adaptations that infer these different dimensions of interdependence. Thus, FIT hypothesizes that individuals possess four psychological mechanisms to infer their interdependence with others, each mechanism functionally specialized to infer a specific dimension of interdependence.

Recent evidence supports certain hypotheses of FIT. Evolutionary agent-based models suggest that behavioral strategies that account for the type of interdependence in a situation, such as conflict and power, can outperform simpler strategies that are ignorant of interdependence (e.g., tit-for-tat; Dawkins, 2010; Fischer et al., 2013). Experimental evidence in psychology also suggests that certain cues during social interactions vary according to the dimensions of interdependence and that people use these cues to infer that aspect of interdependence. For example, certain partner emotional responses during an interaction, such as happiness and anger, would occur more frequently in situations that involve corresponding versus conflicting interests, respectively.

Indeed, when people observe an interaction partner smiling, they infer that the situation involves corresponding interests, but when an interaction partner expresses anger, they infer that the situation contains conflict (Pietroni, Van Kleef, De Dreu, & Pagliaro, 2008; Reed, Zeglen, & Schmidt, 2012; Van Doorn, Heerdink, & Van Kleef, 2012). Cues of an interaction partner mimicking one's own nonverbal behavior (i.e., gestures and posture), or showing similar emotional responses to one's own, can indicate that a situation requires coordination (e.g., Lakin, Jefferis, Cheng, & Chartrand, 2003; Manson, Bryant, Gervais, & Kline, 2013). Similarly, estimates of own and others' formidability (i.e., the ability to inflict costs or deny benefits; Sell, Tooby, & Cosmides, 2009) can reliably indicate that one is in a situation with asymmetric power. Thus, existing evidence suggests that evolution could select for mechanisms to infer interdependence, and that people indeed use cues in a social interaction to infer specific characteristics of interdependence.

FIT proposes that interdependence inferences should guide individual behavior in an adaptive manner. The output of mechanisms to infer interdependence could feed into other adaptations that regulate behavior in specific adaptive problems, such as cooperation, status striving, or aggression. Focusing on cooperation, individuals should cooperate with others more when they perceive the situation as containing higher interdependence (e.g., Roberts, 2006) and lower conflict (e.g., Weimann et al., 2014), and when they see themselves as having low power (e.g., De Cremer & Van Dijk, 2005; Sivanathan, Pillutla, & Murnighan, 2008). Indeed, several studies have provided support for the role of interdependence perceptions across these dimensions in predicting cooperation. Gerpott, Balliet, and de Vries (2017) conducted two studies ($N$s = 717 and 579), in which they examined interdependence perceptions and cooperation in different economic games (Prisoner's Dilemma, see Yamagishi et al., 2013; Dictator game,

Forsythe, Horowitz, Savin, & Sefton, 1994). Across both studies, they found that participants were more cooperative when they perceived the situation as containing higher interdependence and less conflict, and when they perceived themselves as having lower power.

Recently, we conducted a lab study, in which participants made decisions in one-shot experimental games, across two sessions which were separated by approximately one week (Session 1: $N$ = 89; Session 2: $N$ = 83; Molho & Balliet, 2016b). In the first session, we manipulated conflict in a two-person Public Goods game (Ledyard, 1995) by varying the private return for contributions to a common account (i.e., marginal per capita return; see Weimann et al., 2014). In the second session, we manipulated power by having participants distribute money as the proposers either in a Dictator game (high power) or in an Ultimatum game (low power; Güth, Schmittberger, & Schwarze, 1982; Sivanathan et al., 2008). In the first session, participants who perceived the situation as containing lower conflict exhibited higher levels of cooperation (β = −.54, $p$ < .001). Further, participants who perceived themselves as having higher power in the second session exhibited lower levels of cooperation (β = −.40, $p$ < .001).

While these results offer preliminary support for the importance of interdependence perceptions in predicting cooperation, further work is needed to test the predictions of FIT. One interesting question concerns the structure of interdependence perceptions, that is, the extent to which individuals represent interdependence using *dimensions* (Balliet et al., 2016), *templates* (Halevy et al., 2012), or both. While perceptions in terms of prototypic games may be used to represent the different strategic possibilities and motives involved in conflict and hard bargaining negotiations (Halevy et al., 2006, 2012; Thielmann et al., 2015), they appear less able to represent win-win situations or interactions that involve asymmetric power. Situations that contain a mixture of corresponding and conflicting interests, power asymmetries, and coordination opportunities might be represented across various, continuous dimensions of interdependence perceptions. Future research on interdependence perceptions would benefit from examining the relations between these two approaches, and from comparing their predictive power in various domains, such as cooperation, status competition, and aggressive bargaining. These research questions can be addressed by taking advantage of recent methodological developments in the measurement of subjective perceptions of interdependent situations.

# Measures of Subjective Interdependence

Various measures have been developed to assess how people think about their interdependence with others. However, in the past, these measures were often limited to a specific type of situation, such as task interdependence in organizations (Pearce & Gregersen, 1991) or interdependence in negotiations (Thompson & Hastie, 1990; Van Kleef et al., 2008). Moreover, past measures often did not capture the full variation in interdependence but focused on one aspect, such as conflict or power. Finally, many measures of perceived interdependence tended to measure how people think about a relationship as opposed to referring to a specific situation (Aron, Aron, & Smollan, 1992; Gaertner & Schopler, 1998). Recently, however, two methods have been developed to assess how people think about their interdependence in diverse situations.

## Mental Templates Measure

The first measure has been used by Halevy and colleagues (2012) in a number of studies on perceptions of interdependence. Specifically, these researchers initially asked participants to think about or actually prepare for a dyadic negotiation and then assume that in this negotiation the participants can achieve four possible outcomes, rank ordered as follows: (1) *worst outcome*; (2) *bad outcome*; (3) *good outcome*; and (4) *best outcome*. Then participants were asked to assume that, in this situation, each negotiation party can either cooperate (e.g., make concessions on secondary issues) or compete (e.g., refuse to make concessions even on unimportant issues). Individuals were then asked to complete an empty outcome matrix, by indicating what they thought were the most likely outcomes for themselves and their negotiation counterpart in a series of scenarios: (a) when both parties cooperate; (b) when they cooperate and their partner competes; (c) when they compete and their partner cooperates; and (d) when both compete. Halevy and colleagues (2012) have used this method to categorize individuals' perceptions of interdependence and found that participants created the four archetypal games mentioned in the previous section at rates significantly higher than expected by chance.

As an alternative method, Halevy and colleagues (2012) have presented participants with the four game templates—either in matrix form or using verbal descriptions of games— and measured their endorsement of each template. More specifically, they have used the same outcome matrices as those included in Figure 2, but replacing the numbers with verbal labels (1 = *worst outcome*, 2 = *bad outcome*, 3 = *good outcome*, 4 = *best outcome*). In other cases, they have provided participants with verbal descriptions of game templates (e.g., Halevy et al., 2006). Typically, after being presented with each game matrix or verbal description, participants are asked to indicate how well each game describes a situation. Participants either rank the different games from most to least

descriptive of the situation or rate their endorsement of each game using a 7-point Likert scale (1 = *not at all*; 7 = *very much*).

Using these measures, Halevy and colleagues (2012) have found that endorsements of different interdependent situations predict cooperative decisions, as well as the use of deception in negotiations. Moreover, in the context of the Israeli-Palestinian conflict, endorsements of different interdependent situations relate to individual differences in national identification, religiosity, and voting behavior (Halevy et al., 2006). For example, 75% of participants who had voted for right-wing parties in the preceding Israeli elections perceived the Israeli-Palestinian conflict as a Chicken game and only 18% perceived it as an Assurance game. However, only 4% of participants who had voted for left-wing parties perceived the conflict as a Chicken game and 58% perceived it as an Assurance game. Approximately 50% of right-wing voters and 25% of left-wing voters perceived the Israeli-Palestinian conflict as a Prisoner's Dilemma.

One limitation of these measures is that when people are asked to indicate their endorsement of different games using both ranking and rating scales, they often provide inconsistent responses regarding the *same* situation. According to Halevy and colleagues (2006), this issue can be attributed to individual differences "in their [participants'] tendency to utilize structures of outcome interdependence to describe real-life intergroup conflicts or even in their tendency to perceive real-life intergroup conflict in such terms" (p. 1687). Still, this brings into question the notion that individuals consciously and naturally (i.e., even in the absence of explicit instructions from experimenters) represent conflict in interdependent situations via different game templates. Further, these measures are less able to examine perceptions of other interdependence dimensions. Indeed, a previous study (Halevy et al., 2012) has found that participants rarely use the four prototypical games to represent situations that arise in communal sharing relationships—which are presumably characterized by highly corresponding interests—or authority-ranking relationships, which contain strong power asymmetries (Fiske, 1992).

## Situational Interdependence Scale

Recently, Gerpott and colleagues (2017) developed the Situational Interdependence Scale (SIS) to measure five distinct dimensions of how people think about interdependence with others across situations. The development of the SIS was inspired by Interdependence Theory (Kelley & Thibaut, 1978; Kelley et al., 2003) and FIT (Balliet et al., 2016). Expanding on the classic Interdependence Theory approach, Kelley and colleagues (2003) have proposed that six dimensions of interdependence can be used to describe similarities and differences across interdependent situations. Gerpott and colleagues (2017) used this model to generate items that corresponded to low and high positions on each of the six interdependence dimensions: interdependence, conflict, coordination,

power, future interdependence, and information certainty. Table 1 includes definitions for each of these dimensions.

| Table 1. Six Dimensions of Interdependent Social Situations | |
|---|---|
| **Dimension** | **Definition** |
| Interdependence | Degree to which each person's outcomes are determined by how each person behaves in that situation. |
| Conflict | Degree to which the behavior that results in the best outcome for one individual results in the worst outcome for the other. |
| Coordination | Degree to which an individual's behavior influences how a partner's behavior determines that individual's outcomes. |
| Power | Degree to which an individual determines their own and others' outcomes, while others do not influence their own outcome. |
| Future Interdependence | Degree to which own and others' behavior in the present situation can affect own and others' behavior and outcomes in future interactions. |
| Information Certainty | Degree to which a person knows his/her partner's preferred outcomes and how each person's actions influence each other's outcomes. |

Gerpott and colleagues (2017) asked people to describe situations in their daily lives by using those items and discovered that five—instead of six—dimensions characterized how people thought about their interdependence with others. Across several studies, there was no support for the hypothesis that people perceive everyday life situations according to the degree of coordination. Instead, participants tended to conflate items describing coordination with items describing the degree of interdependence. The final SIS—excluding the coordination dimension—consists of 30 items, with six items for each of the five remaining dimensions of interdependence (Gerpott et al., 2017).

All of the SIS items have passed a content validity check with experts correctly assigning each item to its corresponding dimension. Further, in support of construct validity, individuals' responses using the SIS correspond to objective differences in interdependent situations. Specifically, Gerpott and colleagues (2017) report results from a study in which participants were randomly assigned to interact either in a Prisoner's Dilemma or in a Dictator game and then indicate their perceptions of the situation using the SIS. Their findings indicated that participants playing the Dictator game accurately perceived this situation as containing less interdependence, greater conflict, and higher

power compared to the Prisoner's Dilemma. Moreover, perceptions of interdependence, as measured by the SIS, mediated the effect of the objective situation on cooperative decisions. Thus, evidence so far suggests that the SIS is a reliable and valid measure of interdependence perceptions in various situations, which allows researchers to assess multiple dimensions of interdependence with a brief scale.

# Future Directions

Various theoretical approaches, derived from both game-theoretic and interdependence theory perspectives, have been proposed to study how individuals think about and infer their interdependence with others. In combination with recent innovations in the measurement of interdependence perceptions, both in terms of game *templates* and interdependence *dimensions*, we believe that this theoretical foundation can be expanded upon to gain new insights into how people perceive and categorize situations. Here we briefly discuss some directions for future research on the perception of social situations.

## Cues for Interdependence Inferences

While some of the approaches discussed in this chapter explicitly acknowledge that, in real-life situations, individuals lack objective information regarding their interdependence with others (Balliet et al., 2016; Gonzalez & Martin, 2011), very little work has actually examined how people make interdependence inferences under conditions of incomplete information (for notable exceptions, see Martin et al., 2014; Vuolevi & Van Lange, 2012). Recently, Balliet and colleagues (2016) have proposed that mechanisms to infer interdependence may act like internal regulatory variables, which gather and store information that is specific to the fundamental dimensions of interdependence, and then use it to guide behavior in an adaptive manner (see also Cosmides & Tooby, 2013).

Importantly, this approach suggests that internal and external cues are integrated to create indices of interdependence in a given situation (Balliet et al., 2016). For example, when making inferences regarding the covariation of interests in a situation, individuals may use various internal sources of information, such as estimates of genetic relatedness with an interaction partner (Lieberman, Tooby, & Cosmides, 2007) and/or the weight assigned to the welfare of an interaction partner (Delton & Robertson, 2016). At the same time, they should take into account external sources of information, such as an interaction partner's emotional expressions (e.g., Reed et al., 2014) and nonverbal behavior (e.g., DeSteno et al., 2012), as well as environmental features, such as the scarcity of contested resources (Pietraszewski & Shaw, 2015). Future research can expand on social psychological insights—for example, on the role of emotions in decision making (Van Dijk et al., 2008; Van Kleef et al., 2004)—by using novel methods, such as agent-based modeling, virtual reality technologies, and human-robot interactions (e.g., De Melo, Carnevale, Read, & Gratch, 2014; DeSteno et al., 2012) to identify which cues people use to infer their outcome interdependence with others. Such a program of research may be able to eventually map the various forms of information that can be used to infer each dimension (or prototype) of interdependence.

## Future Interdependence and Biased Inferences

Recently, interdependence theorists (Kelley et al., 2003) have proposed that future interdependence is an additional dimension of interdependence that can influence behavior in social situations. Future interdependence is defined as the extent to which own and others' behavior in the present interaction can affect behavior and outcomes during future interactions (see Table 1). So far, a plethora of research suggests that perceptions of future interdependence influence one's current levels of cooperation. The mere expectation of future interactions increases cooperation in the present; this is the case both among children and young adults (Blake, Rand, Tingley, & Warneken, 2015; Van Lange, Klapwijk & Van Munster, 2011) and in both dyadic and intergroup interactions (Wolf, Cohen, Kirchner, Rea, Montoya, & Insko, 2009).

Specifically, Wolf and colleagues (2009) have shown that intergroup competition is significantly reduced when individuals consider how their own behavior will influence a rival group's behavior in the future. Similarly, considerations of future interdependence can have important implications for punishment behavior. If punishment and aggression function to deter non-cooperation (Krasnow, Cosmides, Pedersen, & Tooby, 2012), then individuals should punish others when there exist possibilities for future interactions. Importantly, recent work using agent-based modeling suggests that individuals should be able to somehow infer the probability of future interactions with another person (Delton, Krasnow, Cosmides, & Tooby, 2011).

Further, this research suggests that people may have specific biases when forming perceptions of (future) interdependence. According to Error Management Theory (Haselton & Buss, 2000), there are two types of perceptual errors that a person might commit: Type I errors (false-positives) and Type II errors (false-negatives). It could be that certain types of errors in perceiving interdependence are more costly than others. Delton and colleagues (2011) have proposed that the costs of mistaking a one-shot interaction for a repeated interaction may be lower than the costs associated with mistaking a repeated interaction for a one-shot encounter. This is because the latter mistake could result in the loss of opportunities for long-lasting cooperative relationships. It remains unknown if it is more costly to perceive situations with corresponding interests as containing conflict, or vice-versa. Also, is it more or less costly to mistakenly perceive oneself as having higher power than an interaction partner (compared to falsely perceiving lower power)? Further research can address this issue by studying the biases people have when making inferences of interdependence. Do people commonly make inferential errors in one or the other direction on each dimension of interdependence?

## Interdependence in Daily Life

Across the social sciences, there is still a lack of consensus regarding the types of interdependence that researchers should focus on when studying human behavior—should it be prisoner's dilemmas, coordination problems, or asymmetric games? According to Camerer (2003), a leading challenge for social scientists today is to understand "what games do people think they are playing" (p. 474). That is, social scientists should seek to understand how people mentally represent interdependence in their everyday life either in terms of specific game-theoretic structures—to the extent that people spontaneously use such representations—or in terms of broader dimensions of interdependence perceptions, which can then be mapped onto different prototypical games. Unfortunately, there is little descriptive work on the forms of interdependence that are more frequently encountered in people's daily lives. Yet this type of empirical approach has been fruitfully applied in recent studies to identify, classify, and understand which situations are psychologically important in real-world settings (e.g., Brown, Neel, & Sherman, 2015; Morse, Neel, Todd, & Funder, 2015; Parrigon, Woo, Tay, & Wang, 2016; Rauthmann et al., 2014). The measures of interdependence perceptions discussed earlier

can similarly be used to study the common types of interdependence that people experience daily. In turn, this knowledge can guide decisions about the types of situations that researchers should focus on.

Previous research has used a diary approach to study individuals' perceptions of interdependence in everyday life interactions. Specifically, Halevy & Philips (2015) conducted a study in which participants were asked to "think about the most recent interpersonal interaction you've had that involved you and just one other person" (p. 16). They were then asked to describe what happened in the interaction—for example, who was present, where it happened, what occurred—and indicate their endorsement of different game templates (i.e., verbal descriptions of prototypic games) as descriptive of the situation. Interestingly, these researchers found substantial within-person consistency in perceptions of interdependence, with participants endorsing the same game templates as descriptive of different situations encountered during a three-week period (Halevy & Philips, 2015). This finding suggests that personality and other individual differences may influence people's endorsements of specific game templates over time, either because personality plays a role in selecting specific types of situations or because individual differences directly influence how people construe social situations. We return to this point in the next section.

Similarly, Gerpott and colleagues (2017) conducted numerous studies in which they asked participants to write about a situation in their daily lives and then describe that situation using the SIS. They observed high correlations between specific interdependence dimensions. First, individuals tended to perceive situations with high conflict as containing less information certainty. This result could have occurred because people tend to think of others as more self-interested and less trustworthy than they actually are, especially in situations of information uncertainty (Vuolevi & Van Lange, 2012). Second, when people perceived situations as containing high interdependence in the present, they also described these situations as involving high future interdependence. This makes sense, since people tend to interact with those they will likely meet again in the future.

Recently, we replicated these findings in a study in which participants used the SIS to describe situations that they encountered in their daily lives in the context of different relationship types (see Fiske, 1992; Molho & Balliet, 2016b). We also found that participants described situations as containing different types of interdependence depending on the relationships they focused on. For example, situations within asocial or null relationships—those in which individuals either ignore each other or merely use each other as means to achieve a goal—were described as containing the highest conflict relative to other relationship types. Situations within authority-ranking relationships— those in which another person has a higher hierarchical position—were described as containing the highest power asymmetry (i.e., individuals perceived themselves as having the lowest power) relative to other relationship types. There is a need for more descriptive research that outlines the common forms of interdependence people

experience on a daily basis in different relationship types, social settings, and even across different societies and cultures.

## Personality and Interdependence Inferences

While this work suggests there is some consensus between individuals regarding the situations encountered within basic relationship types, important interindividual differences have also been documented in the ways people construe daily life situations (e.g., based on gender and personality; Sherman, Nave, & Funder, 2013). Consistent with this notion, Halevy and colleagues (2006) have provided evidence that the perception of a real-world intergroup conflict—the Israeli-Palestinian conflict—is influenced by individual differences, such as ethnocentrism, religiosity, and right-wing authoritarianism. Still, interdependence perceptions are not merely reflections of basic personality traits or individuals' motivational orientations (i.e., their relative concern for own and others' outcomes). Previous work has found few and relatively weak correlations of HEXACO personality traits (i.e., Honesty-humility, Emotionality, eXtraversion, Agreeableness, Conscientiousness, and Openness to Experience; Ashton & Lee, 2007) and social value orientation (Murphy, Ackermann, & Handgraaf, 2011) with interdependence perceptions in terms of mental *templates* (Halevy & Philips, 2015). Specifically, Halevy and Philips (2015) report that out of 144 correlations between HEXACO personality traits and endorsements of game templates over a period of six weeks, only nine correlations were statistically significant (all $r$s < .30; p. 21). Consistently, a recent meta-analysis of five studies ($N = 1,767$) suggests that HEXACO personality traits are only weak predictors of situation perceptions in terms of different interdependence dimensions (i.e., correlations range from $r = -.15$ to $r = .18$; Gerpott et al., 2017).

Yet another path by which personality might influence perceptions of real-life interdependent situations is by exerting influence on the situation types that individuals tend to experience and the situations that they actively seek (Rauthmann, Sherman, Nave, & Funder, 2015). Indeed, previous research suggests that situation selection might partly explain why individuals' perceptions of interdependence appear to be consistent over time. As mentioned earlier, Halevy and Philips (2015) have shown that individuals tend to endorse the same interdependence templates as descriptive of different negotiation situations, but their interdependence perceptions are even more consistent when describing real-life interactions. Building on these findings, future work would benefit from studying how individuals perceive daily life situations across various interdependence dimensions—such as the degree of interdependence, conflict, and power. Using experience sampling and longitudinal designs could help track how the interplay between persons, situations, and interdependence perceptions unfolds over time.

## Perceptions of Interdependence and Other Situation Taxonomies

Of course, everyday life situations can be markedly different and not all variations across situations are captured by interdependence dimensions. Various lines of empirical research have resulted in different taxonomies of situations according to their basic characteristics (e.g., Edwards & Templeton, 2005; Morse et al., 2015; Parrigon et al., 2016; Rauthmann et al., 2014; Yang, Read, & Miller, 2009). Recently, Gerpott and colleagues (2017) examined the relations between interdependence perceptions (i.e., SIS dimensions) and perceptions in terms of a newly developed situation taxonomy—the DIAMONDS—which includes eight dimensions of fundamental situation characteristics (Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception, and Sociality; Rauthmann et al., 2014). As expected, perceptions of conflict were related to perceptions of Adversity, Deception, Negativity, and pOsitivity in daily life situations. Further, situations that were perceived as involving more Sociality were also perceived as containing greater interdependence—both in the present and in the future. However, despite some overlap, both the DIAMONDS and the SIS captured unique aspects of how people think about situations. For example, the DIAMONDS does not measure differences in power across situations, and the SIS did not capture variation in Mating motives across situations. Thus, the DIAMONDS and the SIS can be considered complementary approaches to examining how people evaluate social situations.

Another recent effort to classify situations was based on evolutionary theoretical perspectives (i.e., the Fundamental Motives Theory; Kenrick, Griskevicius, Neuberg, & Schaller, 2010). Specifically, Morse and colleagues (2015) examined the content of situations based on their relevance to evolutionary important goals and Brown and colleagues (2015) developed a measure of situation perceptions according to the presence of different goals: self-protection, disease avoidance, affiliation, status, mate seeking, mate retention, and kin care. One interesting direction for future research would be to examine whether situations that afford one or more of these goals tend to be perceived as containing specific types of interdependence. For example, situations that involve affiliation and kin care may be perceived as containing highly corresponding interests, whereas those involving self-protection and mate retention may be characterized by more conflicting interests—to the extent that threats to self-protection or mate retention are due to others' actions. Similarly, situations that involve mate seeking or status concerns may be perceived as containing more asymmetric dependence than other situation types.

# Concluding Remarks

Interdependence is a fundamental characteristic of all social situations. Yet people do not have direct, objective, and common knowledge of the form of interdependence that characterizes any specific situation. Nonetheless, people can benefit from making accurate inferences of their interdependence with others, especially compared to a position of complete ignorance of interdependence. However, to complicate matters, there is substantial variability in the types of interdependent situations people can experience. Here we briefly reviewed three approaches to understanding how people might be able to infer the form of interdependence that characterizes any specific situation—experiential learning, mental templates approach, and Functional Interdependence Theory. Surprisingly little research has tested these different theoretical approaches to understanding how people make interdependence inferences. We outlined two recent advances in the measurement of interdependence inferences and believe that these developments provide the tools for future research on this topic. Future research questions include

Do people need to experience outcomes firsthand to infer interdependence in a situation?

Do prototypes or dimensions best characterize how people think about interdependence?

What are the cues that people use to infer interdependence?

What are the most frequent types of interdependence that people experience in their daily lives?

Do people have biases when making interdependence inferences?

How does personality affect interdependence inferences?

Answers to these (and more) research questions will advance our understanding on how people navigate interdependent social situations.

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