# How Do People Think About Interdependence? A Multidimensional Model of Subjective Outcome Interdependence

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Interdependence is a fundamental characteristic of social interactions. Interdependence Theory states that 6 dimensions describe differences between social situations. Here we examine if these 6 dimensions describe how people think about their interdependence with others in a situation. We find that people (in situ and ex situ) can reliably differentiate situations according to 5, but not 6, dimensions of interdependence: (a) mutual dependence, (b) power, (c) conflict, (d) future interdependence, and (e) information certainty. This model offers a unique framework for understanding how people think about social situations compared to another recent model of situation construal (DIAMONDS). Furthermore, we examine factors that are theorized to shape perceptions of interdependence, such as situational cues (e.g., nonverbal behavior) and personality (e.g., HEXACO and Social Value Orientation). We also study the implications of subjective interdependence for emotions and cooperative behavior during social interactions. This model of subjective interdependence explains substantial variation in the emotions people experience in situations (i.e., happiness, sadness, anger, and disgust), and explains 24% of the variance in cooperation, above and beyond the DIAMONDS model. Throughout these studies, we develop and validate a multidimensional measure of subjective outcome interdependence that can be used in diverse situations and relationships—the Situational Interdependence Scale (SIS). We discuss how this model of interdependence can be used to better understand how people think about social situations encountered in close relationships, organizations, and society.

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Social psychologists often stress the strength of the situation in determining behavior—or at least how people think about the situation (Ross & Nisbett, 2011). Yet, there has been surprisingly little theoretical development on the defining characteristics of situations and on individuals' perceptions of situations. Although personality psychologists have long emphasized how personality can exert its influence on behavior via the construal of situations (Allport, 1937; Funder, 2009; Mischel & Shoda, 1995; Murray,

1938), only recently have personality psychologists become more interested in understanding how people construe situations (e.g., Funder, 2009; Rauthmann et al., 2014). Here we advance our understanding about how people think about situations by drawing attention to a fundamental and defining characteristic of *social* situations: interdependence.

Humans are interdependent in all spheres of their social lives. In fact, all social interactions are characterized by some form of interdependence, that is, how each person's behavior affects their own and others' outcomes. In close romantic relationships, partners experience a vast range of interdependent situations—from cleaning the house, making financial decisions, and caring for family members. In organizations, supervisors and coworkers experience tasks that can vary in the amount each person depends on others for optimal outcomes. In society, each individual's behavior can affect fellow citizens in myriad ways, such as paying taxes, conserving resources, and voting in elections.

The type of interdependence that characterizes any single situation, however, can vary tremendously and may contain important implications for how interactions unfold. For example, a person in a close romantic relation is likely to face many interdependent situations that involve largely corresponding interests in which each of the romantic partners can easily achieve desirable outcomes. However, the same person who works in an organization may face situations in which his or her gain can be another's loss.

Yet again, in another situation, as a citizen, this person may find that his or her own outcomes are relatively more dependent on other citizens' behavior. In general, romantic partners, coworkers, and citizens can all experience variable interdependent situations which may result in—and provide a basis for understanding—different cognitions, motivations, and behaviors during social interactions (Kelley et al., 2003; Reis, 2008).

Research across the social and behavioral sciences suggests that people are able to detect the form of interdependence in situations and then respond in a way that benefits themselves and (sometimes) others. Indeed, previous studies found that people can infer the degree to which they are mutually dependent with others (Gaertner & Schopler, 1998; Pearce & Gregersen, 1991), if the situation contains a conflict of interests (De Dreu, Koole, & Steinel, 2000; Thompson, & Hrebec, 1996), and whether one person is more dependent on the other (Fiske, 2010; Keltner, Gruenfeld, & Anderson, 2003; Magee & Smith, 2013). Furthermore, research provided evidence that mutual dependence, power, and conflict are linked to people's emotional states (e.g., Pietroni, Van Kleef, De Dreu, & Pagliaro, 2008; Van Doorn, Heerdink, & Van Kleef, 2012) and cooperative behavior (e.g., Bachrach, Powell, Collins, & Richey, 2006; Komorita, Sweeney, & Kravitz, 1980; Righetti et al., 2015). Yet, these research programs have been developed in isolation within and across different disciplines. To date, there is no multidimensional model and measure of how people think about their interdependence to test whether each dimension of interdependence contains unique insight into the emotions people experience or when people cooperate.

We take the position that an ability to infer situational interdependence should be anchored in the objective properties of interdependence that people face on a daily basis (see Funder, 2009; Jussim, 1991; Rauthmann et al., 2014; McArthur & Baron, 1983). This perspective implies that the structure of subjective perceptions of interdependence mirrors the structure of objective interdependence (see Balliet, Tybur, & Van Lange, 2016; Rauthmann, Sherman, & Funder, 2015). Interdependence Theory suggests that six dimensions describe differences and similarities in objective interdependent situations: mutual dependence, power, conflict, coordination, future interdependence, and information certainty (Kelley et al., 2003; Kelley & Thibaut, 1978). Yet, prior research has not examined whether people think about situations according to these six dimensions.

The current research makes five contributions. First, we develop a pool of 242 items that describe a situation according to the six dimensions of interdependence, and then use endorsements of those items to examine the hypothesized six factor structure of how people think about interdependence. Second, we examine how this model of subjective outcome interdependence relates with a recent model of how people think about situations (DIAMONDS). Third, we test predictions about how specific situational cues (e.g., nonverbal behavior) and personality relate to how people think about their interdependence. Fourth, we test whether the different dimensions of interdependence contain unique predictive insight into the emotions people experience during situations and when people decide to cooperate. Finally, in the process of this work we develop and validate a multidimensional measure of how people think about their interdependence with others in a situation—the Situational Interdependence Scale (SIS).

## Structure of Interdependence Across Situations: A Six-Factor Model

Each interdependent situation people experience can be unique, just like each person is unique. Nonetheless, a few properties of interdependent situations can describe similarities and differences across all unique interdependent situations—again, similar to how a few dimensions of personality describe differences and similarities between people. What exactly are these properties of interdependence? To answer this question, Kelley and Thibaut (1978) examined variations of the simplest form of interdependence, whereby two individuals each have two behavioral options (i.e., $2 \times 2$ matrices), and each of the four possible outcomes varies across individuals. They then described how each individual's outcomes could be determined by (a) their own behavior, (b) their partner's behavior, and/or (c) a combination of their own and their partner's behavior (e.g., coordination). Kelley and Thibaut (1978) used these components to describe the variance in each person's outcomes in dyadic interactions. When considering many different interdependent situations, Kelley and Thibaut (1978) found that each component would explain a different proportion of variance in each person's outcomes across situations. This insight led to the conceptualization of four dimensions that describe similarities and differences across interdependent situations: mutual dependence, conflict, coordination, and power. More recently, Kelley and colleagues (2003) added two dimensions of interdependent situations: future interdependence and information certainty.

The six dimensions of interdependence are considered properties of social situations. Individuals often do not have direct knowledge of their interdependence with others. Nonetheless, there are substantial benefits associated with being able to infer these properties of interdependence, including better predicting other's behavior, engaging in attempts to influence other's behavior, selecting the most appropriate partner for a situation, and exiting situations with undesirable interdependence (Balliet et al., 2016). Thus, people may have an ability to form subjective perceptions of interdependence that involve the six dimensions that characterize objective interdependence (Kelley & Thibaut, 1978) and this may affect how people behave and navigate through social interactions and relationships. Next, we describe each dimension of interdependence (for an overview see Table 1).                    T1

### Mutual Dependence

In some situations each person determines their own outcomes, and their behavior has no effect on their partner's outcomes. That is, people in these situations are independent. The other end of this dimension is described by complete mutual dependence. In these situations, each individual's outcomes depend on how their own behavior combines with their partner's behavior. Thus, situations vary in how much each person's outcomes are determined by how each person behaves in that situation (Kelley & Thibaut, 1978).

People can form subjective perceptions of the degree of mutual dependence in a social interaction, and these inferences can shape how people think and behave. In close relationships, when a situation involves a high degree of mutual dependence, people tend to be more attentive to their partners (Berscheid, Graziano, Monson, & Dermer, 1976) and tend to be more committed to their partners (Rusbult, 1983). In organizations, when work tasks in-

Table 1

*Six Dimensions of Interdependent Social Situations and Sample Scale Items That Represent Low and High Ends of Each Dimension*

| Dimension | Definition | Sample item low | Sample item high |
|---|---|---|---|
| Mutual Dependence | Degree of how much each person's outcomes are determined by how each person behaves in that situation. | Each person's actions only affect their own outcomes, and not the other's outcomes. | We need each other to get our best outcome in this situation. |
| Power | Degree to which an individual determines their own and others' outcomes, while others do not influence their own outcome. | Who has the least amount of influence on the outcomes of this situation? | Who do you feel was most in control of what happens in the situation? |
| Conflict | Degree to which the behavior that results in the best outcome for one individual results in the worst outcome for the other. | We can both obtain our preferred outcomes. | It is difficult to make us both happy with the outcomes of this situation. |
| Coordination[a] | Degree to which an individual's behavior influences how a partner's behavior determines that individual's outcomes. | There is nothing I can do to influence how the other's actions affect me.[b] | Each person's outcomes rest on coordination with the partner's actions.[b] |
| Future Interdependence | Degree to which own and others' behavior in the present situation can affect own and others behavior and outcomes in future interactions. | The outcome of this situation does not affect my future interactions with the other. | My behavior in this situation affects how the other will behave in future situations. |
| Information Certainty | Degree to which a person knows their partner's preferred outcomes and how each person's actions influence each other's outcomes. | The other does not understand how his/her actions affect me. | We both know what the other wants. |

[a] This dimension was excluded from the final SIS due to the results of expert raters and Studies 1a and 1b. [b] These items were part of the original item pool (see supplementary material), but are not included in the final 30-item SIS.

volve mutual dependence with other coworkers, people are more likely to engage in greater amounts of cooperation (Bachrach et al., 2006). During highly mutual dependent situations, people tend to engage in greater prosocial behaviors (Martin, Gonzalez, Juvina, & Lebiere, 2014) and less aggressive behaviors (Green, 1998).

## Power

Situations vary in the degree to which each individual depends on their partner to acquire desirable outcomes. In some situations an asymmetrically *dependent* person can have their outcomes completely determined by their partner's behavior, and their own behavior does not at all influence their partner's outcome. However, an asymmetrically *independent* individual, on the other hand, can completely control their own and their partner's outcomes. Asymmetric dependence has been offered as a definition of social power (Keltner et al., 2003; Magee & Smith, 2013).

Research suggests that people use an abundance of cues during social interactions to infer their relative power in the interaction (e.g., Hall, Coats, & LeBeau, 2005). These inferences contain wide ranging implications across different social interactions. For example, high power persons in close relationships are less willing to sacrifice for their partner (Righetti et al., 2015). High-power—compared with low-power—individuals are also less trusting and cooperative with their interaction partners (Bendahan, Zehnder, Pralong, & Antonakis, 2015; De Cremer & Van Dijk, 2005; Schilke, Reimann, & Cook, 2015). High-power, compared with low-power, individuals in a negotiation tend to demand more and to concede less during the negotiation (De Dreu, 1995; Pinkley, Neale, & Bennett, 1994). Additionally, employees who have desirable and easily accessible alternative employment opportunities, tend to be relatively less asymmetrically dependent on an organization and engage in fewer prosocial behaviors that contribute to the organization (Thau, Bennett, Stahlberg, & Werner, 2004).

## Conflict

In some interdependent situations everyone can behave in a way to achieve their most desired outcome. In these types of situations people have perfectly corresponding outcomes. However, in other situations people can have completely conflicting outcomes. In these situations, the behavior that results in the best outcome for one individual results in the worst outcome for the other individual (and vice versa). Situations often contain a mixture of corresponding and conflicting outcomes (Balliet & Van Lange, 2013; Deutsch, 1949; Kelley & Thibaut, 1978).

An abundance of research demonstrates that people make inferences about the degree of conflicting interests in situations and that these inferences affect how interactions unfold. During negotiations, people infer the degree of conflicting interests between negotiating parties, and people who perceive a negotiation as containing more conflicting than corresponding outcomes tend to make fewer concessions, and experience less mutually rewarding negotiation outcomes (De Dreu et al., 2000; Thompson & Hrebec, 1996). Similarly, research in behavioral economics finds that people are generally less inclined to cooperate with others in situations that contain conflicting, compared with corresponding, outcomes (Ledyard, 1995; Murnighan & Roth, 1983). Additionally, situations that contain corresponding interests can lead people to cooperate both within and between groups (Bornstein, 2003; De Dreu & Weingart, 2003).

## Coordination

In some situations, people need to coordinate their behavior with each other to achieve desirable outcomes. In these situations, each person can improve their outcome by adjusting their behavior based on what their partner is doing (i.e., coordination). In other situations, coordinating behavior with others has no effect on outcomes, but each person's outcomes can still be influenced by

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others' behaviors, independent of their own behavior (i.e., social exchange).[1]

People can use cues from a partner, such as partner mimicry and synchrony of behavior, to infer that a situation involves coordination or not (Argyle, 1990; Manson, Bryant, Gervais, & Kline, 2013). When people perceive that a situation involves coordination, they tend to engage in more prosocial behaviors (Manson et al., 2013; Valdesolo, Ouyang, & DeSteno, 2010). On the other hand, situations characterized by social exchange may involve greater suspicion, demand greater trust in others to cooperate, and people may respond with relatively less cooperation (Kelley et al., 2003).

### Future Interdependence

In some situations the outcomes of an interaction can affect future behavior and possible outcomes in future interactions between the same people. In other situations, however, behavior and outcomes may not affect what happens in future interactions (even if the same people are likely to interact again). Hence, whereas mutual dependence characterizes the present situation, future interdependence involves a relatively extended time frame and describes how the behavior and outcomes that occur in a present situation can vary in impact on future situations (Kelley et al., 2003).

Indeed, close romantic partners who see a future for the relationship tend to engage in more sacrifices for their partner (Van Lange, Agnew, Harinck, & Steemers, 1997). Employees are more likely to engage in cooperative behavior at the workplace when they perceive to have an extended future with the organization (Joireman, Kamdar, Daniels, & Duell, 2006). People even cooperate more with a stranger when they know they will interact with that stranger again (Van Lange, Klapwijk, & Van Munster, 2011).

### Information Certainty

In situations characterized by information certainty people possess comprehensive information about what the other wants and how each person's actions influence each other's outcomes. However, in other situations people may not be aware of what each person prefers and wants and how their behavior affects others' outcomes in a situation. Therefore, situations vary in the degree of information certainty (Kelley et al., 2003).

When people experience uncertainty during a negotiation, they tend to scrutinize and process information more thoroughly, which **AQ: 4** can promote mutual agreement (Anderson & Neale, 2004). Yet, uncertainty can also reduce cooperation in some situations. For example, when people must cooperate to sustain a shared resource, uncertainty about the resource size and replenishment rate can reduce cooperation (De Kwaadsteniet, van Dijk, Wit, & de Cremer, 2006).

### Subjective Interdependence: Limitations of Previous Models and Measures

In the past, studies across disciplines have mostly manipulated a single dimension of the objective type of interdependence in a situation and found that this can affect people's motivation (e.g., emotional states) and social behavior (e.g., cooperation). This

research has implicitly assumed that people have an ability to assess situations according to several of the basic properties of interdependence and that these perceptions possess unique effects on how behavior unfolds within social interactions. Yet, because different properties of a situation can covary—such that people perceive situations with less information certainty as containing more conflict (Vuolevi & Van Lange, 2010), or such that people with high power perceive less conflict given their lack of attention to others' interests—existing research cannot really disentangle which interdependence properties predict specific emotional outcomes and behaviors. Furthermore, there is no multidimensional measure of how people think about their interdependence in a situation.

The few instruments that have been designed to measure subjective interdependence have several shortcomings. First, these measures are often restricted to a specific domain, such as task interdependence in the workplace (Pearce & Gregersen, 1991), or power and conflict in a negotiation (Thompson & Hastie, 1990; Van Kleef et al., 2008). These measures are not easily adaptable to a broad range of social interactions that can be experienced in different relationship contexts, such as between romantic partners, family, coworkers, and encounters between strangers. Second, prior measures do not assess multiple dimensions of interdependence in a single set of items. Although there exist scales to measure mutual dependence, conflict, and power, no instrument has been developed that simultaneously measures these three dimensions of interdependence. Moreover, no instrument exists that measures how people think about the three additional dimensions of interdependence. Third, some existing instruments confound several dimensions of interdependence. For example, a measure of power in a negotiation contains items that conceptually relate to both mutual dependence and power (e.g., "during the negotiation I did not feel dependent on the buyer"; Van Kleef et al., 2008, p. 581). Fourth, measures of interdependence often capture how people think about their interdependence *in a relationship* with others (e.g., perceived closeness; Aron, Aron, & Smollan, 1992) or within a group (e.g., perceived entitativity; Gaertner & Schopler, 1998). Unfortunately, these scales cannot be used to measure how people think about interdependence *in a specific social situation*. People can experience variable interdependent situations with others who they are highly mutually dependent with. Even if people tend to experience a specific type of interdependence with another person across situations, people can still experience situations when the interdependence is not typical or characteristic of that property of the relationship. Taken together, these limitations of previous measures prohibit a test of the six-factor model of subjective outcome interdependence.

### Examining the Six-Factor Model of Subjective Outcome Interdependence

We aimed to design a theory-based measurement tool that could overcome the limitations of previous measures. There were several standards we applied to developing this measure. First, the mea-

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[1] Kelley and Thibaut (1978) used the label *basis of interdependence* for this dimension of interdependence. Here we use the label *coordination*, because it is simple and relates back to existing relevant literature on this dimension of interdependence.

sure should assess how people think about their interdependence *in a social situation*, as opposed to a relationship. Second, the measure should be able to describe a broad range of social situations in both laboratory and field settings. The researcher (or participant) should be able to specify a situation, and then respond to how the scale items describe that situation. Third, the measure should be applicable to situations experienced in all types of social relationships, such as family, friends, close partners, coworkers, and strangers. Fourth, the measure should be able to capture interdependence in outcomes across situations that contain different types of possible outcomes, such as economic, material, emotional, and symbolic outcomes. Finally, the measure should capture the six dimensions that are hypothesized to characterize how people think about their interdependence.

We developed an item pool based on the theory and criteria mentioned above, and asked people to use those items to describe (a) situations that they directly experience (in situ raters) and (b) situations they observe other people experience (ex situ raters). We expect that a six-factor model will generalize across both in situ and ex-situ raters. Furthermore, we expect that this model will offer a more detailed approach to how people think about social situations, relative to an existing broader model about how people think about all social and nonsocial situations (DIAMONDS; Rauthmann et al., 2014).

## Antecedents and Consequences of Subjective Outcome Interdependence

We test several hypotheses about how cues in a situation and personality shape inferences along specific dimensions of interdependence, and how each dimension of interdependence can have unique relations with emotional states and behavior in situations.

### Cues to Infer Interdependence

A recent theoretical account suggests that people may use nonverbal behavior from their partner to infer characteristics of interdependence (Balliet et al., 2016). Specifically, different forms of nonverbal behavior may covary across situations according to different dimensions of interdependence (Balliet et al., 2016). This perspective implies that specific nonverbal cues will have discrete impact on how people think about specific dimensions of interdependence. Therefore, we examine whether two different nonverbal cues in a social interaction independently affect two different dimensions of interdependence. Specifically, we test the hypothesis that a partner's arms crossed versus arms loosely hanging by the sides during an interaction affects inferences of conflict, but not the other dimensions of interdependence. Furthermore, we examine whether standing over a person versus sitting and looking up at a person affects perceptions of power, but not the other dimensions of interdependence.

### Personality

Individual differences in personality may shape how people think about characteristics of situations (see Rauthmann et al., 2014; Sherman et al., 2015), including their interdependence with others. Across our studies, we map out how six broadband personality traits link to different dimensions of subjective outcome

interdependence. Specifically, we use the HEXACO personality model, which distinguishes between six virtually independent trait domains: Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience (Ashton, Lee, & De Vries, 2014; Ashton et al., 2004; De Raad et al., 2014; Saucier, 2009). Although we largely take an exploratory approach to this topic, we propose several predictions about how Honesty-Humility and Agreeableness relate to perceptions of interdependence.

People scoring high on Honesty-Humility display greater concern about others' outcomes, are less willing to manipulate and exploit others, and feel equal with others. Thus, these people may perceive greater mutual dependence, less conflict, and equal power with others. Highly agreeable persons tend to trust others, compromise, and experience less anger toward others who conduct a transgression. Therefore, highly agreeable people may perceive greater mutual dependence and less conflict with others.

Prior theory has mostly focused on how narrower versus broadband traits relate to subjective interdependence. For example, social value orientation (SVO; Balliet, Parks, & Joireman, 2009), a trait most closely corresponding with Honesty-Humility (Ackermann, Fleiß, & Murphy, 2016; Hilbig, Glöckner, & Zettler, 2014; Hilbig & Zettler, 2009; Thielmann & Böhm, 2016), has been theorized to influence how people think about their interdependence in a situation. Specifically, people who place greater weight on others' outcomes during social interactions (i.e., a prosocial SVO), are predicted to think situations contain less conflict, which in turn can lead to greater cooperation (Kelley & Thibaut, 1978). Here we examine whether the positive relation between SVO and cooperation is mediated by perceptions of conflict, even after controlling for SVOs corresponding broadband trait, Honesty-Humility.

### Emotions

Emotions have been hypothesized to covary across different types of interdependent situations (Balliet et al., 2016). For example, anger and disgust may be emotions more frequently experienced in situations involving high relative to low conflict (Pietroni et al., 2008), such as, in response to others' unfairness (Seip, Van Dijk, & Rotteveel, 2014; Chapman, Kim, Susskind, & Anderson, 2009) or morally hypocritical behavior (Laurent, Clark, Walker, & Wiseman, 2014). In contrast, happiness may be an emotion that occurs more frequently in low conflict situations, relative to high conflict situations (Van Doorn et al., 2012). Furthermore, power may be associated with more positive emotions (e.g., happiness), and less negative emotions (e.g., sadness), in social interactions (Keltner et al., 2003; Smith & Hofmann, 2016). Yet, so far no previous research has examined these hypotheses while controlling for other dimensions of interdependence. Here we take an initial step toward understanding what emotions people experience in different interdependent situations. Specifically, we test how four basic emotions—happiness, sadness, disgust, and anger—covary with different dimensions of subjective interdependence.

### Cooperative Behavior

Previous research has found that people are more inclined to cooperate with others when they are mutually dependent (Bach-

rach et al., 2006), the situation contains less conflict (Komorita et al., 1980), they have less power than others (Righetti et al., 2015), share future interdependence with others (Wu, Balliet, & Van Lange, 2015), and have information certainty (Martin et al., 2014). Yet, previous research has only manipulated objective interdependence and measured cooperation, rather than examining whether each dimension of subjective interdependence explains unique variation in cooperation. Here we examine this issue by observing (a) when people engage in behaviors that benefit others in a broad range of naturally occurring situations, and (b) cooperative behavior in different social exchange tasks.

## Overview of Studies

Studies were approved by the Scientific and Ethical Review Board (VCWE) of the Vrije Universiteit Amsterdam (#2015–202, Thinking about interdependence; and #2016–042, Cooperation in economic games). Data and research materials for all studies can be retrieved online (http://doi.org/10.17605/OSF.IO/JHRPR).

To measure the hypothesized dimensions of subjective outcome interdependence, we created an initial item pool of 242 items that reflected each of the six dimensions of interdependence theory (Kelley et al., 2003). Using expert ratings from 10 scholars familiar with interdependence theory, this number was reduced to 72 items (12 items per dimension, see supplementary materials). Studies 1a–1d investigated whether the responses to these 72 items fit the hypothesized six factor structure. In each study, we asked participants to describe a situation when another person was present in their daily lives. Participants subsequently rated how the different items described that situation. We found that participants did not differentiate situations according to one of the dimensions of interdependence—coordination—and so we removed this factor from the scale. After selecting the 30 items (6 items per dimension) comprised by the final Situational Interdependence Scale (SIS), we again used 11 expert ratings to provide content validation of the items.

In Study 2 we turned our attention toward generalizing the five-factor model of subjective outcome interdependence to both in situ and ex situ raters of situations. Here (in situ) participants were randomly assigned to describe a situation in their daily lives that was either low or high on a specified dimension of interdependence. Subsequently, we asked participants to use the SIS to evaluate that situation. Additionally, we had (ex situ) raters code whether the situations described by (in situ) participants were low or high on each of the five dimensions of interdependence.

Study 3 compared the SIS with a recent instrument developed to measure how people think about situations—the DIAMONDS model (Rauthmann et al., 2014). We predicted that a few dimensions of both models would correlate (e.g., mutual dependence and sociality), but largely expected that each model would measure different constructs. Study 4 tested whether nonverbal behavioral cues relate to how people draw inferences about specific aspects of interdependence in a situation. Moreover, several of our studies included a measure of personality (HEXACO), and in Study 5 we conduct a meta-analysis to summarize how six broadband dimensions of personality relate to how people think about interdependence.

Study 6 examines how subjective interdependences relates to emotional states and cooperative behavior in situations. Additionally, this study generalizes the factor structure of the SIS to a Dutch sample and uses a repeated measures design to estimate the proportion of variance in responses that are due to the situation or individual differences. Study 7 tests whether variation in subjective interdependence corresponds with variations in objective interdependence and how each dimension of subjective interdependence predicts behavior in two cooperative decision making tasks. Furthermore, we use this study to test how SVO, a trait corresponding with Honesty-Humility, relates to how people think about their interdependence and cooperation. Table 2 provides an **T2** overview of the studies.

## Studies 1a–1d: Item Selection and Model Testing

### Method

**Participants.** To select items for the SIS, we conducted four studies with U.S. participants using the online platform Mechanical Turk (MTurk). MTurk provides a diverse sample, delivers reliable data quality (Buhrmester, Kwang, & Gosling, 2011; Casler, Bickel, & Hackett, 2013), and allowed us to efficiently obtain large sample sizes. Respondents received $1.00 USD for participation in Studies 1a and 1b, and $0.50 USD in Studies 1c and 1d. We only included the data of participants who answered the complete questionnaire. Moreover, for each survey we removed participants from analyses who participated twice (as indicated by their IP address), reducing our sample size in Study 1a from 307 to 300 (38.3% male, $M_{age}$ = 37.14, $SD_{age}$ = 13.03), Study 1b from 305 to 299 (35.8% male, $M_{age}$ = 36.39, $SD_{age}$ = 12.88), Study 1c from 302 to 298 (40.9% male, $M_{age}$ = 36.71,

Table 2
*Overview of Studies*

| Study | $N$ | # of items | Purpose of study |
|---|---|---|---|
| Study 1a | 300 | 72 | Item selection and improve item pool |
| Study 1b | 299 | 72 | Item selection, improve item pool, and test a six factor model |
| Study 1c | 298 | 80 | Item selection and test a five factor model |
| Study 1d | 299 | 65 | Test a five factor model and select the final 30 items in the SIS |
| Study 2 | 514 | 30 | Test the relation between in situ and ex situ ratings of subjective interdependence |
| Study 3 | 192 | 30 | Compare two models of situation construal: SIS and DIAMONDS |
| Study 4 | 177 | 30 | Test how nonverbal cues can relate to specific dimensions of subjective interdependence |
| Study 5 | 1,767 | 30 | Personality and subjective interdependence: A meta-analysis across 5 studies |
| Study 6 | 330 | 30 | Subjective interdependence, emotions, and cooperation in naturally occurring situations |
| Study 7 | 280 | 30 | Subjective interdependence, Social Value Orientation, and cooperation in an experiment |

$SD_{age}$ = 11.92), and Study 1d from 303 to 299 (33.4% male, $M_{age}$ = 36.06, $SD_{age}$ = 12.60).[2]

**Procedure.** To test the six-factor model of subjective outcome interdependence, it is important that we use a method that generates a very diverse sample of situations and captures the full range of variation on each dimension of interdependence. Therefore, we replicated a method applied in prior research that asks participants to describe a situation in their daily lives (e.g., Rauthmann & Sherman, 2016; Rauthmann, Sherman, Nave, & Funder, 2015). This retrospective procedure was shown to encourage respondents to report on a wide range of situations. We asked participants to think about a situation they experienced recently when one or more persons were present. We instructed participants that the situation should be an event that resulted in a specific outcome, such as cooking dinner with a partner or dividing work with a coworker. We asked participants to describe in about 10 sentences; (a) what happened in the situation, (b) how they behaved in that situation, (c) how the other(s) behaved in that situation, and (d) what the outcome of the situation was (e.g., had a dinner, decided how to share work). To encourage participants to think about the situation, participants also replied to five questions about the situation they described (e.g., how many persons were present during the situation, where the situation occurred, how long it lasted).

In Studies 1a ($N$ = 300) and 1b ($N$ = 299), participants were asked to think of a recent situation in their daily lives. Participants described a broad range of social situations in which they interacted with one or more partner(s), including their romantic partner (41.3%; 44.1%), a friend (33.0%; 33.1%), a relative (24.3%; 31.1%), a coworker or supervisor (18.7%; 16.4%), a stranger (10.3%; 12.4%), and/or some other person(s) (22.3%; 18.1%), for Study 1a and 1b, respectively.[3] Nonetheless, there could be possible memory or recall biases that could systematically affect what types of situations people tended to think about and describe. To reduce these possible reporting biases, in Studies 1c and 1d we asked participants to indicate when they woke up and went back to sleep on the previous day, and then based on this information we provided participants with a randomly generated time of the day and asked them to describe an interaction that took place during or near that time.

Across each study, after participants described the situation, we asked participants to think about the situation they just described and respond to what extent they agreed that each statement described that situation on a 5-point Likert-type scale (1 = *completely agree*, 2 = *slightly agree*, 3 = *neither agree nor disagree*, 4 = *slightly disagree*, 5 = *completely disagree*).[4]

In Studies 1a and 1b we used the same 72 items. As a consequence of the study results, we modified, added and deleted items (described below), resulting in a total number of 80 items for Study 1c and 65 items for Study 1d. The four studies intended to incrementally improve our item pool, such that we could use Study 1d to select the best items to be included in the final version of the SIS. Lastly, 11 experts rated the content validity of the final 30 items.

## Results

**Study 1a and 1b.** To select the items for the SIS, we used confirmatory factor analysis (CFA) with Mplus 7.2 because our scale development was based on a theoretical framework. Given

that Studies 1a and 1b consisted of identical items, we examined the CFA results of both studies to develop the amended item pool for Study 1c. Overall, we found good interitem reliability among items measuring mutual dependence, conflict, and information certainty. For these three scales, we selected the eight best fitting items (4 low, 4 high). The remaining three subscales displayed some challenges.

We initially included 10 items that measured coordination. Contrary to our expectation, the low and high items on this scale were positively correlated ($r$ = .24 in Study 1a, $r$ = .34 in Study 1b). Additionally, an exploratory factor analysis showed that the coordination items possessed high cross-loadings on the mutual dependence factor. The coordination items showed undesirable factor loadings and even the experts tended to have difficulty classifying these items correctly in a pretesting phase (see supplementary materials). Thus, we removed these items and this dimension of interdependence from our scale.

Across both studies, we found that the items for high power (e.g., "The outcomes of this situation are more controlled by my behavior than by the other's behavior") and low power (e.g., "The other affects my outcomes but I do not affect the other's outcome") were positively correlated ($r$ = .30 in Study 1a, $r$ = .38 in Study 1b). Given that the items used in Study 1a and 1b were possibly too difficult for participants to comprehend, we added 13 reformulated power items. Notably, and in contrast to the coordination items, our initial expert survey showed that the power items could be assigned correctly to the power scale (see supplementary material). Therefore, participants might have had difficulty thinking about the degree of dependence experienced by each person in the situation, compare the different degrees of dependence, and then indicate how much they agreed with a statement about who had more or less dependence on the other in that situation.

For this reason, we decided to generate an additional set of 18 items using a different format. These items included a simple statement about who had low or high power in response to a 5-point scale (1 = *definitely the other*, 2 = *maybe the other*, 3 = *neutral*, 4 = *maybe myself*, 5 = *definitely myself*; see Van Kleef, De Dreu, Pietroni, & Manstead, 2006). Thus, power is absent when scores are at the midpoint of the scale (i.e., where neither individual has power over the other), but power is higher above the scale midpoint (i.e., the respondent has more power than the other) and power is lower below the scale midpoint (i.e., the other has more power over the respondent). A sample item for high power was "Who do you feel was most in control of what happens in the

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[2] The sample size was guided by the recommendation of Guadagnoli and Velicer (1988), who suggest that the minimum desirable $N$ for factor analytic investigations should be $N$ = 200. Furthermore, Marsh, Hau, Balla, and Grayson (1998) point out that although a sample size of $N$ = 50 can be sufficient for confirmatory factor analyses with 6 to 12 indicator variables per factor, a larger sample size and more items per factor can improve model testing.

[3] Participants could indicate more than one category of persons present in the situation.

[4] We chose a 5-point Likert scale format because the reliability with Likert-type scales has been shown to increase up to a 5-point scale, and it is the most widely used answering format in self-report scales (Hinkin, 1995; Lissitz & Green, 1975). We elected to have a statement at each scale point, because this practice can increase scale reliability (Weng, 2004).

situation?" An item for low power was "Who do you feel had the weakest influence on the outcomes of this situation?"

The future interdependence scale also did not have satisfactory factor loadings. For this subscale, seven of 12 items had satisfactory factor loadings (i.e., $\geq 0.65$ in both studies), but five items had very low loadings (from $-0.03$ to $0.27$). We examined each item and recognized that this discrepancy was due to two different types of content in the items. Seven items measured whether the respondent thought they would interact with the other(s) in the future. The remaining five items described how the current situation affected future interactions and outcomes. Because these latter five items are more directly aligned with interdependence theory, we removed the other seven items. Additionally, we developed eight new items that better reflect the definition of future interdependence.

In summary, based on the results of Study 1a and 1b, we made several changes to the item pool, including eliminating 13 items from three subscales (mutual dependence, conflict, and information certainty), removing the entire set of 10 items measuring coordination, adding 13 power items using the same format and 18 power items with a different scale format, and finally developing 8 new items for future interdependence.

**Study 1c.** Before we conducted the CFA, we examined the 25 items measuring power using the same scale format as the entire scale (1 = *completely agree*, 5 = *completely disagree*). We continued to find a (small) positive correlation between the 12 low power items and 13 high power items ($r = .06$). However, when we examined the 18 power items that used a revised scale format, we found that the low and high power items were negatively correlated ($r = -.81$). Therefore, we decided to remove the power items using the same scale format as the entire scale and continued our analysis with the 18 power items with the revised format.

Applying CFA, we found that a five-factor model had acceptable fit to the data ($\chi^2/df = 2.37$, $p < .001$, CFI = .79, RMSEA = .07, SRMR = .07).[5] Nevertheless, the mutual dependence dimension had some items with low factor loadings (ranging from .33 to .79). Therefore, we decided to add 10 differently phrased items (equally distributed between low and high) for this dimension and replicated the study.

**Study 1d.** The CFA testing a five-factor model with the entire 65 items had acceptable fit to the data, $\chi^2/df = 2.49$, $p < .001$, CFI = .73, RMSEA = .07, SRMR = .08. To create a 5-dimensional scale with a convenient number of items, we decided to retain six items per subscale (3 low and 3 high). We applied a two-step approach to reach this goal. First, we chose the best fitting items for each dimension. Second, we made sure that items with similar wordings were not included in the final scale. In this case, we chose the next highest loading item. Table 3 shows each item included in the 30-item SIS, their factor loadings, and the reliability of each subscale.

The factor loadings for studies 3 to 7 are reported in the supplementary material. The five-factor model of the final 30-items provided acceptable fit to the data, $\chi^2/df = 3.08$, $p < .001$, CFI = .80, RMSEA = .08, SRMR = .07 (see Table 10).[6] Furthermore, we had 11 experts rate the content validity of the final 30 items, showing that all items were correctly classified by at least 90% of the judges (see supplementary material).

## Study 2: In Situ and Ex Situ Ratings of Interdependence

To examine the construct validity of the items, we first asked participants to describe situations that were either low or high on a specific dimension of interdependence (in situ raters). This allowed us to observe whether the participants could use the SIS to discriminate how situations varied on each dimension of interdependence. Next, to investigate the intersubjectivity of the SIS dimensions, we had six blind experts rate each situation according to whether the situation was low or high on each dimension of interdependence (ex situ raters). This enabled us to investigate to what extent the form of interdependence in situations were perceived and evaluated similarly by in situ and ex situ raters of situations.

### Method

**Participants.** We recruited 514 U.S. participants (37.5% male, $M_{age} = 37.22$, $SD_{age} = 13.57$) via MTurk. They received $0.60 USD for their participation.

**Procedure.** Participants were asked to describe a recent situation in their daily lives. However, in this study each participant was asked to think about and describe a situation that was either low or high on a specified dimension of interdependence. Participants were randomly allocated to one of 10 conditions (5 dimensions of interdependence × 2 low vs. high).

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[5] A number of different recommendations have been brought forward to evaluate model fit. For instance, a $\chi^2/df$ ratio between 2 and 3 has been suggested to represent a plausible model fit (Carmines & McIver, 1981), whereas a chi-square ratio of less than 5 indicates an acceptable model fit (Jackson, Wall, Martin, & Davids, 1993). Furthermore, RMSEA and SRMR values below .05 have been considered as a good fit, values between .05 and .08 as an adequate fit, and values between .08 and .10 as a mediocre fit (Browne & Cudeck, 1993). However, although these recommendations are widely used, the indices tend to be lower with increasing parameters (Hooper, Coughlan, & Mullen, 2008) and "should be considered only as rules of thumb" (Hu & Bentler, 1999, p. 4). To avoid the incorrect rejection of an "acceptable" model, researchers have recommended to use a norm-reference approach to evaluating model fit (e.g., Marsh, Hau, & Wen, 2004). To illustrate, this means that CFI values around .80 can be acceptable in areas where that is the norm. Indeed, Rauthmann and Sherman (2016) reported fit statistics that are comparable to our SIS results for their DIAMONDS scale (with correlated dimensions), "$\chi^2/df = 4.55$, $p < .001$, CFI = .79, RMSEA = .08, SRMR = .12" (p. 5). Such values are typical in personality and situation research. Therefore, taking a norm-reference approach, we considered a model to have acceptable fit with $\chi^2/df$ ratio less than 5, RMSEA and SRMR values less than .10, and CFI values greater than .80.

[6] Some of the dimensions are strongly correlated, such as mutual dependence and future interdependence ($r = .72$). An exploratory factor analysis (principal component analysis, oblique rotation) with a predefined number of five factors showed that the items for power, conflict, and information certainty loaded on separate factors, but the degree of mutual dependence and future interdependence factors were loading on the same factor (see supplementary material). This could be because people more frequently interact in mutual dependent situations with others when the outcomes of those interactions can also affect what happens in future interactions with the same people. Indeed, when participants were placed in a situation where they were mutually dependent with another person they would never interact with again, then we did not observe a strong correlation between self-reported mutual dependence and future interdependence in that situation (Study 7). The factor correlations across each of the studies can be found in the supplementary materials.

Table 3
*30 SIS Items Selected in Study 1d, CFA Factor Loadings, and Alpha Reliabilities When an Item Is Deleted From the Subscale*

| Dimension | Item | Factor loading | $r$(i–s) | $\alpha^*_{SIS}$ |
|---|---|---|---|---|
| Mutual Dependence | Each person's outcomes depend on the behavior of the other. | .76 | .66 | .82 |
| | We need each other to get our best outcome in this situation. | .70 | .60 | .83 |
| | *What each of us does in this situation affects the other. | .80 | .68 | .81 |
| | Each person's outcomes are not influenced by what the other does.(r) | .63 | .60 | .83 |
| | *Whatever each of us does in this situation, our actions will not affect the other's outcomes.(r) | .64 | .59 | .83 |
| | Each person's actions only affect their own outcomes, and not the other's outcomes.(r) | .63 | .64 | .82 |
| Power | Who has the most impact on what happens in this situation? | .66 | .71 | .84 |
| | *Who do you feel had more power to determine their own outcome in this situation? | .67 | .67 | .85 |
| | Who do you feel was most in control of what happens in the situation? | .71 | .71 | .84 |
| | Who has the least control to determine their own outcomes in this situation?(r) | .76 | .63 | .85 |
| | *Who has the least amount of influence on the outcomes of this situation?(r) | .70 | .61 | .86 |
| | Who do you feel had the weakest influence on the outcomes of this situation?(r) | .80 | .67 | .85 |
| Conflict | The other prefers different outcomes than I do in this situation. | .62 | .56 | .76 |
| | *Our preferred outcomes in this situation are conflicting. | .71 | .60 | .75 |
| | It is difficult to make us both happy with the outcomes of this situation. | .65 | .59 | .75 |
| | Both of us can achieve our most desired outcomes in this situation.(r) | .78 | .57 | .76 |
| | *We can both obtain our preferred outcomes.(r) | .79 | .55 | .76 |
| | What satisfies me also satisfies the other.(r) | .58 | .43 | .79 |
| | My behavior in this situation affects how the other will behave in future situations. | .67 | .63 | .86 |
| | *How we behave now will have consequences for future outcomes. | .59 | .66 | .85 |
| Future Interdependence | Whatever happens in this situation will affect future interactions I have with the other. | .68 | .76 | .84 |
| | *Our future interactions are not affected by the outcomes of this situation.(r) | .62 | .64 | .86 |
| | Our interaction has no effect on future behavior in interactions with each other.(r) | .74 | .69 | .85 |
| | The outcome of this situation does not affect my future interactions with the other.(r) | .69 | .66 | .85 |
| | We both know how our behavior affects each other's outcomes. | .45 | .34 | .80 |
| | Each person is informed about the other's preferred outcomes. | .62 | .53 | .76 |
| Information Certainty | *We both know what the other wants. | .78 | .69 | .73 |
| | We both lack knowledge about what the other wants. (r) | .60 | .51 | .77 |
| | *I don't think the other knows what I want.(r) | .76 | .66 | .73 |
| | The other does not understand how his/her actions affect me.(r) | .60 | .52 | .77 |

*Note.* $N = 299$; $r$(i–s) = item-scale correlation; $\alpha^*_{SIS}$ = alpha reliability if item is deleted; (r) = item is reverse coded. Items for the short form of the SIS are marked with an asterisk (*).

They were first randomly assigned to read a description of one of the five dimensions of interdependence (mutual dependence, power, conflict, future interdependence, or information certainty). Each description included an explanation about the low and high ends of each dimension. Afterward, participants completed a comprehension check item to assess their understanding of the dimension of interdependence. They were then randomly assigned to think about a situation in their daily lives that was either low or high on that dimension of interdependence. Participants described that situation in about 10 sentences (see Studies 1a–1d). Finally, they answered the 30-item SIS with reference to that situation.

We used the HEXACO Personality Inventory—Revised to assess six dimensions of personality, namely Honesty-humility (H), Emotionality (E), eXtraversion (X), Agreeableness (A), Conscientiousness (C), and Openness to experience (O; Lee & Ashton, 2006). Participants completed the 104 item-version of the HEXACO (De Vries, Wawoe, & Holtrop, 2016), an extension of the 100-item HEXACO-PI-R that includes four additional items capturing engagement. Response options range from 1 = *strongly disagree* to 5 = *strongly agree*. A sample statement includes "I find it boring to discuss philosophy." Each dimension of personality displayed adequate inter-item reliability ($\alpha > .80$). We measured personality across several studies and report the results in a meta-analysis in Study 5. For

detailed analyses on the relation between the HEXACO dimensions of personality and the SIS in this study, see the supplementary materials.

In the second part of Study 2, we investigated whether the properties of interdependence as perceived by one individual reflect the properties of interdependence, as perceived by other individuals. Therefore, we applied a multiple-rater approach (Rauthmann et al., 2015) comparing the SIS ratings of raters in situ (who experienced the situations first-hand) and raters ex situ (who read participants' factual descriptions of the situations). In particular, we used the situations generated in the first part of the study for ratings by external raters. We trained six research assistants to classify situations on the five SIS dimensions. Each rater was provided a standardized explanation of the five SIS dimensions. Afterward we gave them a link to an online questionnaire. In this survey, participants first had to correctly answer 10 comprehension check items about the SIS dimensions. Afterward each of the coders evaluated all situations generated in the first part of Study 2 on the five SIS dimensions. Specifically, they answered one item per dimension on a 7-point Likert-type scale (1 = *very low* to 7 = *extremely high*) about how much mutual dependence, conflict, future interdependence, and information certainty the participants in the situation experienced. Furthermore, they evaluated who had more power in the situation (1 = *very much the other(s)*, 7 = *very much the person describing the situation*).

## Results

**Participant responses.**    We found that a five-factor model had acceptable fit to the data, $\chi^2/df = 4.63$, $p < .001$, CFI = .82, RMSEA = .08, SRMR = .07 (see Table 10). Table 4 displays the standardized mean differences ($d$ values) comparing the mean participant ratings of each subscale of the SIS in the low and high conditions of each dimension of interdependence. For the low and high conditions on each dimension of interdependence, the corresponding subscale was able to distinguish between those two conditions. For example, participants assigned to write about a situation that was low on conflict described that situation as containing less conflict, compared to participants who were asked to recall and write about a situation that was high on conflict ($d = 2.36$, $p < .001$). Additionally, across the low and high conflict conditions, participants most strongly differentiated these situations with the conflict subscale, compared to the other subscales (see Table 4). This general pattern was obtained across each of the interdependence conditions. As displayed in Table 4, for each interdependence condition, the largest difference in how participants responded to the SIS occurred for the corresponding subscale ($d$s = 2.11 to 2.76). Thus, participants were able to describe situations as low or high on a specific dimension of interdependence and their responses to the SIS corresponded to those differences in interdependent situations.

We also observed a number of other significant differences in how people described situations that were either low or high on a specific dimension of interdependence. These results correspond with our findings that some of the dimensions of interdependence are correlated across situations. For example, participants in the mutual dependence condition also tended to rate situations as having differential amounts of future interdependence. Similarly, participants in the future interdependence conditions rated situations as involving different amounts of mutual dependence (see Table 4). The same pattern is found comparing the conflict and information certainty conditions. We take these findings as evidence that some of these dimensions are correlated across the situations people experience in their daily lives.

**Expert ratings.**    We found high interrater agreement for each of the dimensions. The intraclass correlation coefficients (ICC(3,1); ICC(3,6)) for the six raters coding each dimension of interdependence on a 7-point Likert scale for 514 situations were as follows: mutual dependence (.49; .85), power (.64; .92), conflict

(.68; .93), future interdependence (.62; .91), and information certainty (.37; .78)—all significant at $p < .001$.

We calculated the average ratings of interdependence for each situation and then correlated these average ratings with the participant's rating of interdependence in those situations. As shown in Table 5, we found that expert-rated situational interdependence correlated with participant-rated situational interdependence on each corresponding SIS subscale ($r$s = .29–.61). We also examined these correlations between participants and raters within the five interdependence conditions, that is, in each condition in which participants were asked to describe a situation (low or high) on a specific dimension of interdependence. For example, when considering the two conditions in which participants were asked to either describe a situation that was low or high in conflict, we found a strong correlation between participants' and raters' perceived conflict in those situations ($r = .76$). Similarly, when conducting analyses across the other interdependence conditions, we found strong correlations between participants and raters on the corresponding dimension of interdependence ($r = .66$ to $r = .81$; see Table 5).

To summarize, participants were able to describe situations that were low or high on a specific dimension of interdependence, the SIS could differentiate among those situations, expert raters of those situations could differentiate among those situations according to the five dimensions of interdependence, and we observed a strong correlation between (in situ) participant and (ex situ) expert ratings in those situations.

## Study 3: SIS and DIAMONDS Model of Situation Construal

Interdependence theory contributes to our understanding of how people think about *social* situations. Recently, Rauthmann and colleagues (2014) empirically derived an eight-factor model of situation construal based on how people describe situations according to the Riverside Situational Q-sort. The eight factors are known by the DIAMONDS acronym, which stand for "Duty (does something need to be done?), Intellect (is deep information processing required?), Adversity (is someone being overtly threatened?), Mating (is the situation sexually and/or romantically charged?), pOsitivity (is the situation pleasant?), Negativity (do negative things taint the situation?), Deception (is someone deceptive?) and Sociality (is social interaction and relationship forma-

Table 4

*Standardized Mean Differences (d Value) Comparing Low and High Conditions for Each Interdependence Condition (IV) on Each Subscale of the SIS (DV) (Study 2)*

| SIS | Mutual Dependence | | Power | | Conflict | | Future Interdependence | | Information Certainty | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low ($n = 44$) | High ($n = 68$) | Low ($n = 58$) | High ($n = 38$) | Low ($n = 51$) | High ($n = 46$) | Low ($n = 53$) | High ($n = 53$) | Low ($n = 48$) | High ($n = 55$) |
| 1. Mutual Dependence | **2.765**[*] | | .302 | | .136 | | 1.269[*] | | .673[*] | |
| 2. Power | −.528[*] | | **2.756**[*] | | −.459[*] | | −.397[*] | | .210 | |
| 3. Conflict | .021 | | .828[*] | | **2.359**[*] | | .154 | | −.881[*] | |
| 4. Future Interdependence | 1.280[*] | | .114 | | .359 | | **2.113**[*] | | −.320 | |
| 5. Information Certainty | .797[*] | | .485[*] | | −.606[*] | | .856[*] | | **2.151**[*] | |

*Note.*    $N = 514$. A positive $d$ value indicates higher ratings on the subscale in the high condition, compared with the low condition.
[*] $p < .05$ (two-tailed).

Table 5

*Study 2 Correlations Between In Situ and Ex Situ Raters' Evaluations of Situations on the Interdependence Dimensions Across the Entire Sample of 514 Situations (Left) and Within the Subsamples for the Manipulation of Each Dimension of Interdependence (Right)*

| | Ex situ raters | | | | | | |
| | Entire Sample | | | | | Subsample | |
| In situ Raters | 1 | 2 | 3 | 4 | 5 | N | r |
|---|---|---|---|---|---|---|---|
| 1. Mutual Dependence | .56* | | | | | 112 | .75* |
| 2. Power | −.05 | .59* | | | | 96 | .81* |
| 3. Conflict | −.08 | −.15* | .61* | | | 98 | .76* |
| 4. Future Interdependence | .25* | −.02 | .15* | .29* | | 105 | .71* |
| 5. Information Certainty | .37* | .06 | −.16* | .30* | .37* | 103 | .66* |

*Note.* In the left panel the convergent correlations are along the outer diagonal. The right panel reports the correlation between in situ and ex situ raters for the corresponding dimension in each of the manipulated conditions. For example, there is a strong correlation between in situ and ex situ raters for mutual dependence ($r = .75$) within the sub-sample requested to describe either a low or high mutually dependent situation.
* $p < .05$ (two-tailed).

tion possible, desired, or necessary?)" (Rauthmann & Sherman, 2016, p. 1).

The five-factor model of interdependence may complement and extend the DIAMONDS model of situation construal. Specifically, certain dimensions of interdependence are hypothesized to relate to the DIAMONDS dimensions. First, when people think a situation contains greater conflict, they are probably also more likely to think that this situation contains greater adversity, potential for deception, negativity, and less positivity (see Balliet & Van Lange, 2013). Second, mutual dependence and future interdependence are likely to positively relate to sociality, because when a "social interaction and relationship formation is possible" people can be mutually dependent in the immediate situation and the current interaction may shape future interactions. Third, because people tend to avoid ambiguity (Keren & Gerritsen, 1999), less information certainty is likely to be present in situations characterized by greater negativity and less positivity. However, some of the dimensions of interdependence are not clearly represented in the DIAMONDS framework, such as power. Thus, we assume some overlap between the SIS and DIAMONDS, but we also expect that each model captures unique characteristics of how people think about situations.

## Method

**Participant and procedure.** We used MTurk to recruit U.S. participants and paid $0.60 USD for participation in the study. We removed 14 participants from analyses who participated twice and one participant who did not report a situation, resulting in a final sample of 192 participants (38.0% male, $M_{age} = 38.04$; $SD_{age} = 13.12$). Participants first completed the HEXACO personality inventory. Then, replicating the study design of Rauthmann et al. (2014), participants were asked to describe in about 10 sentences a recent situation in which they interacted with one or more persons (see procedure of Studies 1a–1b). After writing about the situation, participants were asked to describe that situation using the SIS and DIAMONDS measures.

**DIAMONDS inventory.** The DIAMONDS inventory consists of 24 items that describe a situation (3 items per dimension;

Rauthmann & Sherman, 2016). An example item of positivity is "the situation is playful" and an example item of negativity is "the situation could elicit stress." Participants rated the items on a 7-point scale ranging from 1 (= *not at all*) to 7 (= *totally*). The alpha reliabilities for the eight DIAMONDS scales ranged from .67 to .86 (see Table 6).

**T6**

**HEXACO.** Participants completed the same 104-item version of the HEXACO personality inventory used in Study 2. All domain scales displayed adequate alpha reliabilities ($\alpha > .81$). For detailed analyses on the relation between the HEXACO domain scales of personality and the SIS see the supplementary materials and Study 5.

## Results

The five-factor model provided acceptable fit to responses to the SIS, $\chi^2/df = 2.37$, $p < .001$, CFI = .77, RMSEA = .08, SRMR = .08 (see Table 10). Table 6 displays the correlations between the SIS and the DIAMONDS dimensions. First, in line with our expectations, we found small to medium correlations between conflict and four DIAMONDS dimensions; adversity ($r = .42$), deception ($r = .28$), negativity ($r = .29$), and positivity ($r = -.35$). Second, when people reported the situation as containing greater sociality, they were more likely to describe the situation as involving mutual dependence ($r = .17$) and future interdependence ($r = .15$). Third, information certainty was significantly related to less negativity ($r = -.26$) and more positivity ($r = .23$). Overall, only 16 of the total 40 correlations between the SIS and DIAMONDS dimensions were statistically significant.

Table 6 also reports the results of the total amount of variance explained in each of the SIS and DIAMONDS dimensions by the eight or five dimensions of the other model, respectively. These analyses indicate that some of the dimensions do not overlap with the other model. For example, there is not a significant amount of variance in power explained by the eight DIAMONDS dimensions ($R^2 = .05$, $p = .33$). Additionally, the five dimensions of interdependence did not explain a significant amount of variation in the mating dimension from the DIAMONDS model ($R^2 = .02$, $p = .57$). However, there is a significant amount of variance explained

Table 6

*Correlations Between the SIS and DIAMONDS Dimensions (Study 3)*

| Dimension | $M$ (SD) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. SIS: Mutual Dependence | 3.53 (.81) | (.75) | | | | | | | | | | | | |
| 2. SIS: Power | 3.11 (.84) | −.11 | (.88) | | | | | | | | | | | |
| 3. SIS: Conflict | 2.13 (.84) | −.21* | −.10 | (.81) | | | | | | | | | | |
| 4. SIS: Future Interdependence | 3.04 (.93) | .53* | .02 | −.08 | (.81) | | | | | | | | | |
| 5. SIS: Information Certainty | 3.84 (.77) | .23* | .02 | −.65* | −.06 | (.78) | | | | | | | | |
| 6. DIAMONDS: Duty | 4.12 (1.96) | .14 | .06 | .01 | .27* | −.03 | (.82) | | | | | | | |
| 7. DIAMONDS: Intellect | 3.74 (1.71) | −.06 | −.12 | .03 | .21* | −.08 | .49* | (.80) | | | | | | |
| 8. DIAMONDS: Adversity | 1.76 (1.31) | −.15* | −.12 | .42* | .11 | −.40* | .25* | .31* | (.86) | | | | | |
| 9. DIAMONDS: Mating | 2.71 (1.79) | −.03 | −.03 | .07 | .08 | −.11 | .04 | .23* | .32* | (.77) | | | | |
| 10. DIAMONDS: pOsitivity | 4.79 (1.75) | −.10 | .03 | −.35* | −.14 | .23* | −.29* | .04 | −.21* | .32* | (.84) | | | |
| 11. DIAMONDS: Negativity | 3.66 (1.77) | .14 | −.04 | .29* | .22* | −.26* | .47* | .29* | .48* | .08 | −.40* | (.85) | | |
| 12. DIAMONDS: Deception | 2.85 (1.63) | .01 | −.08 | .28* | .10 | −.25* | .13 | .29* | .47* | .18* | −.02 | .43* | (.78) | |
| 13. DIAMONDS: Sociality | 5.11 (1.40) | .17* | −.04 | −.25* | .15* | .24* | .16* | .45* | −.04 | .27* | .43* | .09 | .14 | (.67) |
| Model $R^2$ | | .16* | .05 | .31* | .11* | .15* | .08* | .10* | .24* | .02 | .16* | .16* | .10* | .10* |

*Note.* $N = 299$. Cronbach Alpha values in brackets. Model $R^2$ = the percent of variance explained in the corresponding dimension from the entire set of dimensions from the other model. For example, the eight DIAMONDS dimensions explain 16 percent of the variance in mutual dependence, whereas the five SIS dimensions explain 10 percent of the variance in Sociality.

* $p < .05$ (two-tailed).

in each of the other dimensions of the SIS ($R^2 = .11–.31$) and DIAMONDS ($R^2 = .08–.24$). These findings suggest that none of the relations between the SIS and DIAMONDS dimensions were as strong to suggest that these dimensions measure the same construct. Taken together, these results provide evidence for the convergent and discriminant validity of the SIS. We conclude from this study that the 30-item SIS partly overlaps and partly complements the DIAMONDS model in measuring how people think about a situation.

## Study 4: Nonverbal Cues and Subjective Interdependence

Study 4 extends the previous studies by (a) generalizing the factor structure of the SIS to *ex situ* ratings and (b) testing how specific forms of nonverbal behavior relate to different dimensions of subjective interdependence. Recent theory suggests that partner nonverbal behavior can be a rich source of input to make inferences about interdependence (Balliet et al., 2016). Here we examine whether two specific nonverbal behaviors, arms crossed (or not) and standing (vs. sitting), are used to make inferences about specific dimensions of interdependence, conflict and power, respectively.

### Method

**Participants and procedure.** We recruited 177 U.S. participants (54.2% male, $M_{age} = 36.32$, $SD_{age} = 13.33$) via MTurk. They received $0.40 USD for their participation. After signing an informed consent, participants completed a self-report measure of personality. Next, participants were randomly assigned to view one of two images of a drawing of an interaction between two people. They were asked to take the perspective of a specific person in the interaction, describe what they thought was happening, and complete the SIS. Lastly, participants completed demographic questions and were debriefed on the study.

**Images.** Participants were presented one of two images from the Operant Motives Test (Kuhl & Scheffer, 1999; image #10 &

#13). Both images contained two persons—one person standing, the other person sitting at a table, and both facing each other. The images differ primarily with the individuals either having their arms crossed or not having their arms crossed. Participants were randomly assigned to view one of these images. Furthermore, participants were randomly assigned to take the perspective of either one of the two persons in the picture. Therefore, the study involved a 2 (arms crossed vs. arms not crossed) × 2 (standing vs. sitting) between subjects design. Participants were asked to provide a brief description of what they thought was happening in that situation by responding to the same set of questions used in Study 1.

**HEXACO.** Participants completed the 60 item-version of the HEXACO personality inventory (Ashton & Lee, 2009). This version uses a subset of the items described in Study 2. Each domain scale had adequate alpha reliabilities ($\alpha > .74$). For detailed analyses on the relation between the HEXACO and the SIS see the supplementary materials and Study 5.

### Results

**SIS factor structure.** The five-factor model had acceptable fit to the data, $\chi^2/df = 2.45$, $p < .001$, CFI = .77, RMSEA = .09, SRMR = .09 (see Table 10).

**Nonverbal cues and subjective outcome interdependence.** In the image with arms crossed, participants reported a situation with greater conflict ($M = 3.02$, $SD = .94$), compared to the situation when the people did not have their arms crossed ($M = 2.65$, $SD = .83$), $t(175) = 2.78$, $p = .006$, $d = .20$. Arms crossed did not influence the other four dimensions of interdependence ($ps > .17$). Participants self-reported greater power in a situation when they were the person standing ($M = 3.40$, $SD = 1.01$), compared with when they were sitting ($M = 2.96$, $SD = 1.10$), $t(175) = 2.75$, $p = .007$, $d = .20$. We did not predict that this manipulation would affect the other four dimensions of interdependence. However, we found that participants reported a situation with greater certainty when they were standing, compared to when they were sitting, $t(175) = 2.05$, $p = .041$, $d = .15$. Sitting or

standing did not influence the other three dimensions of interdependence ($ps > .132$).

Overall, we find that the factor structure of the SIS generalizes to a situation when people are asked to think about a situation they did not directly experience (ex situ ratings). We also provide initial evidence for some cues in social interactions that can be used to make inferences about the type of interdependence in a situation. Specifically, two forms of nonverbal behavior—arms crossed (or not) and standing (vs. sitting)—influenced how people rated the situation on two specific dimensions of interdependence, conflict and power, respectively. Notably, these nonverbal behaviors largely did not affect how people thought about the other dimensions of interdependence.

## Study 5: Personality and Subjective Interdependence

Personality can influence behavior via the selection of situations and by affecting how people think about a situation (Funder, 2009; Mischel & Shoda, 1995; Sherman, Nave, & Funder, 2013). Yet, previous research has not addressed how personality is associated with the way people think about their interdependence with others. Studies 2, 3, 4, and 7 included a broad measure of personality, the HEXACO model. We also collected additional data in our research that measured both the HEXACO and how people thought about their interdependence using the SIS. In Study 5, we apply meta-analysis to estimate the true effect size between 6 broad dimensions of personality (HEXACO) and each of the 5 dimensions of subjective outcome interdependence.

### Method

We included a total of 5 studies in the meta-analysis ($n = 1,767$). Each study measured the 30-item SIS and the HEXACO, either with the 104-item or 60-item questionnaire. The studies varied in the type of situation people described using the SIS. Three studies asked participants about a situation in their daily lives. One study asked participants what they thought was happening in a situation in a picture (see Study 4). One study asked participants about a situation they experienced in an experimental task (see Study 7).

We used the correlation coefficient as the measure of effect size and applied a random effects approach to average correlations across studies (Lipsey & Wilson, 2001). The correlations and reliability measures for each study included in the meta-analysis are reported in the supplementary materials. We used the Comprehensive Meta-analysis Software version 3 to conduct the analyses.

### Results

**T7** Table 7 reports the meta-analytic estimate of the correlation between each dimension of personality and each dimension of interdependence. As displayed in Table 7, people high on Honest-Humility reported greater mutual dependence, less conflict, and greater information certainty. People high on emotionality reported greater mutual dependence. People high on extraversion reported less conflict and greater information certainty. People high on agreeableness reported less conflict and higher information certainty. People high on conscientiousness reported greater mutual

Table 7

*Meta-Analysis of the Relation Between the HEXACO and the SIS (k = 5, N = 1,767)*

| SIS | Personality | | | | | |
|---|---|---|---|---|---|---|
| | H | E | X | A | C | O |
| Mutual Dependence | .11* | .09* | .04 | .03 | .15* | .15* |
| Power | .02 | −.01 | .03 | .01 | .04 | .02 |
| Conflict | −.12* | −.02 | −.15* | −.10* | −.13* | −.11* |
| Future Interdependence | .02 | .01 | .02 | .00 | .03 | .09* |
| Information Certainty | .13* | .01 | .16* | .07* | .18* | .11* |

*Note.* H = Honesty-Humility; E = Emotionality; X = Extroversion; A = Agreeable-ness; C = Conscientiousness; O = Openness.
* $p < .05$.

dependence, less conflict, and higher information certainty. People high on openness perceived greater mutual dependence, less conflict, higher future interdependence, and greater information certainty. We did not find that any of the domain scales of personality were linked to how people think about power in a situation. Moreover, all the correlations were weak, which may be attributable to correlating measures of a broad personality construct with measures of how people construe a single specific situation. Although the meta-analysis did suggest that broad personality traits can relate to how people think about their interdependence in a specific situation, prior theory has primarily focused on the importance of narrower traits—a topic we consider in Study 7. Next, we examined how subjective interdependence may more strongly link to state responses in situations, such as felt emotions and cooperative behavior.

## Study 6: Subjective Interdependence, Emotions, and Cooperation

All of the previous studies were conducted using MTurk samples. Although MTurk provides many advantages, such as heterogeneous samples (e.g., ethnicity, age, and socioeconomic status), large sample sizes, and valid and reliable data (Buhrmester et al., 2011; Casler et al., 2013), we might be targeting a specific US population with situational experiences that do not generalize very well to a broader population. Therefore, we translated the scale to Dutch and conducted a conceptual replication on a large representative Dutch sample. We also utilized this opportunity to develop a brief, 10-item version of the SIS (for a detailed description, see supplementary material). To do so, we conducted a two-wave longitudinal design, whereby each participant reported on two different situations (at least one week apart). This approach allowed us to understand how much variance in the items is attributable to variance in situations, as opposed to variance in persons (following latent state-trait theory, Steyer, Ferring, & Schmitt, 1992; Eid, 1996). We aimed to select items for the brief scale that had substantial variation due to situations. Furthermore, we also measured four distinct emotional states in these situations (happiness, sadness, anger, and disgust). We expected that each discrete emotion will covary with different dimensions of interdependence. Lastly, we included a measure of people's cooperative behavior in these situations, to examine how each dimension of interdependence relates to engaging in behaviors that benefit others.

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## Method

**Participants and procedure.** Dutch participants were recruited using Flycatcher—a Dutch panel company. We aimed to recruit a participant sample that was representative for the Dutch population in terms of age, gender, education level, and province. To participate, members of the panel needed to be older than 18 years, as well as fluent in Dutch (the surveys were administered in Dutch). Participants were asked to complete the exact same survey twice, separated by about 1.5 weeks. On average there were about 12 days between participation in each survey.

Participants were compensated via Flycatcher and we paid one overall fee for Flycatcher's services. Consistent with the standards applied in our previous studies and based on an a priori power analysis, we aimed for a sample size of 300 participants. This sample size allows for 97% statistical power to detect a small-to-medium ($f^2 = 0.05$) main effect (two-tailed) of the dimensions of interdependence on emotion and cooperative behavior. Wave 1 included 759 participants (50.00% male, $M_{age} = 47.13$, $SD = 15.42$) and Wave 2 included 376 persons (47.89% male, $M_{age} = 47.55$, $SD = 15.27$). We only included participants with complete data in both surveys, resulting in a final sample of 330 persons (48.78% male, $M_{age} = 47.24$, $SD = 15.07$).

The study design was similar to Studies 1a and 1b. Participants were asked to describe the most recent situation that they experienced with another person. We asked them to describe what happened in the situation (i.e., who was with them, what did each person do) and they answered a few questions about the situation (i.e., when and where did the situation happen, what was the gender and age of the other person, how many others were present). Next, the participants responded to the 30-item SIS, and completed items about their emotions and their behavior in the situation.[7]

**30-item SIS (Dutch translation).** The full scale was translated into Dutch by a native Dutch speaker. Translation quality was assured through back translation into English by a different native Dutch speaker, including additional checks made by three native Dutch speakers. We find that each subdimension has good interitem reliability ($\alpha s = .76–.87$ for Wave 1, $\alpha s = .78–.90$ for Wave 2). The Dutch translation can be found in the supplementary materials.

**Emotions.** We measured participants' emotions in the situation (i.e., *anger*, *disgust*, *happiness*, and *sadness*). For each emotion, participants responded to two types of items: (a) verbal terms indicating different emotions, and (b) facial arrays displaying emotional expressions, using one male and one female face from the Radboud Faces Database (Langner et al., 2010). More specifically, participants were asked to indicate the extent to which they felt *anger*, *disgust*, *happiness*, and *sadness* in this situation (in randomized order), using 5-point Likert scales (1 = *not at all*; 5 = *very much*). Participants also indicated the extent to which each array of facial expressions (i.e., showing *anger*, *disgust*, *happiness*, and *sadness* in randomized order) matched how they felt in the situation, using 5-point Likert scales (1 = *not at all*; 5 = *very much*). We also randomized the order of presentation for verbal terms versus facial expressions. There were high correlations between responses to the verbal items and facial arrays for anger ($r = .78$), disgust ($r = .58$), happiness ($r = .80$), and sadness ($r = .76$), and so we collapsed these items into a single index for each

emotion. Higher scores on each index refer to higher felt emotion in the situation.

**Behavioral outcomes and cooperation.** After indicating their emotional responses to the situation, participants were asked about the outcomes associated with their own and the other person's behavior in the interaction. Specifically, we asked participants to indicate, using 5-point Likert scales: (a) the extent to which their own and the other person's behavior was 1 = *costly to themselves* versus 5 = *beneficial to themselves*, and (b) the extent to which their own and the other person's behavior was 1 = *costly to the other person* versus 5 = *beneficial to the other person*. We used participants' self-reports of how beneficial their own behavior was for the other person, as a measure of their *cooperation*, with higher numbers indicating more cooperative, pro-social behavior.

## Results

**Overall CFA.** The five-factor model provided acceptable fit to the data (see Table 10), $\chi^2/df = 4.10$, $p < .001$, CFI = .748, RMSEA = .097, SRMR = .085 (Wave 1) and $\chi^2/df = 4.72$, $p < .001$, CFI = .740, RMSEA = .106, SRMR = .081 (Wave 2).

**Situation specificity of the SIS.** Beyond reliability of measurements, we used this two-wave study to examine to what degree the SIS items are situation- (or occasion-) specific (cf. Eid, 1996; Eid & Diener, 1999, 2004; Steyer, Ferring, & Schmitt, 1992). *Specificity* is the proportion of variance in subjective outcome interdependence due to occasion-specific effects, whereas *consistency* captures variability due to stable individual differences.[8]

To test the situation-specificity of the scale, we fitted multistate-doubletrait longitudinal CFA models with two uncorrelated states and two correlated traits to both waves of data, again for each subscale separately ($n = 330$), using full information maximum likelihood estimation.[9] All subscale models had excellent fit (CFI $\geq .99$, RMSEA $< .01$, $\chi^2(1)$, $p > .05$). The subscales were all highly reliable (all reliabilities $\geq .85$). Specificity parameters ranged from .354 (future interdependence, wave 1) to .783 (power, wave 2), whereas consistency parameters ranged from .125 (power, waves 1 and 2) to .559 (future interdependence, wave 1). Overall, specificity was somewhat higher than consistency (see Table 8), and so subjective interdependence in a situation may be more strongly influenced by features of the situation than by stable individual differences.

**Subjective interdependence, emotions, and cooperation.** We tested the relation between the five dimensions of subjective

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[7] Participants also rated how important the situation was to them (1 = *very unimportant*, 5 = *very important*), and how likely they think it is that they will interact with the same person in the future (1 = *very unlikely*, 5 = *very likely*). Furthermore, we included several additional measures of welfare-tradeoff ratios, relationship value, and SVO that were included for a different purpose and not reported in this study.

[8] Occasion-specific effects and nonrandom situation-specific experiences (i.e., situation selection, manipulation, or evocation, cf. Buss, 1987) are confounded, and so person-situation transaction effects are included in the specificity parameter.

[9] We used item parceling to create two test halves, with scores on items 1, 3, and 5 of each subscale averaged to obtain the first test half score, and the remaining three items averaged to obtain the second test half score. We computed aggregated reliability, specificity, and consistency parameters following Eid (1996) and using the aggregation formulas provided by Eid and Diener (1999, 2004).

Table 8

*Aggregated Scale Parameters Derived From Multi-State Double Trait Models (Study 6)*

| SIS | Reliability | | Specificity | | Consistency | |
|---|---|---|---|---|---|---|
| | Wave 1 | Wave 2 | Wave 1 | Wave 2 | Wave 1 | Wave 2 |
| Mutual Dependence | .849 | .890 | .361 | .493 | .489 | .396 |
| Power | .881 | .908 | .756 | .783 | .125 | .125 |
| Conflict | .916 | .939 | .554 | .550 | .362 | .389 |
| Future Interdependence | .913 | .936 | .354 | .470 | .559 | .466 |
| Information Certainty | .863 | .874 | .504 | .542 | .359 | .332 |

*Note.* $n_1 = 330$ (Wave 1), $n_2 = 330$ (Wave 2).

interdependence and participants' emotions (i.e., happiness, sadness, anger, and disgust) and their self-reported cooperation (i.e., the extent to which their behavior benefits others), using multilevel modeling with repeated measures. Specifically, repeated observations of emotion and cooperation (in Time 1 and Time 2 surveys) were treated as Level 1 data, and were nested within the 330 participants who completed both surveys (Level 2). In all reported models, we allowed the intercepts of our dependent variables to randomly vary between participants.[10] Table 9 provides an overview of the relations between subjective interdependence and state emotions and cooperation.

**Happiness.** Several dimensions of subjective interdependence were associated with self-reported happiness in the situations described by participants. Specifically, participants experienced less happiness in situations that they perceived as having greater mutual dependence, $F(1, 630.32) = 6.86$, $p = .009$, $b = -0.17$, 95% CI = $[-0.31, -0.04]$, as well as in situations that they perceived as containing more conflict, $F(1, 649.25) = 139.19$, $p < .001$, $b = -0.61$, 95% CI = $[-0.71, -0.51]$. Further, participants who perceived themselves as having higher power in the situation experienced more happiness, $F(1, 635.81) = 6.54$, $p = .011$, $b = 0.17$, 95% CI = $[0.04, 0.29]$. There was a marginally significant positive association between information certainty and experienced happiness, $F(1, 643.01) = 3.72$, $p = .054$, $b = 0.13$, 95% CI = $[-0.002, 0.27]$.

**Sadness.** Only conflict was significantly associated with self-reported sadness, such that participants reported more sadness in situations that they perceived as containing higher conflict, $F(1, 646.48) = 82.25$, $p < .001$, $b = 0.48$, 95% CI = $[0.38, 0.59]$. Further, we observed marginally significant associations between perceptions of mutual dependence and information certainty, and experienced sadness. Consistent with results on happiness, participants reported experiencing more sadness in situations that they perceived as having greater mutual dependence, $F(1, 631.80) = 3.32$, $p = .069$, $b = 0.12$, 95% CI = $[-0.01, 0.26]$, as well as in situations that they perceived as containing less information certainty, $F(1, 644.15) = 2.78$, $p = .096$, $b = -0.12$, 95% CI = $[-0.26, 0.02]$.

**Anger.** Several dimensions of subjective interdependence were uniquely associated with anger in the situations. Participants experienced more anger in situations that they perceived as containing greater mutual dependence, $F(1, 642.23) = 5.83$, $p = .016$, $b = 0.15$, 95% CI = $[0.03, 0.27]$, as well as more future interdependence, $F(1, 640.98) = 4.11$, $p = .043$, $b = 0.11$, 95% CI = $[0.003, 0.21]$. Further, perceptions of higher conflict in the situation were associated with increased anger, $F(1, 653.79) = 141.55$,

$p < .001$, $b = 0.57$, 95% CI = $[0.48, 0.66]$, as were perceptions of less information certainty, $F(1, 650.04) = 9.31$, $p = .002$, $b = -0.20$, 95% CI = $[-0.32, -0.07]$.

**Disgust.** Participants experienced more disgust in situations that they perceived as containing more future interdependence, $F(1, 652.46) = 7.27$, $p = .007$, $b = 0.12$, 95% CI = $[0.03, 0.20]$, more conflict, $F(1, 648.69) = 117.06$, $p < .001$, $b = 0.42$, 95% CI = $[0.35, 0.50]$, and less information certainty, $F(1, 646.36) = 11.93$, $p = .001$, $b = -0.18$, 95% CI = $[-0.29, -0.08]$. Therefore, several dimensions of subjective interdependence had unique relations to feelings of disgust in social situations.

**Cooperation.** Consistent with previous findings regarding the importance of conflict in shaping cooperative behavior, participants' reported that their behavior was less beneficial to the other person in situations that contained higher conflict, $F(1, 652.14) = 68.17$, $p < .001$, $b = -0.38$, 95% CI = $[-0.47, -0.29]$. Perceptions of mutual dependence in the situation also had a marginally significant effect on cooperation, such that participants reported behaving more beneficially toward others in situations with higher mutual dependence, $F(1, 644.10) = 3.34$, $p = .068$, $b = 0.11$, 95% CI = $[-0.01, 0.22]$. There were no significant associations between the other dimensions of subjective interdependence and cooperation (all $p$s > .390).

To summarize, we developed a Dutch version of the SIS and used a two-wave longitudinal design to select a brief 10-item version of the SIS. We found that variation in the SIS items was largely due to variation in situations, as opposed to traits. We also observed that each dimension of subjective interdependence explained unique variation in the emotions people experienced during situations. Lastly, we showed that people who reported being in a high conflict situation were less likely to engage in behaviors that benefited others.

## Study 7: Subjective Interdependence and Cooperative Behavior

As we observed in Study 6, how people think about their interdependence with others can have substantial implications for how people feel and behave in social interactions, and especially in terms of their willingness to engage in behaviors that benefits others (i.e., cooperation; Balliet et al., 2016; Halevy & Katz, 2013; Messick, 1999; Weber, Malhotra, & Murnighan, 2004). In Study 6,

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[10] We also ran more complex, random-intercept, random-slope models, in which we allowed both the intercepts and slopes to randomly vary across participants. Using this approach we obtained the same results.

Table 9
*Mutilevel Models on the Relations Between Subjective Interdependence and State Emotions and Cooperation (Study 6)*

| SIS | Happiness | | Sadness | | Anger | | Disgust | | Cooperation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | b | p | b | p | b | p | b | p | b | p |
| Mutual Dependence | −.17 | .009 | .12 | .069 | .15 | .016 | .03 | .502 | .11 | .068 |
| Power | .17 | .011 | −.11 | .105 | −.06 | .337 | −.04 | .411 | −.04 | .523 |
| Conflict | −.61 | <.001 | .48 | <.001 | .57 | <.001 | .42 | <.001 | −.38 | <.001 |
| Future Interdependence | .02 | .706 | .08 | .150 | .11 | .043 | .12 | .007 | .04 | .392 |
| Information Certainty | .13 | .054 | −.12 | .096 | −.20 | .002 | −.18 | .001 | .04 | .473 |

*Note.* $n_1 = 330$ (Wave 1), $n_2 = 330$ (Wave 2).

we asked people about the extent to which their behavior benefitted others in a wide range of naturally occurring situations. We found that conflict, and to some extent mutual dependence, predicted whether the participants engaged in behaviors that benefitted others. Yet there are limitations to the self-report measure of cooperation used in Study 6, such as possible response biases. In Study 7, we randomly assigned people to interact in one of two cooperative decision making tasks, measured how they thought about their interdependence with their partner, and observed their cooperative behavior. Thus, we can provide a further test about how the five dimensions of interdependence predict cooperation.

Additionally, in Study 7 we investigated how variations in objective interdependence relate to variations in subjective perceptions of interdependence, and examine whether these subjective perceptions mediate the relation between objective interdependence and cooperative behavior. Specifically, we compared how people thought about and behaved in two objectively different interdependent cooperative decision making tasks—the dictator game and prisoner's dilemma. In comparison to the prisoner's dilemma, participants in the dictator game have objectively less mutual dependence, greater conflicting interests, and greater power differences. Using these social exchange tasks, we could examine whether participants' subjective perceptions of interdependence correspond to objective differences in interdependence, and whether those subjective perceptions of interdependence were associated with people's decision to cooperate.

In Study 7 we also considered whether a personality trait known to relate to cooperation, SVO (Balliet et al., 2009), was linked to cooperation via perceptions of interdependence. Specifically, Kelley and Thibaut (1978) hypothesized that SVO is associated to cooperation via the construal of less conflicting interests in the situation. Here we tested this mediation model and examined whether this relatively narrow personality trait was more strongly linked to subjective outcome interdependence than its corresponding broadband trait (i.e., Honesty-Humilty; Hilbig & Zettler, 2009).

## Method

**Participants and procedure.** Two hundred eighty U.S. participants (52.9% male, $M_{age} = 36.48$, $SD = 12.02$) were recruited from MTurk. Each participant was paid $2.00 USD. Thirteen participants won an extra 2-dollar bonus based on their decisions during the study.

Participants first completed two measures of personality (SVO and HEXACO). Then participants were randomly assigned to have

a single interaction with another person in one of two decision making tasks: a dictator game and a prisoner's dilemma. After participants read the instructions to these tasks they were asked several comprehension questions to make sure they understood the situation. Specifically, participants were asked questions about how certain behaviors by themselves and their partner would result in specific outcomes. Each participant had to correctly answer these questions before proceeding to make their decision. Lastly, participants evaluated the decision making task using the SIS and the DIAMONDS measures of situation construal.

**Social exchange task.** Participants were randomly assigned to either a modified dictator game or prisoner's dilemma. The dictator game involved two roles: Person A and Person B. Person A was endowed 100 lottery tickets (each worth a 0.20% chance to win a $2.00 prize) and was able to decide to give between 0 and 100 tickets to Person B. Any amount given to Person B was doubled in value. Person B made no decision, but could only accept any amount shared by Person A. All tickets kept by Person A retained the same value. All participants in this condition were assigned to the role of Person A.

The prisoner's dilemma involved two roles: Person A or Person B. In contrast with the dictator game, both Person A and B were endowed with 100 lottery tickets (each worth a 0.20% chance at winning a $2.00 prize) and both persons could decide to give between 0 and 100 tickets to their partner. Any amount given to their partner would be doubled in value. All tickets kept by Person A and Person B retained the same value. All participants were assigned to the role of Person A. In both the dictator game and prisoner's dilemma, how many lottery tickets the participant decided to give to their partner (0–100) was the measure of cooperation.

**Social value orientation.** Participants completed the 6-item SVO Slider Measure (Murphy, Ackermann, & Handgraaf, 2011). For each item, they chose how to distribute money between themselves and an anonymous person. At the same time, participants were asked to imagine that the anonymous person was making similar decisions that could affect their outcomes in the task. Based on participants' choices, we computed their index of SVO (i.e., SVO; $M = 25.80$, $SD = 13.12$). Higher scores indicate greater concern for others' outcomes, relative to concern for own outcomes.

**HEXACO.** Participants completed the same 60-item HEXACO personality inventory used in Study 4 (Ashton & Lee, 2009). All domain scales had adequate alpha reliabilities ($\alpha >$

.77). For detailed analyses on the relation between the HEXACO and the SIS see the supplementary materials and Study 5.

## Results

**Factor structure of the SIS.** The five-factor SIS model provided a good fit to the data, $\chi^2/df = 2.84$, $p < .001$, CFI = .85, RMSEA = .08, SRMR = .09 (see Table 10).[11]

**Objective and subjective outcome interdependence: Construct validity.** The dictator game contains less mutual dependence, greater conflict, and higher power differences than the prisoner's dilemma game. Therefore, we conducted a multivariate model with the type of social exchange task predicting mutual dependence, conflict, and power. The type of task explains a significant portion of variance in these dimensions of interdependence $F(3, 277) = 143.57$, $p < .001$, $\eta_p^2 = .61$. The pattern of means support the predictions. Participants reported less mutual dependence in the dictator game ($M = 3.64$, $SD = .63$) than in the prisoner's dilemma ($M = 4.32$, $SD = .69$), $F(1, 280) = 76.34$, $p < .001$, $d = .463$. Participants also self-reported greater conflict in the dictator game ($M = 3.25$, $SD = .90$) than in the prisoner's dilemma ($M = 2.66$, $SD = .96$), $F(1, 280) = 27.73$, $p < .001$, $d = -.298$. They also reported greater power in the dictator game ($M = 4.45$, $SD = .81$) than in the prisoner's dilemma ($M = 2.96$, $SD = .61$), $F(1, 280) = 301.27$, $p < .001$, $d = -.722$. In fact, participants even used the scale to indicate near equal power in the prisoner's dilemma ($M = 2.96$), which did not significantly deviate from the scale midpoint (i.e., 3.00), $t(137) = 0.780$, $p = .432$. Thus, overall we find that variation in subjective outcome interdependence as measured by the SIS correspond to objective differences across interdependent situations.

**Subjective outcome interdependence and cooperation.** People should cooperate more if they think a situation contains greater mutual dependence, less conflict, and less power. We conducted a multiple regression model with the five dimensions of the SIS predicting cooperation across the two social exchange tasks. The model explained 32% of the variance in cooperation, $F(5, 275) = 25.60$, $R^2 = .32$. People were more cooperative if they perceived the situation as containing less conflict ($\beta = -.48$, $p < .001$). Although the following effects did not reach conventional standards of statistical significance, there was a tendency for participants to also be more cooperative when they perceived the situation as containing greater mutual dependence ($\beta = .10$, $p = .067$), and less power ($\beta = -.09$, $p = .097$). Both future interdependence and information certainty did not relate to variance in cooperation. This is understandable, because these studies involved complete information in one-shot interactions. The findings also hold after controlling for the variance in cooperation due to the HEXACO traits. In this model, none of the HEXACO traits significantly related to cooperation. Conflict continued to have a significant negative relation with cooperation ($\beta = -.471$, $p = .023$), whereas mutual dependence had a small positive relation with cooperation ($\beta = .109$, $p = .060$).

We also consider whether the SIS had unique predictive validity above and beyond another existing model of situation construal: DIAMONDS. First, we examined the correlations between the DIAMONDS and SIS. We largely replicated our findings from Study 3 (see supplementary material for greater detail). We conducted a two-step multiple regression model predicting coopera-

tion, with step 1 containing the eight DIAMONDS dimensions, and step 2 adding the five SIS dimensions. The first step explained 11% of the variance in cooperation, $F(8, 272) = 4.106$, $p < .001$, $R^2 = .11$. People who thought the situation called for greater intellect were more cooperative ($\beta = .298$, $p < .001$), and those who thought the situation involved mating opportunities were less cooperative ($\beta = -.185$, $p = .043$). All the other DIAMONDS dimensions did not have a statistically significant relation to cooperation. The SIS explained an additional 24% of variance in cooperation, above and beyond the DIAMONDS model, $F\Delta(5, 267) = 20.07$, $p < .001$, $R^2\Delta = .24$. People who reported the situation contained less conflict ($\beta = -.485$, $p < .001$) and less power ($\beta = -.12$, $p = .04$) were more cooperative. The other SIS dimensions were nonsignificant. In this model, the effect of intellect was reduced ($\beta = -.169$, $p = .014$), and mating was no longer a significant predictor of cooperation (along with all other DIAMONDS dimensions). Thus, we find that the SIS can predict variance in cooperation beyond an existing model of situation construal.[12]

We also examined whether the variation in subjective outcome interdependence mediates the effect of the type of social exchange task on cooperation. We conducted a multiple mediation model, with mutual dependence, conflict, and power mediating the relation between the type of social exchange task and cooperation. People were more cooperative in the prisoner's dilemma than the dictator game ($b = 20.97$, $p < .001$). We found a significant indirect effect for the degree of conflict ($b = 9.94$, 95%CI [6.24, 14.06]), but not mutual dependence and power. After taking into account the mediation, there was no longer a statistically significant effect of the type of social exchange task on cooperation ($b = 7.24$, $p = .188$). Thus, people were more cooperative in the prisoner's dilemma, because this situation contained less conflict than the dictator game.

**SVO, conflict, and cooperation.** We hypothesized a mediation model of SVO, conflict, and cooperation. When testing this model, we controlled for the broadband trait that corresponds with SVO, Honesty-Humility. Indeed, replicating past research, SVO had a positive correlation with Honesty-Humility, $r = .27$, $p < .001$. Furthermore, SVO had a negative relation with conflict, $r = -.21$, $p < .001$, and a positive relation with cooperation, $r = .26$, $p < .001$.

We used Preacher and Hayes (2008) method to estimate the indirect effect. The indirect effect of conflict was statistically significant, $b = .25$, 95% CI [.14, .46]. After controlling for the indirect effect, there remained a statistically significant relation between SVO and cooperation, $b = .34$, $p = .015$. We used Honesty-Humility as a covariate in the model. Honesty-Humility did not have a significant relation with cooperation, $b = 3.23$, $p =$

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[11] Here we observed a weak correlation between mutual dependence and future interdependence dimensions ($r = .20$). We also find a weak relation between conflict and information certainty ($r = -.28$). These correlations observed in an experimental setting are weaker than in the previous studies sampling daily life situations. This discrepancy may be attributable to the fact that these dimensions are strongly correlated across situations people experience in their daily lives.

[12] We also ran a model with the SIS in Block 1 and the DIAMONDS in Block 2. The DIAMONDS did not explain any (substantial and statistically significant) incremental variance in cooperation, $R^2\Delta = .03$, $F(8, 266) = 1.746$, $p = .088$.

Table 10

*Confirmatory Factor Analyses for the Five-Factor Model of Subjective Outcome Interdependence*

| Study | AIC | BIC | BIC$_{adj.}$ | $\chi^2$ | $df_x$ | $p_x$ | CFI | TLI | RMSEA | 90% CI RMSEA | SRMR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Study 1d | 24605.01 | 24975.06 | 24657.92 | 1214.84 | 395 | <.001 | .801 | .781 | .083 | .078–.089 | .073 |
| Study 2 | 45269.48 | 45693.70 | 16454.65 | 1829.08 | 395 | <.001 | .824 | .807 | .084 | .080–.088 | .074 |
| Study 3 | 16445.67 | 16771.42 | 16454.65 | 934.62 | 395 | <.001 | .770 | .746 | .084 | .077–.091 | .080 |
| Study 4 | 14746.11 | 15063.73 | 14747.05 | 971.10 | 395 | <.001 | .764 | .740 | .091 | .084–.098 | .088 |
| Study 6$_{W1}$ | 24147.36 | 24527.26 | 24210.06 | 1618.78 | 395 | <.001 | .748 | .723 | .097 | .092–.102 | .085 |
| Study 6$_{W2}$ | 23707.38 | 24087.29 | 23770.09 | 1865.36 | 395 | <.001 | .740 | .714 | .106 | .101–.111 | .081 |
| Study 7 | 23790.96 | 24154.79 | 23837.69 | 1120.63 | 395 | <.001 | .846 | .830 | .081 | .075–.086 | .086 |

*Note.* Model with freely correlated dimensions. AIC = Akaike Information Criterion; BIC$_{adj.}$ = Bayesian Information Criterion (adjusted for sample size); CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; CI = Confidence Interval; W1 = Wave 1 sample; W2 = Wave 2 sample.

.20. Thus, we find support for the idea that SVO relates to cooperation through influencing how much conflict people perceive in a situation. Moreover, we observe this for the relatively narrower trait of SVO, but not its corresponding broadband trait of Honesty-Humility.

In summary, we found that the SIS had good properties when being used to describe a standardized experimental situation. Importantly, we found that variation in the objective interdependence between the two decision making tasks was reflected in responses to the SIS, and that subjective interdependence mediated the relation between objective interdependence and cooperation. Replicating Study 6, we found that conflict was the strongest predictor of cooperation, but we also found some evidence that people were more cooperative in situations that had greater mutual dependence and less power. Furthermore, we found that the dispositional weights people assign to other's outcomes during social interactions (i.e., SVO), correlated with perceived conflict in the situation, and that conflict mediated the relation between SVO and cooperation.

## Discussion

Although interdependence underlies all social interactions, people rarely have objective information about their interdependence, and so people may make subjective inferences about the form of interdependence that characterizes social interactions. Yet, little is known about how people think about their interdependence, or even if they do at all. Recognizing this oversight in past research, Camerer (2003) has suggested that one of the leading open research questions for the study of social behavior is: "what games do people think they are playing?" (p. 474). We took a theory-driven approach to investigate how people think about their interdependence with others in a broad range of social situations. Particularly, we used Interdependence Theory as a guiding theoretical perspective (Balliet et al., 2016; Kelley & Thibaut, 1978; Kelley et al., 2003), which suggests that six dimensions describe variation across interdependent situations. We initially generated a large pool of items that described situations according to these six dimensions and had people use these items to describe situations in their daily lives. We found that five, but not six, dimensions explained variance in responses to our item pool: mutual dependence, power, conflict, future interdependence, and information certainty. This factor structure generalized across both in situ and

ex situ raters of situations and was shown to be a unique approach to measuring how people think about social situations, compared to an existing model of situation construal (i.e., DIAMONDS). Furthermore, we tested hypotheses about how situational cues (e.g., nonverbal behavior) and personality (e.g., HEXACO) relate to perceptions of interdependence in social situations, and how the distinct dimensions of interdependence have unique relations with emotions and behavior in situations. Table 11 provides a summary of findings across our studies.

### Situational Interdependence Scale

Throughout this program of research, we establish and validate a 30-item (and 10-item) Situational Interdependence Scale (SIS) that can be used to advance our understanding of behavior in diverse situations people experience in the lab, at home, in the workplace, and society at large. Two findings provide strong evidence for the construct validity of the SIS. In Study 2, we found that people are able to describe situations in their daily lives that are low or high on each of the five dimensions of interdependence and that they are able to use the SIS to discriminate between those situations. Additionally, we found that ex situ raters of these situations largely agreed with each other about the form of interdependence contained in each of these situations. Moreover, how ex situ raters described the interdependence in those situations (which provides a measure of consensus estimating objective interdependence; Funder, 2009) strongly correlated with the participants' subjective perceptions of interdependence in those situations.

For additional evidence of construct validity, in Study 7 we randomly assigned participants to one of two social situations that differed in the form of objective interdependence—the dictator game or prisoner's dilemma. Participants used the SIS to correctly describe the dictator game as involving less mutual dependence, and greater power and conflict, than the prisoner's dilemma. Thus, across our studies we find that variation in objective interdependence corresponds with variations in subjective interdependence, as measured by the SIS.

Providing evidence for the convergent and discriminant validity of the SIS, we found in Studies 3 and 7 that the SIS dimensions correlated in the expected direction with a recent measure of how people think about situations—the DIAMONDS model (Rauthmann et al., 2014; see Table 11). To illustrate, conflict positively

Table 11
*Overview of Main Findings*

| SIS | % Specificity[a] | DIAMONDS[b] | Antecedents | | Consequences | |
|---|---|---|---|---|---|---|
| | | | Nonverbal Behavior[c] | Personality[d] | Emotions[e] | Cooperation[f] |
| Mutual Dependence | 48.96% | • Sociality (+)<br>• Adversity (−) | • No effect of nonverbal cues | • Honesty-Humility (+)<br>• Emotionality (+)<br>• Conscientiousness (+)<br>• Openness (+)<br>• SVO (+) | • Happiness (−)<br>• Sadness (+, *ms*)<br>• Anger (+) | • Studies 6 and 7: Positive relation with cooperation (+, *ms*) |
| Power | 86.02% | • No relation to DIAMONDS | • Participants who imagined to be a person standing (sitting) reported more (less) power | • No relation with HEXACO | • Happiness (+)<br><br>• Sadness (−, *ms*) | • Study 6: No relation with cooperation<br>• Study 7: Negative relation with cooperation (−, *ms*) |
| Conflict | 59.53% | • Adversity (+)<br>• Deception (+)<br>• Negativity (+)<br>• Positivity (−)<br>• Sociality (−) | • Participants who imagined to be a person with their arms crossed (or not) reported more (less) conflict | • Honesty-Humility (−)<br>• Extraversion (−)<br>• Agreeableness (−)<br>• Conscientiousness (−)<br>• Openness (−)<br>• SVO (−) | • Happiness (−)<br>• Sadness (+)<br>• Anger (+)<br>• Disgust (+) | • Studies 6 and 7: Strong negative relation with cooperation (−) |
| Future Interdependence | 44.49% | • Sociality (+)<br>• Duty (+)<br>• Intellect (+)<br>• Negativity (+) | • No effect of nonverbal cues | • Openness (+)<br>• SVO (+) | • Anger (+)<br>• Disgust (+) | • Studies 6 and 7: No relation with cooperation |
| Information Certainty | 60.21% | • Negativity (−)<br>• Positivity (+)<br>• Adversity (−)<br>• Deception (−)<br>• Sociality (+) | • Participants who imagined to be a person standing (sitting) reported more (less) certainty | • Honesty-Humility (+)<br>• Extraversion (+)<br>• Agreeableness (+)<br>• Conscientiousness (+)<br>• Openness (+) | • Happiness (+)<br>• Sadness (−, *ms*)<br>• Anger (−)<br>• Disgust (−) | • Study 6 and 7: No relation with cooperation |

*Note.* + indicates a positive relationship with the respective SIS dimension; − indicates a negative relationship with the respective SIS dimension; *ms* = marginally significant.
[a] % Specificity is the average specificity (*s*) divided by the average reliability (*r*) from both waves in Study 6: $(((s1/r1) + (s2/r2))/2) * 100$.  [b] Studies 3 and 7.  [c] Study 4.  [d] Study 5.  [e] Study 6.  [f] Studies 6 and 7.

correlated with adversity and deception, whereas mutual dependence and future interdependence both positively correlated with sociality. Yet, these correlations were all quite low, suggesting each scale measures different constructs. Furthermore, some of the SIS dimensions did not correlate with any of the DIAMONDS dimensions. For example, power did not relate to any of the DIAMONDS dimensions, yet research across the social sciences suggests that power is an important feature of social situations (for a review, see Fiske, 2010). Thus, we conclude that the SIS provides a measure of the five-factor model of subjective outcome interdependence that is a unique framework of how people think about *social* situations. In contrast to the DIAMONDS instrument that covers broad-band situational characteristics that may or may not involve interpersonal interactions (e.g., Intellect, Positivity, and Negativity), the SIS focuses on how people think about situational characteristics that uniquely describe differences and similarities between social interactions.

## Models of Subjective Interdependence

Functional Interdependence Theory (FIT) proposes that people may think about their interdependence along four dimensions: mutual dependence, power, conflict, and coordination (Balliet et al., 2016). Interdependence Theory has proposed two additional dimensions of interdependence: future interdependence and information certainty (Kelley et al., 2003). We initially designed an item pool that considered all six factors, but we eventually found

that five factors captured how people used our items to describe their interdependence with others in diverse social situations. Therefore, our studies provide some initial evidence in support for each perspective on the structure of how people think about interdependence. We did find that people could use the items of the SIS to reliably differentiate situations according to three dimensions hypothesized by FIT (Balliet et al., 2016). Additionally, we find that future interdependence and information certainty are two additional dimensions that characterize how people think about their interdependence.

We did allow the factors to correlate in our model, and under naturally occurring situations some factors did strongly correlate across situations. Specifically, when we asked participants to write about a situation in their daily lives and then describe that situation using the SIS, we found that there was a medium to strong correlation between (a) mutual dependence and future interdependence, and (b) conflict and information certainty. However, when we placed people in a situation where these factors were unrelated (Study 7), we found that there was not a strong correlation between these factors. Thus, we conclude that the SIS contains five theoretically and empirically distinct factors that represent how people think about their interdependence. Future research may further examine why and how these dimensions correlate across situations. For example, it might be that in situations with low information certainty, people tend to think others are more selfish than they actually are (see Vuolevi & Van Lange, 2010), or people

might be more likely to conceal their preferences in high conflict situations.

Halevy, Chou, and Murnighan (2012) suggested that people think about situations according to one of four prototypes of interdependence. They found that how people described a negotiation as one of these four prototypes was linked to their perceptions of conflict, as well as the extent to which they engaged in deception. One of the four prototypes is the prisoner's dilemma, which was one of the objective situations used in Study 7. We found that even when people were placed in an objective prisoner's dilemma, there remained substantial variation in how people thought about their mutual dependence, conflict and power and these dimensions explained substantial variation in cooperation (Study 7). We conclude that people can represent interdependence along several continuous dimensions. Future work is encouraged to provide a more direct test of these two models of subjective interdependence.

## Antecedents and Consequences of Subjective Outcome Interdependence

Regardless of the structure of how people infer interdependence, there is a need "to improve our understanding of how social situations are perceived and what the role of personal factors and environmental factors are in this process" (Messick, 1999, p. 27). Previous theory suggests that perceptions of situations should be strongly tied to the actual (objective) situation (Balliet et al., 2016; Funder, 2009; Jussim, 1991; Rauthmann et al., 2015). This would imply that how people respond to the SIS should vary more across situations than between people, in other words, should be more state-like than trait-like. Study 6 utilized a longitudinal design to understand if a substantial proportion of variance in subjective interdependence can be explained through situation-specific effects. Importantly, specificity was higher than consistency, that is, the proportion of variance in subjective interdependence due to stable individual differences. As displayed in Table 11, across our studies we found evidence for both situational cues (e.g., nonverbal behaviors) and personality can explain variation in subjective interdependence, and that subjective interdependence relates to emotions and behavior during social situations.

**Nonverbal behavioral cues.** To date, we possess limited knowledge about the cues people use during social interactions that enable them to form inferences of interdependence and partner nonverbal behavior may be a rich source of information to make these inferences (see Balliet et al., 2016). Indeed, "nonverbal behavior is crucial . . . for defining the social psychological situation" (Ambady & Weisbuch, 2010, p. 473), and "many of the key parameters of our social life are quickly and efficiently negotiated through nonverbal communication" (DePaulo & Friedman, 1998, p. 27). In Study 4 we provide initial evidence indicating that partner nonverbal behavior may be used to infer the underlying interdependence in a situation. We found that two different nonverbal behaviors in a social interaction, arms crossed (or not) and standing (vs. sitting), were used to form inferences about different aspects of interdependence, conflict and power, respectively. However, these nonverbal cues largely did not affect how people thought about the other dimensions of interdependence. Future research is needed to further test hypotheses about how different

cues in social interactions can provide input to making inferences about specific features of interdependence.

For example, FIT hypothesizes that the interaction partner's nonverbal emotional expressions may serve as a cue for the type of interdependence in a situation (Balliet et al., 2016). In Study 6, we found that participants' who self-reported greater happiness also reported situations with less conflict, less mutual dependence and more information certainty. In contrast, greater anger was experienced in situations that contained higher mutual dependence and conflict, but less information certainty. This is initial evidence that emotional states do covary across interdependent situations, and so partner emotional expressions may be nonverbal cues people can use to infer interdependence. Future work may manipulate or measure partner emotional expressions during social interactions and observe how this affects people's inferences of interdependence and social behavior.

**Personality.** We did observe a significant proportion of variance in subjective interdependence attributable to individual differences, and prior theory and research suggests that personality shapes behavior by influencing how people think about—and to what extent they are attracted to—different situations (De Vries, Tybur, Pollet, & Van Vugt, 2016; Funder, 2009; Mischel & Shoda, 1995). Study 5 reported a meta-analysis across several studies which discovered the dimensions of interdependence correlate in expected ways with broad personality traits (HEXACO). For example, our findings provide some support for the hypothesis that high, compared to low, agreeable persons perceive less conflict in situations (see White et al., 2012). Honesty-Humility, on the other hand, which captures concerns about fairness and other's wellbeing, was positively related to perceiving greater mutual dependence in a situation.

It is possible that personality influences the types of situations people recalled or selected, but not how people thought about situations. This perspective would predict a stronger relation between the HEXACO traits and subjective interdependence when people freely recalled a situation (Studies 2 and 3), compared with when people were all placed in the same situation (Studies 4 and 7). However, we found that the correlations were largely the same across all these studies, suggesting that personality may be influencing how people construe the situation.

We found that a narrower, compared with broadband, trait had a stronger association with how people thought about interdependence. Study 7 tested and supported the hypothesis that the positive relation between social value orientation and cooperation is mediated by perceived conflict in the situation. Given that most prior theory on the relation between personality and subjective interdependence has focused on narrower personality traits, future research might want to build on these initial findings and continue focusing on testing predictions about narrower personality traits, such as trust, empathy, and social dominance orientation.

**Emotions.** We found that each dimension of subjective interdependence explained unique variation in the emotions people experienced during situations (see Table 11). FIT has suggested that detecting the form of interdependence in a situation can enable people to pursue specific behavioral strategies in social interactions, and some of these strategies may be motivated by distinct emotional states (Balliet et al., 2016). For example, we find that people are more likely to experience anger in situations that involve a conflict of interest. This could occur because noncoop-

eration is common in these situations and anger can communicate an intention to, and the actual implementation of, punishment of other's noncooperative behavior (Reed, DeScioli, & Pinker, 2014; Seip et al., 2014; Sell, Tooby, & Cosmides, 2009). Similarly, recent work suggests that (moral) disgust motivates specific responses to transgressions of others, such as indirect aggressive actions (Molho, Tybur, Güler, Balliet, & Hofmann, 2017). Here we find that people report greater feelings of disgust in situations that involve conflict, reinforcing the idea that disgust may serve an important role in regulating responses to others noncooperative behavior (see also Chapman et al., 2009). Another theory has suggested that being in positions of power leads to an approach motivation (vs. an inhibition motivation) that, in turn, results in positive feelings in social interactions (Keltner et al., 2003; Smith & Hofmann, 2016). Here we find that power does relate to greater feelings of happiness in situations (although it only marginally predicts weaker feelings of sadness). Future research can experimentally test predictions about how subjective interdependence may actually cause emotions that reliably produce specific behaviors in social interactions.

**Cooperation.** Across two studies we found that subjective interdependence relates to cooperation, essentially behaviors that benefit others (and often oneself too; see Table 11). In Study 6, we asked participants about the extent that their behavior was beneficial to others across a broad range of naturally occurring situations. This is the first study, to our knowledge, that has tested whether each of the dimensions of interdependence has a relation with cooperation after controlling for the other dimensions. We found that conflict was strongly negatively related to engaging in behaviors that benefited others, whereas mutual dependence had a marginally significant positive association with behavior that benefitted others. The finding that conflict is the dimension of interdependence that most strongly relates to engaging in cooperative behavior, supports an abundance of research across the social sciences that have focused on how this dimension can determine when people cooperate (Bornstein, 2003; Deutsch, 1949; Ledyard, 1995; Rapoport, 1967). The other finding also supports previous conclusions that people tend to be more cooperative when they are mutually dependent (Bachrach et al., 2006; Martin et al., 2014). Nonetheless, asking people about the extent to which their behavior was beneficial to others can raise demand characteristics, such as providing socially desirable responses. Therefore, we generalized our findings to a study that actually measured costly behaviors that benefit others.

In Study 7 we placed participants in common experimental social exchange situations used to study cooperation. We found that subjective interdependence predicted approximately 24% of the variance in cooperation, above and beyond the DIAMONDS framework and the HEXACO model of personality. Replicating the results of Study 6 that involved naturally occurring situations, people in the experimental setting were more cooperative when they thought the situation contained less conflict. We also found that mutual dependence had a small positive relation with cooperation. Furthermore, people who felt less powerful in the interaction were more cooperative. This later finding was in contrast with the nonsignificant relation between power and cooperation reported in Study 6 and may be due to the experimental setting of the dictator game having clear, absolute power over the other—a

situation that may not be a frequent, naturally occurring situation reported in Study 6.

We also manipulated the social exchange task that involve two different forms of interdependence: the dictator game and the prisoner's dilemma. We found that although the objective interdependence between the tasks was related to cooperation ($R^2 = .09$), subjective interdependence had a relatively stronger link to cooperation ($R^2 = .32$), and subjective perceptions of interdependence mediate the relation between objective interdependence and cooperation. Thus, how people think about their interdependence with others in a situation, and especially the degree of conflict, contains substantial insight for understanding cooperation in social interactions.

## Broader Implications

Interdependence is a fundamental feature of social situations. Indeed, research across the social sciences has used interdependence as a foundation for understanding social behavior. We briefly illustrate how this multidimensional model of subjective interdependence can be applied to advance research on interdependence and social behavior in close relationships, organizations, and environmental conservation.

**Close relationships.** Close romantic relationships may involve the most intense setting of interdependence and people can experience a wide range of different types of interdependence with their close partner. Indeed, when we asked people to freely recall a situation on the previous day, they most frequently recalled a situation when they were with their close partner (see Studies 1a and 1b). In those situations we observed great variation in every dimension of interdependence. Interdependence can play an important role in understanding feelings of closeness (Berscheid, Snyder, & Omoto, 2004), commitment (Rusbult, 1980), and trust (Rempel, Holmes, & Zanna, 1985), which link to prorelationship behaviors, such as sacrifice for a partner (Powell & Van Vugt, 2003; Righetti, Finkenauer, & Finkel, 2013), and forgiving and accommodating a partner's transgression (Finkel & Campbell, 2001; Finkel, Rusbult, Kumashiro, & Hannon, 2002; Rusbult, Verette, Whitney, Slovik, & Lipkus, 1991). Although measures have been developed to tap how interdependent people feel in their relationship with another (Aron et al., 1992; Berscheid et al., 2004), there has been no measure to assess how couples think about their interdependence in a specific situation, such as when deciding to make a sacrifice, conduct a transgression, or accommodate a partner's transgression. This model of subjective outcome interdependence can be used by close relationship researchers to understand (a) how each partner thinks about a specific situation, (b) incongruence between how partners think about their interdependence, and (c) how perceptions of interdependence deviate from the objective interdependence in that situation (e.g., measured by how most couples would think about their interdependence in that situation).

**Organizational behavior.** It is widely recognized that coworkers experience diverse forms of interdependent situations in organizations that vary in terms of the degree of mutual dependence (Pearce & Gregersen, 1991), power (Brass & Burkhardt, 1993), conflict (Thomas, 1992), and future interdependence (Joireman et al., 2006). Variation in interdependence is known to shape important forms of employee behavior, such as organizational citizenship behaviors (Bachrach et al., 2006; Bachrach et al., 2006)

and workplace deviance (Robinson & O'Leary-Kelly, 1998; Tepper et al., 2009), which can ultimately influence team and organizational performance (Wageman & Baker, 1997). The SIS can be applied by managers to understand how employees think about their interdependence with fellow coworkers in specific work tasks, which can inform strategies to influence employee behavior. Managers could also use the SIS to examine how types of strategic organizational change, such as cost-focused changes (e.g., downsizing) or people-focused changes (e.g., skill development programs), affect how employees think about their mutual dependence, conflict, and power with other coworkers, and how this in turn is associated with performance-related behaviors.

**Environmental psychology.** Humans are inextricably interdependent in managing the earth's resources, and environmental psychologists are beginning to consider how the form of interdependence can affect proenvironmental behaviors (e.g., Gärling, Biel, & Gustafsson, 2002; Gifford, 2014; Joireman, Lasane, Bennett, Richards, & Solaimani, 2001). For example, carbon consumption and climate change presents an interdependent problem on a grand scale (Hardin, 1968; Milinski, Sommerfeld, Krambeck, Reed, & Marotzke, 2008). Recent research finds that people who feel mutually dependent with others tend to engage in greater proenvironmental behaviors (Arnocky, Stroink, & DeCicco, 2007), and cooperative solutions to resource management are more difficult when there exist power asymmetries in a group (Tavoni, Dannenberg, Kallis, & Löschel, 2011). However, when engaging in proenvironmental behaviors people often do not observe the consequences of their own behavior on others, and neither do they understand how other's behavior affects their own outcomes. The SIS can be used by researchers to understand how people think about their interdependence with others when they decide to recycle, turn down their air conditioning at home, take shorter showers, or buy an energy saving vehicle. Furthermore, the SIS can be used to research how communication is linked to perceptions of interdependence and subsequent proenvironmental behavior.

### Limitations

We aimed to test the six-factor model of how people think about their interdependence in a situation. Our model was informed by theory, and so we used theory to guide our hand in generating items that could describe situations along each of the six dimensions. Although using theory is arguably a strength, there is also an inherent limitation to this approach: We cannot claim that these six (or five) dimensions exhaust all possible dimensions that people use to think about interdependence. Although we are not aware of any other dimensions that have been discussed in previous work, future work may build on this model by integrating additional possible theoretically (or empirically) derived dimensions.

We did not find that people could use our items to distinguish situations according to the degree of coordination. Although this suggests that people may not explicitly represent the degree of coordination in how they think about situations, it could still be that people can infer the degree of coordination in a situation, but either our items were too complex or people cannot explicitly represent what is an unconscious representation of the degree of coordination. Indeed, the definition of coordination is complex and even experts sometimes have difficulty in understanding this construct. Interestingly, some research has suggested that people can

use various cues, such as partner mimicry and synchrony, to infer the degree of coordination in a situation (Argyle, 1990; Bavelas, Black, Chovil, Lemery, & Mullett, 1988; Manson et al., 2013). Future research could explore whether people are using those cues to infer coordination or another dimension of interdependence.

When developing the power subscale, we found that people were unable to respond to power items in the same scale format as the other scale items (e.g., strongly agree). These items were difficult to comprehend, because participants were asked to think about their own dependence on the other, think about the others' dependence on themselves, compare the dependence between themselves and others, and then indicate the extent to which they agreed with a statement describing asymmetrical dependence. We sought to use a different item and response format for the power items and found inspiration in an existing scale that measured power in negotiations (Van Kleef et al., 2006). Although these power items might load on their own factor due to methodological differences, there are several reasons why we think these items form an independent, valid measure of power. First, we found that people indicated they had more power in the dictator game, compared to the prisoner's dilemma. Second, participants correctly used the scale to indicate they had equal power in the prisoner's dilemma. Third, replicating previous research we found that perceptions of power were positively related to more feelings of happiness (Kifer, Heller, Perunovic, & Galinsky, 2013; Smith & Hofmann, 2016) and negatively related to cooperation (Righetti et al., 2015). Indeed, power displayed a unique relation with happiness and cooperation even after controlling for the other dimensions of subjective interdependence. Thus, the SIS provides a valid measure of power in the context of a broader measure of subjective interdependence.

### Concluding Remarks

People live intense social lives characterized by a rich diversity of interdependent situations with others in many different environments, such as at home, in the workplace, and in society at large. Although interdependence underlies all social interactions, people do not have direct objective knowledge of that interdependence, and there is a need to develop theory and methods to understand how people think about their interdependence with others in situations. Across several studies, we develop the Situational Interdependence Scale (SIS) that measures five dimensions of how people think about a social situation. Furthermore, we address several factors thought to be important in shaping how people think about interdependence (i.e., nonverbal behavior and personality), and address two consequences of subjective interdependence in social situations (i.e., emotions and cooperation). Although clearly more research on subjective interdependence is warranted, outcomes in the studies presented here suggest that how people think about their interdependence with others can contain substantial insights into understanding motivation and behavior in a broad range of situations people experience.                    AQ: 6

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## Appendix

## 30-Item Situational Interdependence Scale (SIS)

Instructions: For each item, please think of the situation [. . .] and indicate how strongly you agree or disagree with how the statement describes that situation. In each item "the other" refers to the person(s) in the situation [. . .].[a] (1 = *completely disagree*, 2 = *slightly disagree*, 3 = *neither agree or disagree*, 4 = *slightly agree*, 5 = *completely agree*)[b]

1. The outcome of this situation does not affect my future interactions with the other. (F, R)
2. Each person's actions only affect their own outcomes, and not the other's outcomes. (MD, R)
3. The other prefers different outcomes than I do in this situation. (C)
4. The other does not understand how his/her actions affect me. (IC, R)
5. How we behave now will have consequences for future outcomes. (F, S)
6. What each of us does in this situation affects the other. (MD, S)
7. We can both obtain our preferred outcomes. (C, R, S)
8. We both know how our behavior affects each other's outcomes. (IC)
9. Our future interactions are not affected by the outcomes of this situation. (F, R, S)
10. Whatever each of us does in this situation, our actions will not affect the other's outcomes (MD, R, S)
11. It is difficult to make us both happy with the outcomes of this situation. (C)
12. We both lack knowledge about what the other wants. (IC, R)
13. Whatever happens in this situation will affect future interactions I have with the other. (F)
14. We need each other to get our best outcome in this situation. (MD)
15. Both of us can achieve our most desired outcomes in this situation. (C, R)
16. We both know what the other wants. (IC, S)
17. Our interaction has no effect on future behavior in interactions with each other. (F, R)
18. Each person's outcomes are not influenced by what the other does. (MD, R)
19. Our preferred outcomes in this situation are conflicting. (C, S)
20. I don't think the other knows what I want. (IC, R, S)
21. My behavior in this situation affects how the other will behave in future situations. (F)
22. Each person's outcomes depend on the behavior of the other. (MD)
23. What satisfies me also satisfies the other. (C, R)
24. Each person is informed about the other's preferred outcomes. (IC)

Instructions: For each item, please think of the situation [. . .] and indicate how the statement describes yourself and "the other" in that situation. In each item "the other" refers to the person(s) in the situation [. . .]. (1 = *definitely the other*, 2 = *maybe the other*, 3 = *neutral*, 4 = *maybe myself*, 5 = *definitely myself*)

25. Who do you feel was most in control of what happens in the situation? (P)
26. Who has the least control to determine their own outcomes in this situation? (P, R)
27. Who do you feel had more power to determine their own outcome in this situation? (P, S)
28. Who do you feel had the weakest influence on the outcomes of this situation? (P, R)
29. Who has the most impact on what happens in this situation? (P)
30. Who has the least amount of influence on the outcomes of this situation? (P, R, S)

*Note.* MD = Mutual Dependence; p = Power; C = Conflict; F = Future interdependence; IC = Information Certainty; R = Reverse coded item; S = included in short 10-item scale.
[a] In the instructions above we place in brackets [. . .] where researchers can insert a label or statement directing the respondents' attention to a past, present, or future situation. For example, in Studies 1a-1d we inserted [you just wrote about] so that participants use the items to describe a past situation they just wrote about. [b] In most studies we actually used a reverse scale format (1 = *completely agree* and so on), but in Studies 6 and 7 we used this format (1 = *completely disagree*). We elected to continue with this scale format.