Influence of Indirect Information on Interpersonal Trust Despite Direct Information

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Trust is integral to successful relationships. The development of trust stems from how one person treats others, and there are multiple ways to learn about someone's trust-relevant behavior. The present research captures the development of trust to examine if trust-relevant impressions and behavior are influenced by indirect behavioral information (i.e., descriptions of how a person treated another individual)—even in the presence of substantial direct behavioral information (i.e., self-relevant, first-hand experience with a person). Participants had repeated interpersonal exchanges with a partner who was trustworthy or untrustworthy with participants' money. The present studies vary the frequency with which (Studies 1 & 2), the order in which (Study 3) and the number of people for whom (Study 4) indirect information (i.e., brief vignettes describing trustworthy or untrustworthy behavior) were presented. As predicted, across 4 studies, we observed a robust effect of indirect-information despite the presence of substantial direct information. Even after dozens of interactions in which a partner betrayed (or not), a brief behavioral description of a partner influenced participants' willingness to actually trust the partner with money, memory-based estimates of partner-behavior, and impressions of the partner. These effects were observed even though participants were also sensitive to partners' actual trust behavior, and even when indirect behavioral descriptions were only presented a single time. Impressions were identified as a strong candidate mechanism for the effect of indirect-information on behavior. We discuss implications of the persistence of indirect information for impression formation, relationship development, and future studies of trust.

Keywords: dyadic relationships, impression formation, indirect information, social learning, trust game

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Trust is integral to successful romantic (Rempel, Holmes, & Zanna, 1985), professional (Schindler & Thomas, 1993), and interethnic relationships (Rudolph & Popp, 2010) and was equally important for our ancestors whose survival depended on trusting others for protection and shared communal resources (Balliet & Van Lange, 2013; Raihani, Thornton, & Bshary, 2012; Simpson, 2007). The functional importance of trust suggests that people should be selective in whom they decide to trust, and such decisions may follow from the impressions they form of others. Here, we discuss how the type of information used to form impressions can have important implications for trust. Specifically, impressions formed from *indirect behavioral information* (how a target person behaves toward someone else) may influence the decision to trust, in addition to impressions formed from *direct behavioral information* (how a target person behaves toward oneself), and we often have access to both types of information. For example, Sally might hear that Bill has lied to a previous coworker before or after she has the opportunity to work with him directly and experience his behavior as trustworthy or not. Yet little is known about how

people form impressions of others when both of these types of information are present, and how those different types of information together influence trust. We here explored whether and how trust is influenced by indirect behavioral information even when substantial direct information is available.

Direct Versus Indirect Behavioral Information: A Conceptual Framework

Group living confronts every human being with a number of epistemological challenges. People must acquire knowledge of other individuals to function effectively in groups and relationships and to identify those people best suited for coalitions (Dunbar & Shultz, 2007). People presumably develop such social knowledge from many forms of social information, but here we argue that one key distinction is between direct and indirect behavioral information.

This distinction has historical roots in the philosophies of empiricism (Hume, 1772/2011) and rationalism (Kant, 1781/1998). Empiricist epistemologies assume that people acquire knowledge about the external world through direct interaction with that world (Hume, 1772/2011), and consistent with this principle, we define *direct behavioral information* as knowledge about a target person's behavior that a perceiver acquires by direct interaction with that person. For brevity, we will refer to direct behavioral information as *direct information* from here onward. Conversely, rationalist epistemologies assume that knowledge is acquired outside of direct interaction with the world (Kant, 1781/1998), and consistent with this principle, we define

indirect behavioral information as knowledge about a target person's prior behavior that a perceiver acquires through a third-party.[1] For brevity, we will refer to indirect behavioral information as *indirect information* from here onward.

Direct Information

In real-world (Dirks & Ferrin, 2002; Konovsky & Pugh, 1994) and laboratory settings (Johnson & Mislin, 2011), direct information has been shown to critically guide behavior. Direct interactions with another individual provide a perceiver with a rich source of information that can have compelling and complex effects on social behavior (Holt & Laury, 2002; Johansson-Stenman, Mahmud, & Martinsson, 2005; Johnson & Mislin, 2011). For instance, studies of reward-learning indicate that individuals' repeated, direct interactions with other people exert an overwhelming influence on behavior (Balliet, Mulder, & Van Lange, 2011; Bechara, Damasio, Tranel, & Damasio, 1997; Kringelbach, 2005; Kuhnen & Knutson, 2005; Schultz, Dayan, & Montague, 1997; Van Overwalle, 2009). Whether through simple reward-learning or more complex processes, it is fairly uncontroversial to suggest perceivers form impressions of others from how those others behave toward oneself.

To understand how such direct information might influence impression formation and trust, we propose memory as plausible mediator of such effects. We assume that perceivers explicitly learn the association between a person's identity and that person's behavior toward oneself, and store this association in memory (Balliet et al., 2011; Johnson & Mislin, 2011). Therefore, we expect such memory for partner behavior to (at least partially) explain how a target person's behavior toward a perceiver influences the perceivers' trust of the target person. After all, in many types of associative learning, memory of task contingencies is necessary for the presented contingency to influence perceiver behavior (Vriezen & Moscovitch, 1990).

Indirect Information

A rich but separate literature in social cognition describes the influence of indirect information on impression formation.[2] Classic studies of impression formation often manipulated indirect information, and demonstrated that even a single description of another person's previous behavior can lead to powerful trait inferences about that person (Anderson, 1965; Anderson & Hubert, 1963; Asch, 1946). Subsequent studies indicate that indirect information (e.g., a list of descriptions of a target person's past behaviors) may automatically produce strong trait inferences about the target (Carlston & Skowronski, 1994; Dreben, Fiske, & Hastie, 1979; Fiske, 1980; Skowronski & Carlston, 1989; Todorov & Uleman, 2002, 2003, 2004; Winter & Uleman, 1984). These effects may have significant implications for social behavior. For example, indirect information caused team members in one study to either include or exclude a potential teammate (Feinberg, Willer, & Schultz, 2014). In a different paradigm, participants made consequential financial choices regarding an interaction partner when they had previously learned (indirectly) about the positive (vs. negative or neutral) behavior of this partner (Delgado, Frank, & Phelps, 2005). Such findings suggest that indirect information can guide how perceivers form impressions of and behave toward other individuals. Critically, though, ongoing relationships also include direct interaction between partners, and in such contexts, the influence of indirect information remains unexplored—we aim to address this paucity.

Indirect information might influence perceivers' behavior toward a target by influencing trait impressions. We are *not* claiming that direct information will fail to influence impressions, but rather that indirect information will influence trait impressions even after perceivers have had many interactions with a target person. As illustrated in classic research, a single description of another person's behavior can continue to shape perceivers' impressions over time, with effects persisting even after encountering other indirect information about that person (Deese & Kaufman, 1957; Murdock, 1962), and even if encountered after initial impressions (Mende-Siedlecki, Cai, & Todorov, 2013; Mishina, Block, & Mannor, 2012; Skowronski & Carlston, 1989), suggesting that its influence may be robust to information encountered during social interaction. Once an impression has formed, perceivers typically behave in impression-consistent manner, as noted by classic accounts of expectancy confirmation and self-fulfilling prophecy (e.g., Darley & Fazio, 1980; Jones, 1986). The link between an impression and behavior is exemplified in previous research demonstrating that impressions can influence how warmly we treat a new acquaintance (Bond, 1972), whether we're likely to hire the target of the impression (Dougherty, Turban, & Callender, 1994; Sackett, 1982), and whether we're likely to treat others in a manner that confirms our initial impression (Snyder & Swann, 1978). Accordingly, we expected indirect information to influence trust behavior by shaping impressions of a target person.

The Trust Game

The *Trust Game* is an economic game that provides a useful means for exploring how direct and indirect behavioral information influence social behavior (Burks, Carpenter, & Verhoogen, 2003; Burnham, McCabe, & Smith, 2000; Johnson & Mislin, 2011; King-Casas et al., 2005; McCabe, Rigdon, & Smith, 2003). In the original trust game, participants choose between keeping a sum of money or having their money tripled and given to a partner. If participants select the second option, the partner can then give half of the money back to the participant or keep the entire amount (Berg, Dickhaut, & McCabe, 1995). Participant sharing in this paradigm is regarded as an indicator that participants trust the partner to reciprocate (hence, the "trust game"). One study used this paradigm to test whether indirect information influenced sharing, reporting that participants shared most with partners described as moral and least with partners described as immoral (Delgado et al., 2005). Although this indirect information clearly influenced

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[1] We do not argue that indirect information is innate and in that way, such information differs from rationalism.

[2] Information about a person that fails to include behavior would not meet our definition of indirect behavioral information. For example, presentations of neutral or expressive faces, although they have been shown to impact trust behavior (Scharlemann, Eckel, Kacelnik, & Wilson, 2001; van't Wout & Sanfey, 2008), arguably fail to describe behavior and therefore cannot be considered indirect information. Information about behavior that fails to include a specific person also would not meet our definition. Studies using stimuli as varied as the word "Hitler" to prime aggressiveness or "unlikeable" to prime hostility (Bargh & Pietromonaco, 1982; see Decoster & Claypool, 2004 for a summary of some of this work) are thus excluded from our definition of indirect behavioral information.

perceivers, partner cooperation rates were constant and thus could not be used to distinguish among partners: the only varying source of information on which to base trust decisions was indirect. Accordingly, to date, no one has explored how both indirect and direct information shape trust impressions and behavior.

The Present Research

Our research focuses on the outstanding question of if and how indirect information influences the development of trust in social relationships that are also substantially influenced by direct information. We examine this influence by simultaneously manipulating both direct and indirect information in the Trust Game. Direct information regarded the frequency of partner reciprocity (25% or 75%), and was thus predictive of how much the partner could be trusted to reciprocate. In contrast, indirect information was operationalized as a brief written description (vignette) of untrustworthy, neutral, or trustworthy behavior (e.g., stealing tips from a tip jar for untrustworthy) exhibited by the partner. Each of 6 partners represented a cell in a 2 (partner reciprocity) × 3 (vignette) design, such that vignettes did not predict reciprocity. The lack of reliable predictive information in the vignettes was designed to make indirect information relatively weak, providing a strong test of the influence of indirect information in the face of direct information.

In daily life, indirect and direct information are rarely presented in the same order, nor are they presented with the same frequency. One aim of the present studies was to determine how the frequency and timing of indirect information influences trust. Testing the influence of indirect information in different contexts enabled us to potentially identify boundary conditions, such as whether this influence is robust (vs. fragile) to variability in when the information is introduced, and more generally to test alternative explanations such as primacy effects (Deese & Kaufman, 1957; Murdock, 1962).

In an initial study, we sought proof of concept for the idea that indirect information would influence trust when indirect information and direct information were presented with equal frequency. In Study 2, we tested the hypothesis that indirect information exerts a lasting influence on trust by examining the effects of a single description for each partner's behavior at the beginning of the study. Study 3 addressed an alternative account of Study 2: that primacy effects account for the influence of indirect information. Specifically, in Study 3, we introduced a single presentation of indirect information, but only after perceivers had many trust-relevant interactions with targets. Finally, in Study 4, we addressed the alternative hypothesis that the influence of indirect information was limited to contexts in which memory was overloaded. In Studies 1 through 3 participants played with six partners, potentially making it difficult to remember the behaviors of any single partner and potentially strengthening reliance on indirect information. Conversely, the between-subjects design of Study 4 required participants to play with a single partner, potentially making the direct information easier to understand, encode, conceptualize, and act upon. Based on previous research (Mishina et al., 2012; Todorov & Uleman, 2002, 2003, 2004) we expected indirect information to have a lasting impact on trust behavior in all studies.

Finally, to determine how direct and indirect information influence impression formation, we measured different facets of trust: trial-by-trial sharing behavior, memory for each partner's behavior, and self-reported impressions. These measures highlight three important aspects of trust: (a) trust behavior toward another person, (b) memories for how trustworthy another person was, and (c) impressions of another person's trustworthiness. We predicted that trust conveyed through social interaction (direct information) would influence sharing behavior through memory for partner behavior, and that trust conveyed by a third-party (indirect information) would influence sharing behavior through impressions.

Study 1

Method

Participants and design. Fifty-three undergraduate students at a small, private university (M = 19.10 years, SD = 1.18; 58% female) participated in exchange for partial course credit. Target sample sizes were set to N = 50 for Studies 1 through 3 and N = 50 per cell for Study 4 a priori (Simmons, Nelson, & Simonsohn, 2013). While recruiting, we allowed for flexibility around this sample-size goal to account for practical considerations such as the conclusion of the academic year and limitations owing to the university subject pool. The design of Study 1 was completely within-subjects, with each partner representing one cell in a 3 (trustworthy, neutral or untrustworthy vignette) × 2 (25% or 75% cooperation rate) repeated measures design.

Procedure. The Trust Game was played on a laboratory computer with E-prime software (Schneider, Eschman, & Zuccolotto, 2002). Following informed consent, the experimenter described the task and answered questions. Participants then learned that they would earn the money they won on one randomly selected trial (0, $4, $8, or $12) as incentive.

After instructions, participants were presented with vignettes (see online supplemental materials) alongside pictures of each of the six male partners, one at a time. A pilot study, N = X confirmed that the pictures did not vary in rated trustworthiness or likability, Fs(5, 20) < 0.30, ps > .9. Participants read each vignette and immediately rated how much they (a) liked and (b) trusted each player (from 0 = *not at all*, to 9 = *very much so*). Players described with untrustworthy vignettes were rated as significantly less likable (M = 1.83, SD = 1.12) than trustworthy (M = 7.81, SD = 0.98), or neutral vignettes (M = 6.25, SD = 1.05), and those described with neutral vignettes were rated less likable and trustworthy than those described with trustworthy vignettes, (all ps < .001). Please note that the identical pattern was observed in Studies 2 through 4 (all ps < .001). The vignette manipulation thus appeared to be successful in all 4 studies.

Following the vignettes and ratings, participants began the Trust Game. A trial unfolded as follows: An offer/decision screen with the picture and vignette of the partner appeared indicating how much money ($2, $4, or $6) the participant had on that trial to either share or not share; on the same screen, participants indicated their decision with a button press (i.e., to give all money to the partner or to keep it all for themselves). After a varying interstimulus interval (ISI; 200ms-7s, M = 1.65s), an outcome screen appeared. On trials for which the participant elected to share with the partner, the outcome screen indicated whether or not the partner shared back, and how much money the participant made on that trial. On trials for which the participant elected to not share with the partner, the outcome screen indicated whether or not the partner would have shared back and how much the money partic-

ipant actually made and would have made on that trial (counterfactual information). This counterfactual information was important to include in our design so that each participant received the same amount of direct information (i.e., on every trial) regardless of what he or she chose to do on a given trial. The outcome screen was displayed for 2.5 seconds and was followed by a varying ISI (200ms-7s, $M = 1.65s$) before the next trial.

There were 24 trials (4 trials per partner) per block across five blocks (120 total trials). Measures were computed as follows: Trust behavior was measured in each block as the proportion of trials on which participants' choose to share their money. Memory-based estimates of partner reciprocity were measured immediately after each block when participants indicated "The proportion of time [player name] shared with you during the last block" from 1 to 100. Impressions were measured at the end of the game when participants completed the same liking and trust measures as at the outset of the study (on the same 0–9 scale). Trustworthiness and likability ratings were closely related (Study 1, $\alpha = .79$; Study 2, $\alpha = .80$; Study 3, $\alpha = .76$; Study 4, $\alpha = .89$), and were thus averaged into a single measure of impressions (see online supplemental materials for correlations among measures).

After the task, participants completed a funneled debriefing form that assessed their understanding of the task. No participants deduced the hypotheses. Finally, participants were compensated and thanked. In addition, we should note that the four studies we report represent the entirety of our efforts to answer the specific question we propose: we have not omitted any experiments, conditions, or participants in an effort to streamline our reports. The University of Denver's Institutional Review Board approved all procedures.

Results

The data analyses were nearly identical in all studies. Accordingly, we describe the analytic strategy here and describe minor adjustments to this strategy as necessary. For measures of trust behavior and memory, we conducted a 2 (cooperation) $\times$ 3 (vignette) $\times$ 5 (time) repeated measures General Linear Model (GLM). To test for interactions with the linear trend of time, the five-level time variable was converted to a single linear trend score and submitted to a 2 (cooperation) $\times$ 3 (vignette) GLM. For both variables, we also analyzed data separately from the final block, to test hypotheses about the duration of indirect information effects. Analyses on impressions were nearly identical, but the time variable was only 2 levels (pre–Trust Game/post–Trust Game). The pre-Trust Game measure was used primarily as a manipulation check, such that our analyses focused specifically on (a) postgame impression and (b) pre–post differences in impressions. For all analyses and studies, alpha level was set to .05.

When main effects of vignette were observed, follow-up comparisons were conducted. When linear trends of time interacted with (a) cooperation rate and/or (b) vignette, simple effects tests were conducted by testing the linear trend against zero *within* each level of the (a) cooperation rate factor and/or (b) the vignette factor. Finally, we report mediational analyses for all four studies immediately prior to the General Discussion.

Sharing behavior.   The GLM indicated a main effect of cooperation rate, $F(1, 52) = 77.41$, $p < .001$, $\eta_p^2 = .60$, such that participants shared more with cooperative ($M = 0.62$, $SD = 0.16$) than uncooperative partners ($M = 0.37$, $SD = 0.15$; Figure 1; see

Table 1 for all means). A main effect of vignette was also observed, $F(2, 104) = 57.45$, $p < .001$, $\eta_p^2 = .53$, such that participants shared more with partners described with trustworthy ($M = 0.60$, $SD = 0.17$) than untrustworthy, $t(52) = 8.25$, $p < .001$; $M = 0.32$, $SD = 0.15$ or neutral vignettes, $t(52) = 2.02$, $p = .05$; $M = 0.56$, $SD = 0.18$, and more with partners described with neutral than untrustworthy vignettes, $t(52) = 8.53$, $p < .001$. Indirect information thus influenced trust behavior (sharing) even in the context of meaningful and influential direct information.

Main effects were qualified by two interactions with the linear trend of time. First, a cooperation rate by time interaction was observed, $F(1, 52) = 82.44$, $p < .001$, $\eta_p^2 = .61$, such that sharing behavior decreased over time with uncooperative partners, $F(1, 52) = 53.85$, $p < .001$, $\eta_p^2 = .51$, and increased over time with cooperative partners, $F(1, 52) = 32.31$, $p < .001$, $\eta_p^2 = .38$ (see Figure 1 for trend over time). Participants thus learned to trust or distrust interaction partners over time, according to how those partners treated participants. Second, a vignette by time interaction was observed, $F(2, 104) = 23.97$, $p < .001$, $\eta_p^2 = .32$, such that sharing behavior increased over time toward partners described with untrustworthy vignettes, $F(1, 52) = 20.43$, $p < .001$, $\eta_p^2 = .28$, but decreased over time toward partners described with neutral, $F(1, 52) = 13.23$, $p = .001$, $\eta_p^2 = .20$, and trustworthy vignettes, $F(1, 52) = 14.08$, $p < .001$, $\eta_p^2 = .21$ (see Figure 1 for trend over time). These effects suggest that the influence of vignette on sharing behavior appeared to decrease over time. Yet even in the final block, we observed a significant effect of vignette, $F(2, 92) = 5.86$, $p = .004$, $\eta_p^2 = .11$, such that participants shared significantly less with partners described with untrustworthy ($M = 0.38$, $SD = 0.23$), versus those described with neutral, $t(46) = 2.10$, $p = .04$; $M = 0.48$, $SD = 0.24$ or trustworthy vignettes $t(46) = 2.97$, $p = .01$; $M = 0.53$, $SD = 0.23$. No other effects were significant.

Memory-based estimates of partner behavior.   The GLM indicated a main effect of cooperation rate on estimates, $F(1, 46) = 71.01$, $p < .001$, $\eta_p^2 = .61$, such that participants estimated more frequent sharing from cooperative ($M = 0.55$, $SD = 0.16$) than uncooperative partners ($M = 0.31$, $SD = 0.14$).[3] A main effect of vignette was also observed, $F(2, 92) = 18.21$, $p < .001$, $\eta_p^2 = .28$, such that participants estimated less frequent sharing from partners described with untrustworthy vignettes ($M = 0.36$, $SD = 0.13$) than from partners described with neutral, $t(51) = 5.18$, $p < .001$; $M = 0.45$, $SD = 0.13$ or trustworthy vignettes, $t(51) = 5.04$, $p < .001$; $M = 0.48$, $SD = 0.15$; which did not significantly differ, $t(51 = 1.69$, $p = .10$). Indirect information thus influenced estimates for the trust-relevant behavior of partners, even though such information was not systematically related to this behavior.

These main effects were qualified by interactions with the linear trend of time. First, a cooperation rate by time interaction was observed, $F(1, 46) = 8.58$, $p < .01$, $\eta_p^2 = .16$, indicating that

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[3] We tested whether these estimates differed significantly from actual cooperation rates (i.e., 75% for cooperative and 25% for uncooperative partners) and observed significantly underestimated cooperation rates for cooperative partners, $t(46) = -8.50$, $p < .001$, $d = 1.24$, but less dramatically overestimated cooperation rates for uncooperative partners, $t(46) = 3.27$, $p = .001$, $d = 0.48$. These patterns were nearly exactly replicated in all 4 studies (see General Discussion for interpretation).
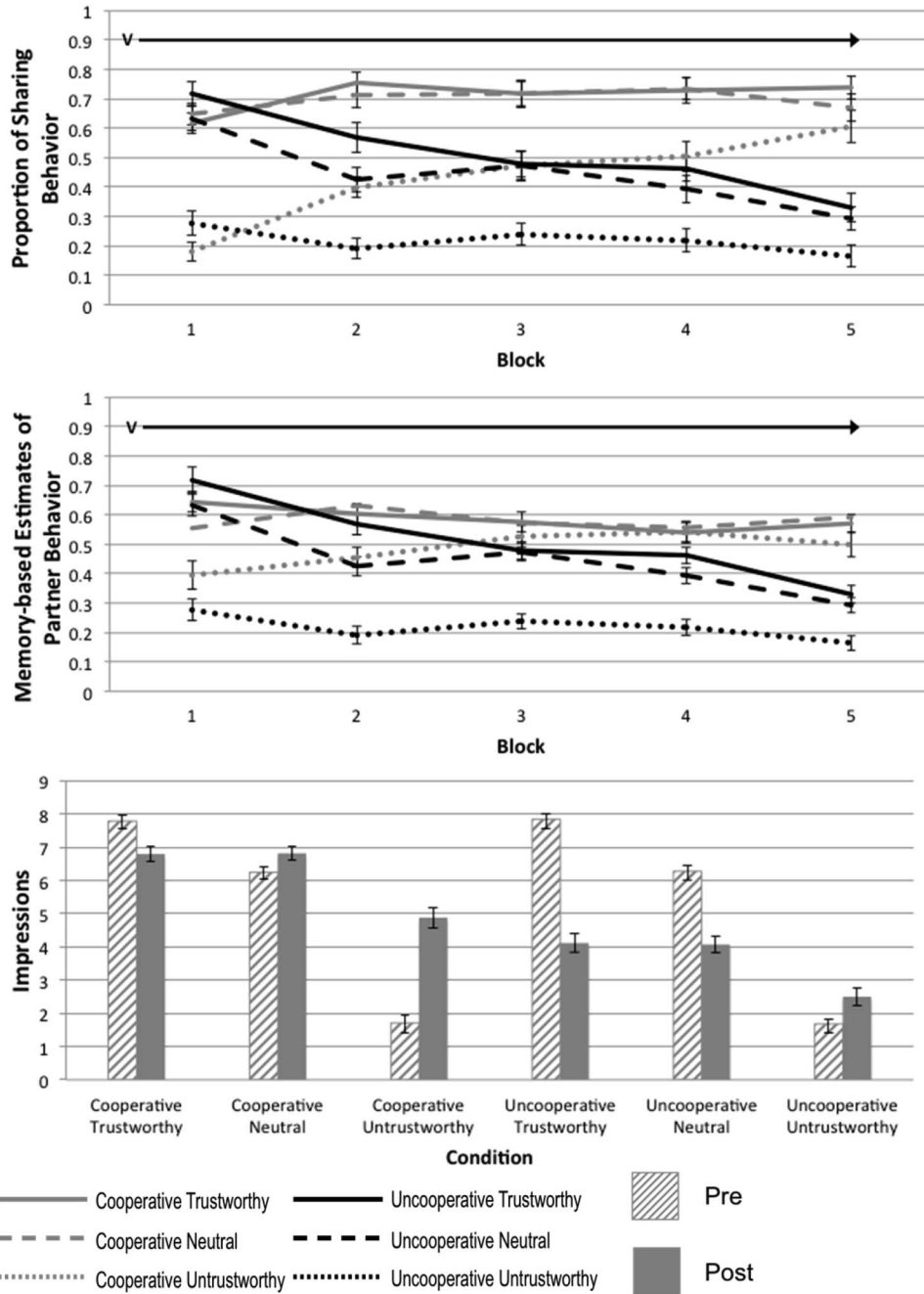
Figure 1. Observed means for the effects of direct and indirect information on all measures for Study 1. The 'V' indicates that the vignettes were presented before the first trial and the arrow indicates that they were presented on every subsequent trial. Error bars represent standard error of the mean.

participants' estimates of sharing frequency did not change (linearly) over time with cooperative partners, $F(1, 46) = 0.22$, $p = .64$, $\eta_p^2 = .01$, but decreased over time with uncooperative partners, $F(1, 46) = 14.06$, $p < .001$, $\eta_p^2 = .23$. Second, a vignette by time interaction was observed, $F(2, 92) = 13.79$, $p < .001$, $\eta_p^2 = .23$, indicating that participants' estimates of sharing frequency increased over time for partners described with untrustworthy vignettes, $F(1, 46) = 4.50$, $p < .05$, $\eta_p^2 = .09$, but decreased over

time for partners described with neutral, $F(1, 46) = 4.64$, $p < .05$, $\eta_p^2 = .09$, and trustworthy vignettes, $F(1, 46) = 22.40$, $p < .001$, $\eta_p^2 = .33$. These interactive effects suggest that the influence of vignette on memory-based estimates of partner behavior decreased over time. Yet even in the final block we observed a significant effect of vignette, $F(2, 92) = 6.95$, $p = .002$, $\eta_p^2 = .13$, such that participants estimated less sharing from partners described with untrustworthy ($M = 0.37$, $SD = 0.18$) versus neutral, $t(46) = 2.94$,

Table 1
Means and Standard Deviations for Studies 1, 2, 3, and 4 for All Measures

Study, measure, and condition	Untrustworthy	Neutral	Trustworthy	Total mean
Sharing behavior				
Study 1				
Cooperative	.43 (.24)	.70 (.22)	.71 (.21)	.62 (.16)
Uncooperative	.20 (.16)	.42 (.21)	.49 (.23)	.37 (.15)
Total mean	.32 (.15)[a]	.56 (.18)[b]	.60 (.17)[c]	
Study 2				
Cooperative	.58 (.26)	.76 (.21)	.76 (.19)	.70 (.15)
Uncooperative	.32 (.25)	.38 (.21)	.34 (.19)	.35 (.18)
Total mean	.45 (.19)[a]	.57 (.14)[b]	.56 (.14)[b]	
Study 3				
Cooperative	.61 (.31)	.69 (.33)	.82 (.22)	.71 (.22)
Uncooperative	.23 (.31)	.36 (.33)	.45 (.31)	.35 (.28)
Total mean	.42 (.24)[a]	.52 (.27)[b]	.64 (.21)[c]	
Study 4				
Cooperative	.44 (.35)	.71 (.25)	.75 (.16)	.64 (.31)
Uncooperative	.25 (.24)	.40 (.26)	.40 (.24)	.34 (.25)
Total mean	.34 (.31)[a]	.55 (.30)[b]	.61 (.30)[b]	
Memory-based estimates of partner behavior				
Study 1				
Cooperative	.49 (.22)	.58 (.17)	.61 (.20)	.55 (.16)
Uncooperative	.23 (.16)	.32 (.16)	.36 (.17)	.31 (.14)
Total mean	.36 (.13)[a]	.45 (.13)[b]	.48 (.15)[b]	
Study 2				
Cooperative	.59 (.21)	.66 (.20)	.66 (.19)	.64 (.16)
Uncooperative	.24 (.20)	.28 (.19)	.30 (.18)	.28 (.16)
Total mean	.42 (.16)[a]	.47 (.14)[b]	.48 (.15)[b]	
Study 3				
Cooperative	.56 (.19)	.42 (.14)	.63 (.25)	.53 (.15)
Uncooperative	.25 (.29)	.31 (.19)	.33 (.19)	.31 (.19)
Total mean	.41 (.17)[a]	.37 (.11)[b]	.47 (.14)[c]	
Study 4				
Cooperative	.52 (.22)	.63 (.23)	.64 (.23)	.60 (.23)
Uncooperative	.30 (.16)	.23 (.14)	.20 (.14)	.21 (.15)
Total mean	.35 (.25)[a]	.43 (.28)[b]	.47 (.29)[b]	
Impressions post				
Study 1				
Cooperative	4.97 (2.13)	6.92 (1.41)	6.89 (1.53)	6.25 (1.12)
Uncooperative	2.44 (1.79)	4.07 (1.79)	4.15 (1.89)	3.55 (1.13)
Total mean	3.71 (1.30)[a]	5.49 (1.12)[b]	5.51 (1.18)[b]	
Study 2				
Cooperative	6.04 (2.04)	6.81 (1.65)	6.76 (1.74)	6.54 (1.27)
Uncooperative	2.53 (2.02)	2.98 (1.58)	3.30 (1.82)	2.93 (1.18)
Total mean	4.29 (1.54)[a]	4.89 (1.09)[b]	5.03 (1.28)[b]	
Study 3				
Cooperative	4.99 (1.96)	5.83 (1.80)	6.86 (1.66)	5.90 (1.25)
Uncooperative	2.40 (2.25)	4.02 (2.08)	4.48 (2.17)	3.63 (1.78)
Total mean	3.69 (1.41)[a]	4.93 (1.28)[b]	5.67 (1.42)[c]	
Study 4				
Cooperative	2.78 (2.45)	5.83 (1.74)	5.79 (1.64)	4.88 (2.39)
Uncooperative	1.15 (1.03)	2.63 (1.66)	2.79 (1.90)	2.11 (1.70)
Total mean	1.92 (2.01)[a]	4.21 (2.33)[b]	4.61 (2.27)[b]	

Note. Planned comparisons for cooperation rate are all significant (all *p*s < .001). Significant differences for planned comparisons of vignette are indicated with a superscript. Different letters indicate which pairs are significantly different (all *p*s < .05).

$p = .005$; $M = 0.44$, $SD = 0.15$ or trustworthy vignettes, $t(46) = 2.92$, $p = .005$; $M = 0.45$, $SD = 0.15$. No other effects were significant.

Impressions. The GLM indicated a cooperation rate by time interaction, $F(1, 50) = 77.55$, $p < .001$, $\eta_p^2 = .61$, such that participants rated cooperative partners more positively ($M = 6.25$, $SD = 1.12$) than uncooperative partners ($M = 3.55$, $SD = 1.13$) at posttest, $F(1, 50) = 97.96$, $p < .001$, $\eta_p^2 = .66$, but not at pretest, $F(1, 50) = 0.10$, $p = .78$, $\eta_p^2 = .00$. This interaction was expected, as cooperation rate was only manipulated *after* pretest ratings were collected. A vignette by time interaction was also observed, $F(1, 50) = 135.28$, $p < .001$, $\eta_p^2 = .73$, such that the effect of vignette was stronger at pretest, $F(2, 100) = 552.40$, $p < .001$, $\eta_p^2 = .92$, than at posttest, $F(2, 100) = 40.43$, $p < .001$, $\eta_p^2 = .45$. At the

posttime point, impressions were less positive for partners described with untrustworthy vignettes ($M = 3.71$, $SD = 1.30$) as compared to neutral, $t(50) = 7.96$, $p < .001$; $M = 5.49$, $SD = 1.12$ and trustworthy vignettes, $t(50) = 6.50$, $p < .001$; $M = 5.51$, $SD = 1.18$, whereas impressions of partners described with neutral and trustworthy vignettes did not differ, $t(50) = 0.12$, $p = .91$. Although the effect of vignette decreased over time, it is important to note that this effect remained significant at posttest (see above). No other effects were significant.

Discussion

This Trust Game represents direct experiences of trust across 20 interactions with another individual and might reasonably model the development of trust and cooperation in a relationship. In this context, it is noteworthy that indirect information continued to exert an effect throughout the Trust Game, including the game's final block. This first study thus suggests that even after many first-hand experiences with another person's trustworthy behavior, third-hand information about trustworthiness influences behavior toward, memory of, and evaluations of that person.

Notably, however, the effects of indirect information decreased over time but did not disappear, which is not surprising given that participants were reminded of the indirect information on every trial. It thus seems possible that the lasting effects of indirect information are contingent on frequent reminders of this information. However, in real relationships, it is likely rare that one piece of indirect information is presented with the same frequency as direct information. Thus, in Study 2 indirect information was presented only once, as it might be in actual interpersonal interactions.

Study 2

Method

The procedure for Study 2 was identical to that of Study 1 except that the vignettes were presented only once, at the beginning of the study, and not on every trial. Forty-five undergraduate students at a small, private university participated in exchange for partial course credit.[4]

Results

Sharing behavior. We replicated the Study 1 main effects of cooperation rate, $F(1, 44) = 105.93$, $p < .001$, $\eta_p^2 = .71$, (cooperative, $M = 0.70$, $SD = 0.15$; uncooperative, $M = 0.35$, $SD = 0.18$) and vignette, $F(2, 88) = 10.64$, $p < .001$, $\eta_p^2 = .20$ (see Table 1). The only aspect of these main effect patterns that did not replicate is that Study 2 participants shared equally with partners described with trustworthy ($M = 0.56$, $SD = 0.14$) and neutral vignettes, $t(44) = 0.64$, $p = .53$; $M = 0.57$, $SD = 0.14$. However, and as in Study 1, participants shared significantly less with partners described with untrustworthy vignettes ($M = 0.45$, $SD = 0.19$) than with others (vs. neutral, $t(44) = 3.71$, $p < .001$; vs. trustworthy, $t(44) = 3.72$, $p < .001$). Thus, despite being presented a single time at the outset of the study, indirect information influenced perceivers' sharing behavior.

We also observed two interactions with time. First, the cooperation rate by time interaction, $F(1, 44) = 88.75$, $p < .001$, $\eta_p^2 = .67$, indicated sharing behavior increased over time for cooperative part-

ners, $F(1, 44) = 64.87$, $p < .001$, $\eta_p^2 = .60$, and decreased over time for uncooperative partners, $F(1, 44) = 43.15$, $p < .001$, $\eta_p^2 = .50$ (see Figure 2 for trend over time). Second, the vignette by time interaction, $F(2, 88) = 9.34$, $p < .001$, $\eta_p^2 = .18$, indicated sharing behavior tended to increase over time (at a trend level) toward partners described with untrustworthy vignettes, $F(1, 44) = 3.87$, $p = .06$, $\eta_p^2 = .08$, but decreased over time toward partners described with neutral vignettes, $F(1, 44) = 11.62$, $p = .001$, $\eta_p^2 = .21$. The linear trend of time for partners described with trustworthy vignettes was not significant, $F(1, 44) = 0.24$, $p = .62$, $\eta_p^2 = .01$.

Two unpredicted interactions were also observed but were not replicated in Studies 1 or 3 (and not with the same pattern in Study 4). An interaction between cooperation rate and vignette, $F(2, 88) = 5.33$, $p < .01$, $\eta_p^2 = .11$, indicated the effect of vignette was present when participants interacted with cooperative partners, $F(2, 88) = 12.90$, $p < .001$, $\eta_p^2 = .23$, such that participants shared significantly less with partners described with untrustworthy vignettes ($M = 0.58$, $SD = 0.26$), compared with neutral, $t(44) = 3.93$, $p < .001$; $M = 0.76$, $SD = 0.21$, or trustworthy vignettes, $t(44) = 4.42$, $p < .001$; $M = 0.76$, $SD = 0.19$. The effect of vignette was not significant when participants were interacting with uncooperative partners, $F(2, 88) = 1.59$, $p = .21$, $\eta_p^2 = .04$ (see Table 1).

This 2-way interaction became weaker over time, as indicated by a 3-way interaction (including time), $F(2, 88) = 3.39$, $p = .04$, $\eta_p^2 = .07$. For cooperative partners, participant sharing toward those described with untrustworthy vignettes increasingly resembled sharing toward those described with trustworthy or neutral vignettes, resulting in a vignette by time interaction, $F(2, 88) = 10.75$, $p < .001$, $\eta_p^2 = .20$ (see Figure 2 for trend over time). Specifically, sharing toward cooperative partners described with untrustworthy vignettes sharply increased over time, $F(1, 44) = 75.76$, $p < .001$, $\eta_p^2 = .63$, and to a greater extent than the more modest increased sharing toward cooperative partners described with neutral, $F(1, 44) = 3.01$, $p = .09$, $\eta_p^2 = .06$, or trustworthy vignettes, $F(1, 44) = 17.57$, $p < .001$, $\eta_p^2 = .29$ In contrast, the vignette by time linear interaction for uncooperative partners was not significant, $F(2, 88) = 0.58$, $p = .57$, $\eta_p^2 = .01$.

More generally, however, the main effects of cooperation rate and vignette were replicated from Study 1. Despite the absence of a significant effect of vignette in the final block, $F(2, 82) = 1.98$, $p = .144$, $\eta_p^2 = .05$, as in Study 1, participants shared significantly less even during the final block, with partners described with untrustworthy vignettes ($M = 0.48$, $SD = 0.23$) than those described with trustworthy vignettes $t(41) = 2.21$, $p = .03$, $M = 0.55$, $SD = 0.19$ with neutral falling in-between ($M = 0.52$, $SD = 0.22$; vs. trustworthy $t(41) = 0.97$, $p = .34$; vs. untrustworthy, $t(41) = 0.94$, $p = .35$).

Memory-based estimates of partner behavior. We also replicated the Study 1 main effects of cooperation rate,[5] $F(1, 41) = 133.86$ $p < .001$, $\eta_p^2 = .77$, (cooperative, $M = 0.64$, $SD = 0.16$; uncooperative, $M = 0.28$, $SD = 0.16$) and vignette, $F(2, 82) = 4.11$, $p < .05$, $\eta_p^2 = .09$, (untrustworthy, $M = 0.42$, $SD = 0.16$; neutral,

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[4] Demographic information was not measured for this study.
[5] Once again, participants significantly underestimated the cooperation rates of cooperative partners, $t(42) = -4.55$, $p < .001$, $d = 0.70$; however, unlike in Studies 1, 2, and 4, they did not overestimate the cooperation rates of uncooperative partners, $p = .31$.
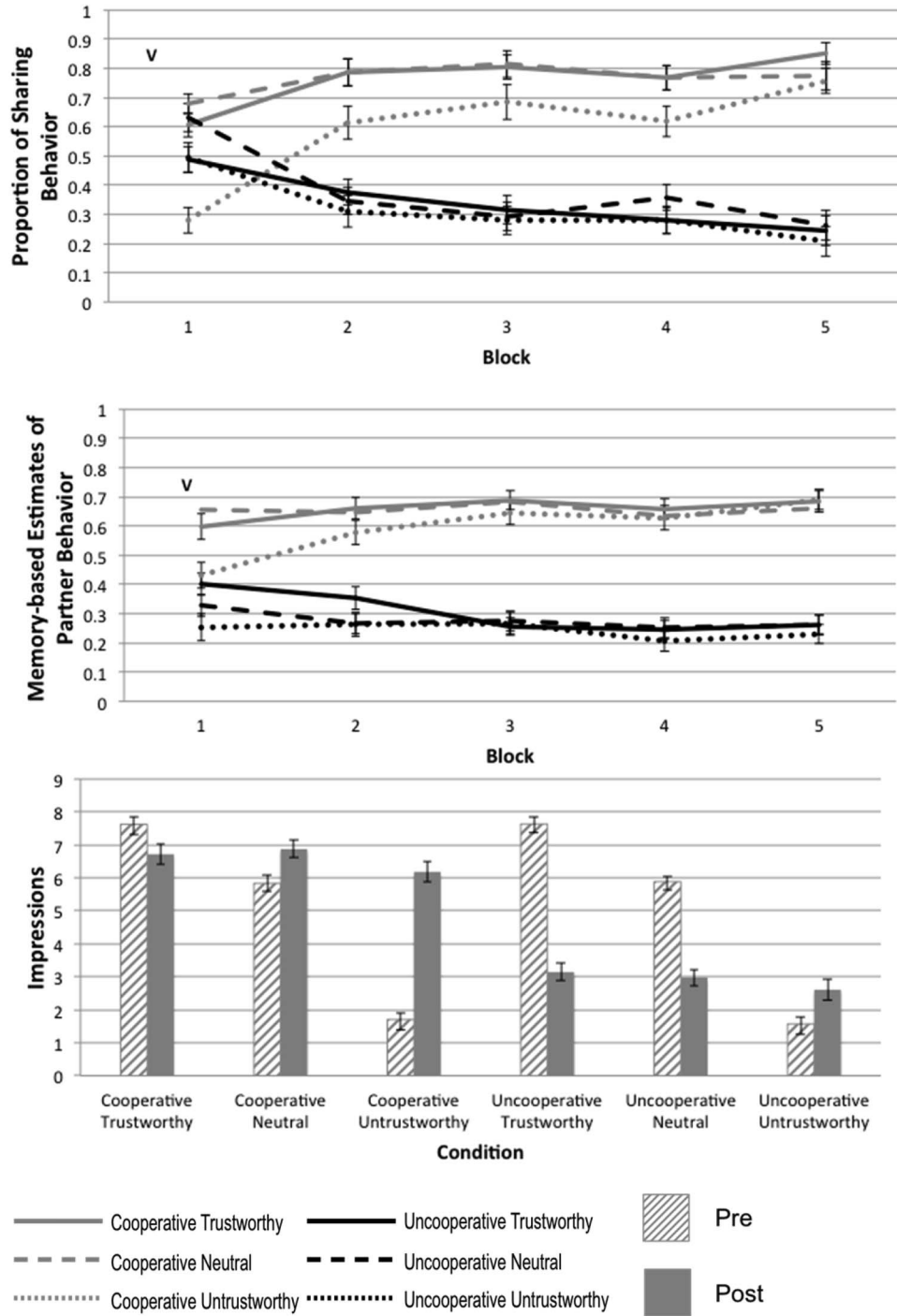
Figure 2. Observed means for the effects of direct and indirect information on all measures for Study 2. The 'V' indicates that the vignettes were presented only once, before the first trial. Error bars represent standard error of the mean.

$M = 0.47$, $SD = 0.14$; trustworthy, $M = 0.48$, $SD = 0.15$) in the same pattern as observed in Study 1 (untrustworthy significantly differed from neutral, $t(44) = 2.25$, $p = .03$, and trustworthy, $t(44) = 3.01$, $p = .004$; trustworthy and neutral did not significantly differ, $t(44) = 0.98$, $p = .33$). We also observed two interactions with time (see

Figure 2 for trend over time). The cooperation rate by time interaction, $F(1, 41) = 27.99$ $p < .001$, $\eta_p^2 = .41$, indicated that participants' estimates of sharing behavior increased over time for cooperative partners, $F(1, 41) = 15.70$, $p < .001$, $\eta_p^2 = .28$ (note: this effect was not statistically significant in Study 1), and again decreased over time for

uncooperative partners, $F(1, 41) = 12.16$, $p = .001$, $\eta_p^2 = .23$. A vignette by time interaction was also observed, $F(2, 82) = 7.10$ $p < .001$, $\eta_p^2 = .15$, such that participants' estimates of sharing frequency increased over time for partners described with untrustworthy vignettes, $F(1, 41) = 8.53$, $p < .01$, $\eta_p^2 = .17$. Unlike Study 1, these estimates did not significantly decrease over time for partners described with neutral, $F(1, 41) = 1.46$, $p = .23$, $\eta_p^2 = .03$, or trustworthy vignettes, $F(1, 41) = 2.12$, $p = .15$, $\eta_p^2 = .05$. Overall, in both studies, the effect of vignette appears to weaken over time.

Additionally, we observed a 3-way interaction (including time), $F(2, 82) = 4.92$ $p < .01$, $\eta_p^2 = .11$, that did not replicate in other studies. A vignette by time linear interaction for cooperative partners, $F(2, 82) = 7.30$ $p < .001$, $\eta_p^2 = .15$, indicated estimates increased over time for partners described with untrustworthy vignettes, $F(1, 41) = 29.86$ $p < .001$, $\eta_p^2 = .42$, but not for partners described with trustworthy, $F(1, 41) = 2.32$ $p = .14$, $\eta_p^2 = .05$, or neutral vignettes, $F(1, 41) = 0.00$ $p = .99$, $\eta_p^2 = .00$ (see Figure 3 for trend over time). For uncooperative partners, a vignette by time linear interaction, $F(2, 82) = 3.92$, $p = .02$, $\eta_p^2 = .09$, indicated that estimates for partners described with untrustworthy vignettes did not significantly change over time, $F(1, 41) = 1.32$ $p = .26$, $\eta_p^2 = .03$, but decreased over time for partners described with neutral, $F(1, 41) = 4.64$, $p < .05$, $\eta_p^2 = .10$, or trustworthy vignettes, $F(1, 41) = 14.51$, $p < .001$, $\eta_p^2 = .26$. Thus, for cooperative partners, the effect of time (in which estimates increase over time) is driven by those described with untrustworthy vignettes but for uncooperative partners, the effect of time (in which estimates decrease over time) is driven by those described with trustworthy vignettes. One possible explanation of this 3-way interaction is that participant memory may be especially sensitive to violations of preexisting expectations, but we are reluctant to speculate further about an unreplicated effect. Finally, unlike Study 1, memory for partner behavior did not significantly differ by vignette after the final block, $F(2, 82) = 0.20$, $p = .82$, $\eta_p^2 = .01$. No other effects were significant.

Impressions. We replicated the Study 1 cooperation rate by time interaction, $F(1, 44) = 160.25$, $p < .001$, $\eta_p^2 = .79$, indicating that participants rated cooperative partners ($M = 6.54$, $SD = 1.27$) more positively than uncooperative partners ($M = 2.93$, $SD = 1.18$) at posttest, $F(1, 44) = 161.65$ $p < .001$, $\eta_p^2 = .79$, but not pretest ($F(1, 44) = .01$, $p = .93$, $\eta_p^2 = .00$). We also observed a vignette by time interaction, $F(1, 44) = 191.48$, $p < .001$, $\eta_p^2 = .81$, such that the effect of vignette was stronger at pretest, $F(2, 88) = 364.20$, $p < .001$, $\eta_p^2 = .89$, than at posttest, $F(2, 88) = 4.08$, $p = .02$, $\eta_p^2 = .09$. Once again, although the effects of vignette decreased over time, it is important to note that this effect remained significant at posttest, such that partners described with trustworthy, $t(44) = 2.16$, $p = .04$; $M = 5.03$, $SD = 1.28$ and neutral vignettes, $t(44) = 2.24$, $p = .03$; $M = 4.89$, $SD = 1.09$ were rated more positively than partners described with untrustworthy vignettes ($M = 4.29$, $SD = 1.54$). No other effects were significant.

Discussion

The results of Study 2 replicated all of the main effects observed in Study 1, despite the fact that indirect information was introduced only once at the very beginning of the study. The main effect of partner sharing and the key differences between the positive and negative vignettes both replicated. As noted above, though, Study 2 included a

slightly different pattern of the neutral vignette condition. These findings suggest that even after a dozen trust-relevant interactions with another person, a single-instance of third-hand information about this person's behavior is sufficient to influence how much a perceiver will trust that person.

Several additional findings were observed in Study 2, all involving interactions that either did not replicate in any other studies or only replicated in Study 4 (e.g., sharing behavior but with a different interactive pattern). The interaction for sharing behavior in Study 2 does suggest that indirect information has a greater impact on sharing behavior when the partner the participant is interacting with treats them well versus poorly. Along these lines, the 3-way interaction for memory-based estimates indicates that memory changes most dramatically over time when there is a violation of prior expectations (i.e., the content of the vignette is incongruent with the way you are treated). These 3-way interactions for both sharing behavior and memory estimates are not replicated with the same underlying patterns in any other study, we thus refrain from further speculating about the causes of these interactions here.

More broadly, the effects of indirect information on memory and impression formation remained significant in the final block of trials despite that indirect information was communicated only once. The effect of indirect information (specifically, untrustworthy vs. trustworthy vignettes) on participant sharing behavior was significant through Block 5, suggesting that such third-hand information remains influential after even after a great many direct and relevant interactions.

Study 3

The results of Studies 1 and 2 may be attributable to the temporal primacy of indirect information rather than the indirect nature of this information (Deese & Kaufman, 1957; Murdock, 1962). The purpose of Study 3 was to examine if indirect information would influence impression formation even when presented after direct information has been encountered.

Method

Participants. Fifty-three undergraduate students at a small, private university and 8 community members from a large metropolitan area participated in exchange for partial course credit or $20 ($N = 61$; $M = 23.35$ years, $SD = 6.69$; 57% female).

Procedure. The procedure of Study 3 was identical to Studies 1 and 2 with the following exceptions. First, before the trust game began, participants were presented only with images of the partners and asked to make the same impression ratings as in prior studies. Vignettes were not presented until just prior to Block 4 and then presented only once. Finally, Study 3 included 6 blocks rather than 5 in order to assess linear effects following Block 3 (when vignettes are introduced).[6] Otherwise, Study 3 procedures and measures were identical to Study 2.

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[6] Skin conductance electrodes were placed on participants' left hand, but these data were unusable. Because of a lab-wide error, the solution applied to the electrodes was incompatible with those electrodes, rendering the resulting data uninterpretable. Therefore, these skin conductance data collected will not be analyzed now or in the future. Additionally, and on an exploratory basis, we added a measure of memory for participant's own behavior. Analyses on this measure are reported in the online supplementary materials.
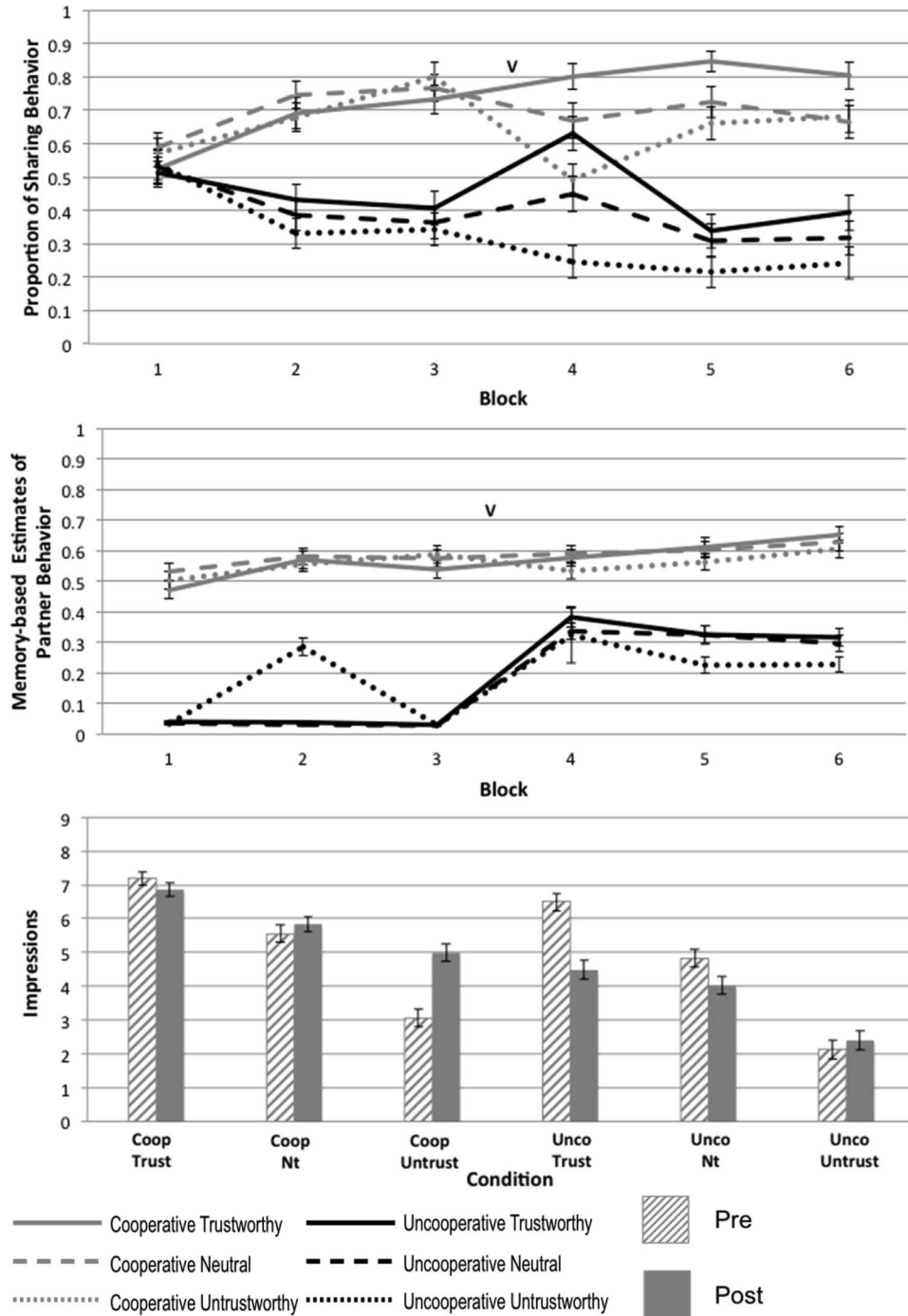
Figure 3. Observed means for the effects of direct and indirect information on all measures for Study 3. The 'V' indicates that the vignettes were presented only once, after the third block. Error bars represent standard error of the mean.

Results

To directly compare Study 3 with Studies 1 and 2, data analyses were restricted to the last three blocks of the study, after both sources of information were available (see online supplementary materials for analyses on Blocks 1–3). Hence, the time factor is restricted to 3 levels (Block 4, Block 5, Block 6).

Sharing behavior. We again replicated the main effects of cooperation rate, $F(1, 58) = 79.10$, $p < .001$, $\eta_p^2 = .58$, and vignette, $F(2, 116) = 26.69$, $p < .001$, $\eta_p^2 = .32$ (see Table 1). One nuance emerged with the vignette main effect. As in Studies 1 and 2, participants shared less with partners described with untrustworthy vignettes ($M = 0.42$, $SD = 0.24$) than those described with

trustworthy, $t(58) = 7.04$, $p < .001$; $M = 0.64$, $SD = 0.21$ or neutral vignettes, $t(58) = 3.18$, $p = .002$; $M = 0.52$, $SD = 0.27$. However, as in Study 1 (but not Study 2), participants shared more with partners described with trustworthy vignettes than with those described with neutral vignettes, $t(58) = 4.43$, $p < .001$.

We also observed two-way interactions with time. We replicated the cooperation rate by time interaction, $F(1, 58) = 14.19$, $p < .001$, $\eta_p^2 = .20$, which indicated that sharing behavior increased over time for cooperative partners, $F(1, 58) = 4.44$, $p = .04$, $\eta_p^2 = .07$, and decreased over time for uncooperative partners, $F(1, 58) = 15.45$, $p < .001$, $\eta_p^2 = .21$ (see Figure 3 for trend over time). The vignette by time interaction, $F(2, 116) = 9.16$, $p < .001$, $\eta_p^2 = .14$, indicated that sharing behavior increased over time toward partners described with untrustworthy vignettes, $F(1, 58) = 9.65$, $p < .01$, $\eta_p^2 = .14$, but tended to decrease over time toward partners described with neutral, $F(1, 58) = 3.56$, $p = .06$, $\eta_p^2 = .06$, and trustworthy vignettes, $F(1, 58) = 9.42$, $p < .01$, $\eta_p^2 = .14$. Even during the final block, we observed a significant effect of vignette, $F(2, 116) = 6.26$, $p = .003$, $\eta_p^2 = .10$, such that participants shared more with partners described with trustworthy vignettes ($M = 0.60$, $SD = 0.26$), versus those described with neutral, $t(58) = 2.62$, $p = .01$; $M = 0.49$, $SD = 0.29$, or untrustworthy vignettes, $t(58) = 3.06$, $p = .003$; $M = 0.46$, $SD = 0.27$. No other effects were significant.

Memory-based estimates of partner behavior. We again replicated the main effects of cooperation rate, $F(1, 56) = 64.53$, $p < .001$, $\eta_p^2 = .54$, and vignette, $F(2, 112) = 5.70$, $p = .004$ $.01$, $\eta_p^2 = .09$.[7] One nuance emerged with the vignette main effect. As in Studies 1 and 2, participants estimated that partners described with untrustworthy vignettes ($M = 0.41$, $SD = 0.17$) shared less frequently than partners described with neutral, $t(58) = 2.23$, $p = .03$; $M = 0.37$, $SD = 0.11$ or trustworthy vignettes, $t(58) = 2.77$, $p = .008$; $M = 0.47$, $SD = 0.14$. Unlike Studies 1 and 2, however, participants estimated that partners described as neutral shared less than partners described with trustworthy vignettes, $t(58) = 7.56$, $p < .001$.

We also replicated the cooperation by time interaction observed in Studies 1 and 2, $F(1, 58) = 11.93$, $p < .001$, $\eta_p^2 = .17$, such that participants' estimates of sharing frequency increased over time for cooperative partners, $F(1, 58) = 8.96$, $p = .004$, $\eta_p^2 = .13$, and again decreased (at a trend level) over time for uncooperative partners, $F(1, 58) = 3.64$, $p = .06$, $\eta_p^2 = .06$. Unlike Studies 1 and 2, there was not a significant interaction between vignette and time, $F(2, 116) = 0.79$, $p = .46$, $\eta_p^2 = .01$. Even after Block 6, $F(2, 116) = 4.16$, $p = .02$, $\eta_p^2 = .07$, participants estimated that partners described with untrustworthy vignettes ($M = 0.41$, $SD = 0.13$) shared less than partners described with trustworthy, $t(58) = 2.37$, $p = .02$; $M = 0.51$, $SD = 0.30$ or neutral vignettes, $t(58) = 2.39$, $p = .02$; $M = 0.45$, $SD = 0.14$. No other effects were significant.

Impressions. We observed two-way interactions, including the cooperation rate by time interaction, $F(1, 58) = 34.82$, $p < .001$, $\eta_p^2 = .38$, indicating that the extent to which participants rated cooperative partners more positively than uncooperative partners was stronger at post, $F(1, 58) = 58.05$, $p < .001$, $\eta_p^2 = .50$ (postcooperative, $M = 5.90$, $SD = 1.25$; postuncooperative, $M = 3.63$, $SD = 1.78$), than the half-way point, $F(1, 58) = 13.44$, $p < .001$, $\eta_p^2 = .19$ (midcooperative, $M = 5.27$, $SD = 1.21$; midunco-operative, $M = 4.49$, $SD = 1.29$). We also observed a vignette by time interaction, $F(2, 116) = 56.44$, $p < .001$, $\eta_p^2 = .49$, such that

which the effect of vignette was larger at the half-way point, $F(2, 116) = 156.80$, $p < .001$, $\eta_p^2 = .73$ (miduntrustworthy, $M = 2.59$, $SD = 1.57$; midneutral, $M = 5.18$, $SD = 1.57$; midtrustworthy, $M = 6.86$, $SD = 1.14$), than at post, $F(2, 116) = 48.20$, $p < .001$, $\eta_p^2 = .45$. As in the previous studies, this effect remained significant at post, such that partners described with trustworthy vignettes ($M = 5.67$, $SD = 1.42$) were rated more positively than those described with neutral, $t(58) = 4.07$, $p < .001$; $M = 4.93$, $SD = 1.28$ or untrustworthy vignettes, $t(58) = 8.31$, $p < .001$; $M = 3.69$, $SD = 1.41$, and partners described with neutral vignettes were rated more positively than those described with untrustworthy vignettes, $t(58) = 6.78$, $p < .001$. No other effects were significant.

Discussion

The results of Study 3 replicated all of the main effects observed in Studies 1 and 2 (though note that the neutral condition more closely resembled Study 1 than Study 2). Accordingly, primacy cannot explain the influence of indirect behavioral information on perceivers' trust-related behaviors, cognitions, and impressions, as indirect information remains influential even when introduced after perceivers had a dozen trust-relevant interactions with a target person. Despite the effects of direct information on sharing behavior and memory established in the first three blocks of Study 3 (see online supplemental materials), indirect information introduced only after Block 3 still influenced subsequent sharing behavior, memory and impressions. These results suggest that it may be possible for indirect information to change the way a person is treated, remembered, or generally thought of, even after a perceiver has acquired plenty of direct information about that person.

Study 4

It may be the case that the persistent influence of indirect information in Studies 1 through 3 is attributable to the volume of direct information (information about 6 different partners) interfering with participants' ability to track individual partner behavior. In Study 4 we address this alternative explanation, by examining whether indirect and direct information would influence trust when participants interacted with only one partner.

Method

Participants. One hundred twelve undergraduate students at a small, private university ($M = 19.84$ years, $SD = 3.00$; 66% female) participated in exchange for partial course credit and 120 American MTurk workers ($M = 32.13$ years, $SD = 9.38$; 37% female) with a 95% approval rate participated in exchange for $3 (Goodman, Cryder, & Cheema, 2013; Paolacci & Chandler, 2014). Hence, 232 individuals participated in full ($M = 26.25$ years, $SD = 9.37$; 51% female).

Procedure. Study 4 took place entirely online. The between-subjects design ensured that each participant played with only one

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[7] As in Study 1, participants significantly underestimated the cooperation rates of cooperative partners, $t(58) = -10.47$, $p < .001$, $d = 1.36$, but less dramatically overestimated the cooperation rates of uncooperative partners, $t(58) = 2.06$, $p = .04$, $d = 0.28$.

partner (e.g., a cooperative trustworthy partner). As in prior studies we incentivized participants by awarding them the amount won on a random trial, a procedure that seems effective for online studies (Goodman et al., 2013).

After three practice rounds of the Trust Game, participants were randomly assigned a single partner, whom we called Dave. Participants were told that they would be playing the trust game with Dave, were shown his picture, asked to provide impression ratings, and then played 20 trials. To mimic the block structure of the previous studies, Dave shared on three of every four trials if he was cooperative and one of every four trials if he was uncooperative, thus keeping cooperation rate consistent within block (as in Studies 1–3). At the completion of the Trust Game, participants reported their memory of Dave's sharing behavior, their own sharing behavior, and again rated their impressions of Dave. Participants then completed a funneled debriefing form similar to that of Studies 1 through 3.

Results

We made several adjustments to the data analytic strategy used in Studies 1 through 3. First, the GLM was now mixed with between-subjects factors for cooperation and vignette, and a within-subjects factor for time. Second, the initial GLM for each measure included an extra factor reflecting whether participants were recruited on campus or via MTurk. For measures on which this participant factor did not interact with any of the experimental manipulations, we report the results of the simpler GLM (without the participant factor). Finally, memory for partner behavior was only recorded at the conclusion of the game, so analyses on this measure were conducted without a time factor.

Sharing behavior. We once again replicated the main effects observed in Studies 1 through 3 for cooperation rate, $F(1, 220) = 64.86$, $p < .001$, $\eta_p^2 = .23$, and vignette, $F(2, 220) = 20.07$, $p < .001$, $\eta_p^2 = .15$ (see Table 1). The difference in sharing toward partners described with neutral ($M = 4.21$, $SD = 2.33$) versus trustworthy vignettes ($M = 4.61$, $SD = 2.27$)—observed only in Study 3—did not replicate here, $t(151) = 1.12$, $p = .23$. As in all 3 prior studies, participants shared less with partners described with untrustworthy ($M = 1.92$, $SD = 2.01$) versus trustworthy, $t(153) = 5.63$, $p < .001$, and neutral vignettes, $t(154) = 4.50$, $p < .001$.[8]

We also observed two-way interactions with time. However, the cooperation rate by time interaction, $F(1, 220) = 50.47$, $p < .001$, $\eta_p^2 = .19$, followed a slightly different pattern than observed in the previous studies. First, when including all five blocks in the analysis, sharing behavior for cooperative partners did not increase linearly over time, $F(1, 120) = 1.08$, $p = .30$, $\eta_p^2 = .01$, though it did increase during the first three blocks, $F(1, 120) = 4.67$, $p = .03$, $\eta_p^2 = .04$. Second, as in Studies 1 through 3, sharing behavior decreased over time for uncooperative partners, $F(1, 110) = 60.10$, $p < .001$, $\eta_p^2 = .35$. As in Studies 1 through 3, the vignette by time interaction was significant, $F(2, 220) = 3.89$, $p < .05$, $\eta_p^2 = .03$, such that sharing behavior decreased over time for partners described with neutral, $F(1, 76) = 6.01$, $p < .05$, $\eta_p^2 = .07$, and trustworthy vignettes, $F(1, 75) = 17.51$, $p < .001$, $\eta_p^2 = .19$. However, unlike in previous studies, sharing behavior did not increase over time toward partners described with untrustworthy

vignettes ($F(1, 78) = 2.37$, $p = .13$, $\eta_p^2 = .03$; see Figure 4 for trend over time).

As in Study 2 (but not Studies 1 and 3), there was a 3-way interaction involving time, $F(2, 220) = 4.38$, $p = .01$, $\eta_p^2 = .04$. However, the pattern here departed from the pattern in Study 2. Unlike in Study 2, there was not a significant vignette by time interaction for cooperative partners, $F(2, 118) = 0.43$, $p = .65$, $\eta_p^2 = .01$. Also unlike Study 2, we did observe a significant vignette by time interaction for uncooperative partners, $F(2, 108) = 7.30$, $p = .001$, $\eta_p^2 = .12$, indicating that sharing behavior decreased over time most strongly toward partners described with trustworthy vignettes, $F(1, 30) = 72.78$, $p < .001$, $\eta_p^2 = .71$, followed by neutral, $F(1, 38) = 22.23$, $p < .001$, $\eta_p^2 = .37$, and much less strongly toward partners described with untrustworthy vignettes, $F(1, 40) = 5.13$, $p = .03$, $\eta_p^2 = .11$ (see Figure 4 for trend over time).

As in Studies 1 through 3, even during the final block, we observed a significant effect of vignette, $F(2, 224) = 9.08$, $p < .001$, $\eta_p^2 = .08$, indicating participants shared less with partners described with untrustworthy ($M = 0.32$, $SD = 0.38$), versus the trustworthy, $t(151) = 4.25$, $p < .001$; $M = 0.58$, $SD = 0.39$ or neutral, $t(154) = 3.15$, $p = .002$; $M = 0.51$, $SD = 0.38$ vignettes. No other effects were significant.

Memory-based estimates of partner behavior. We once again replicated the Study 1 through 3 main effects of cooperation rate, $F(1, 218) = 220.54$, $p < .001$, $\eta_p^2 = .50$, and vignette, $F(2, 218) = 3.23$, $p < .05$, $\eta_p^2 = .03$.[9] Note that the main effect of vignette was most similar to Studies 1 and 2 in that it did not include higher estimates of partner sharing for partners described with trustworthy ($M = 0.47$, $SD = 0.29$) than neutral, $t(149) = 0.91$, $p = .37$; $M = 0.43$, $SD = 0.28$ vignettes, (while both were higher than estimates for partners described with untrustworthy vignettes, $M = 0.35$, $SD = 0.25$; untrustworthy vs. neutral at trend level, $t(154) = 1.81$, $p = .07$; untrustworthy vs. trustworthy, $t(151) = 2.69$, $p = .008$). No other effects were significant.

Impressions. We observed two-way interactions, including the cooperation rate by time interaction, $F(1, 220) = 108.17$, $p < .001$, $\eta_p^2 = .34$, indicating that participants rated cooperative partners ($M = 4.88$, $SD = 2.39$) more positively than uncooperative partners ($M = 2.11$, $SD = 1.70$) at posttest, $F(1, 226) = 122.26$, $p < .001$, $\eta_p^2 = .35$, but not pretest, $F(1, 226) = 0.03$, $p = .86$, $\eta_p^2 = .00$. We also observed a vignette by time interaction, $F(2, 220) = 73.60$, $p < .001$, $\eta_p^2 = .40$, such that the effect of vignette was stronger at pretest, $F(2, 226) = 329.68$, $p < .001$, $\eta_p^2 = .75$ (untrustworthy, $M = 1.77$, $SD = 1.72$; neutral, $M = 6.26$, $SD = 1.37$; trustworthy, $M = 7.69$, $SD = 1.31$), than posttest, $F(2, 226) = 44.55$, $p < .001$, $\eta_p^2 = .28$. As in Studies 1 and 2, partners

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[8] The main effect of vignette was qualified by an interaction with participant type such that the sharing behavior distinguished between vignette type in the expected direction to a greater extent for MTurk participants (untrustworthy, $M = 0.22$, $SD = 0.29$; neutral, $M = 0.51$, $SD = 0.34$; trustworthy, $M = 0.56$, $SD = 0.34$; $F(2, 114) = 15.28$, $p < .01$, $\eta_p^2 = .22$) than for student participants (untrustworthy, $M = 0.46$, $SD = 0.29$; neutral, $M = 0.59$, $SD = 0.25$; trustworthy, $M = 0.67$, $SD = 0.21$; $F(2, 103) = 4.24$, $p = .02$, $\eta_p^2 = .08$).
[9] As in Studies 1 and 3, participants significantly underestimated the cooperation rates of cooperative partners, $t(120) = -7.10$, $p < .001$, $d = 0.65$, but overestimated the cooperation rates of uncooperative partners, $t(108) = 2.82$, $p = .01$, $d = 0.27$.
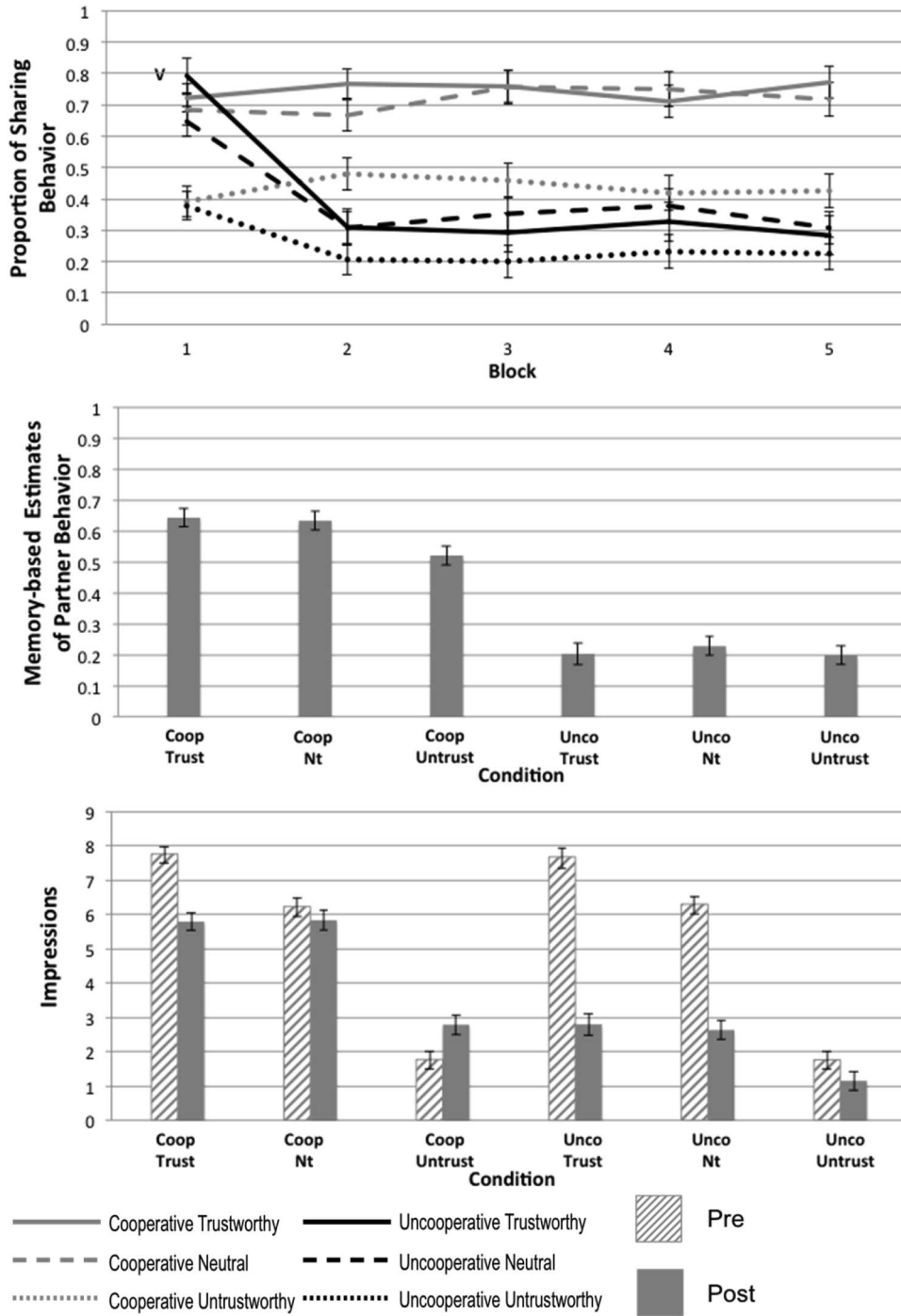
Figure 4. Observed means for the effects of direct and indirect information on all measures for Study 4. The 'V' indicates that the vignettes were presented only once, before the first trial. Error bars represent standard error of the mean.

described with trustworthy, $t(153) = 7.76$, $p < .001$; $M = 4.61$, $SD = 2.27$ or neutral vignettes, $t(154) = 6.57$, $p < .001$; $M = 4.21$, $SD = 2.33$ were rated more positively than partners described with untrustworthy vignettes ($M = 1.92$, $SD = 2.01$). As in all previous studies, note that this effect remained highly significant after the final block (see above).

Unlike in Studies 1 through 3, these effects were qualified by a 3-way interaction, $F(2, 220) = 4.28$, $p = .02$, $\eta_p^2 = .04$. We did not observe a cooperation rate by vignette interaction at pretest, $F(2, 226) = 0.11$, $p = .89$, $\eta_p^2 = .00$, but did observe such an interaction at posttest, $F(2, 226) = 4.48$, $p = .01$, $\eta_p^2 = .04$. At posttest, the effect of vignette was stronger for cooperative, $F(2, 118) = 31.90$,

$p < .001$, $\eta_p^2 = .35$, than for uncooperative partners, $F(2, 108) = 13.62$, $p < .001$, $\eta_p^2 = .20$, although the pattern of means for vignette were comparable across the two types of partners (see Table 1).This interaction mimics the cooperation by vignette by time interaction seen in Study 2 for sharing behavior, as vignette seems to have a stronger impact on impressions of cooperative partners, than uncooperative partners after playing a considerable number of trials with their partner.

Discussion

The results of Study 4 replicated all of the main effects for sharing behavior observed in Studies 1 through 3 (though see slight differences in mean patterns for the neutral condition). These results were obtained even though vignette was presented only once at the beginning of the game (as in Study 2), and even though participants could more easily track the extent to which their partner's behavior was predictive of trust (there was only 1 partner to track compared to 6 in Studies 1 through 3). A meta-analysis of the effects of direct and indirect information across all four studies further support these results (see online supplemental materials).

Mediation Analyses for the Four Studies

Results of mediation analyses were generally consistent across studies, so we report them together here. Recall that we hypothesized that the influence of direct information on trust behavior is mediated by memory for partner behavior, as supported by research on associative learning and memory. Recall also that we hypothesized that the influence of indirect information on trust behavior is mediated by impressions of the partner reported by the participant, consistent with work demonstrating that impressions can lead to dramatic differences in how a perceiver treats another person (Dougherty et al., 1994; Snyder & Swann, 1978).

We tested these hypotheses using generalized estimating equations (GEEs; Liang & Zeger, 1986) with exchangeable correlation matrices. Through the use of a link function (transformation), GEE models mimic multiple regression but adjust standard errors to be appropriate for analyses on data with correlated observations, yielding a single significance test for each predictor across all measurements. GEE analyses are robust to misspecifications of the correlation matrix and do not require any specific distribution among responses but coefficients from GEE models have analogous meaning to coefficients from standard multiple regression (e.g., Seery, Holman, & Silver, 2010).

In the current work, cooperation rate (reference group: uncooperative) was dummy-coded, as was vignette (reference group: untrustworthy; neutral was excluded for ease of interpretation). Effect size metrics in GEE are not well established, so we z-standardized all continuous variables to make coefficients roughly comparable to traditional estimates of effect size based on standard deviation units (e.g., Cohen's d). For each mediation test, three GEE models were run, corresponding to the guidelines described by Baron and Kenny (1986), testing the effect of both factors (cooperation rate and vignette) on mediators (Model 1), the effect of both factors on sharing behavior (Model 2), and the effect of both factors and the mediator on sharing behavior (Model 3). We interpret regression coefficients (b) for each predictor with conventions (Cohen, 1992) for small, medium, and large effects.

Mechanisms of Direct Information

Cooperation rate influenced participants' memory-based estimates of partner behavior (Model 1 bs = 1.29, 1.06, 0.99, and 1.35 in Studies 1–4, respectively, all ps < .001) and memory was predictive of participant sharing behavior (Model 3 bs = 0.86, 0.54, 0.50, and 0.43, all ps < .001). Critically, and consistent with mediation, the effects of cooperation rate on participants' sharing behavior (Model 2 bs = 1.18, 0.81, 0.94, and 0.78, all ps < .001) change from large to small when memory for partner behavior was included as a predictor (Model 3 bs = 0.08, 0.24, 0.45, and 0.20, ps = .01, = .01, < .001, = .34). The effect size drops from an average of roughly 0.93 to roughly 0.25, suggesting that memory for partner behavior mediates the influence of direct information on sharing behavior, though not completely.

Next, we examined whether impressions also mediated the effect of cooperation rate on sharing behavior. Cooperation rate influenced participants' impressions (Model 1 bs = 1.34, 1.08, 0.88, and 0.89, all ps < .001) and such impressions were predictive of participant sharing (Model 3 bs = 0.61, 0.28, 0.48. and 0.67, all ps < .001). Critically, the effect of cooperation rate on participants' sharing behavior (Model 2 bs = 1.18, 0.81, 0.94, and 0.78, all ps < .001) changes from large to moderate when impressions were included as a covariate (Model 3 bs = 0.36, 0.51, 0.52, and 0.18, ps = .01, < .001, < .001, = .21), consistent with mediation.

The mediating effects of memory for partner behavior appeared to be larger than mediating effects of impressions, making it unlikely that the latter accounts for the former. To test whether memory for partner behavior uniquely mediated the influence of cooperation rate on participant sharing, we included both potential mediators in a GEE model predicting sharing behavior and examined which mediator was a stronger predictor of sharing behavior. In this model, both mediators were significant predictors of participant sharing in all four studies (ps < .05), but memory for partner behavior was a stronger predictor than impressions in Study 1 (bs = 0.73 vs. 0.16), Study 2 (bs = 0.51 vs. 0.13), and Study 3 (bs = 0.37 vs. 0.28). In Study 4 the reverse was true (bs = 0.24 vs. 0.60). The results of this model should be interpreted with caution, as should any multiple mediator model (especially those with within-subject experimental designs). With that said, memory for partner behavior appeared to be the stronger mediator, reducing effects of direct information on trust behavior from large to small, and memory for behavior was a stronger mediator of impressions in 3 of 4 studies.

Mechanisms of Indirect Information

Partner vignette influenced participants' memory for partner behavior (Model 1 bs = 0.27, 0.50, 0.12, and 0.25, ps < .005, < .001, = .20, = .02) and such memory was predictive of participant sharing behavior (Model 3 see above for coefficient weights). However, the effect of vignette on sharing behavior (bs = 0.36, 1.01, 0.47, and 0.74, all ps < .001) was *not* substantially reduced when memory for partner behavior was included as a predictor (bs = 0.13, 0.74, 0.42, and 0.63, ps = .02, < .001, < .001, < .001). The average effect size dropped negligibly from roughly 0.64 to roughly 0.48.

Next, we examined whether impressions mediated the effect of vignette on participant sharing behavior. Partner vignette influenced participants' impressions (Model 1 bs = 0.28, 0.74, 0.67,

and 0.96, ps $< .001$, other than Study 1's $p = .02$) and as reported above, such memory was predictive of participant sharing (Model 3). Critically, and consistent with mediation, the effect of vignette on participants' sharing behavior (Model 2 bs $= 0.36, 1.01, 0.47,$ and 0.74; ps $< .001$) changed from large to small when positive impression was included as a predictor (Model 3 bs $= 0.19, 0.80,$ 0.16, and 0.10, ps $= .02, < .001, = .13, = .46$). The effect size drops from an average of roughly 0.65 to roughly 0.31, suggesting that impressions at least somewhat mediate the influence of direct information on sharing behavior.

General Discussion

Trust is essential to the survival of both the individual and society (Balliet & Van Lange, 2013; Raihani et al., 2012). The purpose of the present research was to examine how two sources of information influence trust: direct behavioral information (acquired by perceivers through interacting with another person) and indirect behavioral information (acquired by perceivers through a third-party). Our main question was the extent to which indirect information had an influence on perceivers' trust, even when perceivers have considerable direct experience with that target person. In general, the two sources of information *independently* influenced participants' trust of other people as reflected in trust behavior (sharing), memory for the trustworthiness of others' behavior (memory for partner behavior), and explicit judgments of others as trustworthy and likable (impressions).

Indirect Behavioral Information: Robust Influence on the Development of Trust

From articles in newspapers and blogs to gossip transmitted in person and on social media, it can be difficult to avoid learning about others' behaviors from third-hand sources, and it is often easy to locate such indirect information if one searches for it. Existing research on social cognition suggests that indirect information should influence what we think of others, as indicated by work on trait attribution and automaticity (Bassili & Smith, 1986), in which study participants learn about others' behavior through friends, acquaintances, and experimenters. Yet ongoing human relationships are characterized by social interaction, and prior research has established that the development of trust and distrust in these relationships depends crucially on how people behave toward each other when interacting (Lewicki, Tomlinson, & Gillespie, 2006). Is the influence of indirect information on trust-relevant impressions and behaviors thus limited to new relationships, in which people have had no direct experience with each other? Our research, particularly the results from Study 3, suggests the answer is "no," suggestive of a substantial role for indirect information in ongoing relationships.

In all four studies, indirect information influenced trust behavior (sharing), memory for the partners' trust behavior (memory for partner behavior), and explicit impressions of partners as trustworthy and likable. Such influence occurred when participants encountered only one piece of indirect behavior information before interacting with target persons (Studies 2 & 4), after interacting with target persons (Study 3), and even after 20 consecutive interactions with the same target person (Study 4). To be more precise, a significant main effect of indirect information on trust

was observed on 3 outcomes in each of 4 studies (12 of 12 main effects were significant), suggesting robust effects of indirect information.

Previous research has emphasized that indirect information can influence impression formation (Delgado et al., 2005; Mishina et al., 2012; Skowronski & Carlston, 1989), but it was not clear that such information would remain influential even when perceivers had several diagnostic interactions (direct information) with another person. The interactions we observed with time indicate that considerable direct experience with another person's trustworthiness reduces, but fail to eliminate, the influence of a single piece of indirect information on how much one person trusts another. Indeed, the lasting impact of indirect information remained regardless of the frequency with which it was presented, the time at which it was presented, and whether or not it was presented in the context of others' trust behavior.

Mediation analyses suggested that indirect information influenced perceivers' trust behavior by influencing explicit impressions of their partner's trustworthiness and likability. We did not find consistent evidence that indirect information influenced participants' trust behavior through biased memories of how much partners were sharing. Together, these results suggest that indirect information may influence perceivers' global impressions of a target person, which in turn compels perceivers to simply trust their partners. Although indirect information also impacts how perceivers remember being treated, we did not find support for the idea that these biased memories account for the persistence of indirect information on trust. Therefore, attempts to overcome the impact of nondiagnostic indirect information on trust behavior might target global impressions, rather than focusing upon how perceivers encode and recall previous interactions.

The present results also have key implications for the increasing online availability of information about people and organizations. From cyberbullying to online reviews, people frequently acquire indirect behavioral information via the Internet. Our results suggest that even a single piece of information about another person's behavior that is widely circulated might have a lasting influence on the development of the real romantic, occupational, and informal relationships developed by the targets of gossip. For example, recent research suggests that information presented on social-networking sites is commonly used in hiring practices (Brown & Vaughn, 2011; Llama, Trueba, Voges, Barreto, & Park, 2012; Wilson, Gosling, & Graham, 2012). so it seems reasonable that indirect information (e.g., gossip) posted on such sites may exert a similar influence. Of course, these speculative comments remain untested and thus mark one direction for future research.

Direct Behavioral Information: Information Processing in the Development of Trust

Direct behavioral information clearly influenced trust in the present studies. Although it may be unsurprising that perceivers grow to trust or distrust people who repeatedly confirm or betray that trust, respectively, the current work supports two premises about how people develop trust with each other over time through social interaction. First, there was little consistent evidence that indirect information interacted with direct information in shaping trust. This evidence is consistent with the view that direct information influences the development of trust in a manner that is

robust to (at least) one piece of relevant but third-hand information. Second, the influence of direct information on participants' trust behavior toward their partners was mediated primarily by their memory of how often those partners reciprocated in the prior block. Thus, memory for how the partner treated the participant emerged as a strong candidate mechanism through which direct (but not indirect) information influenced sharing behavior.

Although memory-based estimates of partner reciprocity were clearly meaningful and related to trust behavior, participants consistently underestimated the percent of time cooperative partners shared with them (Studies 1–4) and less dramatically overestimated the percent of time uncooperative partners shared with them (Studies 1, 3, and 4). This finding might be interpreted as a methodological artifact. The overall sharing rate in any given block was 50%, and this rate may have served as an anchor from which participants insufficiently adjusted their estimates of cooperative partners (insufficient adjustment is typical of anchoring; Epley & Gilovich, 2006). This heuristic effect may have been a little larger for cooperative partners because of the advantage that negative (uncooperative) information often has in memory (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), such that participants had slightly better memory for what uncooperative partners actually did and relied less on a heuristic. This explanation is highly speculative, but because the discovery of a memory bias does not qualify the pattern of results, our explanation for this bias awaits exploration at a later time.

In the current work, participants had direct interactions with another person after reading about that person's behavior in a separate context. It is in this context in which large effects of direct information were observed, suggesting that people are not simply rationalists who interpret the social world strictly according their prior knowledge but rather also exhibit traits of empiricists, monitoring the behavior of other individuals, distinguishing in memory between individuals who do versus do not reciprocate, and then relying on this information in their decisions to trust another person. The relatively limited overlap in the mediators of direct and indirect information inform a new hypothesis that relatively independent pathways underlie rationalist and empiricist processing and influences.

Nuances and Limitations

There were several nuances to our results worthy of discussion. The effects of indirect information were largely driven by the robust, consistent difference in trust for partners who had been described with untrustworthy vignettes versus those described with trustworthy or neutral vignettes. In some studies and for some measures, participants' responses distinguished between partners described with trustworthy and neutral vignettes. The more reliable effect associated with the untrustworthy vignette might owe (in part) to our specific stimuli, but might reflect a negativity bias, or might reflect the fact that untrustworthy behavior is often counternormative (Mende-Siedlecki, Baron, & Todorov, 2013).

Finally, although our hypothesized effects (the main effects of cooperation and vignette) were quite consistent across all studies, we did observe some nuances in the interactions with time across studies. For partners described with untrustworthy vignettes, sharing behavior increased over time in Studies 1 through 3 but not in Study 4. Similarly, sharing behavior toward cooperative partners

increased over time in Studies 1 through 3 but did not change over time for Study 4. These differences may have emerged because the between-subjects design of Study 4 required each participant to play with only one type of partner (e.g., a cooperative partner paired with a trustworthy vignette). Specifically, for cooperative partners described with untrustworthy vignettes, participant sharing over time tended to remain close to the low start point and failed to ever reach the levels of participant sharing toward cooperative partners described with neutral or trustworthy vignettes (see Figure 4). Thus participants in Study 4 may have incorporated untrustworthy vignettes into their trust decisions (especially about cooperative partners) to a greater extent than participants in Studies 1 through 3 because that was the only information they needed to track at any given time. We also did not observe a vignette by time interaction for memory-based estimates of partner behavior in Study 3 (unlike in Studies 1, 2, and 4). This may be because participants played three full rounds of the trust game with partners before indirect information was presented, making their estimates of partner behavior in the following three rounds more stable than in the entire five rounds of Studies 1, 2, and 4. However, none of the above nuances replicated in other studies, so we are hesitant to further speculate about the mechanisms underlying these effects.

We also observed some unexpected three-way interactions. Most of these unexpected three-way interactions did not replicate and the one that did replicate was inconsistent in terms of the data patterns that produced it. Because we cannot be sure whether these differences are attributable to differences in study design or other external factors, we refrain from interpreting the changes across studies (please see individual study Discussions for our interpretation of these findings on a study-by-study basis).

As with any set of experiments, there were also limitations to our methodology. First, indirect information was presented only once in three out of four studies and in all studies the content of the indirect information was a description of a single behavior. Conversely, direct information was conveyed on every trial. We chose to present one piece of indirect information about each partner to provide the most conservative test of its influence. A future study might test how direct and indirect information influence trust when there are a greater number of distinct behaviors presented as indirect information. This could be done, for example, by replicating Study 1 with *different* trust-relevant behaviors described on each trial. At the least, however, the current set of studies suggests that indirect behavioral information has a robust and long-lasting influence on trust, over and above any influences of direct behavioral information.

A second limitation is that we presented information about how each partner would have behaved (i.e., counterfactual information), potentially limiting the external validity of our design. We chose to provide counterfactual information as means of ensuring that direct information was delivered at the same frequency to every participant. For example, if one has a negative interaction with a person the first time he or she is encountered, one may be less likely to want to engage with them again, preventing an opportunity for redemption and creating impression that this individual is a 'bad person' (Mende-Siedlecki, Baron, & Todorov, 2013). In our design, such an effect would have prevented us from evaluating the impact of indirect information in the context of direct information. This type of effect might be an important

real-life analogue to relationship development, however, so future work should explore this possibility.

In addition, our computer-based task is better controlled but less ecologically valid than a face-to-face interaction. This is a limitation common in judgment and decision making studies (Delgado et al., 2005; Koenigs & Tranel, 2007), often justified by the idea that the live presence of another individual can muddle key distinctions (e.g., between direct and indirect information). However, because participants were paid the amount won on a randomly selected trial, this study was high on *experimental realism* even if it is not high on *mundane realism* (Rosenthal & Rosnow, 1991). Nonetheless, a promising avenue for future work is to explore how indirect and direct information influence impression formation and trust when those types of information are presented in other contexts (e.g., face-to-face, social media, video).

Determining the generalizability of the observed effects to other modalities and mechanisms may provide additional insight into its how indirect and direct information shape impression formation. For example, most sources of reputation are passed on through word of mouth, and are thus communicated as indirect information. A promising path of further study is to determine whether substituting another modality (e.g., observational indirect information; Olsson & Phelps, 2004) for the verbal modality would change the nature of the effects. In general, future research should examine the boundary conditions under which this influence of indirect information persists in order to hone our use of this powerful tool for a myriad of applications.

Conclusion

The present research provides evidence that indirect behavioral information can have a persistent effect on trust behavior, memory for others' behavior, and impression formation. Our results suggest that indirect information has an independent and powerful influence on trust even in the presence of repeated trust-diagnostic behavior of another person toward oneself. Indirect information impacts interpersonal behavior even after such direct information has been acquired, and one candidate mechanism for this effect is the formation of strong impressions of the target, rather than biased memory of that person's previous behavior. Therefore, indirect information has a significant impact on trust, even when that information does not predict how an individual actually behaves. Broadly, our research suggests that trust is influenced by behavioral information communicated by a third-party (indirect information) even when directly interacting with another person. The current work thus suggests that people are both social empiricists and social rationalists when it comes to trust; yet rationalism has a surprisingly robust influence on trust even in the presence of directly encountered empirical information about another person.

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