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Contextualizing Person Perception: Distributed Social Cognition

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Research on person perception typically emphasizes cognitive processes of information selection and interpretation within the individual perceiver and the nature of the resulting mental representations. The authors focus instead on the ways person perception processes create, and are influenced by, the patterns of impressions that are socially constructed, transmitted, and filtered through social networks. As the socially situated cognition perspective (E. R. Smith & G. R. Semin, 2004) suggests, it is necessary to supplement consideration of intra-individual cognitive processes with an examination of the social context. The authors describe a theoretical model of processes of distributed social cognition that takes account of 3 levels: the individual perceiver, the interacting dyad, and the social network in which they are embedded. The authors' model assumes that perceivers elicit or create as well as interpret impression-relevant information in dyadic interaction and that perceivers obtain information from 3rd-party sources who are linked to perceivers and targets in social networks. The authors also present results of a multiagent simulation of a subset of these processes. Implications of the theoretical model are discussed, for the possibility of correcting biases in person perception and for the nature of underlying mental representations of persons.

Keywords: person perception, gossip, social networks, multiagent

People's impressions or mental representations of others are fundamental tools for social life. Whether they are valid or invalid, based on years of acquaintanceship or just a cursory glance, our impressions of other people shape our choices of romantic partners, our judgments about political candidates or job applicants, our detection and sanctioning of cheaters and norm violators, and our daily interactions with colleagues, friends, and family.

Motivated by the fundamental importance of person perception, researchers have intensively studied how individual perceivers select, interpret, and integrate information about other people. We know a good deal, for instance, about the types of cues social perceivers notice and integrate into their impressions, the conditions under which they automatically access their existing knowledge structures (such as stereotypes), and the ways they use their impressions to make judgments and decisions about other people (Gilbert, 1998; E. R. Smith, 1998). Rigorously controlled laboratory studies have given a clear picture of the nature, time course, and effects of these and other subprocesses of impression formation.

However, as advocates of the "situated cognition" approach have argued, even a detailed understanding of the properties of isolated psychological processes cannot fully account for the ways the processes actually operate in concrete social contexts (Robbins & Aydede, 2008; E. R. Smith & Semin, 2004). When people act and interact with other individuals and groups, additional processes often become relevant, and psychological processes are often "scaffolded" by externally available information rather than relying solely on inner representational resources (Clark, 1997). For example, people may incorporate information about the target passed along by others rather than relying solely on firsthand behavioral observations when they form an impression. Therefore, to gain a fuller understanding of impression formation one must examine it in context. Such an examination takes us beyond the cognitive processes of information interpretation and integration within an individual perceiver to include the ways information about people is actively elicited and coconstructed by perceivers and targets interacting as dyads, as well as the ways multiple perceivers and targets share and filter information within a social network as they jointly construct impressions. This perspective shifts the focus from the cognitive processes of the individual perceiver to the interacting dyad embedded in an entire social group or network.

Equally, this new perspective shifts focus regarding the outcome or product of impression formation from the content and structure of impressions as mental representations within the individual perceiver to the distribution of impressions within a group—in other words, to the social patterning of people's reputations (Craik, 2008). Friends and acquaintances may hold relatively similar impressions of a hypothetical individual, but there may also be systematic differences—for example, those who are fellow members of the sports team on which a hypothetical man stars may view him more positively than do his housemates, who know that he rarely does his assigned chores. Beyond those who have an impression of him based on firsthand interaction and observation,

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others will know him only at second or third hand, on the basis of socially communicated information. Their impressions too may be relatively positive or negative, depending on whether they hear about the target from his admiring teammates or from his angry ex-girlfriend. And of course many people will have access to both direct interaction and socially transmitted information—which may be consistent or may differ sharply and have to be reconciled in some way. To fully understand the social patterning of impressions we have to supplement the consideration of perceivers' information interpretation and integration by consideration of their larger context: multiple perceivers and targets who actively elicit information from each other in interaction and share their impressions within networks of social relationships, influencing each others' impressions over time.

This article seeks to expand the theoretical focus at both the process and outcome levels, as just described. First, we examine a broader range of processes involved in impression formation than has been typical in the past literature, complementing consideration of the microprocesses of the perceiver's information interpretation and integration with analysis of the ways information is elicited and shaped in dyadic interaction, and the ways information is transmitted and filtered within social networks. Second, we analyze consequences of these processes not for the mental representation of an impression within an individual perceiver's head but for patterned reputations—the distribution of impressions of an individual within the social network. This approach parallels the perspective regarding social influence put forward by Mason, Conrey, and Smith (2007). They noted that most research on social influence focuses on the microprocesses that mediate the effects of a source's attitude or behavior on a target, whether through persuasion or conformity. Yet even full understanding of these microprocesses does not suffice to predict the patterns of outcomes that emerge when multiple sources and targets of influence linked in social networks interact and mutually influence each other over time. A key outcome of interest is whether multiple competing sets of beliefs, attitudes, and behavior can persist over time within subgroups or whether the entire group converges to uniformity. Mason et al. reviewed models of social influence in this broader context and advocated the use of multiagent modeling (E. R. Smith & Conrey, 2007) as a technique for exploring the emergent, broader scale implications of specific assumptions about influence.

Both this article and Mason et al. (2007) exemplify a recent trend in the cognitive sciences: to consider individual-level cognition and behavior not in isolation but in the context of many interacting individuals. For example, cognitive scientists have developed models of collective search, where multiple agents acquire information in parallel and share it, allowing the group to converge to good problem solutions (Goldstone & Janssen, 2005; Mason, Jones, & Goldstone, 2008). Researchers studying mate choice have examined the success of different heuristics or criteria an agent could use (Simão & Todd, 2002). When many interdependent agents interact, each individual's outcomes are codetermined by the heuristics and strategies being used by the surrounding population of agents. The same is true when individuals form and share impressions of each other, with each being able to draw on information that was originally elicited by other social perceivers.

Overview of Article

This article has three main sections. First, we outline a new integrative model of impression formation that, in the spirit of the socially situated cognition approach (E. R. Smith & Semin, 2004), places impression formation in a broader social context. We label the model *distributed social cognition* (DSC) because it focuses on the patterned distribution of impressions within a group or social network, rather than being a model of a single perceiver's impression of one target. In the course of presenting the model, we review existing literature in support of some of its assumptions. At the same time, the review points to empirical gaps and issues that require further research, for this new perspective raises questions that have not previously been asked.

Second, we present results of a multiagent simulation of a subset of the processes included in the DSC model. Multiagent modeling allows investigation of the overall patterns that emerge when many agents interact over time following the assumptions of a theoretical model (E. R. Smith & Conrey, 2007). In some cases we are able to show that those emergent patterns match the distribution of impressions in real social groups; in other cases, the patterns stand as predictions that invite empirical testing and confirmation. Third, we discuss some implications and possible extensions of the theoretical model.

Patterned Reputations and the Social Relations Model

Studies of the mental representation of impressions draw on powerful tools including reaction time measurement methods and theories of representational structure (e.g., associative or schema theories; E. R. Smith, 1998). Our focus is on analyzing the patterns of impressions within social groups—that is, of reputations, defined as what is said or believed about an individual by others (Craik, 2008). While the term *reputation* may connote a specific impression (e.g., a positive view of the person) that is consensual and generally shared, in many cases different perceivers will have their own unique views of a target. Important questions about reputations therefore include whether perceivers generally agree or disagree in their impressions of a target, whether perceivers' impressions (especially if they agree) accurately describe the target's actual social behavior, and whether reciprocal impressions are correlated (e.g., if Jack likes Jill, will Jill tend to like Jack?).

Our primary tool for formulating and answering such questions is Kenny's (1994) *social relations model* (SRM). This is a componential model of person perception (Kenny, West, Malloy, & Albright, 2006) that separates a single judgment (e.g., John's degree of liking for Mary or John's rating of how honest he believes Mary to be) into conceptually independent and meaningful components. Assume that each of 5 individuals reports his or her liking for all 4 others. The SRM decomposes John's rating of his liking for Mary into four additive components: the overall mean level of liking ratings, plus the extent to which John generally likes other people (termed John's perceiver effect), plus the extent to which Mary is generally liked by other people (Mary's target effect), plus the extent to which John uniquely likes or dislikes Mary above and beyond those other effects (the relationship effect). Each of these effects is shaped by many distinct cognitive and social processes. For example, John's perceiver effect (the extent to which John holds favorable vs. unfavorable

impressions of people in general) is influenced both by the types of behavior John tends to elicit from other people (because of the kind of person he is, his physical attractiveness, etc.) and by the ways he tends to interpret others' behaviors (because of the particular schemas and other knowledge structures that are cognitively accessible for him).

The SRM's breakdown of an impression into separate components represents the two main effects and interaction in a two-way analysis of variance (ANOVA) model; indeed, the SRM is a modified version of ANOVA. It is a random-effects ANOVA model because in general we are not interested in the effects for the specific individuals sampled (John or Mary) but instead wish to estimate the proportions of the total variance in ratings of liking (or any other social judgment) attributable to perceiver, target, and relationship effects. In a SRM analysis, if each perceiver makes two or more related ratings, or makes ratings at two or more time points, then error variance can be separated from stable (nonerror) variance. Otherwise, as is the case in most existing empirical studies, error variance is included in the estimate of relationship variance (represented by the two-way interaction).

The SRM offers a language for quantitatively describing the patterns of impressions within a group. The proportion of target variance indicates the extent to which people considered as social targets are consensually seen as likable, honest, and so forth across all perceivers. The proportion of perceiver variance reveals the extent to which people acting as social perceivers consistently tend to elicit, or to interpret, targets' behaviors as being positive versus negative, honest versus dishonest, and so forth. Finally, the proportion of relationship variance represents the extent to which particular perceivers have unique tendencies to view particular targets in certain ways. Empirical evidence suggests that different perceivers tend to interpret a given target in distinctive ways (Mohr & Kenny, 2006), indicated by a high proportion of relationship rather than target variance.

In the SRM, besides the variance partitioning results, two covariations can be estimated. One is the *perceiver–target effect*, also termed generalized reciprocity. It is the correlation, across persons, of the perceiver effect (tendency to rate others high or low) with the target effect (tendency to be rated high or low by others). This answers the question, do people who like others in general also tend to be liked by others? Do people who think other people are generally honest also tend to be seen as honest by others? The second covariation is dyadic reciprocity: It is the correlation across dyads of the reciprocal unique relationship effects. Is John's unique tendency to like Mary (or to see her as honest, etc.) correlated with Mary's unique tendency to like John (or to see him as honest)? In real groups, dyadic reciprocity of interpersonal behaviors is substantial and positive, especially for prosocial behaviors such as laughing, friendliness, and liking (Kenny, Mohr, & Levesque, 2001).

Despite its utility and power, the SRM is a univariate model of a single judgment (e.g., how much perceivers like targets). The SRM offers no way to analyze more nuanced, qualitative impressions such as the perception that Susan is generally very sensitive to others' feelings, but sometimes a bit flighty, and closed-minded in her preferences about art. Our model emphasizes the core dimension of valence (evaluation, or liking vs. disliking for people), because that is the central aspect of person impressions (as it is of mental representations in general; Osgood, Suci, & Tannenbaum, 1957) and is particularly critical in determining whether a perceiver will choose to approach or interact with a target at all. In principle, however, it would be valuable to be able to describe impressions with more depth and complexity.

Distributed Processes of Social Perception

Existing research on person perception has focused on the ways perceivers select, interpret, and potentially bias incoming information—emphasizing that not only the stimulus information but also factors such as the perceiver's knowledge and expectations contribute to social perception. The DSC model seeks to understand these important processes in the context of a broader spectrum of social and cognitive processes. We present the model in three stages, corresponding to the three levels of the individual social perceiver, the interacting dyad of perceiver and target, and the social network in which multiple perceivers/targets are embedded. For each stage we present relevant theoretical principles and (where possible) briefly review existing evidence. After presenting the theoretical stages we describe a multiagent model incorporating a subset of the theoretical processes. Despite including only a limited number of processes, the multiagent model shows new and counterintuitive predictions generated by the theory (see E. R. Smith & Conrey, 2007).

Active Social Perception Processes in the Individual Perceiver

Social perception usually involves active behaviors (not just cognitive processes) on the part of the perceiver. In a typical laboratory study, for the purpose of experimental control, perceivers are placed in a relatively passive mode. They may be exposed to written descriptions of another person's behaviors or presented with photos or video clips—stimuli that are preselected, leaving the perceiver unable to choose how much information to obtain about the target, on what topics, and so forth. However, perceivers in real social contexts are time pressured and simultaneously pursue multiple competing goals, so many factors will influence whether they obtain and process information about a target at all, as well as what information they do obtain and how they interpret it.

In this section, as the starting point for our overall model we consider three issues that are relevant even when a single perceiver forms an impression of a single target. They are whether the perceiver obtains information from the target at all, what specific information the perceiver elicits, and how the perceiver interprets the elicited information. These latter two contribute to perceiver effects in the SRM.

Choosing Whether to Obtain Information

Perceivers can often choose whether to obtain further information about a social target, and their choices will often be based on the valence of their current impression of the target. You might not hold a second conversation with a person if your initial interaction leaves you with the impression that he or she is rude and offensive. Social norms sometimes prevent overt escape from a conversation with a disliked other, but we may choose to converse only about safe, trivial topics such as the weather. Even these more subtle

types of avoidance, though, limit the extent to which we can obtain meaningful, impression-relevant information about the person.

This insight that choosing to obtain information will often depend on impression valence has been part of several recent models. Fazio, Eiser, and Shook (2004) devised a game-like paradigm in which participants choose whether to eat several kinds of "beans." Different beans (distinguishable by visual attributes), if eaten, have positive or negative effects on the player's "energy level." Thus, if initial experiences suggest that a particular type of bean is bad, participants will be unlikely to eat it in the future. If the participant does not eat a bean, no information is obtained about its effects. Fazio et al.'s main conclusion concerns the resulting asymmetry of errors. A mistaken negative impression is unlikely to be corrected (because the beans will not be approached and eaten), whereas a mistaken positive impression will usually be corrected by further experience. In social life, decisions about whether to interact with a target may be driven by category-based perceptions of the target—such as a perceiver's stereotypes—as well as by past experiences with the specific individual. If perceivers use negative stereotypes to guide their decisions about interacting with members of particular categories, the stereotypes will remain unchallenged by concrete experiences (Fazio et al., 2004).

Denrell (2005) formalized this principle in a mathematical model. The valence of the perceiver's impression is represented by a number (with 0.0 being the neutral point). Every time the perceiver interacts with the target, the perceiver obtains an information sample whose valence is drawn from a normal distribution with mean 0.0 and standard deviation 1.0. The perceiver maintains a current impression of the target and updates it after receiving each sample. Finally, the perceiver uses the current impression at each time point to decide whether to sample again from the target (after the very first time point, when the perceiver always samples to form an initial impression). These simple assumptions produce a strong negativity bias: The perceiver's impression will generally be much more negative (averaging −0.82) than the mean of the samples actually provided by the target (0.0). Only a small proportion of the time (13%) does the perceiver end up with a positive impression. The bias arises from the same asymmetry pointed out by Fazio et al. (2004). Because a negative impression discourages further sampling, it will likely remain negative. In contrast, a positive impression will lead to further sampling that may in some cases make the impression negative.

The negativity bias arising from valence-dependent sampling is distinct from the idea that it takes more evidence to disconfirm a negative impression than a positive one (Rothbart & Park, 1986). Valence-dependent sampling means that a perceiver with a negative impression may choose to acquire no evidence at all; no difference in disconfirmability need be assumed to generate this bias.

Denrell's (2005) model has an additional implication: Forced sampling (i.e., obtaining information about a target regardless of one's current impression) will tend to make impressions more positive. This is because on the average the impression is overly negative, so forced sampling exposes the perceiver to information that will generally be more positive than the existing impression. Forced sampling can occur in the real world, with significant social consequences. A prejudiced person who cannot afford to move to a different neighborhood may have to live next to a family of another race. As Denrell's model would predict, even such forced intergroup contact generally reduces prejudice (Festinger & Kelley, 1951; Pettigrew & Tropp, 2006). Of course, multiple processes may contribute to making impressions more positive as the extent of interaction increases. Perhaps most obviously, interaction increases the perceiver's familiarity with the target, increasing liking (Halberstadt, 2006; Zajonc, 1980). Thus multiple conceptually independent processes may explain why impressions based on a larger amount of interaction tend to be more positive.

Bias can be created by a perceiver's decisions about whether to sample, whether the decision is based on valence or any other dimension of the impression. For example, a perceiver may receive information about a target that varies in its stereotypicality (e.g., the target sometimes performs stereotypical behaviors and sometimes counterstereotypical behaviors). Suppose the perceiver is more likely to stop sampling when his or her impression is more stereotypical (perhaps because the perceiver feels that no more information is needed to understand and predict the person). In this case, the perceiver's impression will on average be too stereotypical based on exactly the same logic as the negativity bias: An impression that is overly stereotypical will be less likely to be corrected by further sampling, compared to an overly counterstereotypical impression.

The assumption that perceivers decide whether to seek further information on the basis of their current impressions may hold quite generally. A parallel assumption is found, for example, in Chaiken's (1987) *sufficiency principle*, which holds that perceivers will keep processing or seeking new information only until they reach a subjective threshold of sufficient confidence to make their decision or judgment. Thus, biases due to selective sampling may be widespread; they can occur whenever a particular dimension of an impression (e.g., its valence or consistency with a stereotype) systematically influences the probability of continued sampling.

What Information Is Elicited From the Target

A perceiver's decision to interact with the target is only the first step. Next, perceivers must choose what information to elicit from targets to use in forming impressions. In many cases this amounts to creating information, as in a conversation, that would otherwise not have come into existence at all. Many aspects of the perceiver's own choices and decisions, as well as other characteristics of the perceiver and the setting of the interaction, influence what information is elicited or constructed in this way. These processes generate perceiver effects in SRM terminology.

The perceiver's expectations or hypotheses about the target. Perceivers who expect a target to behave in specific ways (whether the expectations are individualized or due to social category memberships) often elicit behaviors that fulfill those expectations (e.g., Snyder, Tanke, & Berscheid, 1977; Word, Zanna, & Cooper, 1974). Similarly, perceivers may have hypotheses about targets that they seek to test by soliciting relevant information (e.g., Klayman & Ha, 1987). Often they do this by asking questions that would have affirmative answers if the hypothesis is true, such as asking a person hypothesized to be dishonest whether he or she has ever cheated anyone.

The perceiver's goals. A perceiver's goals for a particular person influence what information might be elicited, so a perceiver who wishes to ask the target for a date will act differently (and

elicit different information) than a perceiver who wants to ask the target for help with a work problem. When individuals expect to interact with another person in a short-term, outcome-dependent situation, they pay special attention to individuating information (Neuberg & Fiske, 1987) and seek out information specifically related to the goal at hand (e.g., information about one's accountant's conscientiousness rather than extraversion).

The perceiver's physical characteristics and category memberships. Perceivers who are tall or short, old or young, physically attractive or less attractive, will naturally elicit different behaviors from social targets (Reis, Nezlek, & Wheeler, 1980). Likewise, perceivers' ethnicity, occupation, and gender will influence the ways others behave toward them. For example, Reis, Senchak, and Solomon (1985) found that people's everyday interactions with women were more intimate and personal than those with men.

The perceiver's personality characteristics. Aspects of a perceiver's personality will influence others' behaviors in interaction (Buss, 1987; Mignon & Mollaret, 2002; Thorne, 1987). For example, in a prisoner's dilemma game, someone who is competitive will elicit competitive behaviors from others, even those who would naturally prefer to behave cooperatively (Kelley & Stahelski, 1970). In fact, as Buss (1987) has pointed out, many common terms regarded as personality traits, such as charming, trusted, or fearsome, actually describe the reactions of others to the individual (especially emotional reactions). Perceivers who could be described with such traits will elicit somewhat consistent behaviors from many social targets, influencing the impressions that the perceiver forms.

The context of the interaction. Finally, interactions in different social settings (such as a workplace, dorm room, church, or bar) also constrain social behavior, leading to the formation of different impressions. Someone who knows a target at work, for example, may form the impression that he or she is conscientious on the basis of his or her behavior in that context, but the impression formed by someone who knows the same individual as a social friend might be quite different (Malloy, Albright, Kenny, Agatstein, & Winquist, 1997).

Consistencies in Target Behavior

As we have just described, various attributes of perceivers and the social setting will affect the behaviors that targets display. However, targets also have consistent behavioral tendencies, in the form of personality differences. For the Big Five traits such as agreeableness and conscientiousness, for example, much research establishes that people display a moderate degree of consistency in their behavior (Craik, 2008, chap. 5; Funder, 1999). Kenny et al. (2001) estimated that across various types of social behavior measured in dyadic interactions, on average 31% of the variance represents consistency in the way an individual behaves even with different interaction partners, although an even larger percentage of variance represents unique responses to particular partners (relationship effects). Such behavioral consistencies will produce target effects in the SRM, meaning that different perceivers agree to some extent on who is more versus less agreeable, conscientious, or likable.

How Is the Elicited Information Interpreted?

Finally, once a perceiver decides to interact with a target and elicits impression-relevant information (shaped by the factors just listed), the information must still be interpreted. And even if multiple perceivers received exactly the same information from a target, they would likely interpret it differently, because perceivers view targets through the lens of their preexisting knowledge structures (schemas, stereotypes, exemplars, etc.). An impression is constructed by the perceiver rather than being an unmediated view of the target's characteristics (Gilbert, 1998). Literally hundreds of studies demonstrate this point; as one example, Markus, Smith, and Moreland (1985) showed that perceivers with different self-schemas also differed in their typical perceptions of others. Besides differences between perceivers' social knowledge structures, more transitory situational factors such as the perceiver's power can also influence the way people interpret social information. P. K. Smith and Trope (2006) have shown that occupying a position of power can lead to more abstract, global-level thinking (characterized by more inclusive, superordinate categorization as well as stereotyping; see Fiske, 1993). A low-power position leads to a more concrete, detail-oriented approach to information.

Recent research illustrates how perceiver interpretive processes produce sharp differences in person perception. Mohr and Kenny (2006; see also Park, DeKay, & Kraus, 1994) examined the way that perceivers use *person models* in forming impressions of target individuals. A person model is an integrated interpretation of what a person is like, often expressed as a collection of traits. The researchers had multiple perceivers observe the same videotapes of target behaviors to eliminate any effects of perceiver elicitation biases and found that different perceivers generally come up with two or three distinct person models (incorporating qualitatively different traits and different evaluative tones) for a given target. Once a perceiver adopts a person model for a given target, it is used consistently; operating as an interpretive *schema*, it colors interpretation of future information about the person. Person models can explain both the relatively low consensus displayed by different perceivers in their views of a target person (Kenny, 1994; Park et al., 1994) and the relatively high consistency of a given perceiver's view over time.

Summary

Outside of lab studies, social perceivers typically go beyond simply interpreting a fixed, prespecified body of information: They often choose whether to interact at all and actively elicit information from social targets with which to construct their impressions. Targets' characteristics also account for meaningful variance in the impression-related information that becomes available. Therefore multiple interacting processes affect even the impression formed by a single perceiver of a single target. Valence-dependent sampling will tend to make impressions negatively biased, because perceivers with a negative impression will avoid obtaining further information that might correct their impression. However, processes of elicitation and interpretation may often weaken or reverse that bias. Perceivers will obviously prefer to elicit positive rather than negative information from targets, for example by talking about agreeable conversational topics rather than those that spark disagreement and conflict. In addition, perceivers may in-

terpret the information they elicit using expectations and schemas that cast the information in a positive light (Taylor & Brown, 1988). The overall balance of these processes could tilt either to the positive or negative side, depending on their relative magnitude in a given situation.

Social Perception Processes in Interacting Dyads

Impressions are formed in the course of social interactions, in which social targets are active perceivers as well. Research suggests that the bulk of interaction takes place in dyads (Bakeman & Beck, 1974; James, 1953). Usually either party in a dyad (not just one) can avoid or break off interaction if they find it distasteful and can actively select conversational topics. Both parties are likely to engage in self-presentational strategies to influence the impressions that the other forms of them. In this section we shift focus from the individual perceiver to dyadic interaction, discussing both the decision about whether to interact in the first place and some of the processes that influence impressions within dyadic interaction.

Linked Sampling and the Decision to Interact

Interaction allows each member of the dyad to gain impression-relevant information about the other. Reciprocal sampling (A's obtaining information from B and B's obtaining information from A) is linked, with both parties simultaneously acting as perceivers and as targets. Thus, no longer can A decide whether to sample B only on the basis of A's impression of B (as assumed in Denrell's, 2005, model). How can the two parties' impressions combine to determine whether the interaction will take place? There are three possibilities. First, we could assume that the interaction will occur if either one wants it to. This idea is appropriate in many situations where the two individuals have relatively equal social power and for relatively low-cost social activities such as a brief conversation; people will likely engage in such an activity if the other wants to, even if the individual does not especially want to. A second possibility is that the interaction will occur only if both want it to. An example would be a higher cost activity such as taking a weekend trip together, which people are likely to engage in only if both wish to. The third possibility is that the parties have unequal social power; the more powerful person may be able to decide whether to interact without regard to the other's wishes, as when a boss calls a subordinate in for a talk. In all cases reciprocal sampling is linked (i.e., if the interaction occurs, each obtains information about the other), but there are three possible ways of combining the two individuals' impressions to determine whether the interaction occurs in the first place.

Processes Influencing Mutual Impressions in the Interacting Dyad

As a dyadic interaction allows each participant to sample the other, a whole host of interpersonal processes operate that can shape the two parties' impressions of each other. We can discuss only a subset of such processes here. In general, as we will see, these processes tend to create dyadic reciprocity of impressions and increase the proportion of variance in impressions due to relationships (as opposed to perceiver and target effects).

Responsiveness and synchrony. Interaction often involves embodied processes of the two parties' responding to each other and synchronizing aspects of their behavior (Richardson, Marsh, & Schmidt, 2005; Schmidt & O'Brien, 1997). Responsiveness and synchrony in turn tend to increase positivity (Chartrand & Bargh, 1999). Insko and Wilson (1977) demonstrated that responsiveness during interaction increases liking. They recruited unacquainted students in same-sex groups of three. Students A and B held a getting-acquainted conversation while C sat watching; next, B and C held a similar conversation while A watched. When the students then rated each other, those who had directly interacted liked each other better than those who had simply observed the interaction—even though the observer had access to all the same information and became equally familiar with the person. Mutual responsiveness during interaction is likely to increase dyadic reciprocity of liking. It will also increase relationship variance; as this study suggests, people come to uniquely like those they interact with, instead of having consensual impressions of others based solely on the information they have obtained.

Evaluating the interaction. A conversation or other interaction may be scintillating, informative, and generally enjoyable—or it may be boring, difficult, and generally unpleasant. It is likely that both parties to the interaction will evaluate it in similar ways, although it is possible to imagine exceptions to this generalization (e.g., one partner may enjoy an intellectual debate about political issues while the other hates experiencing face-to-face disagreement). When the partners do share positive or negative evaluations of the interaction, dyadic reciprocity and relationship variance will both increase.

Similarity. Two parties who are getting acquainted tend to search for areas of similarity or overlap (such as shared acquaintances, areas of background, or interests). Finding such areas tends to increase mutual liking (similarity breeds attraction; Byrne, 1971). Thus, discovering similarities (or dissimilarities) will also increase dyadic reciprocity. It will also increase relationship variance in impressions, for targets will be evaluated in systematically different ways by perceivers who have different levels of similarity to the target, rather than being evaluated consensually by all perceivers.

Active self-presentation. Participants in social interaction are likely to actively shape their self-presentation (Leary, 1995). That is, they attempt to portray themselves in positive ways, either by claiming universally positive attributes (honesty, kindness) or by offering agreement with the attitudes (e.g., political views) of the perceiver. People will probably pursue these strategies more strenuously with interaction partners they like, tending to create positive dyadic reciprocity. If A likes B, then A will try harder to present a positive image to B; to the extent that the self-presentation is successful, B will come to like A in return.

The result of all these processes, including linked sampling and the various social and cognitive processes that occur in the course of interaction, will be the formation of a *relationship* between two people. In terms of the SRM, this will be indicated by the presence of stable relationship variance: A's liking for B will tend to have a unique component, differing from A's average or "default" degree of liking for people in general (A's perceiver effect) and from the general extent to which others like B (B's target effect). And the two parties' reciprocal impressions will no longer be independent but will become correlated to create positive dyadic

reciprocity. The more A likes B, the more B will tend to like A, as a consequence of many of the processes just described, such as the mutual discovery of areas of similarity and agreement or shared evaluations of the interaction itself.

Social Perception in the Context of the Social Network

A social perceiver has more than one way of obtaining information about a target. The perceiver may directly interact with the target or may obtain information from other individuals who know something about the target. You may listen to other people's opinions about a new work colleague and use them to formulate your impression of that individual. A major benefit of obtaining information from third parties is that it can be lower in cost than obtaining the information directly for oneself. The principle of valence-dependent sampling means that people may be reluctant to interact directly with others they find unpleasant, but that cost can be avoided by asking third parties about the disliked target.

Surprisingly, the social flow of impression-related information has attracted very little research attention in social psychology (Foster, 2004). For example, with few exceptions (e.g., Collins, Biernat, & Eidelman, in press; Mae, Carlston, & Skowronski, 1999), social cognition research has ignored situations where one person provides information about another, although Kenny (1991) discussed theoretical predictions generated by his weighted-average (WAM) model about the effects of communication on perceivers' consensus about a target. In discussing this phenomenon and its implications we often use the term *gossip*, defined as impressions of an absent third person, usually evaluatively laden, that are communicated between two individuals (cf. Foster, 2004).

Gossip has many functions, not only providing low-cost access to information about others but also allowing individuals to learn about cultural norms and the consequences of norm violation (Baumeister, Zhang, & Vohs, 2004). These multiple functions may explain why estimates of the proportion of naturally occurring conversation that concerns the doings of other people range as high as 70% (Foster, 2004, p. 79). Given its great prevalence, the relative paucity of scientific study of gossip is quite surprising. This is especially true if one considers not only the significant but perhaps secondary impact of gossip on our impressions of close others with whom we interact frequently but also our near-total reliance on secondhand information for our impressions of the perhaps thousands of people that we know more remotely—friends of friends, distant relatives, celebrities, or people in the news (Craik, 2008).

Social Network Structures

To describe the flows of information within a group of people who share their impressions with each other, we need to describe the ways people are connected to each other. In general, if we consider more than a small number of people, the assumption that everyone knows and can interact with everyone else becomes unrealistic. People are linked by patterned social network ties (Wasserman & Faust, 1994)—each person is connected to specific others: his or her friends and acquaintances. These ties give perceivers access to indirect information about people they know through mutual acquaintances and also to information about people they have never met directly, but of whom they may nevertheless form impressions.

The exchange of person impressions as gossip is by definition a form of social influence. When two perceivers share their impressions of a third party, their impressions are likely to become more similar. As Mason et al. (2007) argued regarding social influence in general, the effects of specific microlevel assumptions about impression formation and gossip on the large-scale outcomes that emerge in an entire population depend crucially on the structure of the social network connections. For one thing, network configurations can speed or hinder the convergence to consensus of opinions regarding specific targets (Lyons, Clark, Kashima, & Kurz, 2007; Mason et al., 2007, 2008). The speed with which impressions or other information can reach everyone in the population is influenced by structural properties of the social network (specifically, the average path length, defined as the average number of links that must be traversed to get from one individual to a randomly chosen other). And the presence or absence of network connections between subgroups of perceivers who know a particular target (e.g., work colleagues vs. family members) will influence the extent to which the impressions held by those subgroups are similar or remain highly distinct (Malloy et al., 1997). As these examples illustrate, the structural patterns of social ties among individuals can be just as important as the individual and dyadic processes of impression formation in determining what information each individual has access to, as well as the overall patterns of impressions (e.g., consensus vs. disagreement) in the entire population.

To illustrate the potential effects of social network structure, consider how the network property termed *clustering* might influence impressions. Clustering indexes the proportion of cases in which two friends of a given individual (i.e., B and C, both friends of A) are also friends of each other (so that the network links form a complete A–B–C triangle). High clustering means that information can spread along the B–C link, so that A is likely to receive similar information from both B and C. In contrast, if B and C are not acquainted, they are more likely to provide different information to A. With high clustering, the greater consistency of the information received by A may make A's beliefs or attitudes more confident or extreme. This is because social consensus defines reality for us (Sherif, 1936). When many people share an attitude or belief, it comes to be seen as objectively true, rather than as the potentially fallible view of one individual from his or her limited perspective. Multiple implications might follow from this assumption of validity, including an increased willingness to act or to make decisions based on the impression (Peters & Kashima, 2007). Further, learning that one's impression is shared and therefore valid might naturally lead people to be even more willing to communicate the impression to others, making the flow of information through the network self-reinforcing. Thus, a structural property of the network (clustering) may substantively influence aspects of the impressions that network members are likely to hold—particularly their subjective validity.

Whereas a highly clustered network will tend to provide perceivers with *consistent* information, a network with less clustering provides more *variable* and *diverse* information. If B and C do not know each other, the information they give A represents samples from distinct regions of "social space," potentially increasing its novelty and value for the formation of fleshed-out impressions of

social targets. This is the principle often known as the *strength of weak ties* (Granovetter, 1978): Others who are not members of one's highly clustered core network of close friends and kin can often provide new information that would not otherwise be available. These examples illustrate ways that social network configurations shape not only the speed of information diffusion but also other properties, such as the degree of consensus on impressions within the network. These processes will shape network members' beliefs and behavior, including the behavior of further transmitting information within the network (see Lyons et al., 2007).

Social and Cognitive Processes in Gossip Transmission

Within the social network as the structural context, we turn to considering the social and cognitive processes involved in the communication of person information.

Gossip passes along the source's elicitation and interpretive biases. As discussed above, people have characteristic biases affecting both the types of information that they elicit from social targets and the ways they use their knowledge structures to interpret such information. Thus, the interpretation and elicitation biases of the third-party source will color the impression that is passed along to the social perceiver.

Impressions communicated through gossip are hard to reinterpret. A social source will often provide trait-level interpretations, in effect passing along his or her "person model" (Mohr & Kenny, 2006) expressed as a package of personality trait terms. At times trait impressions may be accompanied by descriptions of specific behaviors. However, although behaviors may in principle be interpreted in multiple, evaluatively distinct ways, it will be extremely difficult for a perceiver who receives a third party's impression to go back to the target's original behaviors and reinterpret them in a different way. For example, a target may be described as dishonest and an occasion when he gave a friend answers on an exam may be recounted. The perceiver might be unlikely to notice that the behavior is ambiguous and could be characterized as helpful as well as dishonest (Carlston, 1994). Of course, if the perceiver hears only a trait impression of the target from a third party, he will lack any access to the original behaviors and would be unable to reinterpret the behaviors from a different perspective or to use them to make judgments about a different trait. The third party's interpretation (influenced by that person's elicitation or interpretation biases) would in effect become frozen and unchangeable at the point where it was communicated to another party. That impression would potentially influence the interpretation of future information about the target. However, learning another's impression may allow a perceiver to reinterpret the target, if both people witness the target's behaviors but interpret them differently (cf. Mohr & Kenny, 2006). In this case, hearing an alternative trait impression may permit each perceiver to reinterpret the target's behaviors. For example, "I thought of him as arrogant and conceited, but now that you mention it, I can see that his behaviors really reflect insecurity."

Socially transmitted information is exaggerated. Not only will gossip-based impressions often be difficult to reinterpret, but research suggests that information systematically changes as it is transmitted through a social network from an initial source to others at second or third hand and beyond. In general, the information is simplified and exaggerated (Baron, David, Brunsman, & Inman, 1997; Gilovich, 1987). Exaggeration is especially likely if members of the network hold a shared expectation about the target, which could arise from a stereotype based on the target's category memberships or from generally observed regularities in the target's past behaviors—for example, common beliefs that women tend to overreact emotionally to events or that Maria has a great sense of humor. Thompson, Judd, and Park (2000) found that information about a target tends to become more extreme in the direction of existing expectations and less variable as it is communicated over increasing numbers of links (i.e., over increasing distance in the social network). Similarly, Lyons and Kashima (2003) found that reports of behaviors that were unexpected drop out of what is communicated, whereas reports of expectation-consistent behaviors remain. One important reason is that sharing stereotype-consistent information (compared to stereotype-inconsistent information) is more effective in linking people together in relational bonds (Clark & Kashima, 2007). All of these processes mean that as information is transmitted ever further through a social network, the impressions will become systematically more unidimensional, simplified, and extreme. On the other hand, Lyons et al. (2007) argued that close, highly clustered network ties (such as those within a family or group of close friends) can transmit more complex types of information such as stereotype-inconsistent behaviors. Some preliminary evidence supports this idea that strong versus weak network ties can mediate the transmission of different types of impression-relevant information.

Gossip as Social Influence: Impressions Become More Similar

Gossip will generally make the participants' impressions of the target more similar, as they each integrate the socially shared trait or behavioral information into their impressions. Other, more subtle, influence processes operate in the gossip situation that will also make impressions more similar. First, communicators tend to slant their report about a target to make it consistent with the audience's known or assumed attitude about the target (Higgins & Rholes, 1978), for example, providing a description that is positively biased when the audience is known to like the target. This biased communication will likely confirm and solidify the audience's existing impression of the target. Importantly, delivering such a biased message can also affect the source's own private attitude toward the target, bringing the source's and audience's attitudes into closer agreement.

Second, Stasser and colleagues (e.g., Stasser & Titus, 1985) have demonstrated a robust tendency of members of decision-making groups to focus their discussion on items of information or evidence that are shared by many group members (compared to information that is possessed by just one or two). We know of no research examining this principle in the domain of gossip, but it is very plausible that when two perceivers with partially overlapping information gossip about a target, they will focus their discussion on the behaviors they both saw (e.g., Joe's wild antics at the party they all attended) at the expense of behaviors of which only one of the perceivers is aware. The focus on shared information will also tend to make the gossipers' impressions of the target more similar.

Third, besides sharing information about the target, gossip may make the gossipers themselves feel close to each other (Clark &

Kashima, 2007; Craik, 2008; Foster, 2004; Peters & Kashima, 2007), especially if they agree (Heider, 1958; Ruscher, 2001). Exchanging secret (or at least not overtly public) information leads the individuals to feel that they are "special" to the other, and if the gossip is negative, they may share a feeling of superiority to the gossip target (Bordia & DiFonzo, 2005). Thus, a gossip session might make two people's impressions of each other more positive, independent of the identity of the target or the content of the information they share. This strengthening of friendship may in turn increase the gossipers' motivation to agree with each other about the target, in accordance with the general principle of homophily (our tendency to like those with whom we agree and agree with those whom we like; McPherson, Smith-Lovin, & Cook, 2001). Consistent with this prediction, evidence shows that two perceivers who are friends (compared to those who are just acquaintances) tend to hold more similar impressions of other people they know (Kenny & Kashy, 1994).

Consequences of Gossip for Accuracy and Bias

What are the implications of gossip transmission in the social network for the accuracy of impressions? In many situations the social sharing of information allows a group to find a desired outcome or problem solution more quickly and efficiently (DiFonzo & Bordia, 2007; Mason et al., 2007, 2008). The gains come through searching in parallel (allowing many potential solutions to be examined at the same time by multiple people) and sharing information between people (allowing solutions that appear promising to be more intensively searched). Models of this sort have been developed both in social psychology (i.e., models of group discussion and problem solving; Stasser & Titus, 1985) and in cognitive science (Goldstone & Janssen, 2005; Gureckis & Goldstone, 2006; Kennedy & Eberhart, 2001). These models show how the sharing of information within the group is helpful in allowing optimal solutions to be found, although other processes such as premature consensus or "groupthink" may keep a group from optimal performance.

In the same way, exchange of information about individuals in a social network allows the group to achieve consensus on impressions of each individual more quickly and efficiently than would be possible if perceivers formed impressions on their own without communication. In addition, the social exchange of impression-relevant information allows each perceiver to aggregate larger amounts of information, leading to the formation of more accurate and reliable impressions than would be possible if each individual was limited to the small and potentially unrepresentative samples of information he or she collected personally (Fiedler, 2000). As Craik (2008) noted, a social network can operate as a distributed surveillance system, monitoring the behavior of members of the network more effectively than a solo perceiver could. This is especially important in the case of rare or concealable instances of negative behavior (cheating, lying, etc.). To take an extreme (but realistic) example, suppose that one is considering entering a romantic relationship with a new partner and is concerned that he or she may be emotionally unstable, and very occasionally (once or twice a year, say) become enraged and physically aggressive. Finding out whether this is true by directly sampling the partner's behavior is extraordinarily costly: One would need to be in the relationship for a year or more to become confident that this negative trait is absent, and one would risk being abused. In contrast, asking others who know the person could be a lower cost way of obtaining this important impression-relevant information.

Just as the beneficial effects of collective decision-making in general are limited by the possibility of groupthink, a shared group impression may prematurely converge to consensus without adequately considering all available information (Mason et al., 2007). This is especially likely if individuals fail to share information that they uniquely possess, focusing instead on discussion of shared information (e.g., Stasser & Titus, 1985). In addition, social flows of information may not improve impression accuracy if the information itself is inaccurate and biased. Many of the individual and social functions of gossip—especially the function of keeping group members aware of the socially significant behaviors of other members, such as their propensities to tell the truth or lie, deal fairly or cheat—depend on the information being at least relatively accurate (Craik, 2008). Correspondingly, some studies have found that rumors are almost always accurate (DiFonzo & Bordia, 2007). But people can also strategically manipulate gossip, spreading false, exaggerated, or unrepresentative information to boost their friends and allies and derogate their rivals and enemies. Presumably people should attempt to protect themselves against such manipulation, for example by discounting negative gossip about a target if it comes (directly or indirectly) from a source known to be an enemy of the target (Hess & Hagen, 2006). Or perceivers may attempt to protect themselves against bias more categorically, by simply discounting others' impressions to the extent they differ from the perceiver's own (Van Overwalle & Heylighen, 2006). This tendency might be magnified if, consistent with the general "better than average" effect (Alicke & Govorun, 2005), most people regard themselves as better than average at judging other people's character, and therefore entitled to rely on their own impressions and to disregard others' if they disagree. We return to these intriguing issues when we discuss correction processes more generally later in the article.

Multiagent Model of Distributed Social Cognition

The previous sections of this article have been theoretical in nature, describing numerous processes (besides the commonly studied perceiver interpretive processes) that influence impression formation, at the levels of the individual perceiver, the interacting dyad, and the social network. The emphasis was on the ways multiple processes operate simultaneously and interdependently, dynamically generating outcomes that may be less predictable and certainly less studied than the results of a single process operating in isolation (as in a highly controlled person-perception study). To examine the outcomes that emerge when multiple processes operate in concert, we turn to multiagent modeling. As described by E. R. Smith and Conrey (2007), a multiagent model incorporates theoretically specified properties of individual agents (representing people), their connections (a social network structure), and their interactions (conversations, social influence, cooperative or competitive moves in a game, etc.). The model can then be run to generate predictions about the overall patterns of behavior in the entire population of agents, such as the patterns described by Kenny's (1994) SRM.

Multiagent modeling can be applied in several ways to achieve distinct research goals. In one approach, researchers can identify

an empirically observed pattern of data, such as the typical configuration of impressions in small groups of people, measured by questionnaires and described using the SRM (Kenny, 1994). Then a variety of detailed microspecifications of individual agent behavior and interactions can be tried, to see which one(s) successfully reproduce the known overall pattern. In a different approach, a multiagent model can be used in a more theoretical and exploratory fashion, conducting "thought experiments" to map out the implications of different postulated microlevel specifications. The model may generate novel, counterintuitive patterns of outcomes that can be tested by further empirical studies. We focus on the second approach in this article, although where possible we reference existing research results that are reproduced by our model.

Our multiagent model will be presented in stages, sequentially adding distinct processes. However, the model incorporates only a subset of the theoretical processes discussed in the article: valence-dependent sampling by individual perceivers, linked sampling in interacting dyads, and the transmission of impressions as gossip in the social network. This is not for reasons of programming difficulty; additional processes would be technically easy to add. The reason is more fundamental: to keep the multiagent model simple enough (limited to perhaps three or four independent conceptual principles) that its behavior can be understood. As many modelers have argued (summarized in E. R. Smith & Conrey, 2007) a model that seeks to incorporate all the complexity of the real world risks becoming so complex that its behavior is no more transparent than the real-world effect under investigation. Only by limiting the model to a few of the most theoretically basic processes will the results end up generating insight rather than confusion. As we will see, even this limited set of processes interact to generate novel and counterintuitive outcomes.

It is also important to recognize that the theoretical processes discussed in the first part of this article combine to generate rich, qualitative trait-based impressions as well as evaluations, but the multiagent model (like the SRM) uses a univariate conception of impressions—in this case, only evaluation. Although evaluation is a central dimension of any impression (Osgood et al., 1957) and is especially important in determining whether interaction will occur at all, in the future it would be desirable to model impressions in a more complete manner.

Active Social Perception Processes in the Individual Perceiver

The multiagent model assumes that each individual perceiver uses valence-dependent sampling. We adopt most of Denrell's (2005) assumptions and parameter values. Every time the perceiver interacts with the target, the perceiver obtains an information sample whose valence is drawn from a normal distribution with mean 0.0 (an assumption we will change below) and standard deviation 1.0. The perceiver maintains a current impression of the target and updates it after receiving each sample, using a weighted average. Denrell specifies a 0.5 weight based on the fit to empirical data, as outlined in his article. Therefore the new impression is 0.5(the old impression) + 0.5(the new sample obtained from the target). Finally, the perceiver uses the current impression at each time point to decide whether to interact again with the target (after the very first time point, when the perceiver always samples to form an initial impression). Using a Luce choice function, the probability of sampling is

$$\frac{e^{C + S(\text{impression})}}{1 + e^{C + S(\text{impression})}}$$

where the parameter C specifies the baseline probability of sampling (Denrell uses 0.0) and S affects the sensitivity of the sampling decision to the current impression (Denrell uses 3.0). With these parameters, for a negative impression with valence –1.0 the sampling probability is .047; for –0.5, it is .18; and for a neutral impression of 0.0 the sampling probability is .5. For a positive impression of 0.5 the sampling probability is .82 and for 1.0, it is .95.

We use a population with an arbitrary size of 20 agents, each serving as both a perceiver and target. In this baseline version of the model that incorporates only valence-dependent sampling processes, at each time tick each perceiver uses its impression of every other agent to decide whether to sample that target agent, and if it does sample, it updates its impression of that specific target. This model with a mean of 0.0 should replicate Denrell's (2005) reported results, for each of the 20 × 19 or 380 perceiver–target dyads. In fact, the model does produce a mean impression of –0.33 after 10 ticks and –0.80 after 1,000 ticks, closely replicating Denrell's mathematical results. The model results after 40 ticks, the arbitrary value we use throughout this article, are reported below. All tabulated results are averages of 20 independent runs (as well as averages across all 20 agents within each run).

From a social psychological perspective, it is unrealistic to assume a mean valence of 0.0 for information provided by other people—our encounters with other people are presumably interpreted as positive more often than negative (Matlin & Stang, 1978; Taylor & Brown, 1988). In addition, perceivers differ in their elicitation and interpretation biases, and targets stably differ in their social behavior. For all these reasons, we modify Denrell's (2005) assumption of an invariant mean of 0.0 for information samples. Instead, we incorporate perceiver and target effects in the model. We assign each agent a perceiver effect and a target effect, each independently randomly drawn from a rectangular distribution between –0.5 and 0.5. When perceiver A samples target B, the sample is drawn from a normal distribution with $SD = 1.0$ and $M =$ (overall impression mean + A's perceiver effect + B's target effect). For example, A might be a perceiver who generally likes people a lot (a positive perceiver effect), whereas B might be someone whom others generally dislike (a negative target effect). For the overall impression mean in all further modeling results to be reported, we use 0.25 although the basic findings hold across a range of mean impression values.[1] People on average are probably more positive than negative, and the choice of 0.25, as the mean implies that 75% of targets will yield samples with a positive expected value.

The first columns of Table 1 show results of this version of the model, which we term *onesided* (meaning that each agent decides independently whether to sample every other agent on the basis of

[1] Model runs with means of 0.0, 0.25, 0.50, and 1.00 find that in all cases the average impression is more negative than the actual mean, although the magnitude of the negativity bias decreases as the mean increases. If the mean was high enough that perceivers always sampled, there would be no bias.

Table 1
Results of Model Using Three Types of Direct Sampling

Variable	ONESIDED		EITHER		VETO	
	M	*SD*	*M*	*SD*	*M*	*SD*
Average impression	−0.321	0.101	0.076	0.130	−0.170	0.114
Average *N* of samples (40 trials)	16.764	1.301	30.807	1.967	8.546	1.657
Correlation of impression with *N* samples	0.704	0.028	0.428	0.078	0.362	0.052
Mean sample seen from those sampled	0.315	0.071	0.249	0.103	0.286	0.104
SRM perceiver variance	0.176	0.055	0.110	0.026	0.164	0.032
SRM target variance	0.159	0.036	0.115	0.031	0.144	0.035
SRM stable relationship variance	0.300	0.038	0.086	0.037	0.462	0.050
SRM unstable relationship variance	0.223	0.029	0.302	0.021	0.128	0.024
SRM generalized reciprocity	−0.002	0.042	0.027	0.029	−0.027	0.028
SRM dyadic reciprocity	−0.006	0.034	0.056	0.038	−0.154	0.069
Generalized accuracy	0.957	0.014	0.917	0.037	0.956	0.019
Dyadic accuracy	0.601	0.046	0.341	0.048	0.766	0.046

Note. Runs have $M = 0.25, 0$ social sampling. SRM = social relations model.

its current impression). As predicted, there is a substantial negativity bias with impressions averaging –0.32 (much lower than the actual mean of 0.25). Holding such negative impressions, perceivers sample on fewer than half of the possible trials (16 out of 40). Note that by preferentially sampling targets of whom they hold a positive impression, perceivers actually obtain samples averaging about 0.3, better than the overall mean, because target agents stably differ in the mean samples they produce.

The table also shows results of using the SRM to analyze impressions generated by running the model, The model-generated impressions are recorded at two time points, allowing for the separation of relationship variance into stable relationship variance and error (unstable) variance (Kenny, 1994, p. 241). By using the SRM in this way we are able to see the consequences of the model's assumptions, translated into terms (such as variance proportions and correlations for generalized reciprocity and dyadic reciprocity) that match those used to report results of empirical studies (e.g., Kenny et al., 2001). The SRM analysis shows substantial perceiver and target variance, which were directly built into the model's assumptions. But there is substantial stable relationship variance as well. This is an emergent outcome from the model, for no relationship effects are built in (i.e., targets do not provide uniquely positive or negative information to specific perceivers, over and above the general perceiver and target effects). Relationship variance appears because the actual samples provided by a target to different perceivers vary randomly, creating differences in impressions. And the relationship variance becomes stable (rather than unstable, or error variance) because perceivers with negative impressions tend to cease sampling that target, leaving their impressions fixed. Supporting this explanation, if valence-dependent sampling is turned off so all perceivers sample on every time tick, there is little stable relationship variance. In other words, stable relationship variance is an emergent implication of the model under these assumptions, unlike perceiver and target variance, which are directly built in.

We also report two measures of the accuracy of the impressions generated by the model (Kenny et al., 2007). One measure is *generalized accuracy*, an indication of how well perceivers' average impressions match the actual behaviors of targets. This is defined as the correlation between the consensual reputation of each target (i.e., the average impression of one agent held by the other 19 agents) with the average behaviors actually generated by that target across all interactions. It answers the question, if target T behaves positively toward other people in general, is the average impression others hold of target T positive? The second measure is *dyadic accuracy*, a measure of how well a perceiver's unique impression of another agent corresponds to the way the other behaves with that specific perceiver. Dyadic accuracy is measured in terms of deviations from average: It is the correlation across all perceiver–target pairs of the perceiver's unique impression of the target (i.e., the relational component of the impression) with the target's unique behaviors toward that perceiver. This answers the question, if target T behaves more positively toward perceiver P than T does toward other perceivers in general, will P have a correspondingly uniquely positive impression of T?

Surprisingly, the results in the first columns of Table 1 show high levels of generalized accuracy— higher than dyadic accuracy. How can this be? Because there is meaningful target variance in actual behaviors, targets' average reputations (impressions averaged across all perceivers) reflect the behaviors and attain high generalized accuracy. Dyadic accuracy is limited because (as just noted) relationship variance in actual behaviors is not built into the model. Because of their lack of consistency over time, differences in actual behaviors of targets toward particular perceivers are only weakly reflected in those perceivers' unique impressions of the targets. However counterintuitive the model's prediction of general accuracy exceeding dyadic accuracy may be, it is matched by actual findings. In a study of impressions of interpersonal aggressiveness among school children, Kenny et al. (2007) found substantial generalized accuracy but no evidence of dyadic accuracy. Thus, if perceivers generally agreed that one child was aggressive, it was generally true that that child aggressed against others more than average. But if perceiver P viewed target T as especially aggressive, it was generally not the case that T acted especially (uniquely) aggressively toward P.

Summary

Perceivers differ systematically in the valence of the information they elicit from targets and the interpretations they make of it. Similarly, targets differ systematically in the valence of the information they produce when prompted by active social perceivers. Along with valence-dependent sampling, these processes create perceiver and target variance in the impressions in terms of the SRM. Stable relationship variance emerges as well, even though it was not directly built in as a model assumption. However, to this point the impressions are one-sided. John may like Mary to a unique extent (above and beyond his tendency to like people in general and her tendency to be liked by people in general). However, this "onesided" version of the model involves no interdependence between John's liking for Mary and Mary's liking for

John—because we have not yet introduced the processes that operate in interacting dyads.

Social Perception Processes in Interacting Dyads

With "onesided" sampling a perceiver's decision about whether to sample from a target was based purely on the perceiver's current impression of that target. We now introduce two alternative ways to link sampling in a dyad, as discussed in the theoretical part of this article. EITHER is the rule that both agents will interact and sample each other if either one unilaterally wishes to, based on the valence of its own impression of the other. This might correspond to a relatively low-cost or casual social activity (such as a brief interaction with someone in the hall) that will generally take place if either person wishes it to. Note that with the EITHER rule, an agent can be forced to sample even if it would not individually choose to do so. VETO is the rule that both agents will interact and sample each other only if both wish to sample; no forced sampling can occur. This rule might correspond to a higher-cost social activity (such as a visit to a friend in a distant city) that will generally not take place unless both partners wish it to.[2]

The results of these conditions are shown in Table 1. Both ways of linking sampling between a pair of agents reduce the overall negativity of impressions compared to the one-sided sampling case; the impression is more positive with EITHER than with VETO. The average *N* of samples differs greatly across the cases, with EITHER having a considerably larger *N* than ONESIDED and VETO about half the *N*. Obviously, sampling is more likely to take place when either agent can force it than when both agents must agree to sample. Correlations of impressions with the number of samples are reduced, because in either case there are additional constraints on whether a sample is drawn besides one's own impression of the target.

SRM perceiver and target variances are in the 0.11–0.18 range. The total amounts of relationship variance are similar in the three cases, but partitioning it into stable and unstable components reveals marked differences. The differences, however, may have much to do with the differences in the number of samples across the three cases. Sampling changes an agent's impression of another. Therefore, if fewer samples are made within a period of time the impression will change less, so the proportion of variance that is stable will be higher. For this reason, interpretations of the stable versus unstable components of relationship variance should probably be made only between conditions where the number of samples is relatively similar.

The most interesting aspect of these results is the emergence of dyadic reciprocity in the SRM estimates. With ONESIDED sampling this correlation was near zero, but it was positive for EITHER and negative for VETO. The EITHER sampling model allows forced sampling (an agent receives a sample from an interaction partner even if its negative impression of the partner would not lead it to sample on its own). Forced sampling tends to make impressions more positive on average (Denrell, 2005). This process means that A's positive impression of B can force B to sample from A when they interact, driving B's impression more positive and creating a positive correlation between the reciprocal impressions (Denrell & Le Mens, 2007).

In contrast, in the VETO condition, no forced sampling can occur. The reason for negative dyadic reciprocity can be intuitively grasped by considering the 2 × 2 combinations of A's positive/negative impression of B, crossed by B's positive/negative impression of A. With the VETO sampling rule, in the three cells where one or both impressions are negative, further sampling will be unlikely. Thus, any agent pair that falls into one of those cells through their initial samples will tend to become "stuck" there. In contrast, a pair of agents in the positive/positive cell will continue to sample from each other, leading to further movement and perhaps in some cases a shift to a different cell. The net result is that more agent pairs will be in the other three cells than in the positive/positive cell, producing negative dyadic reciprocity.

Summary

When processes of interdependent interaction in dyads are taken into account as well as cognitive processes within individual perceivers, interdependence between reciprocal impressions is created. For example, we earlier discussed active self-presentation and similarity-induced liking, which will tend to make A's liking for B relatively similar to B's liking for A, creating positive dyadic reciprocity. Although those processes are not in the multiagent model, linked sampling—the fact that interaction allows both parties simultaneously to obtain information from the other—can also generate dyadic reciprocity. However, the seemingly minor difference between interaction that occurs if either party wants it and interaction that occurs only if both parties want it turns out to reverse the sign of dyadic reciprocity. This effect is counterintuitive, illustrating the value of multiagent modeling.

Additional processes not included in the multiagent model are likely to make dyadic reciprocity generally positive. These processes, as discussed earlier, include mere familiarity, discovery of similarity or dissimilarity between agents as they interact, and motivated self-presentation, among others. The effects of these additional processes make it extremely unlikely that negative dyadic reciprocity would be found in a real group of people who interact and form impressions of each other. However, the model's prediction that dyadic reciprocity should be relatively more positive in the EITHER than in the VETO condition does stand as an intriguing and testable hypothesis.

Social Perception in the Context of the Social Network

The third stage of our multiagent model introduces the social flow of information through gossip. With regard to the social network structure, initially we assume that each of the 20 agents is able to interact with all other agents; we consider alternative assumptions later. A probability parameter controls the extent of

[2] A third rule, ASYMM, is also possible: One of the two agents controls whether the interaction will take place; the other agent's impression is irrelevant to the decision. This corresponds to a social situation in which one agent holds power over the other and can unilaterally decide whether the two will interact. Results of multiagent modeling using this rule are not shown, because it essentially represents a mixture of the ONESIDED sampling rule (for the more powerful agent, whose impressions unilaterally control whether interaction occurs) and the EITHER rule (for the less powerful agent, for whom sampling will take place on the basis of whether the other agent wishes). Therefore, model results fall in between those two conditions.

social sampling. At each time tick, after each pair of agents decides whether to sample each other according to one of the rules described earlier, social sampling may occur. With a fixed probability (we use the value of 0.4), a perceiver agent selects a third-party source (not the perceiver or the target) to inform the perceiver about the target. The perceiver then integrates the source's impression of the target into the perceiver's own impression, using a weighted average process with a weight of 0.5. This value is logical for two reasons. (a) It reflects the idea that on average, the third-party source will have just as much information and just as valid an impression of the target as the perceiver does, so the two impressions should be equally weighted. (b) This is the same weight used in direct sampling to update an agent's impression based on information directly obtained from a target. Thus, as a result of social sampling the perceiver's new impression is 0.5(perceiver's former impression) + 0.5(third-party source's impression).

Will people actually shift their impressions that much toward the impression communicated by a third party? Of course the 0.5 coefficient assumed here is arbitrary and somewhat smaller values could be substituted. But research in many domains shows that people routinely conform, moving their attitudes and beliefs toward those expressed by others (Mason et al., 2007). There is little conformity research specifically on person impressions, but one study found that people rely on gossip from others even when they also have direct information about the target's behaviors (Sommerfeld, Krambeck, Semmann, & Milinski, 2007). And evidence in related areas such as stereotyping and prejudice also suggests that other people's beliefs and attitudes exert a powerful impact on one's own (Crandall & Eshleman, 2003; Sechrist & Stangor, 2001).

The model assumes that the third-party source provides its actual impression of the target. That is, the model assumes that gossip is not biased (strategically or as the result of other types of person-perception or attributional processes). An alternative assumption might be that sources give extremitized or exaggerated reports of their impressions (Gilovich, 1987). For example, a source might report its actual impression of the target times a parameter greater than 1.0, to give exaggeratedly positive reports about its "friends" (agents for whom it has positive impressions) and exaggeratedly negative reports about its "enemies." This assumption is not in the baseline model, but we briefly report some of its effects later. Nor does the model incorporate the idea that gossiping (exchanging information about a third party) makes two people like each other more— gossip results in only the perceiver's impression of the target being updated.

How does the perceiver select the third-party source? There are three possible approaches. (a) The source can be selected randomly from among all agents other than the perceiver and target. (b) The source can be the agent of whom the perceiver has the most favorable impression (corresponding with the idea that people often gossip with their friends). (c) The source can be the other agent who has the most information about the target (i.e., the largest number of samples of the target's behavior), corresponding with the idea that people often seek out information from others who are well placed to have a lot of information about the target of gossip. Runs reported here show only random social sampling. Results from all three are generally similar, except that the third condition produces somewhat more positive overall impression means. Because impression valence tends to correlate with the number of samples, selecting the source with the most information automatically leads to positively biased impressions of the target.

Table 2 presents model results showing the effects of social sampling, with a randomly chosen third-party source. The model assumes that direct sampling between perceivers and targets is independent (the ONESIDED condition). The most interesting aspect of these results is that social sampling makes the average impression more positive. But with random choice of a social source, on average the third party will have an impression of the target that is as negative as the perceiver's own. It would be natural to assume that given the negativity bias created by valence-dependent sampling, gossip would simply spread those negative impressions around. The effect might even be assumed to be self-reinforcing, as others who hear secondhand negative information about a particular target then refuse to interact with that target themselves. How then can social sampling make the average impression less negative? The answer is that as social sampling spreads information more widely within the group, it gives each individual perceiver access to samples of information originally obtained by other agents as well as those obtained directly by the perceiver. A larger sample of information must more closely approximate the true mean of the distribution produced by target agents (which is 0.25 in these runs), reducing the negativity bias.

Table 2 presented the effects of social sampling in the simplest conditions, with ONESIDED sampling. Tables 3 and 4 show the effect of social sampling with the other types of direct sampling (EITHER and VETO). In these cases as well, social sampling makes the average impression more positive. This is especially true for ONESIDED and VETO direct sampling, where no forced sampling takes place and average impressions (without social sampling) were especially low. Social sampling also slightly increases the number of direct samples and makes the impression less strongly correlated with the number of direct samples. This is because socially provided information contributes to the impression independent of the direct samples.

Table 2
Results With Different Amounts of Social Sampling, With ONESIDED Rule for Direct Sampling and RANDOM Choice of Social Source

	0.0		0.4/RANDOM	
ONESIDED	*M*	*SD*	*M*	*SD*
Average impression	−0.321	0.101	0.026	0.105
Average *N* of samples (40 trials—direct only)	16.764	1.301	20.214	2.231
Correlation of impression with *N* samples (direct only)	0.704	0.028	0.550	0.077
Mean sample seen from those sampled	0.315	0.071	0.308	0.090
SRM perceiver variance	0.176	0.055	0.028	0.007
SRM target variance	0.159	0.036	0.131	0.038
SRM stable relationship variance	0.300	0.038	0.061	0.027
SRM unstable relationship variance	0.223	0.029	0.191	0.022
SRM generalized reciprocity	−0.002	0.042	0.003	0.014
SRM dyadic reciprocity	−0.006	0.034	−0.003	0.019
Generalized accuracy	0.957	0.014	0.905	0.049
Dyadic accuracy	0.601	0.046	0.231	0.041

Note. Runs have $M = 0.25$, ONESIDED direct sampling, RANDOM social sampling. SRM = social relations model.

Table 3
Results With Different Amounts of Social Sampling, With EITHER Rule for Direct Sampling and RANDOM Choice of Social Source

	0.0		0.4/RANDOM	
EITHER	*M*	*SD*	*M*	*SD*
Average impression	0.076	0.130	0.183	0.109
Average *N* of samples (40 trials)	30.807	1.967	32.891	1.727
Correlation of impression with *N* samples (direct only)	0.428	0.078	0.358	0.054
Mean sample seen from those sampled	0.249	0.103	0.265	0.089
SRM perceiver variance	0.110	0.026	0.046	0.013
SRM target variance	0.115	0.031	0.114	0.023
SRM stable relationship variance	0.086	0.037	0.045	0.018
SRM unstable relationship variance	0.302	0.021	0.236	0.024
SRM generalized reciprocity	0.027	0.029	0.015	0.017
SRM dyadic reciprocity	0.056	0.038	0.010	0.024
Generalized accuracy	0.917	0.037	0.923	0.031
Dyadic accuracy	0.341	0.048	0.197	0.043

Note. Runs have $M = 0.25$, EITHER direct sampling, RANDOM social sampling. SRM = social relations model.

Social sampling also has several more subtle effects. It reduces perceiver variance in impressions (generated by unique elicitation and interpretation biases), because gossip allows each perceiver to obtain information that has been elicited and interpreted by others. Stable relationship variance is also decreased, for the same reason: Perceivers are influenced by other agents' impressions of the target, so the uniqueness of their own impressions is diluted—impressions become more consensual. Dyadic accuracy and dyadic reciprocity also become lower in absolute value, for the same reason. Still, target variance remains constant, reflecting the fact that targets give off consistent information to all social perceivers. And generalized accuracy remains high.

Overview of Multiagent Model Results and Implications

Despite including only a subset of the theoretical processes described in the first part of this article, the multiagent model shows that when processes at the levels of the individual, the dyad, and the social network interact over time, they generate several notable results.

1. In the "onesided" version of the model including only valence-dependent sampling, the average impression was much more negative than the actual information perceivers received from targets. This matches results from Denrell's (2005) mathematical model.

2. Impression valence correlated with the number of samples, even though the model did not include other processes (such as mere familiarity) that might contribute to such a correlation.

3. The impressions show not only the perceiver and target effects that were built into the model assumptions but also stable relationship variance that emerges from the variability of the actual information samples and valence-dependent sampling processes.

4. The model shows that generalized accuracy (correlation of consensual impressions with target effects) is higher than dyadic accuracy (correlation of uniquely positive or negative impressions with the target's unique behavior toward the particular perceiver). This matches empirical results from Kenny et al. (2007).

5. Linked sampling (the assumption that both parties' sampling becomes interdependent in an interaction) makes impressions less negative, especially when interaction is assumed to take place when either agent wishes it.

6. Two different ways of linking sampling (EITHER vs. VETO rules) produce opposite effects on dyadic reciprocity, which is positive for EITHER and negative for VETO.

7. Social sampling makes the average impression less negative, even when the third-party social source is chosen randomly so that source has, on average, the same negatively biased impression the perceiver has.

8. Social sampling also changes several aspects of the SRM results: less perceiver variance, less stable relationship variance, and lower levels of dyadic reciprocity. However, target variance remains relatively unchanged.

9. Social sampling also contributes to making generalized accuracy greater than dyadic accuracy.

Some of these model results are surprising. Probably the three most counterintuitive or "emergent" findings are (a) the opposite effects of linked sampling with the EITHER and VETO rules on dyadic reciprocity, (b) the finding that social sampling with a random source (whose impression must be on average just as negative as the perceiver's own) actually reduces the negativity bias, and (c) the finding of higher generalized than dyadic accuracy

Table 4
Results With Different Amounts of Social Sampling, With VETO Rule for Direct Sampling and RANDOM Choice of Social Source

	0.0		0.4/RANDOM	
VETO	*M*	*SD*	*M*	*SD*
Average impression	−0.170	0.114	0.098	0.084
Average *N* of samples (40 trials)	8.546	1.657	12.058	1.607
Correlation of impression with *N* samples (direct only)	0.362	0.052	0.371	0.069
Mean sample seen from those sampled	0.286	0.104	0.322	0.071
SRM perceiver variance	0.164	0.032	0.023	0.009
SRM target variance	0.144	0.035	0.136	0.033
SRM stable relationship variance	0.462	0.050	0.061	0.023
SRM unstable relationship variance	0.128	0.024	0.146	0.020
SRM generalized reciprocity	−0.027	0.028	0.000	0.015
SRM dyadic reciprocity	−0.154	0.069	0.000	0.014
Generalized accuracy	0.956	0.019	0.918	0.020
Dyadic accuracy	0.766	0.046	0.224	0.037

Note. Runs have $M = 0.25$, VETO direct sampling, RANDOM social sampling. SRM = social relations model.

(even in the absence of social sampling). Without the multiagent modeling results, it would have been extremely difficult to intuitively predict that these results would emerge.

Despite their counterintuitive nature, some of these results are consistent with research findings on actual person impressions. As noted earlier, greater generalized than dyadic accuracy is also found with real perceivers and targets (Kenny et al., 2007). Other model results have not been examined in existing research and stand as predictions that should be tested. This is especially true for the prediction that more positive dyadic reciprocity is expected when interaction takes place when either party desires it, compared to when interaction takes place only if both desire it. If the model's prediction is confirmed, it would suggest that in the real world, social interactions should be structured so that they occur when either party desires (the EITHER condition) rather than only when both parties desire (VETO). High dyadic reciprocity (produced by EITHER) is a recipe for relational satisfaction within a group of people; it means the people you like probably like you. In contrast, lower levels of dyadic reciprocity (especially if the sign is actually negative, as generated by the model using the VETO rule) will produce only frustration, as people find that those they like do not particularly like them. More generally, confirmation of model-generated hypotheses in future research would provide strong support for the heuristic value of the multiagent modeling approach applied to active social perception.

In some cases the model results match familiar and well-documented patterns in real social perception but do so for novel reasons. For example, the model predicts a positive correlation of impression valence with the number of samples from a target. Any social psychologist would likely attribute this finding to mere exposure processes (Zajonc, 1980). However, the process of exposure-induced familiarity producing liking is not in the model; the correlation arises in the model through a completely different mechanism (valence-dependent sampling). As another example, the positive dyadic reciprocity found in the EITHER condition might naturally be attributed to similarity-based liking. But again, that process is not in the model, which instead generates dyadic reciprocity based on the properties of linked sampling. In these and other instances, the multiagent model reminds us that observed patterns in populations do not necessarily arise from the most obvious and straightforward underlying processes (Kalick & Hamilton, 1986). Instead, a particular pattern of outcomes in a population as a whole might be generated by several substantively different sets of assumptions at the micro level, setting an agenda for future research to determine the respective contributions of the distinct processes.

These results illustrate how even a small subset of the theoretical processes described in the first part of this article can combine to produce a range of emergent results. The multiagent model includes only three basic processes: valence-dependent sampling decisions and impression updating within each individual agent, linked sampling in dyads, and social sampling or flows of gossip within the entire population of agents. But when these simple processes interact dynamically over time in a population of agents that are simultaneously perceivers and targets, the complexity of the resulting interactions means that it is not possible to generate the implications through unaided human intuition. Multiagent modeling becomes necessary for a full understanding of the consequences of our theoretical assumptions (E. R. Smith & Conrey, 2007).

Model Extensions

Several potential directions for extension of the multiagent model are described briefly here, although space does not permit presenting the model revisions and the resulting impression patterns in any detail.

Alternative network structures. The model results reported above assumed that all agents are connected to each other (so each can directly sample every target agent and use any other agent as a social source). We can explore the effects of alternative network specifications where only certain agents are connected, when the model incorporates gossip (social sampling) that allows agents to form impressions of others to which they are not directly connected. We investigated three alternative types of networks (see Wasserman & Faust, 1994), all with degree 6: a lattice or local network, a random network, and a small-world network with randomness parameter 10%.[3] We describe here a sample of the results, with the EITHER interaction rule and 0.4 probability of social sampling. First, we never found large differences between agents' average impressions of targets they were connected to and targets they were not directly connected to; this is not surprising because in the latter case the impressions are based on the impressions of others who are directly connected to the target. The most notable effects of the different network specifications are found in the SRM variance decomposition. Compared to the all-connect network, other networks have less perceiver variance and more target variance, as well as more stable relationship variance and less unstable relationship variance (error variance). These patterns reflect the fact that in the model, information obtained directly from a target is highly variable (with a standard deviation of 1.0). In contrast, information from a social source is more stable (if several perceivers all learn the impression of a target from a given source, they all receive exactly the same information). Therefore, in networks where not everyone is directly connected, impressions are more consensual (show more target variance) because many agents' impressions are based on the same limited information obtained from the few social sources who are actually connected to the target. Impressions have lower perceiver variance because perceivers do not interact directly with most targets, removing any opportunity for their elicitation and interpretation biases to operate and influence their impressions. And impressions have more stable relationship variance but less unstable relationship variance (or error) because as already noted, information obtained from social sources is more stable than information obtained directly from a target. These runs suggest, as emphasized by Mason et al. (2007) in the area of social influence, that the pattern of network connections can affect the overall pattern of results just as much as the assumed processes within each individual agent.

[3] In a lattice network, all 20 agents are conceptually arranged in a circle and each is connected to its 3 nearest neighbors on either side (for a total of 6 links). In a random network with degree 6, each agent is connected to 6 randomly chosen other agents. The small-world network is constructed from the lattice network just described by rewiring a small percentage (10%) of all links from neighbors to random agents.

Social tuning. The baseline model changes only the perceiver's impression of the target when a third party offers gossip information. Real communicators "tune" their descriptions of targets toward the known attitudes of their audience, influencing the communicator's private impression of the target as measured later (Higgins & Rholes, 1978). Thus, we could assume that gossip causes both the third party's and the perceiver's impressions to converge, rather than the gossip influencing only the perceiver. Limited simulation runs indicate that this model modification has little qualitative effect, other than speeding the convergence of impressions within the group.

Other processes creating positive dyadic reciprocity. In the current model dyadic reciprocity emerges solely as the result of mechanisms of linked sampling using the EITHER or VETO rules, as described above. The model can be extended to incorporate other factors creating dyadic reciprocity, such as self-fulfilling prophecy, or the assumption that each interaction generates a random positive or negative outcome that is integrated into each party's impression of the other (i.e., if we have fun when we're together, we each like the other more). Limited exploration suggests that this modification also has little overall impact other than, obviously, making dyadic reciprocity more positive.

Exaggeration of gossip. A final potential modification is to assume that third parties transmit in gossip not their actual impression of the target, but the impression times a parameter greater than 1.0, to give exaggeratedly positive reports about "friends" (agents for whom the impression is positive) and exaggeratedly negative reports about "enemies." We tested a parameter value of 1.3 and results show strikingly complex effects. In the conditions without forced sampling (ONESIDED and VETO), impressions become highly polarized, showing great variance and a skew toward positive values. For example, average impressions of the 20 targets might include about 15 that range between 2 and 10 and about 5 that are –20 or below. (In the absence of exaggeration, average impressions almost always have absolute values less than 1.) Obviously, although exaggeration is relatively slight in a single gossip session, the effect grows geometrically as information is transmitted through the social network from person to person. The effect of exaggeration is much more limited in the EITHER condition, as forced sampling tends to keep impressions more closely anchored in the actual samples provided by the targets.

Other extensions. A variety of other extensions of the model invite exploration. The agents could be assumed to be members of two groups. Then (as in Kenny's, 2004, PERSON model) impressions can be analyzed into components representing a group stereotype versus characteristics of the specific individual. Agents can be assumed to be more willing to interact with ingroup members than with outgroup members, or social networks can be assumed to have connections mostly within groups. The effects of these assumptions on the emergent patterns of intergroup cognition and behavior can be investigated. Another possible direction for extension is to relax the assumption that interaction is always dyadic, although the bulk of interaction does appear to take place in dyads (Bakeman & Beck, 1974; James, 1953). A challenge is to model the conditions under which interaction takes place, beyond the dyadic EITHER, VETO, or ASYMM rules discussed here. For example, if A is talking with a friend B, and C walks up who is a friend of A but is disliked by B, will the interaction continue or will B choose to leave?

Research Strategies for Validating the Model

Multiagent models can generally be validated in two different ways (E. R. Smith & Conrey, 2007): Research (often controlled laboratory studies) can test the model's microlevel assumptions about individual agent behavior and agent interactions, or studies can measure naturally occurring outcomes in populations to compare with the model's overall patterns of predictions. Future research should take both of these approaches with regard to the DSC model. First, lab studies can examine many of the model's assumptions. For example, to see whether gossip influences impressions, several participants could be brought into the lab and exposed to impression-relevant information about target persons (either real people or experimenter-constructed, controlled stimuli). Then they could exchange information about their impressions, allowing the researchers to assess how much each participant's impression is affected by others' impressions. Extensions of this design could examine conditions under which gossip has larger or smaller effects (e.g., when it is positive or negative, when it comes from someone the perceiver knows well or only slightly, when it comes from someone who interacts with the target in the same or a different social context).

Turning to the other approach, many studies have used the SRM to obtain estimates of variance partitioning, levels of dyadic reciprocity and impression accuracy, and so forth in real groups that interact over time (such as students sharing dorm suites). Computational explorations will allow searching for model parameters that can reproduce such real-world patterns, and to the extent that is possible, it offers a different type of validation evidence for the model.

Implications of the Distributed Social Cognition Perspective

Perceiver Correction Processes

Throughout this article we have discussed many sources of bias that can influence perceivers' impressions of social targets. For example, valence-dependent sampling generates a negativity bias in impressions; perceiver elicitation and interpretation processes bias the information they obtain from a target and the way they make sense of it; and gossip can be intentionally manipulated or unintentionally biased. Can social perceivers become aware of these biases and actively attempt to correct for them (cf. Wegener & Petty, 1997)? What are the implications for the accuracy of impressions?

Negativity Bias Due to Valence-Dependent Sampling

Denrell (2005, p. 963) has persuasively argued that it would be difficult for an individual to understand and correct for the negativity bias in impressions created by valence-dependent sampling. On the other hand, if people have the insight that a target can provide varying samples so integrating more information would generate a more reliable impression, they can use a simple heuristic to at least reduce the bias. That is, perceivers could decide that they need more than just one or two samples before making a negative decision. A simple version of this heuristic might be to give a target "three strikes" before declaring it "out" (i.e., to keep sampling until there have been three negative experiences, rather

than stopping whenever the overall impression is negative). This idea is similar to the "social judgeability" principle identified by Yzerbyt, Schadron, Leyens, and Rocher (1994), in which perceivers refrain from making negative judgments about social targets until they have a subjectively adequate body of relevant information.

However, it may be difficult for people to implement such a heuristic and refrain from making negative judgments on the basis of initial negative information. At least in domains related to morality (e.g., honesty, prosocial orientation), people regard negative behavioral information as highly diagnostic (Reeder & Brewer, 1979). One or two negative behaviors are likely to produce a strong and compelling impression of the target's negative character, making it unlikely that perceivers will withhold judgment in the interest of obtaining further samples.

Perceiver's Own Elicitation and Interpretation Biases

Perceivers' characteristic elicitation and interpretation biases shape the impressions they form of other people. Because these biases create consistency in the perceiver's experience, it will be difficult for perceivers to become aware of them. In general, instead of thinking "I tend to see people as generally trustworthy," perceivers are likely to be naive realists (Griffin & Ross, 1991), concluding simply "people are generally trustworthy." Indeed, studies demonstrate that people do not tend to see themselves as influencing target's behaviors even when the influence is clear and obvious (Gilbert & Jones, 1986). Hence, they are unlikely to attempt to correct for these self-induced biases.

When people obtain information from third-party social sources, it becomes more likely that they could be aware of, or try to correct for, the third party's elicitation or interpretation biases. A perceiver might have an opportunity, for instance, to compare two third parties' impressions of a common target and to realize that they see the same person very differently. Intuitively, it seems possible that social perceivers might be able to reason in ways like "Karen doesn't like John, but Karen doesn't like assertive men much in general—so maybe John is not as bad as she says." We know of no relevant research.

Extent of Third-Party Source's Information Base

Information from a third-party source can be integrated with information that the perceiver directly obtains from the target to obtain a fuller picture. However, perceivers may not know whether the source's portrayal of the target is based on a mere superficial first impression or many years of acquaintanceship. People cannot be expected to have a clear picture of everyone's relationship closeness or degree of familiarity with everyone else in a group of more than moderate size. This is because the number of relationships $[N(N-1)/2]$ grows quadratically with the group size. For example, in a 30-person group each individual has to keep track of his or her own relationships with only 29 others, but there are 435 possible dyadic relationships within the group (870 if it is desired to understand separately how A feels about B and how B feels about A). Therefore, perceivers may not know how well everyone knows everyone else in the group and may have difficulty deciding on an appropriate weight to give the source's report relative to the perceiver's own impression. However, in some instances the source may indicate their degree of confidence in their impression, allowing perceivers to weight it appropriately.

Two complications arise. First, although perceivers no doubt intuitively expect that greater acquaintance with a target means greater accuracy in impressions of the target, this intuition turns out to be incorrect. Kenny, Albright, Malloy, and Kashy (1994) found that consensus among perceivers in their judgments of targets did not increase with the perceivers' length of acquaintance with the targets. This finding means that accuracy does not greatly increase with acquaintance, because accuracy would imply increasing consensus. The Kenny et al. (1994) finding suggests that perceivers should not generally weight impressions from social sources by the source's amount of knowledge about the target, for amount of knowledge seems to have little relation to accuracy. If perceivers do weight impressions by the amount of knowledge, they will create systematic errors.

Second, a third party may interact with a target in a different context than the perceiver does (contexts such as work, social settings, or family life). Malloy et al. (1997) found good consensus about social targets from people who knew them in the same social context such as work or family but much less agreement about the targets across contexts. Thus, if you are interested in forming an impression of a work colleague, information from a third party who knows the person as a friend may be systematically different from your own impressions. The friend's impression may help you form a fuller, more complete impression of what the target is like as a person, but on the other hand, the friend's impression is unlikely to be as helpful in predicting how you will perceive and experience the target in the work context. We return to this issue later.

Possibility of False Third-Party Reporting

Gossip can be accurate or inaccurate. How can a perceiver tell whether a source is giving his or her honest impression of a target (albeit influenced by the source's perceptual and interpretive biases)? Perhaps the source is trying to strategically exaggerate or mislead the perceiver. One potential clue is the source's relationship to the target (e.g., close friends or rivals; Hess & Hagen, 2006), although as already argued people cannot know all of those relationships in many real cases where group sizes are large. The source's relationship to the perceiver is also important. Is the source a good friend who will be honest with me or someone who might be trying to manipulate me? Successful manipulators have to avoid being obvious, so perceivers cannot always know these things either.

These considerations imply that a perceiver P, in order to properly interpret information provided by a source S about a target T, may *recursively* need (a) an impression of the personal characteristics of S as well as (b) some knowledge about the S–T relationship and also (c) the S–P relationship. Obviously, there is the possibility of an infinite regress here. Further, some or all of S's information about T may have been obtained from yet other social sources, possibly traversing multiple links of the social network. In this case any correction would require not just knowledge about specific individuals and their relationships but a more general understanding of principles governing the flow of reputational information through networks—such as the way information is filtered to become simplified and stereotypic. As a last resort to

eliminate the possibility of being misled by biased gossip, a perceiver might choose to rely solely on his or her own observations of the target, refusing to incorporate any third-party information into the impression. But that approach removes not only potential bias but also a vast reservoir of potentially valid and useful information about the target, as well as about others' reactions to the target.

Instead of any of these options, it seems likely that perceivers will mostly follow the heuristic of taking third-party reports at face value, unless some highly salient cue alerts them to the possibility that information is being strategically supplied for ulterior motives (Hilton, Fein, & Miller, 1993). Indeed, people tend to believe and act on gossip even when they also have access to direct observations of the target (Sommerfeld et al., 2007). Empirical evidence suggests that reputations are generally accurate, based on studies that compare impressions of a target person reported by friends and acquaintances to criteria such as the target's self-report or personality tests (e.g., Funder, 1999; Sommerfeld et al., 2007; see Craik, 2008, chap. 5, for a review). Anderson and Shirako (2008) recently found a consistent correlation between individuals' reputations within their social groups and their directly observed behavior, although the relationship was stronger for targets who were better known in their community. Two studies have examined the same question (in Kenny's terms, *generalized accuracy*) and found such accuracy to be substantial (Kenny, Kieffer, Smith, Ceplenski, & Kulo, 1996; Kenny et al., 2007). However, studies of reputational accuracy all measure reputations among perceivers who are directly connected to the target in the social network. Virtually no research has examined the accuracy of impressions held by perceivers who are separated from the target by two, three, or more network links (Craik, 2008), but their accuracy would be expected to be lower (Lyons & Kashima, 2003; Thompson et al., 2000).

Summary

In general, it appears that it is extremely difficult for perceivers to be aware of and to correct for the various sources of bias that can affect their impressions (Wegener & Petty, 1997). This is true even in the simplest situation with one perceiver and one target, and the difficulty is multiplied for biases that affect socially provided information that has traversed an unknown chain of third parties through the social network. Simple heuristics may be helpful in some instances, but they are likely to be difficult to apply or to risk increasing the chances of other types of bias and error. Given these difficulties in correcting biases, should we expect shared impressions of people to be at all accurate? Although manipulation and less intentional biases can inject false information into the social network, the available evidence, as just noted, suggests that reputations are generally substantially accurate. Thus, the overall gain from information aggregation (Fiedler, 2000) may outweigh the typical sources of bias.

What is the Purpose of Forming Impressions?

Our model assumes that perceivers make use of impressions passed along from third parties, and this assumption raises the issue of the underlying purpose of our impressions. Do we maintain impressions of others for the pragmatic purpose of predicting that person's interactions with us and our own personal reactions to the target (Swann, 1984)? Suppose Mary always behaves in a particular way when John interacts with her, whether because of her own impression of John, because of John's personal characteristics, or because of the context (e.g., work) in which they interact. John's impression of Mary is likely to be adequate for him to understand and predict her behavior, as well as to plan his own actions toward her. In other words, for these pragmatic purposes perceivers may not want or need to correct for perceiver-induced constraints or constantly present contextual factors that may influence their impressions. However, John's impression of Mary may not be equally useful for Karl, to whom John communicates it, because Mary may behave quite differently with Karl.

With this point in mind, what can a social perceiver usefully learn from social sources? Karl is probably not interested narrowly in what John thinks about Mary. Rather, Karl wants to figure out from John's impression (and what Karl knows about John as a person, John's relationship with Mary, the context in which John encounters Mary, etc.) the implications for what Karl can expect in his own interactions with Mary. We face again the question of the underlying nature and purpose of an impression of a person. Is it narrowly a representation of how the person acts *with me* and how I act *with him or her*? Swann (1984) argued that people can often attain this limited form of accuracy in their impressions of those they know in everyday life. And as just argued, gossip might be of limited utility in constructing such an impression. In contrast, a different view is that an impression is intended to be a broader representation of "what the target is really like" as a person, not just how the perceiver personally experiences the target. Gossip or impressions of the target gleaned from other perceivers might be useful input for constructing such a more general representation. And a more general, viewpoint-neutral impression would be useful for predicting how others will react to the person. For this purpose, efforts at correcting for our own elicitation and interpretation biases, contextual influences, and the like might be more worthwhile. However, our ability as social perceivers to make such corrections is questionable, as discussed above.

Although the issue has not been studied, we believe that perceivers often form and maintain both of these types of impressions: representations of their own personal reactions to the target as well as the typical or average reactions of others (in other words, the target's general reputation). The simple agents in our multiagent model do not do this; when obtaining third-party information they simply integrate it into their own impressions in the same way as they integrate directly obtained information. But at least in some cases, real social perceivers represent both of these separately, meaning that we might be able to report "everybody seems to like Sandy but I think she's a total snake" (or the reverse). A conceptual parallel is found in the theory of reasoned action (Fishbein & Ajzen, 1975), which holds that people maintain separate representations of their attitude (their personal feelings about an attitude object) and a *subjective norm* (important other people's feelings about the object). Both of these contribute independently to people's behavioral intentions.

Our hypothesis that social perceivers often maintain separate representations of their own impressions and the target's general reputation is based on the idea that such dual representations might be useful in at least three ways. One is simply the ability to predict others' behaviors toward the target. Independent of your own feelings about the target (say, a hypothetical woman), knowing the

reputation is useful for estimating whether others will invite her to parties, choose to work with her on committees, and so forth. A second reason is the ability to socially tune when discussing the target with others, shaping one's communications to reflect the attitudes of the audience (Higgins & Rholes, 1978). Such social tuning contributes to feelings of closeness with the audience (Clark & Kashima, 2007). Finally, perhaps the most important reason is to hedge one's bets, keeping alert to the possibility that one's own impression might prove wrong and the group consensus prove to be actually correct. We can imagine a continuum. At one end is a perceiver who believes strongly that his own negative impression of the target is correct, while maintaining in the back of his mind the possibility that he has misinterpreted her behaviors and that the more positive social consensus about her might be valid. At the other end is a perceiver who accepts that the consensual impression is valid, while remaining aware that his personal experiences with the target are different (e.g., more negative) than others report.

There appears to be virtually no research on several intriguing issues raised by these considerations. Do people maintain separate representations of their own impressions of others and of those others' consensual reputations, as we hypothesize? If so, do both representations independently influence behavior toward the target, as suggested by the parallel case of attitudes and subjective norms contributing to behavioral intentions in the theory of reasoned action? Do our representations of others' reputations correspond to what other social perceivers actually think about the targets (Craik, 2008, chap. 5)? A fascinating possibility is pluralistic ignorance: Everyone might think that most people like a target, while recognizing that they personally do not. This pattern might be maintained by social tuning (Higgins & Rholes, 1978). As people slant their communications about the target to match the positive attitude that they assume others to hold, it would falsely confirm others' belief that positive impressions are consensual and therefore that their own personal negative impressions are deviant (cf. Lyons et al., 2007). Questions like these can be framed only when we consider person perception not as a task performed by isolated individuals but as a distributed process in the overall social network.

Conclusions

Researchers have often studied specific component processes of person perception, such as the inference of traits from observed behaviors, by isolating them in highly controlled laboratory studies where the process of interest operates uncontaminated by other processes that might mask its effects. This strategy of isolation and control has been fruitful in generating detailed knowledge about the properties of specific processes but is less suitable for advancing understanding about how multiple interacting processes dynamically shape impressions when dyads and groups interact over time. Empirical studies of person perception in more naturalistic environments (including many studies that have used the SRM framework), as well as multiagent modeling approaches that examine the effects of multiple interacting processes over time (E. R. Smith & Conrey, 2007), are more helpful for gaining this broader understanding. Across many substantive topic areas, such research strategies often reveal complex, unpredictable, counterintuitive patterns that emerge from the interaction of lower level microprocesses over time and over multiple interacting agents (Kenrick, Li, & Butner, 2003; Macy & Willer, 2002; Resnick, 1994). These two research strategies of isolating single processes versus examining interactions of many processes in context naturally complement each other. As knowledge about the details of individual process pathways cumulates, we are better able to understand how multiple interacting processes generate the overall patterns of person impressions or other outcomes found in naturalistic situations.

We hope that this article contributes to the study of person perception in two ways. First, our literature review makes clear that although some processes relevant to distributed social perception have been intensively researched (e.g., perceiver interpretive processes), others have been virtually ignored (perceiver elicitation biases, linked sampling in social interaction, gossip and the ways perceivers incorporate it in their impressions, efforts to correct gossip). We hope that this article will spur empirical and theoretical attention to such relatively neglected areas. Second, our multiagent modeling results display several intriguing and counterintuitive patterns, listed earlier, which stand as new hypotheses for future empirical exploration.

Substantively, we believe that the most novel and heuristic aspect of the DSC model is its incorporation of gossip, or flows of impression-relevant information through social networks. Our approach takes impression formation as a product of distributed cognition, enabled by collective elicitation, filtering, and pooling of information, as well as social influence processes that shape people's responses to impression-relevant information spreading through the social network (Mason et al., 2007). Because these processes cause impressions to be more or less widely shared through the social network, DSC stands as a model not of an *individual's* impression of a single target but of *patterned social reputations* of multiple targets. Neither gossip nor reputation have been much studied within social psychology (Craik, 2008; Foster, 2004). This is surprising considering their importance in defining the social context (e.g., of general admiration or disapproval by others) in which we move through our lives, as well as their functionality in norm enforcement and social control. Reputation may even prove to be a key locus of cultural differences; where members of individualist cultures place the most emphasis on their own self-concept, members of collectivist cultures might be expected to value reputation (the view of the individual held by those linked to him or her in social networks) above all (Heine, 2001). We hope that the DSC model advances understanding of the interplay of individual social–cognitive processes and collective processes of information sharing and integration, as they jointly contribute to the evolution and mutual influence of individual representations of others and socially distributed reputations.

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