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Review article

Understanding the mental roots of social perceptions and behaviors: An integrated information-processing perspective

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ABSTRACT

Crick and Dodge's (1994) social information processing (SIP) model asserts that SIP –the mental processes activated when humans encounter social situations and need to produce a response - is a strong predictor of social behavior. However, because SIP measurement is typically limited to conscious, explicit, and subjectively-reported responses, current SIP research may not capture the subtlety of this internal process, and critical components may remain obscured. Accordingly, the present essay takes an information processing perspective to propose ways to assess currently unattended levels of processing that could further our understanding of the mental mechanisms driving social information processing and consequent social behaviors. We focus on four levels of analysis that offer a thorough inspection of the ways by which social representations evolve. First, we discuss the interplay between implicit and explicit processes in SIP affecting social perceptions and behaviors. Second, we distinguish between perceptual and post-perceptual components of encoding and interpretation of social scenarios. Third, we discuss the evolvement of social representations over the course of processing. Finally, we look at the combined effect of prior knowledge and the actual sensory evidence in real-world situations. With terms and advanced methods borrowed from cognitive psychological research, this general perspective offers a more refined model of SIP that may better account for a wide range of social decision making and behaviors.

1. Introduction

For more than two decades, Crick and Dodge's (1994) social information processing (SIP) model provides a robust theoretical foundation that enables a better understanding of the mental processes that precede human behaviors. Using primarily interviews and self-reports, SIP research produced consistent results exemplifying how more adaptive SIP contributes to better social skills (e.g., Nelson and Crick, 1999), and, on the other hand, how specific *biased SIP patterns* (e.g., hostile attribution bias) contribute to maladjusted social behaviors, and, in particular, aggression (e.g., Dodge et al., 1990; Lansford et al., 2006; Martinelli et al., 2018; Ziv, 2012).

However, there is a gap between the SIP model's theoretical foundation and its typical assessment methods – interviews and self-reports. In particular, the model discusses automated social-cognitive processes that evaluate, categorize, and impute the meaning of social information and then feed conscious and controlled judgment and decision processes associated with the production of behavior. Such automated processes are likely to remain unattended when interviews and self-reports are used. Additionally, self-report methods are not built to separate low-levels encoding mechanisms from higher-level behaviorally relevant ones, confounding critical aspects of encoding and interpretation, such as response criteria and biases, with later response decision stages. Given the wealth of evidence for individuals, at all ages, being unconscious of the knowledge conveyed in their implicit responses, methods tapping all processing levels are crucial.

This was indeed acknowledged by Crick and Dodge (1994) that stated that to gain profound insight into SIP, there is a need for the use of "techniques for assessing automatic processes…that are common in cognitive psychology to the study of social behavior" (p. 79). They furthered that findings from studies using traditional self-report measures to assess social information processing "may underrepresent the magnitude of processing problems that are displayed by maladjusted children in automatic responding" (p. 79). Surprisingly, however, their call to examine both automatic and reflective processing was only rarely answered in the more than two decades that passed since their article (but see Horsley et al., 2010; and Wilkowski et al., 2007, for some isolated examples).

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Accordingly, the purpose of this article is to suggest several specific techniques used in cognitive psychology research that are designed to elicit automated, unconscious responses. Using these techniques in the study of SIP is likely to extend our understanding of the mental processes at the roots of social reactions.

In what follows, we provide a short account of the information-processing approach in cognitive psychology, its influence on Crick and Dodge's social information processing approach, as well as what we perceive as limitations in current social information processing research. We then propose some novel approaches to study these processes that go beyond explicit references and reflective processing of information and evaluate the ways by which information is processed without conscious or deliberate regard. Taking an information processing perspective, we aim to suggest an integrated approach to the study of social information processing, incorporating recent advanced techniques to multi-level analysis of information-processing. We focus on several possible levels of analysis of SIP that offer a thorough inspection of the way representations evolve, both in terms of their time-course in the mature brain and during development over the years. We then claim that recent advanced models of information-processing and specifically the Bayesian probabilistic inference model may offer a well-established theoretical and empirical platform for implementing this multi-level analysis in SIP research that could significantly enhance our knowledge of the mental processes contributing to social behavior. This knowledge is important not only theoretically, but is highly practical as it could inform clinical and educational programs aiming to reduce aggressive behaviors on the one hand and help produce more prosocial behaviors on the other.

2. The roots: information processing theories

Information processing theories became a dominant force in psychology in the middle of the 20th century (e.g., Broadbent, 1958; Miller, 1956; Newell and Simon, 1972; Newell and Simon, 1976; Treisman, 1964; Simon and Newell, 1971). Influenced by the development of computer sciences during that period, these theories metaphorically equated human information processing to that of a computer. Like a computer, they claimed, the human mind receives countless inputs from the environment and produces outputs. Because there are limits to the brain's capacity to process information, selection processes filter the incoming information. Thus, some information will be more efficiently encoded, stored, and retrieved when producing an output, whereas other information will be inefficiently processed and not readily available for retrieval (Miller, 1956; Treisman, 1964).

These new perspectives have led to a major shift in psychological science to define and measure internal mental processes. Novel and creative definitions of these processes emerged, paying increasing attention to testing that goes beyond explicit reference and conscious processing of information towards developing experimental settings investigating the extent to which information can be encoded without conscious or deliberate reference. With this aim of scrutinizing mental processes, rather than just considering their products, new approaches also made significant advances in tapping the microgenesis of the cognitive process, revealing the way mental representations unfold during processing. Important distinctions have been made between the first stages of encoding and those occurring later, presumably involving higher-level and post-perceptual processing (e.g., decision processes, response biases). This complicated interplay has recently been formalized as a Bayesian reasoning process that views the brain as a probabilistic prediction inference device (see Parr et al., 2018 for a discussion on utilizing Bayesian framework to understanding a range of psychological behavior). This forms the final percept as the interaction between the probabilistic prediction and sensory evidence such that a given sensory evidence (e.g., a person smiling) may be interpreted differently, depending on the contextual information available (you would most probably give it a positive valence unless you learn, for example, that this person has just saw someone crash into her car, at this point you might add sarcasm to your interpretation). Social cues may produce noisy and even ambiguous scenes. As such, perceivers' interpretation of these scenes is often constrained or altered by other information sources than the actual sensory input. This may be highly relevant in complex social exchanges in which probabilistic inference about others' intentions is very likely to predict behavioral outcomes. By adopting this inferential framework, researchers can formally model social cognition - one's ability to understand and think about one self's and others' mental states in social situations.

3. Social information processing

The information processing perspective has greatly influenced the study of social cognition. New social information processing models emerged, emphasizing the specific internal components involved in the processing of social inputs. The most influential social information processing model was introduced by Crick and Dodge (1994). In their seminal article, these scholars introduced a multi-step, non-linear circular model of social information processing. Like the earlier general information processing approaches, the newly formed SIP field was built on the notion that social adjustment is better understood in the context of the covert mental mechanisms mediating the association of an overt social stimulus and an overt social response.

Whereas Crick and Dodge's model is influenced by several models that come from the fields of social, developmental, and clinical psychology (e.g., Bandura, 1977; Bowlby, 1969; Shank and Abelson, 1977), the description of the specific SIP steps seems to be more clearly rooted in the aforementioned classic information processing theories. The model includes six steps that are theorized to be activated whenever individuals encounter social situations: (a) encoding of social cues; (b) interpretation of these cues; (c) clarification of goals; (d) response construction; (e) response decision; and, (f) the behavioral enactment of a response (Crick and Dodge, 1994). Although the different steps are sequential, they are also considered to act in parallel, i.e., individuals are likely to be always engaged in each of the processes steps simultaneously.

A basic assumption of the model is that social information processing is driven by a database of mental representations of social behavior. This database includes the memory storage of past situations, acquired social rules, social schemes, and knowledge of appropriate and inappropriate social actions. Thus, individuals rarely encounter new social situations as a "clean slate." Instead, they hold a set of existing assumptions, commitments, and restraints that shape how they perceive social information. This assumption was reinforced in previous research showing strong associations between early exposure to adverse experiences and later negatively-biased SIP patterns and behaviors (e.g., Dodge et al., 1990; Martinelli et al., 2018; Ziv, 2012), and, on the other hand, in children exhibiting prosocial behaviors, who were found to process social information through what was described as a "rose colored eyes" (Nelson and Crick, 1999).

However, some prevailing questions about the nature of processing remain unattended in previous SIP research. For example, what do individuals do when they receive disconfirming social cues? Do they pay more or less attention to such cues? Do they ignore them? The limited information existed in SIP research is from studies of aggressive individuals (e.g., Dodge and Frame, 1982; Dodge and Somberg, 1987) who suggests that the answer to this question could change as a function of circumstances (e.g., aggressive boys tend to attribute more hostile intents to others when they perceive the situation as threatening to them) and the database (e.g., aggressive children are also more likely to be the target of aggression from their peers). These findings suggest that measures focused on the final product (e.g., the child's response to a specific universal question about a social scene) may not be sensitive enough to detect possible changes in the database as they unfold.

3.1. Measuring SIP

Multiple measures were developed over the last two decades to examine the validity of the SIP model (e.g., Dodge and Price, 1994; Kupersmidt et al., 2011; McKown et al., 2009; Schultz et al., 2010; Van Rest et al., 2014; Ziv and Sorongon, 2011). Although they may emphasize different aspects, they are all based on similar principles: presenting individuals with different social scenarios and ask them to interpret these scenarios and make decisions about possible responses to these scenarios. The other social agents' intents in these scenarios are typically portrayed as ambiguous and thus could be interpreted in different ways. These measures are instrumental in identifying different conscious responses and connect them to specific predictors (e.g., the quality of the parent-child relationship) and outcomes (e.g., social behavior). However, they are not built in a way that allows for the consideration of all possible components of SIP that may well be part of the underlying mechanism. For example, by merely considering the final subjectively reported products, several stages of the model, encoding and interpretation in particular, often fail to separate low-levels encoding mechanisms from higher-level behaviorally relevant ones. In other words, current SIP measurements seem to lack sufficient attention to various levels of mental processes feeding SIP. In what follows, we detail what we perceive as overlooked processing levels that may comprise SIP, discussing what we believe are the critical analyses necessary for uncovering the whole process and how they can affect our understanding of the mental origins of social behaviors.

4. Four unattended levels of information-processing in current SIP research that could increase understanding of the cognitive origins of social behavior

4.1. Implicit and explicit processes

Research focusing on implicit perception suggests perceivers are not aware of all aspects of sensation and perception, and that implicit perception does not merely reflect a weaker form of the same explicit mechanisms. The evidence goes far beyond the effects on early processing, demonstrating substantial processing without awareness that may influence higher cognitive functions (e.g., Hannula et al., 2005). Critically, conscious perceptual influences typically override unconscious ones when both are present so that unconscious perceptual effects may be obtained most reliably only when conscious perception is completely absent (Snodgrass et al., 2004). Taking this to our case in point, SIP traditional measurements, in which individuals are explicitly asked about their interpretations of hypothetical social situations can only reveal the individual's conscious responses and may not be enough to reveal the full mental process.

Frith and Frith (2008) discuss the distinction between implicit and explicit processing by suggesting two levels of social cognition. First, there are lower-level processes that are fast and rigid. These processes are automatic and implicit and occur with no conscious control. Then, there are higher-level explicit processes that are slower to develop, more flexible, and are the result of a conscious and reflective decision-making process. Examples from studies on prejudice, mentalization, and fear conditioning, demonstrate that *implicit processes do not only differ from explicit processes, but they may also function independently*. Moreover, research shows that implicit processes could be oppositional to the conscious strategies that surface later and interfere with them, such as in the case of gaze-following and imitation (Frith and Frith, 2008).

Of particular relevance to our case, a few empirical studies address the implicit, automatic processes that may govern social information processing in social situations. Tracking patterns of eye-movements of observers during socially-based tasks, these studies provide findings that challenge SIP's traditional hypotheses. Specifically, the model implies that individuals tend to pay *less attention* to social cues inconsistent with their initial scheme. In the case of aggression, for example, that means that aggressive children will pay *less* attention to non-hostile cues. However, Horsley and colleagues (Horsley et al., 2010) found that aggressive children tend to focus their attention *more* on non-hostile cues than to hostile cues but still attributed more hostile intents to others than their non-aggressive peers. Relatedly, in a study examining attention to hostile and non-hostile cues in young adults, Wilkowski and colleagues (Wilkowski et al., 2007) reported that whereas individuals low on trait anger showed no differences in their gaze time on hostile and non-hostile cues, *individuals high on anger tended to gaze significantly longer at non-hostile cues*. One possible interpretation suggests the involvement of top-down decision processes, in which individuals pay more attention to cues that contradict their preexisting perceptions but eventually make conscious decisions that are in agreement with their schemata (Horsley et al., 2010). Other interpretations, however, may involve automated social cognitive processes that evaluate and impute the meaning of social information, leading to short-lived transitional behaviors that remain undetected because of the aggregated nature of the analysis. The different interpretations point to other possible mechanisms that should be thoroughly explored by revealing all components feeding conscious and controlled judgment and decision processes in social situations.

4.2. Perception and post-perception processes

Encoding and interpretation of incoming information also involve another well-established distinction between perceptual and post-perceptual processes that are known to be affected by biases and decision-making factors (e.g., Lynn and Barrett, 2014). Altered mechanisms of encoding and interpreting social information may thus involve either change in perceptual sensitivity (e.g., an enhanced ability to recognize facial expressions associated with aggression: anger and fear) and/or altered biases and decision-making processes (e.g., a tendency to attribute anger or fear to ambiguous facial expressions). The latter is an essential aspect of encoding and interpretation that has hardly been tested in SIP research. If we take aggression as an example, since the SIP model assumes that aggressive individuals encounter new social situations already "armed" with prior aggressively-biased social schemas, these possible effects of the post-perceptual process on the final subjectively reported response of an individual could be significant. Testing only the final representations may thus oversight the altered mechanisms. Moreover, studies fail to separate these earlier encoding mechanisms (perceptual and post-perceptual) from later, behaviorally relevant ones. This led to confounding critical aspects, such as response criteria and biases affecting encoding and interpretation, with later stages of the decision process evaluating the relevance and the significance of this information to generate a behavioral response.

The few studies that tested the role of post-perceptual processes in interpreting social stimuli suggest alternations at both processing levels. Specifically, these studies examined attention biases to different facial expressions in children and adults with a history of exposure to maltreatment and abuse (Gibb et al., 2009; Pine et al., 2005; Pollak and Kistler, 2002; Pollak and Tolley-Schell, 2003), and found that exposed individuals interpret ambiguous expressions as angry more than their non-exposed peers. These findings are consistent with the knowledge about maltreated individuals' tendency to attribute hostile intent as well as to prefer maladjusted (aggressive or inept) responses in ambiguous social scenarios (e.g., Dodge et al., 1990; Dodge et al., 1995; Schwartz and Proctor, 2000; Ziv, 2012). This may suggest a specific mechanism for the circular SIP model in which prior experiences modify biases to depict certain types of information from the environment but do not indicate to what extent perceptual sensitivity – the ability to detect subtle changes in the environment (i.e., changes in the emotional expression) - is also affected. The important question of how experiences may shape encoding and interpretation over the years may earn considerably from incorporating fine-tuned tools to disentangle *perceptual sensitivity* from *biases* and decision criteria.

One of the well-established tools has been offered by the signal detection theory (SDT), an analytic approach for describing decision-making performance in a wide variety of domains, ranging from the perceptual to the conceptual (e.g., Lynn and Barrett, 2014). It has been applied to tasks ranging from simple perceptual decisions (was it an emotional expression on that face or was it neutral?) to cognitive judgments relying on memory (was that a familiar expression?) to meta-cognitive reports about one's own decisions (was my recognition of the expression correct or incorrect?). SDT models an internal decision criterion that depends on the strength of evidence for each choice option (e.g., emotional expression vs. neutral expression). This decision variable is corrupted by noise in the stimulus and by internal noise in the perceptual system. To make a decision, a person selects a criterion value of the decision by which to judge which choice option was more likely to have generated the internal decision variable. The major strength of SDT is its ability to separate a person's sensitivity to the relevant information from his decision rule, or criterion. For example, in a scenario in which a person must discriminate a happy expression of a face from a neutral expression, SDT separates the person perceptual sensitivity to the face expression (measured by d-prime or d') from his possible tendency to report either happy or neutral expression (measured by c, for criterion). This is important, because the tendency to report a given facial expression can be influenced by many factors that are unrelated to perceptual sensitivity. As these decision strategies are independent of the perceptual sensitivity, SDT appropriately separates these two factors that determine behavior, unraveling the different possible underlying mechanisms.

4.3. The evolvement of social information processing over time

Representations of social events are likely to evolve and change over time. Social information processing is dynamic, with a reasonable possibility that different computations may dominate at different time points throughout information processing. Thus, SIP research could benefit from a microgenetic analysis, which, in contrast to traditional approaches, allows us to directly observe change processes and short-lived transitional behaviors that would otherwise remain undetected when data analysis relies on a more aggregated approach.

Microgenetic analysis of perceptual information processing indeed suggests the evolvement of different representations over the course of processing (e.g., Hadad and Kimchi, 2006). Consider the case of hierarchical visual displays, in which a global shape is composed of local elements. The visual system seems to sample the world in a coarse-to-fine fashion, with rapid global and coarse processing guiding, in a top-down manner, the subsequent extraction of higher, more detailed representations (e.g., Bar, 2003). Of particular relevance to SIP, microgenetic research shows that, as time passes, social problem-solving strategies evolve to become more accurate (Kuhn et al., 1995). This suggests that change is not a simple replacement of a less adequate representation with a more adequate one. Instead, less adequate representations continue to compete with the prevailing representations, and, indeed, the more formidable challenge appears to be abandoning the old rather than acquiring the new representation.

Furthermore, research in perception and cognition suggests that processes mediated by areas higher in the brain are not deferred until inputs from basic processes mediated by lower areas penetrate to the system's higher levels. Tracking this change process may reveal the whole set of representations and their interactions, thus allowing more robust predictions of the model. Therefore, it is essential to track the time course of these different processing levels while determining the way they interact to produce the final interpretation. To the best of our knowledge, microgenetic approaches were never used in SIP research. Yet, because such methods are likely to detect subtle within-person evolutions in response to challenging social scenarios, their utilization in SIP study is expected to contribute another layer of understanding of the mental processes that contribute to or withhold social behavior. For example, the evolvement of withholding aggressive responses by an otherwise aggressive person in challenging social situations is essential to better understand the underlying mental mechanisms of aggressive behaviors and to construct interventions that take into account not only the final product (i.e., aggressive behavior) but also the mechanisms that enabled or suppressed the final product.

4.4. Interaction of top-down and bottom-up processes

Advanced theories modeling perceptual processes and general information processing offer a robust theoretical and empirical platform for systematically testing the relative role of early, low-level, and later, higher-level processes in producing the final interpretation. If we accept the approach that treats social cognition as an information processing system (while at the same time accepting the "distinctiveness" of social cognition), we can apply these recent advanced approaches to multi-level analysis of information processing to SIP research. One of the prevailing models is the Bayesian decision theory, a principled method of reasoning under uncertainty that defines perception as an active unconscious inference leading to the "best guess" about the structure of the world. In recent years, this concept has been formally developed to model the statistically optimal combination of noisy incoming evidence (i.e., the sensual experience) and prior knowledge (i.e., schemes of knowledge stored in memory often manifested in biases, expectations and contextual effects). According to this approach, perception is based on the integration of stimulus information (the *likelihood* function) and regularizing (contextual) information based on previous experience (the "*prior*"). These two sources of information are optimally combined to reduce uncertainty: the incoming stimulus information on our senses often appears consistent with various physical objects or events, encapsulated in the *likelihood* function; but some are more prevalent in typical encounters than others, leading to a probability distribution of the *prior* (see Figure 1). The prior is combined with the likelihood to produce the posterior probability distribution, which is narrower (and thus less noisy) than either the prior or the likelihood, thus leading to more precise predictions about the world. Often, the prior draws perception away from the veridical stimulus characteristics (e.g., prosocial individuals perceive ambiguous facial expressions as conveying happiness because they are generally biased by prior scheme or knowledge to relate positive valence to incoming input). Effective and flexible use of previous knowledge is at the heart of everyday social interactions; thus, modulations in the study of SIP are perhaps in more need of the Bayesian treatment.

The Bayesian account allows for the possibility that *similar SIP patterns* of children who show similar social behaviors may arise for *different reasons*. It might be precisely the integration of the incoming input and prior experience during social interactions and the exploitation of social cues provided by others that are particularly relevant to better understand the origin of a specific behavior. As mentioned, SIP traditional measurements, in which individuals are often shown hypothetical social situations and then asked questions about them, can only reveal the final product (i.e., the individual's conscious response to the question), without necessarily tapping the contribution of each of the different components. To illustrate this notion, consider, for example, a social scenario (similar to frequently used stimuli in SIP research) in which a child wants to join other children in play but is rebuffed. In real-world situations like this, social cues are available at varying levels of ambiguity. For example, different children may convey different visual (facial expressions), auditory (tone of voice), and semantic (what they actually say) cues, not to mention the many different possible contexts. Thus, the sensory information in that type of situation may be consistent with several possible interpretations. In addition to the ambiguity in the sensory cues, individuals also differ in their perceptual sensitivity and thresholds (i.e., the minimum intensity of facial expression required for accurate recognition) and, of course, in their prior knowledge and experience (e.g., children who were exposed to violence may have initial expectations to see violence associated with the rejection).

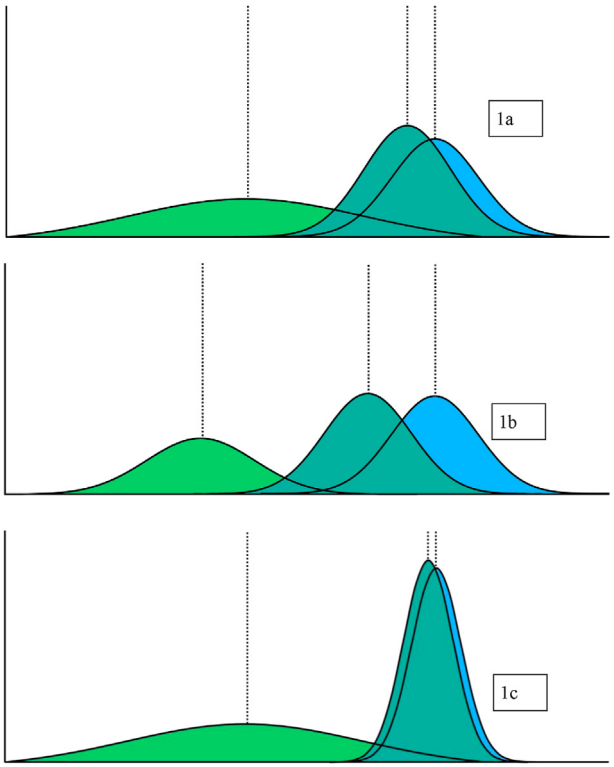

Figure 1. Illustration of the Bayesian framework. Perception begins with a noisy sensory "observation", represented here by a blue Gaussian. This is multiplied by the prior (green Gaussian) to produce a posterior distribution (turquoise Gaussian). The optimal estimate, represented by the center of the posterior distribution, is shifted towards the prior, as indicated by the arrow in Figure 1a. Figure 1b illustrates the strong effects of prior knowledge or biases. In this example, the prior is strengthen by reducing its variance, leading to the optimal estimate that is much closer to the mean of the prior distribution. Figure 1c represents the alternative case in which sensory observation is more precise. Here, the strength of the prior is unaltered from the original example, but there is reduced sensory noise, indicated by a halving of the variance of the observation. The optimal estimate is much closer to the sensory evidence, resulting from enhanced sensitivity. Thus, the often biased SIP patterns of children who show maladjusted social behaviors may either arise from modulations in the prior schemes the child may have (Figure 1b), from modulations in sensory and perceptual sensitivity (Figure 1c), or from their modulated interactions. A better understanding of the mechanism underlying maladjusted SIP and social behaviors entails the analysis of these different sources.

In Bayesian terms, this example demonstrates the combined effect of the ambiguous input and prior knowledge, suggesting that individual differences in the way these social encounters are interpreted, could involve modulations in any of these aspects, or their interaction. As the final reported interpretation is typically the product of the interaction between the sensory input and existing internal models, changes in either the sensitivity to the sensory input (e.g., the ability to recognize subtle differences in facial expression), in the existing internal schemes (e.g., the association of the identity of the face with negative or positive outcomes), or in both, may lead to modulations in the final percept.

Notably, internal priors are shown to constrain perception from early in life but are reweighed during childhood (Thomas et al., 2010). Because of weaker sensory and perceptual representations of the outside input often found in young children (e.g., elevated thresholds of facial expressions discrimination compared to adults), more pronounced effects of internal priors and schemes are seen in childhood than in adulthood (Hadad, Binur, & Hel-Or, under review). Testing the development of SIP as it associates with the production of a specific social behavior must take this different weighing of sensory input and internal priors across age.

Furthermore, the Bayesian approach also allows to include changeable real-world environments involving different forms of uncertainty in which the weighting of new evidence and prior expectations need to be dynamically adjusted. Except for notable cases (e.g., Diaconescu et al., 2014), this relative weighing of the sensory input and prior knowledge has not been examined in social information processing. Adapting this model to social situations allows testing interpretation of such situations in a more ecological approach, considering not only the possible different levels of ambiguity in the sensory evidence and the different contexts and expectations, but also one's ability to adjust expectations to suit a more volatile and less predictable environment. Indeed, recent progress in computational modeling has demonstrated that Bayesian models can be used to formally investigate perceptual mechanisms that underlie social behavior (Diaconescu et al., 2014). Back to our example, taking a Bayesian approach to the study of SIP as a mental source of social behavior means that both the prior and the likelihood should be manipulated such that the respondent may have more complex and multifaceted information about the potentially violent social scene. For example, the child being rebuffed (and/or, the other children in that situation) could be portrayed in different ways: as a popular/-rejected/bully child, thus influencing the prior. These different priors are likely to cause individuals, including those with already biased prior, to adjust their expectations and reach different conclusions. Such important and highly relevant adjustments could be easily applied in existing SIP measures (e.g., Dodge and Somberg, 1987; Lemerise et al., 2017).

5. Conclusions and recommendations

Traditional SIP research tends to make aggregated predictions about the association between SIP and social behavior without necessarily considering possible subtle changes in individuals' responses, which depend on changing circumstances. This tendency typically leads to theoretical conclusions in which some critical components of the final product remain obscured. First, the interplay between implicit and explicit processes that lead to social behavior may not be as coherent as typically predicted. Second, the final perceptual response to social stimuli that leads to a particular social reaction is built up by perceptual and post-perceptual components. Third, SIP and social representations are likely to evolve over the course of processing. Thus, the final interpretation of a specific social situation may not reflect all computations occurring at different stages over time. Finally, social cues are available at varying levels of ambiguity in real-world social encounters, and these different levels are likely to interact differently with variation in one's prior knowledge or expectations, leading to different interpretations. The interplay between these levels may vary with the type of population being tested, the developmental stages, the different contexts, or the type of stimuli used. Thus, accounting for different levels of processing, as the four levels suggested in this essay, is essential.

Analyzing various levels of SIP is thus critical to better understand social behavior. If we truly wish to know why, on the one hand, certain individuals respond negatively to benign social scenarios, and, on the other hand, why other individuals do not react negatively to almost any social scenes, we should understand the complete mental processes that led to these different responses. Additionally, even individuals with significant adjustment problems do not always process information in a negatively-biased manner and do not always respond in a maladjusted way. To understand the differences between such scenarios, one must explore the complete mental process and not just focus on the final product.

In their discussion of general information processing, Simon and Newell (1971) called to "construct an information-processing language, and a system for interpreting that language in terms of elementary operations" (p. 146). Looking at "elementary operations" requires the use of sophisticated measurement approaches that take into account different levels of processing. We suggest that adopting this call in social information processing research and constructing a language in that field that

includes elementary operations of information processing is likely to enhance our understanding of the mental roots of social behaviors.

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