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A Critique of the Concept of Accuracy in Social Information Processing Models of Children's Peer Relations.

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ABSTRACT. According to Kenneth Dodge's social information processing model, children who behave aggressively do so because they interpret others' behaviour, and evaluate aggressive acts, inaccurately. The concept of accuracy is inappropriate here because members of different social groups can differ systematically in their interpretations and evaluations of behaviour. Imposing the concept of accuracy exalts one social group's views as accurate, with others seen as flawed. Social information processing models could remove the concept of accuracy by drawing on the theory of autopoiesis, which states that an organism's response to a stimulus is specified by the organism rather than by the stimulus itself. Thus the environment is seen not as information to be (in)correctly interpreted, but as a set of trig-gers in a person's phenomenological world. This approach is strengthened by attention to the myriad ways in which a person's interpretations are informed (but not determined) by other people, explaining why we are likely to form interpretations and values similar, but not identical, to others in our social groups.

KEY WORDS: accuracy, autopoiesis, peer relations, physical aggression, social cognition, social information processing, *Umwelt*

The Social Information Processing Approach

Since the cognitive revolution in the 1950s (Gardner, 1985), the concept of information processing has dominated theorizing about human thinking and behaviour in cognitive psychology and cognitive science (Eysenck, 2001; Harré, 2006; Richardson, 1996a, 1996b; Smith, 1997). The information processing approach assumes that "information made available in the environ-ment is processed by a series of processing systems" (Eysenck, 2001, p. 2) and attempts to "specify the processes that operate to extract information from the sources of environmental stimulation available to us" (McShane, 1991, p. 7). In other words, the approach seeks to identify information avail-able in the environment, and examine how precisely humans process that information.

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The cognitive paradigm in psychology, of which the information processing approach is an important part, has been widely criticized, for being individualistic (Gergen & Gigerenzer, 1991; Shotter, 1991) and internalistic, for neglecting emotions, culture, and history (Gergen & Gigerenzer, 1991; Valsiner, 1991), for failing to provide genuinely developmental accounts of cognition (Valsiner, 1991), for denying the importance of fantasy in its theorizing of order and control (Walkerdine, 1988), for conceiving of action as causally determined by information processing, and for neglecting the rhetorical, action-oriented aspect of language and cognitive terms (Edwards, 1991, 1997). Despite these challenges, the information processing approach remains strong, and has spread from classic areas of cognitive psychology like memory and reasoning (e.g., Flavell, Miller, & Miller, 1993) to social and developmental domains, in the form of "social information processing" (SIP) models. These models see social phenomena such as friendship as "social cognition" (Kessen, 1981), and explain children's behaviours towards others in terms of the way in which they process social information, such as the beliefs and intentions of other people (Coie & Dodge, 1998; Crick & Dodge, 1996; Crick, Grotpeter, & Bigbee, 2002; Crick & Ladd, 1990; Dodge & Rabiner, 2004). One of the most widely known and extensively researched SIP models is that developed by Kenneth Dodge and his colleagues (e.g., Crick & Dodge, 1996; Dodge, 1980; Dodge & Coie, 1987; Dodge & Frame, 1982) to explain physical aggression in children. According to this model, which is arguably the dominant current model of children's peer relations (Arsenio & Lemerise, 2004), children who behave aggressively do so because they process information about the social world in a biased, inaccurate, and distorted manner (Crick & Dodge, 1996; Dodge & Coie, 1987; Lansford et al., 2006).

This paper argues that while Dodge's SIP theory of aggression has its strengths, it is limited by its reliance on the concept of accuracy. I begin by outlining the model before proceeding to ask how one distinguishes between "accurate" and "inaccurate" processing, drawing on evidence that social information processing varies systematically between social groups. I go on to argue that by not acknowledging such variations, SIP models appear to be value-free whilst actually importing the moral values of the researchers, disguised as "accurate information processing." I proceed to argue that efforts to modify the SIP approach would benefit from attention to the autopoietic approach (Maturana & Varela, 1979; J. von Uexküll, 1931/1982, 1957/1992) and to the myriad ways in which one person's interpretation of behaviour is informed by other people.

Dodge's SIP Model of Aggression

Dodge and his colleagues have developed a model that differentially explains two forms of physical aggression in children, named reactive and proactive. Reactive aggression (henceforth RA) is defined as "a defensive, retaliatory response to a perceived provocation from a peer ... accompanied by a display of anger," while proactive aggression (henceforth PA) is "unprovoked, deliberate, goal-directed behavior used to influence or coerce a peer" (Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001, p. 269). A similar distinction has been made by those examining aggressive behaviour in adults and non-human animals (Dodge & Coie, 1987).

According to Dodge's SIP model, in processing social information, children must pass through six steps, namely: (1) encode cues, (2) interpret cues,(3) clarify goals, (4) access or construct possible responses, (5) decide on a response, (6) enact response (Crick & Dodge, 1994). RA is said to result from *hostile attribution biases* at stage 2 of information processing (interpretation of cues); RA children are more likely than their peers to interpret another child's behaviour toward them as driven by hostile intentions (Dodge & Coie, 1987; Dodge & Frame, 1982; Dodge & Tomlin, 1987). Because these children perceive others' actions as being fuelled by hostile intentions toward them, they respond aggressively, thus producing RA behaviour. PA is thought to result from biased processing at stage 5 (response decision). Specifically, children who engage in PA are said to do so because they (a) evaluate aggressive behaviour more positively than their peers, and (b) expect aggressive acts to have greater efficacy than their peers do (Crick & Dodge, 1996). Note that this is described as a difference not in *values* held by different groups of children, but in *information processing accuracy*, with those seeing aggressive acts as positive and efficacious understood to have impaired or biased information processing mechanisms. For example, Crick and Dodge (1996) describe the positive evaluation of aggressive responses as a "social information-processing pattern" (p. 994) while Lansford et al. (2006) term positive evaluations of the outcomes of aggression as "deficits" (p. 715) and "SIP problems" (p. 716). The "information" that is being erroneously processed thus differs between RA and PA. In the case of RA, the relevant social information is the behaviour of others (and the underlying intentions such behaviours signify), while in the case of PA, it is judgements about the value and efficacy of aggression.

Research conducted by Dodge and others has generally supported the model described above, with small, but usually significant and consistent, effects (Crick & Dodge, 1994; Kempes, Matthys, de Vries, & van Engeland, 2005). Most research has involved administering social information processing tasks to children and comparing the responses of those categorized on the basis of teacher and peer reports as rejected and aggressive (PA or RA or, more commonly, both) with those categorized as nonaggressive (rejected and/or

adjusted) children. Hostile attribution biases are typically assessed by presenting the child with a story or video of a child damaging the property of or harming another child (e.g., spilling drink down the child's back), including a number of cues (such as facial expression, peer witness reports) pointing toward the intention of the provocateur (e.g., prosocial, hostile, benign, ambiguous). The child is asked what they believe the intention of the provocateur to be, and how they would react if they had been the victim (e.g., Dodge & Frame, 1982; Dodge, Murphy, & Buchsbaum, 1984; Dodge & Somberg, 1987).

This kind of research has found that RA children interpret the behaviour of provocateurs in stories and videos in more hostile ways than do those not thus categorized (Crick et al., 2002; Dodge & Coie, 1987; Dodge & Frame, 1982; Dodge et al., 1984). In their 1994 review paper, Crick and Dodge noted that over 20 studies had found a link between hostile attributional biases and social adjustment (including reactive physical aggression), and only two failed to do so. Less research has been conducted on children categorized as PA, but studies have found that children and adolescent boys exhibiting PA viewed aggressive behaviour as more positive and efficacious than did their non-PA peers (Crick & Dodge, 1996; Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Smithmyer, Hubbard, & Simons, 2000).

While the preceding paragraphs provide an overview, it should be acknowledged that over the last 15 years or so, Dodge's SIP theory has changed somewhat. In the review paper mentioned above, Crick and Dodge (1994) noted that the model may neglect or distort non-cognitive aspects of aggression, including emotion, the relationship between self and other, and social experience. They suggested that this problem is exacerbated by reliance on hypothetical situations in their research, which may encourage "active, reflective thinking" and thus emphasize cognition (p. 91). They proposed that this limitation could be addressed by incorporating methods "that allow for more ecologically valid assessments of social information processing (e.g., through the study of actual social situations)" (p. 91). Later work by the group has employed such methods in addition to the methods already described. Thus, Coie and colleagues (1999), Dodge, Price, Coie, and Christopoulos (1990) and Hubbard et al. (2001) collected and analysed observational data of boys interacting with one another, in conjunction with social information processing measures, which involved not an unknown provocateur, as in most of their previous studies, but the boys with whom the interviewed child interacted during the observation sessions. This enabled the researchers to build a differentiated picture of boys' interpretations with reference to specific other boys, as well as averaging the data to give an overall view of how each boy tended to interpret the behaviour of peers.

The findings of these studies led Dodge and his colleagues to argue that, contra traditional views and their own earlier position, aggression is best seen not as an internal trait of the individual, but as a dyadic phenomenon,

unfolding within two-way interactions between specific children (Coie et al., 1999; Dodge et al., 1990; Hubbard et al., 2001). For example, Dodge et al. (1990) found that aggressive behaviour was highly unevenly distributed across the dyads, with 50% of aggressive behaviour occurring in 20% of the dyads. It is not simply that the boys in these dyads were more aggressive than the other boys, because even among the most aggressive third of boys, 46% of aggression occurred in 20% of dyads. In other words, one boy might be highly aggressive in his interactions with a specific peer, whilst getting along quite well with another boy in the group.

Even stronger support for the interactional hypothesis comes from Coie et al. (1999), who found that dyadic relationships accounted for a significant proportion of the variation in the frequency of aggressive behaviours across the boys in a group. They found that above and beyond each boy's general tendencies to enact or be the target of PA, relationship effects (i.e., how often the boy behaved in a proactive aggressive manner in that specific dyad) accounted for a significant proportion (11%) of the variance. Similarly, 16% of the variance in RA was accounted for by relationship effects (although this was only marginally significant). Furthermore, relationship effects accounted for a significant proportion of the variance in the attributional biases (associated with RA) and outcome expectancies (associated with PA) expressed by boys in the social information processing tasks (Hubbard et al., 2001).

These findings suggest that the dyadic relationship is relevant above and beyond the general aggressive behavioural tendencies and cognitive processes of the boys within that relationship. In other words, aggression seems to be not simply an internal trait of the individual child, but a function of specific relationships between children (Coie et al., 1999; Dodge et al., 1990; Hubbard et al., 2001), such that the way in which a child interprets and responds to another child's behaviour is partly a function of the relational history between the two (Coie et al., 1999, p. 1187). In spite of these shifts, however, the model remains firmly embedded within the information processing tradition in that it describes a child's engagement with his/her environment in terms of accurate or biased processing of information. For example, the group's recent emphasis on specific dyads is still viewed in terms of information processing errors such as hostile attribution biases, only now these are seen as being specific to the processing of information about *particular* peers, rather than any peer (see Hubbard et al., 2001).

SIP models such as Dodge's have a number of strengths. Firstly, they offer a careful, detailed exploration of the "online" thought processes involved in aggression (Dodge & Rabiner, 2004), with useful attention to individual differences (Crick & Dodge, 1999). Secondly, they consistently draw our attention to the important point that to understand why child A behaves aggressively to child B, we need to focus not on what B did, but on what A *perceives* B as doing. In the words of Dodge and Coie (1987), "it is the child's perception of the provocateur's intent, and not the actual intent, that

determines whether the child will respond aggressively" (p. 1146). Finally, a third strength of this particular SIP model is that it has developed over the years to incorporate the finding that a child's aggression toward another occurs partly as a function of the unique history of relations between the two.

Accuracy

In the SIP model, aggressive children are differentiated from nonaggressive children by the accuracy of their information processing. So researchers wishing to test this assertion must themselves be able to judge children on their accuracy. The need for such a measure was raised by Dodge and Frame (1982), who presented aggressive and nonaggressive boys with hypothetical stories involving what the authors considered to be an ambiguous provocation. They found that aggressive boys saw the provocation as hostile signifi-cantly more often than did nonaggressive boys. They interpreted this result as demonstrating an attributional bias on the part of the aggressive boys, but admitted that because the provocation was ambiguous, one could argue that it was actually the *nonaggressive* boys who were exhibiting a *prosocial* bias (p. 633). In other words, Dodge and Frame (1982) recognized that finding a difference in how two groups tend to interpret a situation was not sufficient to establish which (if either) group was more *accurate*.

For Dodge and Frame (1982), the inability to judge the accuracy of the information processing arose because the behaviours children were asked to interpret were inherently *ambiguous*. Dodge et al. (1984) sought to address this limitation by developing a measure of processing based on stimuli that were unambiguous: social information cues which unequivocally declared a particular intention, such that a child with intact information processing capabilities would be able to process the information and inevitably come up with the correct intention. The first step in developing this measure was to video-tape pairs of US children (8- and 9-year-olds) acting out scenarios in which one child destroys a possession of the other. The destroying child was told to act with one of five intentions (Dodge et al., 1984):

> … (1) *hostile*, displayed by obviously purposeful destructive behavior accompanied by corresponding verbalizations and facial expressions; (2) *prosocial*, in which the child purposefully destroyed the peer's play object, but did so in an effort to help the peer or someone else (such as destroying a block tower in an effort to clean up the room)—this behavior was accompanied by verbalizations indicating the intent and a smiling facial expression; (3) *accidental*, in which the peer unintentionally destroyed the peers' play object, accompanied by a facial expression indicating surprise and nonrelevant verbalizations; (4) *ambiguous*, in which the child destroyed the peer's play object, but did so without any verbalization or obvious facial expression; and (5) *merely present*, in which the peer who owned the play

> object destroyed it by his or her own actions and then blamed the act on the [other] child … who did nothing. (pp. 164–165)

In this extract, Dodge et al. make clear the behaviours that they understand to unequivocally signify particular intentions. Of 300 vignettes thus constructed and videotaped, 30 were selected "on the basis of acting quality and clarity of the vignette itself" (p. 165), and presented to 15 college undergraduates, "to make sure that the intention acted out by the child was perceived as such by the adult" (p. 165). The 20 vignettes that were perceived most "accurately" by the students (i.e., most similarly to the researchers' instructions to the children acting them out) were incorporated into the measure.

Dodge et al. then conducted a pilot study in which 33 undergraduates and 13 kindergarten children stated what they thought was the intention of the acting child in each vignette. They found that the undergraduates responded "accurately" 93% of the time, while for kindergartners this figure was 59%. They concluded that "the tasks yielded reliable responses that were obvious to most adults and that kindergarten children could respond to with a greater than chance accuracy but with some variation" (p. 165). The authors considered that the test they had developed was able to assess accuracy because, unlike previous studies, it included *unambiguous* behaviours, thus making the correct processing of the information clear.

One might ask at this point how we can be sure that the adults involved in developing this measure did in fact interpret the vignettes accurately. When Boulton (1994) showed a videotape of aggressive and playful fighting to adults and children in the UK he found that "for more than one in ten episodes adults could be thought of as making a 'mistake', that is, they perceived an episode as playful that children themselves tended to view as aggressive, or vice versa" (Boulton, 1994, p. 140). When adults and children interpret behaviours differently, how are we to decide who is correct? One might argue that because adults have more experience, their SIP is likely to be more accurate than a child's. However, the problem of specifying the correct interpretation of behaviour extends beyond child–adult differences. Anthropologists, sociologists, cultural and cross-cultural psychologists have demonstrated repeatedly that people from different social groups interpret the same behaviours very differently. Using SIP terminology, we might say that they are processing the same information but reaching different conclusions about what intention that information signifies. For example, Miller (1984) found that Americans were far more likely than Indian Hindus to explain other people's behaviours in terms of dispositions rather than situational factors. Reviewing this study along with a wide range of other research, Markus and Kitayama (1991) argue that people in different cultures acquire distinctive senses of self, and that this has important implications for their cognitive processing. Toren (2001) uses ethnographic data to describe how particular bodily pos-tures are expressive of shame and anger among Fijian children and adults, and she points out that they are not the same as

those of, for example, a Western cognitive psychologist.

The studies just reviewed concern how people in different social groups interpret behaviour, and as such are relevant to Dodge's explanation of RA in terms of interpreting behaviour in terms of underlying intentions. Studies on how people in different social groups judge the appropriateness and value of particular behaviours are more relevant to Dodge's explanation of PA in terms of children's judgements of the efficacy and value of aggression. Once again, there is a rich literature on how different social groups contrast in the values they assign to certain behaviours, including aggression. For example, in his comparison between two Zapotec-speaking communities in Mexico, Fry (1988, 1992) found higher rates of physical aggression among children in the community that evaluated physical aggression positively than among the children in the neighbouring community in which people tended to frown upon such behaviour.

There is evidence that children (especially boys) in some peer groups evaluate physical aggression positively. For example, they can gain status in the peer group by behaving aggressively (Boulton, 1993; Evans, 2006; Pellegrini & Bartini, 2001; Rodkin, Farmer, Pearl, & Van Acker, 2006; Savin-Williams, 1976; Woods, 2009), and/or establish membership of groups defined by aggression, such as working class, male, and/or "cool" (Evans, 2006; Kenway & Fitzclarence, 1997; Rodkin et al., 2006). In their critique of Dodge's SIP approach to aggression and bullying, Sutton, Smith, and Swettenham (1999a, 1999b, 2001) repeatedly argue that physical aggression is related to social status, dominance, and hierarchy in children's peer groups—issues which are strangely absent from Dodge's SIP model. The evidence suggests that different groups of people evaluate aggression differently. In conjunction with research demonstrating that different groups of people interpret behaviour differently, these findings are a serious problem for Dodge's SIP model because they challenge its underlying assumption that there is one correct way in which to process social information.[1]

Hidden Values

If social information is processed differently by members of different social groups, Dodge's statements about which interpretations and evaluations are accurate and which inaccurate become suspect. Arsenio and Lemerise (2001) note that the SIP model of aggression is apparently free of values, and, indeed, none are explicitly stated. However, in assuming that their own interpretations of social information are accurate, Dodge and his colleagues have in fact imported the values of their own social group into the model. This is perhaps most apparent in a revealing and thought-provoking debate between Sutton et al. (1999a, 1999c, 2001), Crick and Dodge (1999), and Arsenio and Lemerise (2001). Sutton et al.

(2001). Sutton et al. (1999a) point out that the SIP model seems to assume that aggressive behaviour is defective by definition, and that it is always accompanied by erroneous information processing. For instance, Crick and Dodge (1996) assert that "skillful processing at each step [of the SIP model] is hypothesized to lead to competent performance within a situation, whereas biased or deficient processing is hypothesized to lead to deviant social behavior (e.g., aggression)" (p. 994). However, Sutton et al. (1999a) argue that in some cases, (a) it makes sense (i.e., it is socially competent) for a child to behave aggressively, and (b) aggression may arise from *enhanced* rather than impaired information processing. An example might be a child who gains status by bullying a peer, and whose bullying is effective because of their sophisticated cognizance of others' thoughts and feelings. As Arsenio and Lemerise (2001) note in their commentary on the debate, Crick and Dodge (1999) respond equivocally—stating at the start of their reply that the SIP approach "does not require that aggressive behaviour occurs as a function of processing deficits" (p. 128), but later asserting that "even if Sutton et al. are correct in positing that bullies are good perspective takers, other cognitive processes are operating that lead bullies astray and contribute to their engagement in highly aversive behaviors" preventing them from being "competent, prosocial children" (p. 131). As Arsenio and Lemerise (2001) point out, Crick and Dodge do not explain on what grounds they label aggression and bullying as "incompetent," nor do they justify their claim that incompetent behaviour (however defined) is necessarily preceded by incompetent information processing. It seems that the SIP model relies heavily on the apparently neutral contrast between accurate and impaired information processing to import the researchers' own attitudes towards aggressive behaviour.

A similar, albeit more subtle, process can be identified in the measure of social information processing accuracy developed by Dodge et al. (1984), described earlier in this paper. Recall that Dodge et al. produced video clips of children enacting behaviours reflecting particular intentions (e.g., prosocial, hostile, neutral). They found high levels of agreement between researchers and a group of undergraduates in how they interpreted these behaviours. Dodge et al. consider that this agreement shows that *their* interpretations (e.g., this gesture signifies prosocial intent) are correct. They tell us little about the researchers and students involved in the production and test-ing of this measure. For example, how wealthy are the students? Do they live in an urban or rural setting? What is their nationality, ethnicity, age? In the absence of these details, we can surmise that they might be mostly Caucasian middle-class Americans in their early 20s. In other words, it is likely that the adults involved in creating and evaluating this measure are from a fairly narrow social group.

The problem is that as we have seen, it is unlikely that people in all social groups would interpret the behaviours in Dodge et al.'s measure in the same way as these researchers and undergraduates did. Adults (or children) who have lived

very different lives might well interpret the behaviour differently, such that what looks prosocial (for example) to an educated middle-class American might very reasonably look accidental or even hostile to someone with a different history of experience. Any difference in interpretation of the final measure between researcher and participant is seen in terms of accuracy—and since the correct version is synonymous with the researchers' own viewpoint, it has to be the *participant* whose perceptions, thought processes, and actions are impaired, defective, biased, and erroneous. Thus, the measure potentially celebrates the perceptions and behaviours of people like the researchers and their students (who come out as socially adjusted and accurate), whilst pathologizing anyone who sees things differently (socially maladjusted and biased). We might say that this positive skew towards traditional members of the academic community (Western, middle-class, white) is itself a bias (see Burman, 1994; Walkerdine, 1993; Walkerdine & Lucey, 1989, for similar arguments in other areas of developmental psychology).

The problem arises because the researchers did not consider the possibility that there might be more than one reasonable interpretation of a particular behaviour (or piece of information); that variations in interpretations might coincide with different social groups; and that those involved in developing and testing techniques designed to discern differences in interpretation may only (or mainly) have been drawn from one such social group. Consequently, methodologies developed within the SIP framework are likely to present views typical of the researchers' own social group(s) as information, and dif-ference as bias or error.

The Autopoietic Approach

In order to accommodate the finding that people in different social groups interpret and evaluate the same behaviour differently, I suggest that Dodge's SIP model needs to abandon the notion of accuracy. The model is halfway there in that it already states that the way a person interprets behaviour is a function of their previous experiences. For example, Dodge and Frame (1982) found that children (socially accepted as well as rejected) tended to attribute more hostility and to suggest more aggressive responses to a child who they were told was aggressive than to a child who they were told was popular. Dodge and Frame argue that their experimental and observational data "point toward a vicious circle, or escalating spiral, model of peer-directed aggression among boys" (p. 633). Subsequent research by the group suggests that children are informed by their relations with one another not generically, but in a differentiated fashion with different peers (Coie et al., 1999; Dodge et al., 1990; Hubbard et al., 2001). These data indicate that chil-dren respond to one another on the basis of reputation and history, such that aggressive children's interpretations are *warranted* by history

and are, in that sense, entirely reasonable. It is only when the lens of accuracy (attached to ideas about social adjustment) is imposed on the data that these children's interpretations and values appear erroneous.

The SIP approach might learn something here from what might loosely be called the autopoietic approach, which offers a clear rationale for why all interpretations and values assigned to behaviours are reasonable in the sense of being warranted by previous experience. Autopoiesis is a term coined by Chilean biologist Humberto Maturana to characterize the key feature distinguishing living things from the non-living (Maturana & Varela, 1979): only living organisms are self-regulating, self-reproducing systems. To stay alive, an organism is never static; it is engaged in a continual process of bringing itself into being by engaging actively with its environment to ensure (if possible) its own ongoing existence. Somewhat earlier, Jakob von Uexküll (1931/1982, 1957/1992) independently developed a similar approach, although he did not call it autopoiesis. Originally developed in biology, the approach has been applied in the disciplines of anthropology (Toren, 1993, 1999) and artificial intelligence (Ziemke & Sharkey, 2001). Below I outline key concepts, as developed by von Uexküll and Maturana in biology, and following Toren (1993, 1999), I consider how we might use them to theorize human behaviour.

A living organism is able to bring itself into being via the environment because of its ability "to respond to impulses from outside not in a causal-mechanical way, but with its own specific reaction" (T. von Uexküll, 1982, p. 7). Living things are of course influenced by the outside world. However, the particular influence of any stimulus is given not by the stimulus itself, but by the *organism*. For example, Maturana found that to understand a pigeon's colour vision, he needed to map not between the pigeon's subjective colour experience and the external world, but between subjective experience of colour and the activity of the pigeon's retina (Maturana & Varela, 1979). The organism as a whole mediates the relationship of any part of it with an external stimulus. Perception thus entails that the organism (subject) responds to events in its surround never directly but always with reference to itself. The subject's perceptions are not *of* an external world (although they may feel as though they are); they are not more-or-less accurate comprehensions of pre-existing information. Rather, the perceptions themselves are active engagements between self and stimulus; they are non-self with relevance to self (T. von Uexküll, 1982). Jakob von Uexküll calls these *signs*. They are subjective but not internal, because the process of perception incorporates "internal" and "external" as inseparable. As Thure von Uexküll (1982) notes, there are therefore no objective signs, because organisms inevitably experience non-self only with reference to self. The corollary of this is that at the same time that we experience our environments, we inevitably experience ourselves (T. von Uexküll, 1987/1992).

According to this approach, then, the process of interpretation is not the disinterested retrieval of information from the environment. Rather, it is an active, self-directed process whereby the world as perceived and understood is a function of the perceiver (a view shared by constructivists such as Kelly, 1955; Piaget, 1983; and von Glasersfeld, 1995). Thus, Maturana (1974/1999) argues that it is a mistake to view an organism's response to its environment "as if it were the result of the computation by ... the organism ... of its own adequate changes of state after gathering the proper information from the environment" (pp. 157–158). Instead, any changes in the organism's state "are determined by its structure, regardless of whether these changes of state are adequate or not for some purpose that the observer may consider applicable" (p. 158). Varela (1997) makes the same point when he states that a living organism "constantly confront[s] the encounters … with its environment and treat[s] them from a perspective which is not intrinsic to the encounters themselves" (p. 79), or, more poetically, "Like jazz improvisation, environment provides the 'excuse' for the neural 'music' from the perspective of the cognitive system involved" (p. 84).

Not only does an organism perceive environmental events as subjective signs, but it only perceives a subset of all environmental events, because it can only enter into interactions with the environment that are specified by its cognition. Some events in the environment will not trigger a change in the organism, and will not therefore exist for it. Those aspects of the environment which trigger a change in the organism are called by Jakob von Uexküll (1931/1982) the organism's *Umwelt*: its subjective universe or phenomenal world. (Maturana & Varela, 1979, use the term "niche" instead.) Autopoietic theory therefore makes a clear distinction between the environment as perceived by an observer, and the environment as experienced by the organism (Maturana, 1974/1999; Maturana & Varela, 1979; Varela, 1997). SIP models fail to make this distinction, confusing the researcher's perception of a research subject in their environment with the research subject's *Umwelt.* This slippage is what makes claims about accuracy seem so reasonable. The autopoietic approach, in contrast, entails that the researcher moves beyond his/her view of the person-in-environment towards an understanding of the person-in-*Umwelt*, thereby explaining the inevitability of their actions within their own phenomenological world. In so doing, the researcher would demonstrate that everyone's perceptions of and actions in the environment, no matter how different from one another, are warranted by their internal organization (or cognition). Returning to the subject matter of Dodge's model, the autopoietic approach predicts that children are likely to interpret and value specific behaviours differently from one another, because the behaviours in question appear not as a source of information in the environment (as in the SIP approach), but as signs in the child's phenomenological world. By recognizing this, researchers are free to explore what aggression means in an aggressive child's *Umwelt*, without being blinkered by the assumption that the child has simply misunderstood his/her environment.

It might be objected at this point that by dismissing the concept of accuracy, the autopoietic approach commits us to epistemological and moral relativism. Since perception is always an engagement of self and nonself, one cannot escape one's *Umwelt* in order to survey the environment of which it is a part. Therefore there can be no objective knowledge (von Glasersfeld, 1995). Does this mean that all interpretations and evaluations of behaviour are equal? Yes, in the sense that all are *warranted*; no in the sense that we may use criteria to evaluate them differently. For example, the quality of a theory can be assessed by the extent of the data it is able to make sense of, and the value of a behaviour by the extent to which it harms the perpetrator and those around him or her. Ultimately, the question of who gets to formulate the criteria by which knowledge claims and values are judged is a political one—even when criteria are given apparently apolitical labels such as accuracy. The autopoietic approach demands, however, that such assessments of theories, truth claims, or values require close attention to the *Umwelt*s through which the people concerned experience and create themselves and others.

To conclude this section, I have explored how SIP models might learn from autopoietic accounts of organisms as self-reproducing systems for whom the environment is always perceived partially and self-referentially in the form of signs. From an autopoietic point of view, children do not process information about their environment more or less accurately; they experience a subset of events occurring in their environment, which trigger interpretations specified by their cognitive organisation. The approach provides insights as to how SIP models like Dodge's might be reconstrued so as to move away from their dependence on the concept of accuracy.

The Role of Social Interaction

Earlier in this article, I argued that the SIP approach needed to show how we construct our cognitive processes through our interactions with other people, such that members of a social group are likely to interpret and value certain behaviours similarly. The historical constitution of SIP mechanisms was not a priority for Dodge, who sought rather to create an "online" model of children's cognitive processing directly preceding an aggressive act (Dodge & Rabiner, 2004). The model is thus one of *social* information processing insofar as it deals with the child's interpretations of other people's behaviour and their value judgements about their own behaviour towards others. However, the data on inter-group differences suggest that sociality is relevant in another sense: the child's habitual interpretations and judgements (their SIP processes) are themselves informed by the people around him/her, such that s/he tends to make similar interpretations and judgements to the people around him/her. Note that this is not a case of shared meaning with or wholesale internalisation from other people, because, as Dodge has shown, individual differences in habitual

interpretations or values exist *within* social groups, as well as between them. Although it was not originally developed with human social relations in mind, the autopoietic approach is useful here, because it conceives of people as *autonomously* interpreting and evaluating their *Umwelt*s. Insofar as two people's cognition is similar, they will interpret and evaluate an event similarly (though not usually identically). This basic insight can be extended by considering the plentiful evidence that a person's cognition is informed (non-deterministically) by the people around him/her (Toren, 1999), such that intergroup differences tend to be greater than intragroup differences.

A person's autonomous sign-making processes are informed by other people via a range of means, some of which are already operational at birth. Babies are born able to engage with the adults around them. Neonates will track a human face further than other stimuli (Johnson & Morton, 1991) and can imitate a range of facial expressions (Meltzoff & Moore, 1989, 1998). Gallagher (2005) argues that through imitation, newborns' experience of self is "coupled" (but not confused) with other people, such that "*experientially*, and not just objectively, we are born into a world of others" (p. 82). Via the imitative mechanism, infants' developing interpretations and values may be informed by the people around them. A little later, from 9 or 10 months of age, infants become able to attend to an object and a person at the same time, and this enables new forms of learning through others, such as social referencing, where an infant who is unsure of how to respond to an object, person, or event looks at their caregiver's response (Klinnert, 1984). Infants do not respond identically to the same response (Rosen, Adamson, & Bakeman, 1992), suggesting that social referencing is a non-deterministic mechanism by which infants' interpretations are informed by other people.

Babies' developing interpretations are also informed by people in the sense that they are born into a world structured by adults, who dictate how often they are fed, whether they are picked up as soon as they cry, whether and how they are talked to, how they are carried, and so on (Toren, 1999, p. 7), as well as exposing the child to particular technological and psychological tools (Vygotsky, 1978). The child is also accumulating experience of how other people respond to his/her actions. Rewards and punishments from family members and others with whom the young child spends time are likely to impact on the child's emerging interpretations and values. Since adults in different social groups structure babies' and children's lives and discipline them quite differently (Briggs, 1972; Fry, 1992; LeVine & New, 2008), individual children are likely to construct signs and *Umwelt*s that have more in common with others in their social group than with members of other social groups.

As they get older and acquire language, new means by which children's interpretations and values are socially informed emerge. Children who spend time with peers may find that while relatively fixed in their families, status, hierarchy,

and popularity are up for grabs in the peer group, and thus grapple with how their peers see and respond to them, and their actions (such as physical aggression: Evans, 2006; Hey, 1997; Savin-Williams, 1976). Language opens children up to awareness of categories applied to people, such as gender, ethnicity, sexuality, and academic ability (Durkin, 2004). Children can use these categories to interpret the behaviours of other people, and must deal with the fact that everyone around them is doing the same for them. Hence we see the emergence of stereotyping (Martin & Halverson, 1983), prejudice (Nesdale, 2004), stereotype threat (Muzzatti & Agnoli, 2007), looping effects (Hacking, 1995), borderwork (Thorne, 1993), and the policing of activities seen as constitutive of particular identities (Woods, 2007), amongst other phenomena. It is proposed here that children cannot help but draw on the words and actions of others in constructing their own categories and associated values.

Given the many means by which a child's autonomous process of sign-making may be informed (though not determined) by the people around him or her, it would be quite reasonable for members of different social groups to interpret and value behaviours differently. It also follows that new gen-erations must construct their own interpretations and evaluations of behaviour, and these may differ systematically from preceding generations if some aspect of their experience differs systematically also. This is not cultural relativism, for the following reasons: (a) members of a group will not form precisely the same cognitions as one another because each person cognizes autonomously, and does not (indeed, cannot) simply internalize or copy wholesale the cognitions of another; (b) the very mechanism of autopoiesis informed by other people makes meaningful communication between members of different social groups possible; (c) boundaries of social groups are often not sharply defined; (d) people are members of many groups and the boundaries of these will often not coincide; and (e) key similarities in the self (as embodied in a specific form with particular functions, needs and changes over the lifespan) and in the environment (commonalities in the possibilities and restrictions afforded by the physical world) across social groups provide points of understanding and connection. The social mechanisms outlined above in conjunction with the autopoietic approach are able to explain, without reifying culture, how cultural differences come about, because they show how people construct their own ideas and interpretations, but cannot help being informed by the ideas and interpretations of those around them in doing so (Toren, 1999). Moreover, this approach also entails that while differences between members of different groups are likely to be greater than between members of the same group (because people's ideas are informed by the people around them), members of one social group will still vary (because each makes meaning autonomously and based on somewhat different experiences), as Dodge's own research has shown.

Accuracy Revisited

It might be argued that Dodge's SIP model need not abandon accuracy altogether, but might instead reconstrue it as applicable within a specific social group. In other words, perhaps the model describes how members of a particular social group interpret a given behaviour and so can be used to assess the accuracy of other members of that social group. This does not seem to be what Dodge himself had in mind because, as noted earlier, he and his colleagues say very little about the people whose interpretations were seen as accurate when they developed their measure of HAB (Dodge et al., 1984), and, to my knowledge, there is no discussion about the social groups to whom the model and its associated measures can be applied.

However, even if Dodge's model is not geared up for a notion of accuracy specific to a social group, might this not be a better solution than abandoning accuracy altogether? After all, there are certain human behaviours upon whose meaning members of a given social group agree widely, perhaps even unanimously. For example, nodding one's head anywhere in the UK is likely to be interpreted by others as something like "yes." Nonetheless, the autopoietic approach implies that even if every person in the UK interprets a nod to mean "yes," they came to do so autonomously, each constructing for him- or herself the appropriate sign. As such, to speak of one's interpretation of nodding as *accurate* may be a convenient shorthand designating an interpretation that is more or less identical to that of others in the UK. The concept of accuracy might therefore be retained to indicate the extent to which a person's meaning-making is in keeping with the people around him/her—something like the typicality of the per-son in a given social group. For example, if I, an English middle-class woman, were to spend time in the maximum security prison studied by Rhodes (2004), the meaning I make with respect to physical aggression would probably be out of synch with the other prisoners and is therefore likely to create difficulties for me, just as one of the prisoners might struggle if they were suddenly placed in my world. Here, the concept of accuracy might be a useful shorthand for the typicality of my interpretations in a given social setting. This shorthand can easily mislead, however, by implying that the meaning of the behaviour in question resides in the behaviour itself, waiting to be interpreted more or less accurately, whereas according to the autopoietic approach, it is *always* constructed (Toren, 1999). If, across social groups, there are different accurate interpretations of a behaviour, then there is nothing intrinsic in the observed behaviour which prioritizes a particular interpretation; rather it is something about the way that people construct interpretations, autonomously but informed by one another. Calling some interpretations accurate, even in a localized sense, risks losing sight of this point.

Conclusions

This article has argued that Dodge's SIP model of children's physical aggression is limited by its reliance on the concept of accuracy. The model contends that aggressive behaviour results from inaccurate processing of information—either an erroneous interpretation of the intentions underlying someone else's behaviour (leading to RA), or a biased assessment of the efficacy or value of physically aggressive acts (leading to PA: Crick & Dodge, 1996). The trouble with this explanation is that interpretations and evaluations of behaviour vary by social group, and since Dodge and his colleagues' SIP theory and methods seem to have been developed in line with their own interpretations and values, the result is that everyone else's appear inaccurate. Therefore, however unintentionally, the concept of accuracy provides a smokescreen, allowing moral values to be imported into an apparently value-free model and methodology.

I have argued that the autopoietic approach is useful here, because it offers a way of thinking about children's interpretations without the concept of accuracy. According to this approach, events in the environment exist for the person only as subjective signs specified by his/her own cognitive processes, such that that person's *Umwelt* (composed of his/her interpretations and actions) has an inevitability and thus reasonableness to it which is not captured by the notion of accuracy (Maturana & Varela, 1979; J. von Uexküll, 1931/1982, 1957/1992). I have argued that this cognition is informed by the history of social interactions in which the child has engaged, because experiences like social referencing, the construction of hierarchies in the peer group, and so on, all inform the process by which s/he constitutes him/herself and his/her *Umwelt*. The autopoietic approach behoves researchers to move beyond the third-person view laden with assumptions about accuracy taken by SIP models, and try to understand the child's *Umwelt* and how the child produces and sustains it through social interaction. The autopoietic approach therefore points a way for Dodge's SIP model to move beyond the concept of accuracy, and towards an account of childhood aggression that is phenomenologically sound (Toren, 2001) and able to show how children's interpretations and evaluations with respect to aggression are related to their social setting without falling back on deterministic notions of internalization or socialization (Toren, 1999).

An implication of this argument is that interventions to improve the accuracy with which individual aggressive children perceive their social world may be misguided, because they neglect the specific meanings children are assigning to aggression, and the social constitution of those meanings. For example, for boys at a primary school in a working-class area of west London, aggression is a primary means by which popularity and decision-making are achieved (Woods, 2009). The boys who are prepared to use physical aggression are able to enforce their decisions regarding inclusion in and exclusion from playground football games, while peers who are not aggressive have their decisions overturned. If any one aggressive boy stops valuing and carrying out

aggressive acts, he is likely to lose status and efficacy, because other members of the peer group will continue to construct aggression as efficacious. In contrast to a SIP approach, which focuses on individual pathology, the autopoietic approach draws attention to what aggression means to the boys (status, efficacy), and how these meanings are sustained by the peer group. These insights provide new directions for intervention. For example, in my research in a west London primary school, I found that aggression conferred status. This suggests that any effort to persuade the boys concerned to relinquish aggression should offer them accessible alternative routes to prestige. This simple strategy might be missed by a SIP intervention to teach aggressive children to process social information accurately.

Note

1. There are several possible challenges to this argument. Firstly, Grice (1957) argued that some objects or events are connected by cause and effect to their meaning (e.g., "Those spots mean measles"; "The recent budget means we shall have a hard year"; p. 377). It might be argued that for these cases of "natural meaning" (Grice, 1957, p. 378), there is only one accurate reading of the event or object in question, and thus the notion of accuracy is legitimate. The current paper focuses on people's interpretations of the intentions of others, as expressed in their behaviours, and on their evaluations of aggression, and evidence of cross-cultural variation indicates that these are not examples of natural meaning. However, it does not rule out the possibility of natural meaning in other domains.
   Secondly, the argument that people in different social groups tend to process the same information differently might be challenged with reference to evidence that people from different cultures agree on the emotions underlying some facial expressions (Berry, Poortinga, Segall, & Dasen, 2002; Ekman, 1992; Ekman & Oster, 1979), least controversially, those of happiness, anger, disgust, sadness, and combined fear/surprise (Ekman & Oster, 1979, p. 531). This conclusion has been challenged (see, e.g., Russell, 1991), but even if we accept Ekman's position, it does not negate the argument that people from different social groups will at times interpret behaviours in systematically distinct ways. This is because the meanings we assign to human acts concern not only emotions, but also beliefs, attitudes, moods, intentions, and so on. Indeed, Dodge's SIP model has been noted for its rel-ative *neglect* of emotion (Arsenio & Lemerise, 2001, 2004; Lemerise & Arsenio, 2000), and, as such, arguments regarding the universality of emotional expression are of limited relevance to a critique of SIP models.
   Finally, it could be argued that evolution is the guarantor of accuracy, because in our evolutionary past, those who processed information accurately were more likely to survive and reproduce than their less accurate peers (Leslie, 1987). There are several arguments against this position: for example, evolution guarantees not accuracy but efficacy in a given niche; natural selection does not necessarily lead to the best possible adaptation to a specific niche in any case; the biological notion of fitness does not demand that the organism has accurate knowledge of its envi-ronment; and in addition to natural selection there are other processes, such as nat-ural drift, influencing species change (Bradley, 1993; von Glasersfeld, 1995).

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