

Applying systems principles to models of social information processing and aggressive behavior in youth[☆]

Reid Griffith Fontaine^{*}

Psychology Department, Duke University, United States

Received 2 February 2005; received in revised form 18 April 2005; accepted 13 May 2005

Available online 26 August 2005

Abstract

Systems perspectives view development as the product of hierarchically-organized levels of varied life processes that are continually changing and interacting as time passes. This theoretical approach may be of considerable importance to developing research programs in child social cognition, particularly since multilevel, multiprocess models of social information processing and aggressive behavior in youth are still in relatively formative stages. This paper proposes that key systems principles can be conceptually applied to social information-processing models in ways that are critical to furthering future research in social-cognitive foundations of aggressive behavior. Examples of initial applications to current social information-processing models of aggression in childhood are presented. Implications of this theoretical approach for substantive empirical research (e.g., modes of processing) are discussed and directions for methodological design (e.g., computer simulation) are proposed.

© 2005 Published by Elsevier Ltd.

Keywords: Systems theory; Aggressive behavior; Social information processing; Cognitive development; Social cognition

Contents

1. Systems principles and current models of child social cognition	66
2. Social information processing, decision making, and child aggression	66
3. Extracognitive influences: immediate and remote contexts	67
4. Alternative developmental progressions: mediating and moderating relations.	68
5. Applying systems principles to social-cognitive processing in childhood	69
6. A multilevel hierarchy of the social cognition system	69
7. Dimensions of intercomponent functioning	71
8. The impact of development on cognitive specificity and complexity.	72
9. Future directions for social cognition and child development in the 21st century	73
10. Proactive versus reactive processes in children's social development	73

[☆] This research was supported by the NIMH (NRSA Grant 1 F31 MH11764).

^{*} Duke University, 257 Sanford Institute Building, Box 90264, Durham, NC 27708, United States. Tel.: +1 919 613 7319.

E-mail addresses: reid.fontaine@duke.edu, rgf2@duke.edu.

11. Computer simulation: theory construction and methodological design	74
12. Summary	74
Acknowledgement	74
References	75

There is a growing trend in psychological science to conceptualize individual development according to a “systems perspective” (e.g., Emde, 1998; Ford & Lerner, 1992; Gottlieb, 1996a,b; Sameroff, 1995). This perspective advocates analysis across qualitatively distinct levels of functioning that are interrelated within the system of interest (e.g., individual development). System levels are hierarchically organized, providing a heuristic by which development is viewed as a continuum of ongoing interactive processes. Developmental variables and processes are hypothesized to interact both within (e.g., cognition–cognition) and across levels (e.g., cognition–social behavior) of operating. The implications of these principles for understanding the highly complicated system of children’s social information processing appear to be critical to the advancement of theory and empirical inquiry in Crick and Dodge (1994), Huesmann (1998) and Read and Miller (1998). This observation is guided, in part, by the recent pattern among theorists to apply systems concepts to diverse areas of developmental science (e.g., see Barnard & Teasdale, 1991; Cicchetti & Lynch, 1993; Fontaine & Dodge, in press; Gottlieb, 1996a). Systems principles may be particularly useful in advancing social–cognitive research given that multilevel, multiprocess models of children’s social–cognitive processing are still in relatively formative stages.

For example, in their recent formulation of response evaluation and decision making in aggressive youth, Fontaine and Dodge (in press) propose that multiple threshold levels may be used in youths’ response decision making in order to attend to the complex interactions of constantly changing external contexts (e.g., social and physical features of one’s environment) and internal states of functioning (e.g., emotional and physiological variables). During the process of evaluating one’s response options in a given social situation, the alternative responses being considered may be assessed across multiple value thresholds before being selected or rejected for behavioral enactment. These value thresholds are hypothesized to adjust in real time according to ongoing changes in other relevant systems, such as the responding individual’s emotion system or the applicable social system. The idea that value thresholds adjust in real time according to changes in *extracognitive* systems illustrates the utility of applying systems theory principles to models of social–cognitive processing.

Systems theory (see von Bertalanffy’s, 1968 foundational work *General System Theory*) has long provided that real systems, such as biology, personality, and on-line cognitive processing, are open to and constantly interacting with their surrounding contexts (or environments). Through these ongoing exchanges, these open systems develop new properties that are qualitatively meaningful and contribute to their overall evolutions. Systems are hypothesized to be constrained by certain parameters, such as system–environment boundaries, the way that the system’s hierarchy of levels is organized, and what information the system has at its disposal. In contrast with reductionist perspectives that aim to simplify naturally complex entities (e.g., the human being), systems theory has acknowledged that these entities are highly complicated, open systems that are undergoing constant internal and external change and that an understanding of the organization of the entity’s parts, as well as the interrelations of these parts, is essential to scientific study of the entity as a whole.

Historically, systems views have been applied broadly, often for the purpose of strengthening macroscopic theories of individual development (e.g., Ford & Lerner, 1992; Sameroff, 1995). For example, Gottlieb’s (1996a,b) theory of developmental psychobiology considers the individual organism as a system of interactive functioning that ranges from the low level of genes to the high level of social environment. Principles that are germane to systems theories may also be applied *microscopically* in order to focus on the functioning and development of a single level within a larger system (see Fig. 1). The selected level (or subsystem) of functioning may then be viewed as the comprising “system” of interest whereby its qualitatively-distinct components and processes may, in turn, be recast into an organized hierarchy of interactive levels of operating.¹ For example, the social–cognitive level of the larger social–developmental system may be extracted and magnified so that it may be conceptualized and studied according to an

¹ Ford and Lerner (1992) provide a graphical illustration of interrelated “subcomponents” (or sublevels) within each system component (or system level) in order to represent “a person as an integrated . . . unit in continual transaction with an environment” (pp. 112–113).

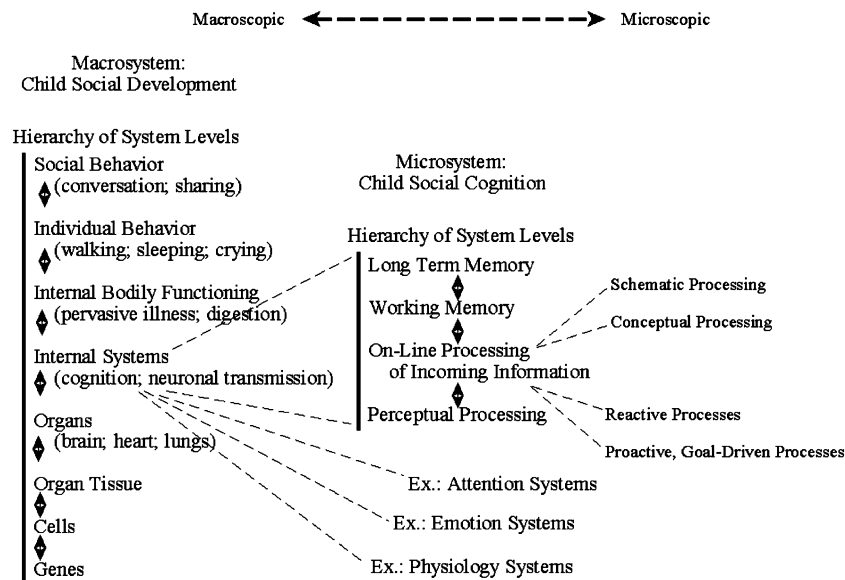


Fig. 1. The microscopic application of developmental systems principles to children's social-cognitive functioning.

organized hierarchy of levels of mental activity. Individual components and processes that are active at each level of cognition, then, may be examined in light of an expanded microsystem of interest: child social-cognitive processing.²

The present paper illustrates how certain key ideas of systems perspectives may be applied in the furtherance of conceptualizing social information-processing models of aggression in youth. Dodge's model of social information processing and aggression (Crick & Dodge, 1994; Dodge, 1986) will be used as the guiding framework to demonstrate how principles of systems approaches may be applied to aggressogenic cognitive operations such as hostile and intent attributional biases and decision-making tendencies that contribute to the development of antisocial conduct. Finally, this paper briefly addresses future directions for research in child social information processing and aggression that may benefit from applications of systems principles.

1. Systems principles and current models of child social cognition

In the past, research on cognitive development in children has been criticized for lacking theoretical foundation (e.g., Brown, 1979). However, recent years have witnessed considerable theoretical growth in areas of child development including cognitive psychology (e.g., McShane, 1991; Schneider & Pressley, 1997), social cognition (e.g., Crick & Dodge, 1994; Huesmann, 1998), and cognitive neuropsychology (e.g., Temple, 1997). In particular, theories of social cognition in childhood have concentrated on the developing, complex relation between children's mental functioning and interpersonal behavior within the broader context of the child's social world. As a result, the critical role that is played by social cognition in children's social and behavioral development has been well established (for recent reviews, see Crick & Dodge, 1994; Fontaine & Dodge, in press).

2. Social information processing, decision making, and child aggression

Information-processing perspectives (e.g., Hayes, 1981; Newell & Simon, 1972) have been guided by a set of assumptions about temporal ordering relations in the flow of processing (see Palmer & Kimchi, 1986). First, there are ordered paths of operations by which input information travels. Second, operations are time-dependent; that is, some minimal period of time must elapse before input may be processed by any single operation. Third, operations can only be activated when all necessary information is available from temporally-antecedent processes and outputs. Based on

² The importance of applying a microscopic focus to the study of children's social cognition within the larger context of individual development was forecast by Turiel (1983, p. 53): "The study of children's social judgments cannot be restricted to analyses of developmental processes. To deal adequately with the question of development or acquisition it is necessary to study also the nature of the domain in which development occurs."

these assumptions, numerous information-processing models have been posited to explain mental functioning according to sequential cognitive steps (or processes) (see Reeves, 1996, for a brief historical discussion). Although information-processing approaches have viewed these individual processes as separate levels of cognitive functioning, each level is distinguished by its place in the presumed temporal order of operating, and not according to reasons that are necessarily inherent to the nature of the cognitive system (such as varying degrees of accessibility or required mental effort that may differentiate cognitive processes and structures).

More recently, social information-processing models have been advanced to explain relations between cognition and antisocial behavior in the course of child development (e.g., Crick & Dodge, 1994; Dodge, 1986; Huesmann, 1988, 1998). These models have been successfully operationalized in varied empirical settings for the central purpose of predicting and explaining aggressive behavioral patterns in childhood and adolescence (e.g., Dodge et al., 2003; Fontaine, Burks, & Dodge, 2002; Huesmann, 1998). Current formulations of these models (Crick & Dodge, 1994; Huesmann, 1998) as well as related models of behavioral decision making (Fontaine & Dodge, in press) and social perception (Read & Miller, 1998) have hypothesized that multiple, interactive levels of cognitive functioning collectively account for social-behavioral outcomes.

Dodge's (1986) initial formulation of social information processing and aggressive behavior in children posited that there is a series of mental operations that takes place when a child is presented with a novel social stimulus or cue. First, the child *encodes* the stimulus by perceiving various features of the social situation and mentally organizing the information that is perceived to be relevant. Second, the child *interprets* the cue by making attributions as to the meaning of the social stimulus such as mental state and purpose of the actor. Third, the child *generates alternative responses* to the cue for consideration. Fourth, the child *selects a response* to the stimulus in order to ultimately *enact the behavior* represented by the chosen mental response. In their most recent formulation of this model, Crick and Dodge (1994) have posited a more nonlinear version of social information processing in which both on-line processes (e.g., causal attributions as they occur in real time) and latent cognitive structures (e.g., behavioral schemas and other representations in memory) continue to interact and influence each other in the course of ongoing social interaction. They have further hypothesized that transactions between on-line processes and latent mental structures occur via interactive feedback loops between on-line activity and a cognitive data base. The data base represents all information (i.e., mental material) that is stored in memory and acts as a mechanism by which information can be transferred from long-term memory storage to on-line activity (and vice-versa). As a result, ongoing on-line activity influences the formation and development of representations to be stored in memory, which, in turn, guide on-line operations when they are accessed for future use.

Huesmann (1988, 1998) has advanced a script-based model of social information processing. This model has continued to provide contributions to detailing the multilevel nature of social cognition. Central to this model are properties that are common to traditional information-processing perspectives. First, social information processing is viewed as constrained by the defined physical space in which its operations are activated and occur. Second, this defined activity space is hierarchically organized into an executive program that guides the flow of processing, subroutines that represent available cognitive operations, and memory structures that store mental representations of past cognitions and experiences (Huesmann, 1998). These separate levels of operating interact and influence each other in ongoing, cyclical patterns of social-cognitive and behavioral functioning—an approach that is clearly in line with developmental systems theories. The multilevel processing framework of this model has been supported by recent empirical findings suggesting that higher-ordered schematic representations may play a role in guiding on-line processing and behavior in children during social interactions (e.g., Huesmann & Guerra, 1997).

3. Extracognitive influences: immediate and remote contexts

A principle that is central to systems views (and one that is related throughout this paper) is that any single factor, process, or multifactor interaction cannot be understood outside of its immediate and remote (or secondary) contexts. This same rule applies, of course, to the study of children's social-cognitive functioning (see Turiel, 1983). For example, if the system of interest is child social cognition, external (or extracognitive) factors that influence social-cognitive functioning may stem from this system's immediate context (i.e., other bodily systems such as attention) or a more remote context (i.e., systems that are external to the individual such as culture; e.g., see Dodge et al., 2003). A research approach that employs a microscopic systems analysis of social cognition in no way denies or displaces the importance of corresponding functioning and development that occurs in the larger context of child development. In

fact, the present perspective is based on the idea that no development within the microsystem of social cognition occurs independently of extralevel or extracognitive activity (i.e., development that takes place “outside” of mental functioning).

This point seems particularly essential to identifying and understanding the utility of considering a “microsystems” perspective on social cognition to scientific inquiry in child social functioning. For example, in social psychology and developmental psychopathology, some researchers have studied the development of individual differences in children’s hostile attributional style. Upon being presented with social stimuli that are ambiguous as to their hostile intent, children differ in the degree to which they tend to attribute hostile versus nonhostile intent (e.g., Dodge, 1980, 1986; Fontaine, Burks, & Dodge, 1998). Although the process of attributing hostile intent to another is an on-line operation, there are numerous other on-line and off-line cognitive variables (e.g., visual perception and memory), noncognitive bodily processes (e.g., heart rate and mood), and environmental factors that may influence individual attributions and the development of an attributional style over time.

This may be obvious even in the case in which the researcher is interested in only a single hostile attribution—that is, the attribution that a single person makes in a specific situation. If one child bumps another by accident in a school hallway, there are seemingly limitless potential factors (both intra- and extracognitive) that may contribute to whether the child who is bumped attributes hostility to his or her peer. Intracognitive factors include such things as visual processing, on-line cognitive operating that precedes the attribution, and various cognitive structures that are stored in different levels of memory (for a comprehensive review, see Fontaine & Dodge, *in press*). For example, it has been hypothesized that the child who perceives his or her peer to exhibit facial-expressive features that are congruent with anger (e.g., eyebrows turned down, frown; Izard, 1977), matches facial expressions of ambiguous others with memories of past provocateurs’ appearances, and has aversive memories of previous experiences of peer victimization readily accessible, is more likely to attribute hostility to others in ambiguous social exchanges. Moving outside of the microsystem of social cognition, factors such as genetic make-up, brain physiology, bodily biochemistry, physical pain, and mood states and transient emotions have all been considered to play potential roles in the cognitive functioning—and, more specifically, the attribution making—of children. The individual who is genetically predisposed toward oppositional interpretation and violent behavior, has alcohol in his or her blood stream, and is in a chronically angry mood state is likely to attribute hostility in ambiguous situations, relative to others who do not share these characteristics.

Moving outside of intrapersonal or bodily systems, numerous experiential and environmental factors are also likely to play an important role. The child who has been physically abused and has grown up in a neighborhood where there is considerable violence may be more likely than his or her peers to develop a hostile attributional tendency. Environmental factors such as these may also influence cognitive processes indirectly through the mediating effects of extracognitive bodily factors such as neurological wiring. For instance, the child who is physically abused may suffer brain damage, which in turn may cause him or her to be more likely to attribute hostile intent to others in ambiguous social situations, as compared to youths with no history of abuse. It quickly becomes evident that the researcher who is interested in the single cognitive event (i.e., the single attribution) must consider various levels of functioning that span across the immediate (e.g., one’s present emotional state) and remote (e.g., early child abuse) contexts within which the attribution occurs. The range and number of complexities that arise upon considering a single cognitive event within its immediate and remote contexts only increase upon considering multiple occurrences of this cognition (or type of cognition) over time.

4. Alternative developmental progressions: mediating and moderating relations

The social information-processing models of Huesmann (1998) and Crick and Dodge (1994) may be viewed in light of systems approaches to understanding the development of an individual’s social–cognitive system. Further, a microsystems approach to social–cognitive functioning and development in childhood may provide additional avenues by which this area of research is able to further advance. For instance, multilevel, interactive models of social cognition allow for complicated conceptualizations of the many possible mediating and moderating effects on cognition–cognition and cognition–behavior relations and paths—both within and across dimensions of functioning. Consider two alternative mediational models of distinct cognitive components: (A) attributions of others’ hostile intent (independent cognition; on-line level) causes one to justify aggressive retaliation (mediating cognition; on-line level), which, in turn, leads one to develop a positive schema for aggression that is stored in memory (cognitive

outcome; off-line level); (B) hostile attribution triggers accessing of positive schema for aggression from memory guides on-line processing so that aggression is judged to be an acceptable style of social behavior. Either path A or B may lead to one's individual enactment of aggressive behavior in a given social context. Of course, these scenarios represent only two of the numerous possible cognitive operating patterns that may account (even partially) for an individual's social behavior. The plausibility of either scenario, as well as their relative degrees of plausibility, may hinge on such factors as cognitive organization and accessibility (or retrievableness). For example, path A may be more likely to characterize the case in which the child is still developing his or her sense of aggression as an acceptable or unacceptable style of behavior. Alternatively, scenario B may better describe the pattern of mental operating in the case of the person who has already formed a positive understanding (or value) of aggressive behavior that is schematically represented in memory. Of course, this latter example is altered in the case where an aggression schema has been stored in memory but, for whatever reason, is inaccessible (or, at least, less than immediately accessible) in future related social situations. This last scenario points to the possible moderating effect of cognitive accessibility on causal relations between hostile attributions, on-line judgments of aggressive response-options, and positive schemas for aggressive behavior.

5. Applying systems principles to social–cognitive processing in childhood

Models of cognition have used multidimensional frameworks in a variety of ways in order to discern alternative levels of operating (Anderson, 1996; Churchland, 1989; Flanagan, 1991). For example, connectionist theories of human cognition have proposed that different on-line mental operations often occur simultaneously (or “in parallel”) (Hinton & Anderson, 1981; Rumelhart, McClelland, & the Parallel Distributed Processing Research Group, 1986a,b). This hypothesis represents a multiprocess framework of sublevels within the specific level at which real-time cognitive processing and development take place—that is, the “cognitive level” (as opposed to, for example, genetic, physiological, and social/interpersonal levels). Because it is clear that not all cognitive processes are activated or occur in parallel with each other, organizing the potentially diverse system of cognitive processes into a hierarchy of levels appears to provide promise for understanding human cognition.

There are various ways in which social–cognitive levels may be conceptualized and hierarchically organized. Cognitive structures and processes may be classified into levels according to degree of accessibility, necessitated mental effort, complexity, duration, substantive content, and strength of association. For example, levels of memory processing have been conceptualized according to varying degrees of schematic abstraction (e.g., Pryor, McDaniel, & Kott-Russo, 1986). Another index, called “cognitive accessibility,” may be used to distinguish between irretrievable memory structures, long-term memory, working memory, and on-line processing, creating an ordered arrangement of levels from least to most accessible. Alternatively, levels at which conceptual (or controlled) processing, schematic (or automatic) processing, and subjective perception occur may be differentiated according to indices of complexity and required mental effort (whereby higher levels of functioning are characterized by greater degrees of complexity and the amount of mental energy needed).

6. A multilevel hierarchy of the social cognition system

Although different conceptual paths may lead to unique sets of social–cognitive levels, as well as alternative organizations of such levels, five levels or processes of the social cognition system are identified at present. As outlined in Fig. 1, these levels are arranged from high-to-low as follow: long-term memory, working memory, on-line schematic processing, on-line conceptual processing, and perception. A large body of empirical work has provided evidence that these cognitive structures and processes are different in qualitatively meaningful ways (e.g., see Anderson, 1996; Crick & Dodge, 1994; Fontaine & Dodge, in press).

First, on-line processes are distinguished from off-line (or secondary or latent) cognitive structures. On-line processes refer to mental operations as they actually occur (e.g., the mental act of attributing intent to another individual). Alternatively, off-line cognitive structures refer to products of on-line processing (e.g., memories) that are represented and stored in memory for later retrieval. This distinction has been made in different ways—for example, on-line and off-line processes may be distinguished by what one *does* versus what one *has* (e.g., Cantor & Kihlstrom, 1981) or as information processing versus latent mental structures (e.g., Dodge, 1993), respectively. Qualitatively unique, on-line and off-line processes are hypothesized to be in continual interaction with each other, neither

developing independent of the other; a concept that is guided by and consistent with developmental systems perspectives (e.g., Ford & Lerner, 1992).

Second, cognitive psychologists have long distinguished between different levels and processes of memory—particularly between long-term and working (or short-term or primary) memory (Baddeley, 1979, 1990; Craik & Lockhart, 1972; Treisman, 1979). For instance, Craik and Lockhart (1972) have maintained that retention of information in memory depends on how deeply the information is processed when first presented. In addition to individual differences in memory retention are additional differences in memory (or cognitive) accessibility. Although their distinct qualities have been overlooked in social-cognitive research, it is unlikely that these concepts are identical—in fact, to say that information in memory is inaccessible suggests that such information has actually remained in a state of retention. Further, retention and accessibility may be of conceptual utility to modeling interactions between on-line processes and memory structures (as well as other multilevel transactions). For example, when a child is presented with a novel social stimulus, he or she may activate a number of cognitive processes in response. These on-line processes may be more or less effective and efficient depending on the degrees to which information about the child's past experiences has been retained and is readily accessible.

Third, numerous models of social cognition have drawn distinctions between on-line cognitions that are conceptually (or consciously) processed versus schematically (or nonconsciously or automatically) executed (Crick & Dodge, 1994; Fontaine & Dodge, *in press*; Smith & Lazarus, 1990; Uleman & Bargh, 1989). For instance, Smith and Lazarus (1990) have recognized that, as opposed to cognitive processes that are volitional, consciously operated, and potentially time-consuming, interpretive and judgment processes are often automatic, instantaneous, and nonconscious. Cognitions that are automatically executed are hypothesized to represent the quick accessing of schema-based information (or scripts) in memory (Huesmann, 1988, 1998). In social contexts in which a schematic representation of the situation at hand is not available, an individual may be forced to use additional time and be more conscious of his or her behavioral cognitions (e.g., constructing possible ways to behave in novel types of social interaction). The distinction between conceptual and schematic processing levels clarifies the importance of distinguishing between on-line processes and memory structures, as well, in that schematic (or script-based) processes depend, to large degrees, on what information about similar past situations has been retained, how such information was encoded and represented, and how accessible it is from off-line cognitive stores.

Finally, certain theories of cognition and information processing have viewed perception as a level of mental functioning that is unique to all other cognitive activity (e.g., Mace, 1986; Rock, 1983). Rock (1983) has claimed that perceptual cognition is separate from all other cognitive levels because of the direct proximity of perception to stimulus information. In contrast, postperceptual processes are presumed to be based on one's perceived stimulus information and, in this sense, is necessarily indirectly related to the "objective" stimulus. Other perception theorists (e.g., Mace, 1986) have distinguished between perception and cognition based on the concept of experience. According to this hypothesis, perception is separate from postperceptual mental functions because experiencing a stimulus may not be accomplished without postperceptual cognitive processing—that is, without cognitions such as encoding and interpreting input information, perceived stimulus data are meaningless and thus necessarily short of experience. The distinction between perceptual processing and other cognitive operations also holds potential import for understanding the occurrence of social-cognition interactions in the larger context of mind. For instance, whereas perception of stimulus information is conceptualized to mediate the path from stimulus presentation to stimulus interpretation, individual differences in children's perceptual style may moderate this causal chain. The child who tends to perceive facial expressions as representing down-turned eyebrows, flared nostrils, tense muscles, and flushed skin color, may be more likely to encode and interpret others as angry and process information in other aggressogenic ways (which, in turn, may promote his or her development of withdrawal or aggressive styles of behavior) (see Izard, 1977, p. 330, for a description of facially-expressed anger). Organizing the cognition system into levels according to differences in structural and functional qualities provides a coherent theoretical framework from which to consider and test this hypothesis (as well as numerous related others).

In addition to the idea of considering and organizing a system across multiple levels, a concept that is critical to systems perspectives is that components at each system level exist and develop while in reciprocal relation with each other—that is, components are continually interacting with each other across system levels throughout the entire developmental course of the system. This idea, is limited, of course by the developmental complexity of the system of interest. For example, the young child's social-cognitive functioning is not as complex or complicated as that of an adult and therefore cannot be organized in an identical manner. Relations among discrete processes and levels of

operating are necessarily multidirectional, and they affect, and are affected by, each other *in ways that are subject to possible change over time and as development unfolds*. This constraint on the stability of system organization across development is crucial to understanding how systems perspectives may be useful to modeling and testing concepts associated with children's social-cognitive development. For example, upon evaluating alternative response options in a given social interaction, an older child may consider both the moral rightness and outcome likelihood of a specific response whereas it is more likely that a younger child will only consider the outcome likelihood of the behavior (Kohlberg, 1963, 1964, 1984; Leon, 1980). In other words, the hierarchical organization of the younger child's social-cognitive system has not developed to the same degree of complexity of that of the older child.³

7. Dimensions of intercomponent functioning

For the investigative case in which analysis focuses on a single component within an individual level (for example, the on-line process of interpreting causality in an interpersonal exchange), it is important to recognize that interactions among level components may influence (directly and indirectly) the social-cognitive component of interest at three dimensions. First, *intralevel* functioning involves the reciprocal interaction between components within the same individual level of functioning. For example, a child may be presented with a social dilemma about which he or she must make some moral assessment of a type of behavior (e.g., interpersonal violence). The judgment that violence is morally wrong may lead to an expectation that a violent behavior in the current situation will lead to a harmful outcome. In turn, this expectation may reinforce the child's initial perception of violence as a morally wrongful way to behave. Here, both components function at the social-cognitive level of on-line conceptual processing.

Second, *interlevel* functioning refers to transactions among components of different levels. The judgment that a violent behavior is morally wrong may trigger the accessing of an associated experience that is represented in working memory. If the past experience involved a scenario in which violence resulted in a positive outcome, the child's initial on-line evaluation of the behavior (as immoral) may be altered; alternatively, the association of a negative result may strengthen the child's initial behavioral assessment as well as make it more likely that the child will make the same on-line judgment in future similar situations.

Third, *extralevel* functioning entails the reciprocal exchange among components that are outside of the level of functioning in which the component of interest is stationed. If the component of interest is the child's on-line moral assessment of violence as a style of interpersonal behavior, an extralevel function might consist of an off-line transfer of a cognitive representation of a past experience from working memory to long-term memory. A child's past experiences may be represented in a multitude of ways. A recent experience of interpersonal violence in school may be readily accessible from the working memory level of functioning. However, although relevant to a similar situation that the child is experiencing outside of school, this information may not be accessed to his or her on-line processing because it is more strongly associated with social life within the school context than it is with acts of violence in general. Over time and across similar nonschool situations, the experience of interpersonal violence in the school setting may be transferred from working memory to long-term storage. This transfer occurs as a function of cognitive efficiency (a generally adaptive process) as it remains unaccessed as time passes. In addition, this transfer may have an important effect on the accessibility of the original experience of school violence during the next situation in which the child is presented with a school situation that involves violence (a specifically maladaptive effect).

Distinguishing intercomponent functioning that takes place at the extralevel dimension also serves to explicate the importance of conceptualizing the development of the social cognition system within a larger context of children's overall development. At first glance, extralevel functioning may seem to be of distal (or at least secondary) relevance to the narrowly-focused examination of specific intercomponent relations. However, extralevel functioning is

³ Note that the idea that reciprocal influences among factors, as well as within factor dimensions, collectively drive individual development has been posited to different degrees and in various forms by several theories that have serious implications for future directions in child development research—including appraisal theory (e.g., Lazarus & Smith, 1988; Smith & Lazarus, 1990), social information-processing theory (Crick & Dodge, 1994; Dodge, 1986; Huesmann, 1988), developmental psychobiology theory (Gottlieb, 1996a,b), transactional perspectives on development and psychopathology (e.g., Cicchetti & Lynch, 1993; Cicchetti & Toth, 1997; Sameroff & Chandler, 1975), interactive perspectives on social networks (e.g., Cairns, 1979; Cairns & Cairns, 1991), and models of behavioral decision making (e.g., Fontaine & Dodge, in press; Fontaine et al., 2002).

anything but removed from central issues associated with transactions among social–cognitive structures and processes. Of course, as time passes and development unfolds, extralevel functioning is continually occurring and in flux, as well as is the potential impact of extralevel operating on both inter- and intralevel activity. As time-dependent variations in extralevel functioning occur, the larger context within which inter- and intralevel processes take place is, by its nature, undergoing successive change. Thus extralevel functions are continually altering environmental constraints by which inter- and intralevel processes are limited. This notion is guided by and consistent with developmental systems theories in that the nature of any single intercomponent relation cannot be understood (nor can its specific role in child development) if it is considered in the absence of its surrounding and continually-changing environment (both immediate and remote). For example, a child's tendency to attribute hostile intent to others in ambiguous social situations cannot be understood to be adaptive or maladaptive unless the child's larger cognitive-operating system (such as memories of past physical abuse and victimization) is considered as the immediate context of this cognitive style. In turn, the child's on-line processing (or attribution making) and larger cognitive system cannot be understood outside of bodily (e.g., emotion and physiology) and environmental (e.g., culture and society) aspects of the overall context in which the child's mental operating takes place. Although these factors may originate outside of the cognitive system, they appear to be continually interacting with and influencing cognitive processes and structures at different levels (e.g., see [Crick & Dodge, 1994](#); [Turiel, 1983](#)). In much the same way, extralevel cognitive operations and interactions may affect processes that take place within the level of cognitive functioning that is of present interest to the researcher.

8. The impact of development on cognitive specificity and complexity

As time passes, variation in substantive (e.g., endorsement of aggressive versus prosocial behavior), structural (e.g., on-line operation versus representation in memory), and procedural (e.g., conceptual versus schematic processing) properties of developmental phenomena occur in simultaneity. Ongoing progressions in variation are often characterized by increases in the specificity and complexity of system components, as well as the many interrelations among these components. The idea that development is marked by increments in specificity and complexity is known as the orthogenetic principle of [Werner \(1957, 1984\)](#). This principle states that development represents the progression “from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchical organization” ([Werner, 1957](#), p. 126). This principle has informed systems perspectives on development in that it emphasizes the continually changing nature of the organization of the developmental entity of interest. The increasing complexity with which the hierarchical organization of a system may be conceptualized can be used to better assess and understand developmental differences in children's social–cognitive functioning. This hypothesis is supported by recent research on cognitive development in which an increase in the complexity of children's categorization processing and knowledge base has been evidenced (and may be measurable) in infants as young as 7 to 11 months of age ([Mandler & McDonough, 1996, 1998](#); [McDonough & Mandler, 1998](#)).

Future models of social–cognitive development need to account for differentiation processes and explain what implications time-dependent changes in differentiation and hierarchical organization have for the maintenance of adaptive system functioning. Also important is how these changes, in turn, affect the development of processes that are external to, and possibly in reciprocal relation to, the system of interest (e.g., what the increasingly complex nature of the social–cognitive system means for the development of a child's social behavior). If snapshots of the social–cognitive system could be viewed at the discrete developmental stages of infancy, middle childhood, and adolescence, they would likely reveal startling differences in the specificity of cognitive contents, structures, and operations, in addition to drastic variations in system organization. Developmental inquiry that has considered such factors will force science to investigate, identify, and explain gradual paths that better account for componential change, differences among intercomponent relations, and overall system variation (both within and between individual children).

It is difficult to imagine that one stage of children's social–cognitive development is necessarily more important to this goal than any other. Whereas change may be more drastic and occur more quickly during early formation, the degrees to which cognitive specificity and complexity broaden and deepen may only be realized during more advanced stages (e.g., later childhood or adolescence). Thus, the entire developmental span of child years may be presumed to be of critical importance to explaining subsequent functioning. For example, whereas change in infants'

and younger children's ability to distinguish between categories of mother and father, parents and nonparents, familiar people and strangers, etc., may occur at a rapid pace that decelerates over time, the specificity and complexity with which people make attributions of intent and causality in interpersonal situations become far more advanced in later childhood and adolescence.

The idea of increasing variation over time is essential to understanding the development of a multilevel, interactive model of social–cognitive functioning. Models that are not guided by this idea cannot comprehensively represent individual differences in social–cognitive growth that tend to characterize development across periods of infant, child, and adolescent maturation. Furthermore, models that do not account for specificity and complexity across developmental periods are likely to be poor predictors of individual differences in social–cognitive (as well as behavioral) functioning *within* any single developmental period (and are thus necessarily limited in their potential contribution to child development).

An obvious example of the importance of considering increases in specificity and complexity in advancing theory in social–cognitive development involves schematic processing of social cues. It logically follows that social information needs to be encoded and represented in memory before schematic processing of such information (or information that is perceived to be sufficiently relevant or familiar) can take place. In turn, encoding information and representing it in memory is largely dependent on having previously experienced social phenomena (e.g., interpersonal conflict) in which such information was presented or at least perceived (e.g., features of an angry face) (see Crick & Dodge, 1994, p. 79). It follows that children who have experienced fewer, more homogenous social interactions are less likely to schematically process (or even *be able to* schematically process) social information in the future, relative to other children who have many varied social experiences. This difference in developmental trajectories may have an exponentially profound impact on individual differences in child social competence as time passes and children grow older. This point is important to the necessary consideration of social–cognitive functioning across development because (a) the number of one's social experiences, (b) the degree of heterogeneity that characterizes one's past experiences, (c) age (or time spent in a social world), and (d) cognitive development, are all likely to covary and impact each other, to different degrees, as time passes.⁴

9. Future directions for social cognition and child development in the 21st century

In addition to the general future directions that are central to the theme of this paper, there are numerous areas of investigation that need and are likely to receive increasing scientific attention as research in child development moves forward. A comprehensive view of this topic would require an extensive review and analysis and is therefore beyond the scope of this paper. However, the following two sections provide a brief sketch of the potentially complimentary nature of two emerging trends in scientific interest that appear to have particular promise for future research on children's social information processing.

10. Proactive versus reactive processes in children's social development

One area of research that appears to be critical to understanding relations between social behavior and different levels of social cognition involves proactive versus reactive processes (Crick & Dodge, 1996; Fontaine & Dodge, *in press*). Historically, cognitive psychologists have drawn a conceptual parallel between two dichotomies: (a) controlled and automatic modes of processing, and (b) mental operations that are goal-directed and internally driven (or proactive) versus processes that are data-driven and entirely responsive to external stimuli (or reactive) (see Anderson, 1996). These multimodal perspectives to on-line processing have been hierarchically organized so that mental functioning may be translated into alternative approaches in computer-based investigation. For example, a third and similar dichotomy in computer science is characterized by bottom-up processing, in which analysis begins with incoming information and ascends to the highest level of mental functioning (e.g., knowledge; Newell, 1982, p. 99), versus top-down operating, in which the opposite direction is taken (Anderson, 1996).

⁴ Of course, a child's past social experiences are only relevant to the encoding and mental representation of information (as well as accessing of such information in later schematic processing) to the degree that they are cognitively mediated.

In recent years, an increasing number of social cognitivists are recognizing a distinction between planful, instrumental behaviors (e.g., bullying and stealing) and reactive, hostile behaviors (e.g., provoked anger and impulsive retaliation) in the formation and growth of aggressive and deviant behavior patterns in children (e.g., Atkins & Stoff, 1993; Crick & Dodge, 1996; Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Fontaine & Dodge, *in press*; Fraser, 1996; Smithmyer, Hubbard, & Simons, 1998). Whereas planful aggressive behaviors are characterized as cold, calculated, deliberate actions, reactive aggression is typified by anger, hostility, impulsivity, and elevated autonomic activity (see Dodge, 1991, for a review). However, the majority of empirical support for this theoretical distinction stems from cognitive processing differences between proactive and reactive aggressive children (Crick & Dodge, 1994, 1996). Whereas proactive aggressors appear to be more confident in their aggressive actions and are more likely to expect positive outcomes of aggression, reactive aggressors tend to show greater tendencies to attribute hostile intent in social situations that involve ambiguous provocations (Crick & Dodge, 1996; Dodge & Coie, 1987; Dodge, Price, Bachorowski, & Newman, 1990; Dodge et al., 1997). Recently, Fontaine and Dodge (*in press*) have articulated several additional hypotheses that involve distinguishing proactive from reactive aggressive behaviors on the basis of behavioral decision-making differences that affect different levels of mental functioning in childhood. For example, because their behaviors are calculated and goal-driven, proactive aggressive children may be less likely to denounce aggressive behavior on moral grounds, relative to their reactive–aggressive and nonaggressive peers. There is good reason to believe that this line of empirical inquiry will continue to receive increasing attention with the rigorous testing of each new hypothesis.

11. Computer simulation: theory construction and methodological design

For several decades, various domains of cognitive psychology have continued to use computer models and simulations as a tool by which to advance theory construction and test design. Recent mathematical models of social cognition in children have proposed that multilevel processes in social reasoning and behavioral decision making may be similarly informed by computer simulation techniques (see Fontaine & Dodge, *in press*, for a discussion). Computer simulation may provide social–cognitive developmentalists with an effective tool for both theory building and designing appropriate methods for data collection and empirical examination (see Whicker & Sigelman, 1991). For example, differences in proactive versus reactive cognitive processes may be better identified using computer simulation. Because it is relatively easy to control and manipulate rules and constraints within computer-simulated paradigms, researchers who are interested in alternative levels of social–cognitive functioning and how social cognition may change across development may be afforded an efficient (i.e., both generative and relatively inexpensive) mean by which to make initial adjustments in theory and empirical operationalization prior to collecting large amounts of human data.

12. Summary

This paper illustrates ways in which key principles of systems perspectives may be useful in conceptualizing social–cognitive processing in children. Conceptually, the social–cognitive level of human functioning may be extracted from the macrosystem of overall child development and magnified so that it may be investigated from a developmental microsystem perspective. The microsystem of social cognition, then, may be viewed as an ongoing multidirectional interaction among qualitatively-distinct mental levels (as well as separate components and processes within each level). The main purpose of this paper is to encourage research scholars to consider major systems principles and approaches in designing, developing, and testing models of social cognition in the larger context of child development. In the interest of advancing science in this domain, it is maintained that systems-perspective applications (as well as related developmental concepts; e.g., see Cicchetti and Rogosch, 1996; Werner, 1957, 1984) encourage researchers to realize more elaborate and varied theoretical models of, as well as investigative approaches to, social–cognitive functioning and development in children.

Acknowledgement

I am indebted to Philip R. Costanzo, Gedeon O. Deák, Kenneth A. Dodge, Gilbert Gottlieb, Stephanie E. Milan, and Robert L. Nix, for their thoughtful, critical reviews of early drafts of this paper.

References

- Anderson, J. R. (1996). *The architecture of cognition*. Mahwah, NJ: Erlbaum.
- Atkins, M. S., & Stoff, D. M. (1993). Instrumental and hostile aggression in childhood disruptive behavior disorders. *Journal of Abnormal Child Psychology*, *21*, 165–178.
- Baddeley, A. (1979). Levels of processing and levels of explanation: Discussion of the papers by Treisman and Bransford, Franks, Morris, and Stein. In L. S. Cermak, & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 355–360). Hillsdale, NJ: Erlbaum.
- Baddeley, A. (1990). *Human memory: Theory and practice*. Needham Heights, MA: Allyn and Bacon.
- Barnard, P. J., & Teasdale, J. D. (1991). Interacting cognitive subsystems: A systemic approach to cognitive–affective interaction and change. *Cognition and Emotion*, *5*, 1–39.
- Brown, A. L. (1979). Theories of memory and the problem of development: Activity, growth, and knowledge. In L. S. Cermak, & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 225–258). Hillsdale, NJ: Erlbaum.
- Cairns, R. B. (1979). *Social development: The origins and plasticity of social interchanges*. San Francisco: Freeman.
- Cairns, R. B., & Cairns, B. D. (1991). Social cognition and social networks: A developmental perspective. In D. J. Pepler, & K. H. Rubin (Eds.), *The development and treatment of childhood aggression* (pp. 249–278). Hillsdale, NJ: Erlbaum.
- Cantor, N., & Kihlstrom, J. (Eds.). (1981). *Personality, cognition, and social interaction*. Hillsdale, NJ: Erlbaum.
- Churchland, P. (1989). *A neurocomputational perspective: The nature of mind and the structure of science*. Cambridge, MA: MIT Press.
- Cicchetti, D., & Lynch, M. (1993). Toward an ecological/transactional model of community violence and child maltreatment. *Psychiatry*, *56*, 96–118.
- Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, *8*, 597–600.
- Cicchetti, D., & Toth, S. L. (1997). Transactional ecological systems in developmental psychopathology. In S. S. Luthar, J. A. Burack, D. Cicchetti, & J. R. Weisz (Eds.), *Developmental psychopathology: Perspectives on adjustment, risk, and disorder* (pp. 317–349). United Kingdom: Cambridge University Press.
- Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*, 671–684.
- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, *115*, 74–101.
- Crick, N. R., & Dodge, K. A. (1996). Social information-processing mechanisms in reactive and proactive aggression. *Child Development*, *67*, 993–1002.
- Dodge, K. A. (1980). Social cognition and children's aggressive behavior. *Child Development*, *51*, 162–170.
- Dodge, K. A. (1986). A social information processing model of social competence in children. In M. Perlmutter (Ed.), *The Minnesota symposia on child psychology. Cognitive perspectives on children's social and behavioral development, vol. 18* (pp. 77–125). Hillsdale, NJ: Erlbaum.
- Dodge, K. A. (1991). The structure and function of reactive and proactive aggression. In D. Pepler, & K. Rubin (Eds.), *The development and treatment of childhood aggression* (pp. 201–218). Hillsdale, NJ: Erlbaum.
- Dodge, K. A. (1993). Social–cognitive mechanisms in the development of conduct disorder and depression. *Annual Review of Psychology*, *44*, 559–584.
- Dodge, K. A., & Coie, J. D. (1987). Social-information-processing factors in reactive and proactive aggression in children's peer groups. *Journal of Personality and Social Psychology*, *53*, 1146–1158.
- Dodge, K. A., Lansford, J. E., Burks, V. S., Bates, J. E., Pettit, G. S., Fontaine, R., et al. (2003). Peer rejection and social information-processing factors in the development of aggressive behavior problems in children. *Child Development*, *74*, 374–393.
- Dodge, K. A., Lochman, J. E., Hamish, J. D., Bates, J. E., & Pettit, G. S. (1997). Reactive and proactive aggression in school children and psychiatrically impaired chronically assaultive youth. *Journal of Abnormal Psychology*, *106*, 37–51.
- Dodge, K. A., Price, J. M., Bachorowski, J., & Newman, J. M. (1990). Hostile attributional biases in severely aggressive adolescents. *Journal of Abnormal Psychology*, *99*, 385–392.
- Emde, R. N. (1998). Early emotional development: New modes of thinking for research and intervention. *Pediatrics*, *102*, 1236–1243.
- Flanagan, O. (1991). *The science of the mind* (2nd ed.). Cambridge, MA: MIT Press.
- Fontaine, R. G., & Dodge, K. A. (in press). Real-time decision making and aggressive behavior in youth: A heuristic model of response evaluation and decision (RED). *Aggressive Behavior*.
- Fontaine, R. G., Burks, V. S., & Dodge, K. A. (1998, March). *The mediating effect of sociomoral judgments about aggression on the relation between hostile attributional style and antisocial conduct*. Paper presented at the biennial meeting of the Conference on Human Development, Mobile, AL.
- Fontaine, R. G., Burks, V. S., & Dodge, K. A. (2002). Response decision processes and externalizing behavior problems in adolescents. *Development and Psychopathology*, *14*, 107–122.
- Ford, D. H., & Lerner, R. M. (1992). *Developmental systems theory: An integrative approach*. Newbury Park, CA: Sage.
- Fraser, M. W. (1996). Aggressive behavior in childhood and early adolescence: An ecological–developmental perspective on youth violence. *Social Work*, *41*, 347–361.
- Gottlieb, G. (1996). Developmental psychobiological theory. In R. B. Cairns, G. H. Elder, Jr., & E. J. Costello (Eds.), *Developmental science* (pp. 63–77). Cambridge, England: Cambridge University Press.
- Gottlieb, G. (1996). A systems view of psychobiological development. In D. Magnusson (Ed.), *The lifespan development of individuals: Behavioral, neurobiological, and psychosocial perspectives* (pp. 76–103). Cambridge, England: Cambridge University Press.

- Hayes, J. R. (1981). *The complete problem solver*. Philadelphia: The Franklin Institute Press.
- Hinton, G. E., & Anderson, J. A. (Eds.). (1981). *Parallel models of associative memory*. Hillsdale, NJ: Erlbaum.
- Huesmann, L. R. (1988). An information processing model for the development of aggression. *Aggressive Behavior, 14*, 13–24.
- Huesmann, L. R. (1998). The role of social information processing and cognitive schema in the acquisition and maintenance of habitual aggressive behavior. In R. G. Geen, & E. Donnerstein (Eds.), *Human aggression: Theories, research, and implications for social policy* (pp. 73–109). San Diego, CA: Academic Press.
- Huesmann, L. R., & Guerra, N. G. (1997). Children's normative beliefs about aggression and aggressive behavior. *Journal of Personality and Social Psychology, 72*.
- Izard, C. E. (1977). *Human emotions*. New York: Plenum.
- Kohlberg, L. (1963). The development of children's orientation toward a moral order: I. Sequence in the development of moral thought. *Vita Humana, 6*, 11–33.
- Kohlberg, L. (1964). Development of moral character and moral ideology. In M. L. Hoffman, & L. W. Hoffman (Eds.), *Review of child development research, vol. 1*. (pp. 383–431). New York: Russell Sage Foundation.
- Kohlberg, L. (1984). *The psychology of moral development*. San Francisco: Harper and Row.
- Lazarus, R. S., & Smith, C. A. (1988). Knowledge and appraisal in the cognition–emotion relationship. *Cognition and Emotion, 2*, 281–300.
- Leon, M. (1980). Integration of intent and consequence information in children's moral judgments. In F. Wilkening, J. Becker, & T. Trabasso (Eds.), *Information integration by children* (pp. 71–79). Hillsdale, NJ: Erlbaum.
- Mace, W. M. (1986). J. J. Gibson's ecological theory of information pickup: Cognition from the ground up. In T. J. Knapp, & L. C. Robertson (Eds.), *Approaches to cognition: Contrasts and controversies* (pp. 137–157). Hillsdale, NJ: Erlbaum.
- Mandler, J. M., & McDonough, L. (1996). Drinking and driving don't mix: Inductive generalization in infancy. *Cognition, 59*, 307–335.
- Mandler, J. M., & McDonough, L. (1998). On developing a knowledge base in infancy. *Developmental Psychology, 34*, 1274–1288.
- McDonough, L., & Mandler, J. M. (1998). Inductive generalization in 9- and 11-month-old infants. *Developmental Science, 1*, 227–232.
- McShane, J. (1991). *Cognitive development: An information processing approach*. Cambridge, MA: Basil Blackwell.
- Newell, A. (1982). The knowledge level. *Artificial Intelligence, 18*, 87–127.
- Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.
- Palmer, S. E., & Kimchi, R. (1986). The information processing approach to cognition. In T. J. Knapp, & L. C. Robertson (Eds.), *Approaches to cognition: Contrasts and controversies* (pp. 37–77). Hillsdale, NJ: Erlbaum.
- Pryor, J. B., McDaniel, M. A., & Kott-Russo, T. (1986). The influence of the level of schema abstractness upon the processing of social information. *Journal of Experimental Social Psychology, 22*, 312–327.
- Read, S. J., & Miller, L. C. (1998). On the dynamic construction of meaning: An interactive activation and competition model of social perception. In S. J. Read, & L. C. Miller (Eds.), *Connectionist models of social reasoning and social behavior* (pp. 27–68). Mahwah, NJ: Erlbaum.
- Reeves, W. W. (1996). *Cognition and complexity: The cognitive science of managing complexity*. Lanham, MD: Scarecrow Press.
- Rock, I. (1983). *The logic of perception*. Cambridge, MA: MIT Press/Bradford Books.
- Rumelhart, D. E., McClelland J.L., Parallel Distributed Processing (PDP) Research Group. (1986a). Parallel distributed processing: Exploration in the microstructure of cognition. *Foundations, vol. 1*. Cambridge, MA: MIT Press/Bradford Books.
- Rumelhart, D. E. McClelland J.L., Parallel Distributed Processing (PDP) Research Group. (1986b). Parallel distributed processing: Exploration in the microstructure of cognition. *Psychological and biological models, vol. 2*. Cambridge, MA: MIT Press/Bradford Books.
- Sameroff, A. J. (1995). General systems theories and developmental psychopathology. In D. Cicchetti, & D. J. Cohen (Eds.), *Developmental psychopathology. Theory and methods, vol. 1* (pp. 659–695). New York: John Wiley and Sons.
- Sameroff, A. J., & Chandler, M. J. (1975). Reproductive risk and the continuum of caretaking casualty. In F. D. Horowitz (Ed.), *Review of child development research, vol. 4* (pp. 187–244). Chicago: University of Chicago Press.
- Schneider, W., & Pressley, M. (1997). *Memory development between two and twenty*. Mahwah, NJ: Erlbaum.
- Smith, C. A., & Lazarus, R. S. (1990). Emotion and adaptation. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 609–637). New York: Guilford.
- Smithmyer, C. M., Hubbard, J. A., & Simons, R. F. (1998, March). *Reactive aggression versus proactive aggression: Differential autonomic reactivity to an anger-induction peer interaction*. Paper presented at the biennial meeting of the Conference on Human Development, Mobile, AL.
- Temple, C. (1997). *Developmental cognitive neuropsychology*. East Sussex, United Kingdom: Psychology Press.
- Treisman, A. (1979). The psychological reality of levels of processing. In L. S. Cermak, & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 301–330). Hillsdale, NJ: Erlbaum.
- Turiel, E. (1983). Domains and categories in social–cognitive development. In W. F. Overton (Ed.), *The relationship between social and cognitive development* (pp. 53–89). Hillsdale, NJ: Lawrence Erlbaum.
- Uleman, J. S., & Bargh, J. A. (Eds.). (1989). *Unintended thought*. New York: Guilford.
- von Bertalanffy, L. (1968). *General system theory*. New York: George Braziller.
- Werner, H. (1957). The concept of development from a comparative and organismic point of view. In D. B. Harris (Ed.), *The concept of development: An issue in the study of human behavior*. Minneapolis, MN: University of Minnesota Press.
- Werner, H. (1984). *Comparative psychology of mental development*. New York: International Universities Press.
- Whicker, M. L., & Sigelman, L. (1991). *Computer simulation applications: An introduction*. Newbury Park, CA: Sage.