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Real-Time Decision Making and Aggressive Behavior in Youth: A Heuristic Model of Response Evaluation and Decision (RED)

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Considerable scientific and intervention attention has been paid to judgment and decision-making systems associated with aggressive behavior in youth. However, most empirical studies have investigated social–cognitive correlates of stable child and adolescent aggressiveness, and less is known about real-time decision making to engage in aggressive behavior. A model of real-time decision making must incorporate both impulsive actions and rational thought. The present paper advances a process model (*response evaluation and decision*; RED) of real-time behavioral judgments and decision making in aggressive youths with mathematic representations that may be used to quantify response strength. These components are a heuristic to describe decision making, though it is doubtful that individuals always mentally complete these steps. RED represents an organization of social–cognitive operations believed to be active during the response decision step of social information processing. The model posits that RED processes can be circumvented through impulsive responding. This article provides a description and integration of thoughtful, rational decision making and nonrational impulsivity in aggressive behavioral interactions. Aggr. Behav. 32:604–624, 2006. © 2006 Wiley-Liss, Inc.

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INTRODUCTION

Factors that contribute to individuals' engagement of aggressive behavioral responses in social situations are numerous and varied. Motivational, attentional, perceptual, physiological, biochemical, emotional, social, and cognitive factors are just some of the types of factors that play a role in the development and enactment of aggressive responsivity and retaliation. In the process of understanding why one person may respond aggressively to the same social cue that does not lead to an aggressive response by someone else, the role of how people make decisions in different social situations has emerged as critical area of study. For example, a child who has been subject to physical abuse and has grown up in a violent community may be more likely to consider and select aggressive response options to negative social interactions; whereas the child who has learned that nonaggressive responses are ultimately in his or her best interests, may be more thoughtful in his or her decision making, even in situations in which there are competing factors that encourage aggressive conduct (e.g., peer pressure). What decision-making operations are involved in this type of social–cognitive processing? How may decision processes explain differences in individual behavioral enactments as well as behavioral response styles?

Social and behavioral scientists have stressed the role of behavioral judgments (including beliefs and values) in patterns of aggressive conduct [e.g, Dodge, 1993; Dodge et al., 2003; Erdley and Asher, 1998; Fontaine, 2006, in press; Huesmann and Guerra, 1997]. Social–cognitive correlates of individual differences in aggression in children and adolescents include normative beliefs [e.g., Huesmann and Guerra, 1997], self-efficacy judgments [e.g., Erdley and

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Asher, 1996], outcome expectancies [e.g., Cuddy and Frame, 1991; Perry et al., 1986, 1989], social goals [Chung and Asher, 1996; Erdley and Asher, 1996], and outcome values [e.g., Boldizar et al., 1989; Guerra and Slaby, 1989]. For example, compared to their nonaggressive peers, aggressive children have been found to expect tangible rewards to result from acting aggressively [Perry et al., 1986], to believe that aggression increases self-esteem [Slaby and Guerra, 1988], and to valuate aggressive responses as sociomorally acceptable [Fontaine et al., 2002]. A different literature has supported the hypothesis that aggressive children fail to act rationally and instead respond impulsively [Dodge and Newman, 1981]. A theory of decision making in aggressive youth must reconcile these paradoxical perspectives. Although multiple aspects of decision making have been related to aggression, nowhere in the literature is it considered how these factors operate in concert or how decision-making processes unfold in real time during actual social interactions. The goal of this article is to propose such a model and to guide future research in this domain.

Behavioral judgments and decisions that occur in "real-time" are distinct from *latent mental structures* (i.e., inactive beliefs, attitudes, values, and "judgment styles") in that *real-time processes* (i.e., cognitive operations that occur during social exchanges) are mental actions immediately prior to behavioral performance and thus directly influence social behavior. Empirical studies have examined social–cognitive correlates (e.g., behavioral values, efficacy beliefs, etc.) of individual differences in aggressive behavior, but few studies have investigated the relation between real-time judgments and decisions to behave aggressively.

The purpose of the present paper is to understand and explain processes through which real-time behavioral judgments may affect decisions to behave aggressively. First, a process model of behavioral judgments and decision making in children and adolescents is proposed. At this step, we review the relevant literature on beliefs and judgments of aggressive youths and propose a heuristic model designed to account for response-comparison processes. This model is offered as a heuristic device by which the complexity of behavioral decision making may be considered, although it is not proposed that children actually complete mathematical calculations during response decision-making. The presented mathematical representations are analogous to the mathematical processes that Tolman [1938, 1951] proposed to explain walking and throwing a ball in that they are hypothesized to serve as a mathematical representation of response decision-making. In these domains, it is not proposed that children complete hundreds of calculations, even though their behavior may follow mathematic principles. Second, this model of RED processes is made more complex by consideration of impulsive reactivity and self-regulation as well as filtering mechanisms such as thresholds of response acceptability. It is proposed that thorough RED is often circumvented through impulsive (or quickened) responding brought on by numerous factors. Third, issues of assessment and methodology, implications for interventions with antisocial youth, and directions for other areas in need of future research are discussed.

A MODEL OF RESPONSE EVALUATION AND BEHAVIORAL DECISION MAKING

Theoretical formulations of social information processing [SIP; Crick and Dodge, 1994; Dodge, 1986; Huesmann, 1988] explain socially competent, aggressive, and other forms of behavior as the additive product of mental operations that are activated when an individual is presented with a social stimulus such as provocation. This model has been particularly effective in accounting for chronic aggressive behavior in children and adolescents [e.g., Dodge et al., 1995, 2003; Fontaine et al., 2002; for a review see Crick and Dodge, 1994]. According to this perspective, an individual responds to a social stimulus by perceiving stimulus cues (step 1: *encoding*), making social inferences about the stimulus and social context (step 2: *interpretation*), clarifying his or her own personal interests (step 3: *clarification of goals*), generating alternative ways to respond to the stimulus (step 4: *response access or construction*), evaluating these alternatives, considering their possible consequences, selecting the preferred response for enactment (step 5: *response decision*), and carrying out the selected behavior in response to the stimulus (step 6: *enactment*).

The present paper focuses on step 5 of SIP, response decision, in order to develop a framework by which advanced real-time judgments about social behaviors and outcomes may lead to aggressogenic decisions and antisocial behavior. In their reformulation of SIP, Crick and Dodge [1994] characterized response decision as a developmentally advanced processing step during which four distinct operations are potentially active. After a behavior has been generated as a possible (or alternative) means of responding to a social stimulus, an individual

appraises the behavior across various substantive domains (called *response evaluation*), such as friendliness or sociomoral acceptability [Crick and Ladd, 1990]. The individual anticipates possible consequences of performing the behavior of interest (called *outcome expectation*). Responses are evaluated for the probability that the individual would be able to enact the response [called *self-efficacy evaluation*; see Bandura, 1977a]. Ultimately, the responding individual identifies the alternative response that is most positively evaluated and selects it for behavioral enactment (called *response selection*).

The model of social decision making presented herein provides a significant advancement from the Crick and Dodge [1994] SIP formulation and addresses the most critical questions that are not sufficiently covered by former models: (a) What role does impulsivity play in RED making processes?, (b) What additional processes are potentially active during step 5 of SIP?, (c) Is it possible that there are filtering mechanisms by which unacceptable response options are ruled out prior to further consideration and processing (e.g., thresholds of response acceptability)?, and (d) Is there a way to quantify the meaning and value placed on alternative response options and mathematically represent the individual RED processes in order to estimate a response option's overall value or score?

A model of RED processes is illustrated in Figure 1. This model is intended to explain the incremental contribution of real-time behavioral judgments and decision making in the prediction of behavioral variability, particularly chronic aggressive behavior. It must be emphasized that, although linear progressions may be explained by RED, an infinite number of nonlinear patterns is also possible. Figure 1 illustrates the proposed response decision operations. It is important to note that this model is not intended to represent a linear chain of cognitive events; Figure 1 provides a visual illustration of a thoughtful and rational sequencing of RED steps by which a behavioral decision may be enacted. During the course of processing, an individual may return to previous RED processes, as well as skip ahead to more advanced stages, of decision making.

According to the RED model, as soon as a script (a specific behavioral response that is organized as a mental blueprint) is accessed from memory or newly constructed, it is "evaluated" within the response decision step by its automatic associations with behavioral preferences and represented outcomes. A script that is fully processed and ultimately enacted is first assessed across multiple thresholds embodied by five evaluative processes: (1) application of a

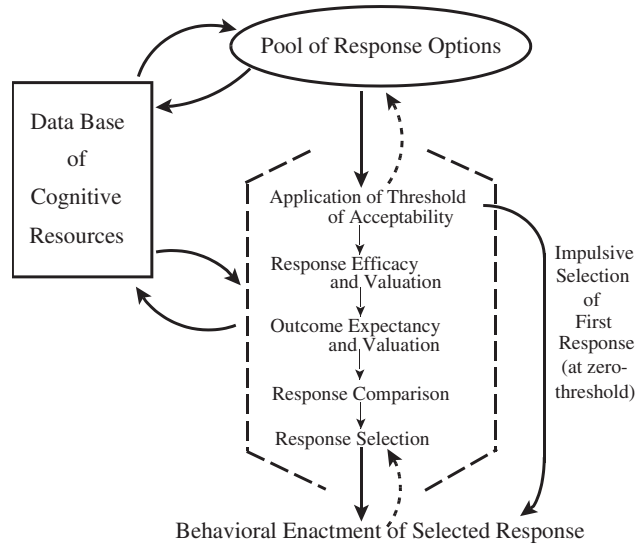

Fig. 1. A model of response evaluation and decision (RED). In the case of nonimpulsive responding, behavioral response options are appraised across multiple dimensions of response decision (outlined in dashes). RED is heuristic for on-line behavioral judgments and decisions that are theorized to be active during advanced social information processing.

primary threshold of acceptability, (2) response efficacy and valuation, (3) outcome expectancy and valuation, (4) response comparison, and (5) response selection. These processes characterize the most competent and thorough mental operations that humans are able to complete. The degree to which each of these processes is actually utilized varies across social settings, however. More typical processing is less thorough and more impulsive. Different situations impose unique demands upon processing resources that compromise these processes. Some situations require rapid (or at least quickened) responding and therefore afford less elaborate (or complete) processing.

As previously stated, an infinite number of alternative sequences of the RED processes is possible. For example, it is likely that outcomes are, at times, considered prior to the sociomoral attributes of the response option being considered; it is also likely that there are social situations in which individuals consider only the likely outcomes of a response and forgo consideration of the sociomoral nature of the response altogether. The RED model in its current formulation is offered as a heuristic by which various response decision-making processes may be conceptualized in an overall framework and considerable empirical research is necessary before more definite assertions regarding the temporal sequencing of decision processes may be made. Similarly, mathematical representations of the deci-

sion processes that are comprised by RED are proposed herein as one possible way to quantify these mental operations and compute an overall response score.

In order to illustrate how these processes may be utilized in real-life social situations, the following example is presented and will continue to be referred to throughout the course of this paper: John, a high-school student, is confronted in the school hallway by George, one of his peers (whom he knows but has had little interaction with historically), while both students are transitioning from one class to another, along with several other students. George initiates the interaction by pushing John's shoulder and then accusing John of making derogatory comments about George behind his back. John is thus presented with a problematic social situation in which George has provoked him and John will need to decide how to respond.

Process 1: Application of a Primary Threshold of Acceptability

During response access or construction (step 4 of SIP), alternative responses are generated either by drawing upon schemas [sometimes called *scripts*; see Huesmann, 1988; Schank and Abelson, 1977] stored in memory, or creating new potential responses to meet situational demands. The rules of response access are complicated enough to merit their own model that is beyond the scope of this article, which is more concerned with the processing of already-accessed responses. Upon being generated, a script is assessed at a rudimentary level according to a *threshold of primary acceptability*. This initial threshold of acceptability acts as a crude filter of scripts, rejecting only those responses that are clearly unacceptable as possible means of responding. Multiple thresholds of acceptability are incorporated throughout the five decision stages of the RED model. The threshold of primary acceptability is the first of these thresholds and represents the crudest of evaluative processes. The strength or value of a response option may be quantified and subjected to a set of decision rules. These decision rules represent the process by which a response option is measured against the acceptability-threshold level:

$$\text{if } TS_i \geq t_j, \text{ then } r_i \text{ is considered further;} \quad (1.1)$$

$$\text{if } TS_i < t_j, \text{ then } r_i \text{ is transferred off-line to working memory for temporary storage;} \quad (1.2)$$

$$\text{if for all } r_i, \text{ no } TS_i > t_j, \text{ then } t_j \text{ is lowered and the responding individual returns to 1.1} \quad (1.3)$$

where r_i = response option i; TS_i = the total evaluation score for r_i; and t_j = acceptability threshold j. A response option that has been assigned a low total score (perhaps because it is irrelevant to the situation) will not pass the primary acceptability stage of RED when the initial threshold is set at a higher level (perhaps because the people watching the interaction are meaningful to the actor). To continue with the example sited above, John may immediately rule out the response option of pretending that he did not hear George's accusation because George also pushed John's shoulder prior to making the accusation, making it clear to on-lookers that George had John's attention. Throughout our continued discussion of RED processes, decision rules 1.1–1.3 will be repeatedly referenced as additional thresholds of acceptability are introduced.

The initial level at which the threshold is set may depend, in part, upon the responding individual's perceived importance of, or personal investment in, the given situation. If the situation is of great value, either in terms of the interaction itself or the stakes involved, then the threshold may be set at an elevated level, and the individual may filter out a high proportion of accessed responses that would otherwise be acceptable and sufficient in a similar situation in which the actor has less invested. The threshold level may also depend more generally on the degree to which the responding person places value on how he or she behaves. The individual who places significant value on certain situations but is generally unconcerned about how he or she acts may be more likely to set lower thresholds in personally meaningful situations.

It is suggested that, typically, at least three criteria must be met in order for a response to pass the primary acceptability threshold. In other words, TS_i for response r_i is heuristically estimated initially based on three criteria. First, the response needs to be *generally relevant* to the social interaction at hand. Kuhl [1982] suggested that task-irrelevant cognitions, such as accessing situationally inappropriate schemas, may occur due to decreased or insufficient ability to control certain mental processes that are fundamental to the task. A response is generally irrelevant (or inept) if it does not correspond to the given situation. Consider the example in which John responds to George by

telling George that history is his favorite class. It may be the case that John's favorite class is indeed history and that he was looking forward to entering his history class when George stopped him still, this response to George would have been irrelevant. With learning and advancing development, this irrelevant and intrusive response may be inhibited and rejected at the threshold of primary acceptability (with some exceptions, including cases of psychopathology; indeed, intrusive thoughts in schizophrenia may be operationally defined as occurring because of an abnormally low threshold of acceptability).

Second, responses that are not *situationally applicable* may be rejected at this processing stage. Varying attentional levels (low vs. high) and types of attention (behavior-focused vs. cue-focused) may influence the likelihood that an individual will generate response options that are ordinarily appropriate but inapplicable to the given situation (see Kuhl, 1982, for a brief discussion of attentional issues in decision-making deficits). A response that is generally relevant but situationally inapplicable corresponds to the demands of the *type* of given social interaction but is fundamentally impossible due to a restriction imposed by the specific structure (or a certain feature) of the situation. In the case of John and George, John may generate the response of turning around and running in the opposite direction, only to remember that he would quickly meet a dead end. During the primary acceptability process, this behavioral response may be filtered out as a deficient response requiring no further evaluation.

Third, the nature of the response must be of sufficient *internal congruence* to the responding individual's self-concept. For example, an individual responding to a provocation might access a response of violent retaliation. This response may have been stored in memory due to the person's observational learning (perhaps from watching violent programs on television). Although the response may be relevant and applicable to the given interaction, if it is, by its nature, deemed internally incongruent to the responding person, it will fail to pass the initial threshold of acceptability. Again borrowing from the stereotyping literature, it is not clear whether the individual who has acquired a nonviolent self-concept actually never accesses violent responses or has raised the threshold of acceptability of these responses to a higher level so that they may be quickly ruled out.

This last criterion, that the nature of the response be sufficiently congruent to the actor, is adapted from the concept of perceived internal congruence [Huesmann, 1988]. Huesmann suggests that the most important aspect of the appraisal of a response "is the extent to which it is perceived as congruent with the child's self-regulating internal standards" (p. 19). Although conceptually distinct, it may be hypothesized that one's self-concept or identity is consistent with his or her self-regulating internal standards and that these internal standards may even serve as the cognitive basis for the maintenance of one's self-identity. According to Huesmann [1988; Huesmann and Guerra, 1997; Huesmann et al., 1992], children maintain internally consistent values or "normative beliefs" about behaviors. Normative beliefs are of important utility in filtering out behaviors that are deemed unacceptable or incongruent with internal standards. By defining a restrictive range within which a script must fall, normative beliefs regulate the degree to which behaviors are considered for enactment. Although normative beliefs potentially affect all levels of evaluative processing, they may be most influential during basic RED operations (particularly the primary acceptability process) as they are independent of situation specificity.

Whereas it may seem unlikely that an individual would consider responses that are internally incongruent, numerous factors may provide an explanation. The example of observational learning above provides one such factor. An individual who, by his or her nature, is not a person prone to violent responses, may have encoded a violent script due to repeatedly watching violent movies and television shows. It is possible that schemas that are developed in fantasy may be retrieved in real-life situations, perhaps only to be discarded because the responding person discerns these schemas as internally incongruent. In the case of John and George, John may quickly filter out the response option of stabbing George with his pen, though he had seen this form of retaliation utilized successfully in a violent movie he had once seen, because this response clearly did not match John's standard of internal congruence.

These three criteria (general relevance, situational applicability, and internal congruence) also constrain the initial accessing of a response. In this sense, response accessing and RED may function as the same process. Under some circumstances, however, a response may be accessed even though it does not meet the criteria of these three rules. In this case, the primary acceptability process of RED may function to restrict behavioral enactment of these irrelevant, intrusive, or otherwise inappropriate response options.

Theoretically, a response must satisfy all three criteria of primary acceptability in order to continue to more advanced RED processes and be considered for response selection and enactment. Note, though, that the level at which the acceptability threshold is set may vary situationally (e.g., as a function of alcohol intake, sexual arousal, mood, fatigue, etc.) and does not necessarily remain constant throughout the response decision process as feedback loops to the threshold of primary acceptability stage may necessitate the lowering of threshold values. As time passes without identifying an acceptable response, the threshold may be lowered as the demand of the situation requires a response (*any* response) or as one begins to experience fatigue or indifference. As a consequence, newly generated responses, or responses previously rejected by a higher threshold but still available via working memory, may be considered for behavioral performance. At its minimum, the threshold may be thought of as having a setting equivalent to zero. In this case, the threshold is completely indiscriminate and serves no practical utility in the response decision process. Without an active filtering mechanism, the first response generated, regardless of the behavior it represents, may immediately advance to be further considered for enactment. Phenomenologically, this is experienced as impulsivity.

Although zero thresholds and impulsive, behavioral decisions may characterize different kinds of responsivity, they may be particularly typical of habitual behaviors. Habitual behaviors include those that have become automatic, and thus require minimal processing, due to repeated mental rehearsals or behavioral performances (i.e., they are scripted). Behaviors that have been mentally rehearsed and carried out numerous times, across varied social contexts, are more likely to be reinforced in one's associative networks, accessed from memory, and selected for enactment [Huesmann, 1988]. As a behavior is repeated across different social settings and becomes more accessible from memory, the process of evaluating alternative responses for the purpose of selecting one for enactment becomes, at some level, less necessary. It may also be the case that certain types of social situations require minimal processing whereas others necessitate more elaborate processing sequences [Ladd and Crick, 1989; Waldman, 1996]. Eventually, in the case of severely chronic or habitual behavioral patterns, a particular response may be drawn from memory automatically and selected immediately for enactment. In this case, response selection is strictly impulsive with the threshold at the zero level and all other RED processes left inactivated.

Additional Processes: Overview

A response that passes the primary acceptability threshold is further assessed during RED processes two, three, four, and five which refine the computation of each potential responses' total evaluation score, TS_i. The overall evaluative score for a response is computed by a process that may be described by the abbreviated formula:

$$TS_i = (Re_i \times Rv_i) + [(POe_i \times POv_i) - (NOe_i \times NOv_i)], \tag{4.1}$$

where TS_i = the total score for a single response alternative (i.e., response option i); Re_i = the response efficacy subscore (or expected likelihood that response option i can be successfully carried out); Rv_i = the response valuation subscore for response i (or average value of response option i across sociomoral evaluation domains); POe_i = the positive outcome expectancy subscore (or expected likelihood that positive outcomes of response option i will result from the response); POv_i = the positive outcome valuation subscore (or average value of all expected positive outcomes of response option i across evaluative domains); NOe_i = the negative outcome expectancy subscore; and NOv_i = the negative outcome valuation subscore.

Each of the components of this evaluation formula will be described in detail below (see Process 4: Response Comparison). However, it is important to realize that any time an evaluation for a response score falls below the threshold of primary acceptability defined in RED process 1, no further processing of that response occurs.

It is also important to recognize the contribution of expectancy–value models to the development of the RED formulation. These models have attempted to answer a recurring question in cognitive psychology: How do expectations and values relate to behavior? In this context, expectations (or expectancies) are beliefs about one's ability to perform behaviors and what outcomes are likely to occur. Ultimately, expectations and values are appraised together in order to make successful social decisions. This process is often expressed mathematically as: expectancy × value = relative strength (of option being considered). Expectancy–value models have been of considerable influence in numerous theoretical contexts, including theories of achievement motivation, attribution, social learning, and decision making [for a review see Feather, 1982].

Process 2: Response Efficacy and Valuation

A response that passes the primary acceptability threshold is next assessed for efficacy and value during RED process 2. For *response efficacy*, a person estimates the likelihood that he or she is capable of actually enacting the response option in the particular situation and at the particular time at hand (note that if it is immediately obvious that a response cannot be enacted for any reason then it may already have been eliminated during the threshold of primary acceptability). Because of the contextual influences on this variable, the individual estimates the likelihood value in real time, rather than merely applying general efficacy values. The response is also appraised across social and moral domains in a process called *response valuation*. Again, this value is computed in real time in the specific context.

In the example of John and George, John may consider the response option of running from George in order to escape the situation, only to realize that this would not be the most efficacious of responses due to his need to get to class on time, the school rule against running in the halls, and the fact that others are watching him to see if he is going to back down or stand up to George (response efficacy). On the other hand, John may also devalue the response option of punching George in retaliation because he believes that acts of violence are sociomorally reprehensible (response valuation).

RED proposes that a response option pass response efficacy and value thresholds (represented by decision rules 1.1–1.3 above) before it is evaluated further for response selection and behavioral performance. For quantitative purposes, a response efficacy score for each response option that is above threshold (i.e., a score representing an individual's estimated likelihood that he or she can successfully perform the response of interest) may be represented by a probability from zero to one. In addition, a response valuation score for each response option that is above threshold (i.e., a score representing the positive value of the response of interest) may be represented by a quantified value from zero to some maximum positive value (e.g., a scale from zero to ten). These scores may be used in the comparison of competing response options in order for an individual to select the response that is "strongest" (see Eq. 4.2 below). The product of corresponding response efficacy and response-valuation scores represents the overall score for the behavior being evaluated:

$$\mathrm{RS}_i = \mathrm{Re}_i \times \mathrm{Rv}_i, \qquad (2)$$

where Re_i = the efficacy score for response i; Rv_i = the response valuation subscore for response i; and RS_i = the overall score for response i (note that RS_i differs from r_i noted in RED process 1 in that RS_i represents the overall score for an individual response option based on the valuation of the response option via the threshold of acceptability, response efficacy, and response evaluation processes). For example, although a child may consider a prosocial behavior to be a favorable way of responding (Rv = 8), he or she may also expect that the response will not be carried out successfully (Re = .10). Thus, the response subscore for this behavioral option would be quite low ($.10 \times 8 = .8$, where the lowest possible product score is 0 and the maximum is 10.00). Of course, it may also be the case that responses that are assigned very low scores of response efficacy and value are immediately filtered out—that is, responses with very low scores may trigger a feedback loop to the primary threshold of acceptability so that the responses may be quickly discarded, making for more efficient decision making. In contrast, responses that receive extremely high scores may be more likely to be impulsively selected, prematurely (and perhaps abruptly) ending the decision-making process with an immediate behavioral enactment of this type of response. It is important to keep in mind that responses are potentially subject to feedback loops allowing for them to be reconsidered by earlier RED steps as are they subject to being impulsively selected prior to moving forward to more advanced RED stages (e.g., *Process 4: Response Comparison*).

Response efficacy (or self-efficacy judgment). Bandura [1977a] introduced the concept of efficacy expectation [also called self-efficacy evaluations, Crick and Dodge, 1994; or self-efficacy perceptions, Erdley and Asher, 1996] as the degree to which a person judges that it is likely that he or she is capable of successfully performing a specified behavior. Several models of achievement motivation and decision making have emphasized the importance of generalized self-concept of ability in competent and successful behaviors [e.g., Crick and Dodge, 1994; Huesmann, 1988; Kuhl, 1982; Kukla, 1972; Meyer, 1973]. Efficacy expectations have several dimensions, however, and may vary across contexts within individuals in terms of their magnitude, generality, and strength [Feather, 1982]. For example, a person who ordinarily expects to be able to behave in a prosocial manner toward others may attribute low self-efficacy to this behavioral style in a situation that he or she perceives as antagonistic or provocative.

Models of SIP [Crick and Dodge, 1994; Huesmann, 1988] hypothesize that in order for a behavior to be selected, the child needs to anticipate that he or she will successfully perform the behavior. Efficacy judgments (or expectancies) are distinct from outcome valuations (see *Process 3: Evaluating Outcome Expectancy and Valuation*) in that expectancies of response efficacy focus on the behavioral process or means by which an individual acts and not the possible consequences or outcomes of the response [see Bandura, 1986; Cuddy and Frame, 1991]. Thus, estimations of response efficacy are hypothesized to take place antecedent to outcome judgments during the response-efficacy-and-valuation process. It may also be the case, particularly for individuals who are guided primarily by outcomes, that outcome and consequence-based evaluations are made prior to response or means-based judgments (i.e., response or means-based judgments are initially bypassed and returned to at a later time, via a feedback loop) or that response or means-based judgments are bypassed altogether and outcome-focused processing serves as the driving force behind a response's ultimate selection and enactment.

Studies of self-efficacy judgments in children have generally found that children's reports of self-efficacy for a behavior are predictive of that behavioral pattern [e.g., Crick and Dodge, 1989; Erdley and Asher, 1996; Price and Ladd, 1986; Wheeler and Ladd, 1982; for an exception, see Cuddy and Frame, 1991]. Aggressive children feel more confident in enacting aggressive behaviors than do their nonaggressive peers [e.g., Crick and Dodge, 1994; Erdley and Asher, 1996; Perry et al., 1986]. Crick and Dodge [1989] found that, compared to children rated as nonaggressive, aggressive children report higher efficacy for both verbal and physical forms of aggression and lower efficacy for conflict-avoidant behaviors. More recently, Erdley and Asher [1996] found that children who report themselves as skilled at behaving aggressively also tend to select aggressive responses to ambiguous provocations. Thus, children may develop aggressive patterns of behavior, in part, because they either feel confident in their ability to perform aggression or lack confidence in performing nonaggressive behaviors [Wheeler and Ladd, 1982]. The tendency of aggressive children to view aggressive responses as self-efficacious may contribute, at least sometimes, to a greater degree of impulsive decision making, leading to the quickened enactment of aggressive response behaviors.

Response valuation. Responses deemed sufficiently likely to be carried out in a successful manner are also evaluated across substantive domains. The response-valuation subprocess is characterized by appraising individual responses across "means-focused" domains of sociomoral acceptability [e.g., Crick and Dodge, 1994; Fontaine et al., 2002; Guerra et al., 1994]. By the term "means-focused," we focus on appraisals of the action itself (e.g., "Is this a good behavior?") and not evaluations of the consequences (or outcomes) that may occur as a result of the act. Note that the term means-focused does not suggest that the process lacks goal direction. That is, response valuation as a decision-making process is not in opposition to the premise that all human decision making and behavior is goal-directed—an idea that has been favored by decision theorists in psychology [Kozielecki, 1981; Lange, 1963; Simon, 1957, 1967; Tomaszewski, 1963].

Although valuative domains at the response-evaluation level are likely to fall under the general umbrella of "sociomoral" concerns [see Fontaine et al., 2002], it may be that they are further distinguishable according to substantive content. For instance, a response dictating physical aggression toward another person may be valuated as morally wrong (a type of moral valuation; e.g., *Is acting this way the right thing to do?*) or appraised according to perceptions of others' values (a type of social valuation; e.g., *Do other people think this behavior is acceptable?*); clearly, both of these valuative questions deal with sociomoral concerns. A possible sociomoral domain may also be defined by the social style of behavior, such as to what degree a behavior is prosocial or friendly [e.g., *Is this a nice thing to do or say*?; e.g., see Crick and Ladd, 1990]. Several studies have provided support for the hypothesis that favorable valuations of a response are predictive of the performance of that response. Fontaine et al. [1998] found that sociomoral judgments favoring aggression predicted both self- and parent-reported antisocial patterns of adolescent participants. Bandura et al. [1996] articulated the process through which a child values an ordinarily cruel behavior as being sociomorally acceptable, a mechanism that they call "moral disengagement." They found that moral disengagement, as measured by child endorsement of items such as "It is okay to treat badly somebody who behaved like a 'worm,'" and "It is alright to beat someone who bad mouths your family," significantly predicted child aggressive behavior as rated by peers, parents, teachers, and selves.

Erdley and Asher [1998] found that children's judgments that aggression is an acceptable manner

of behavior predicted their decision to aggress. Deluty [1983] studied two valuative domains of response decision conceptualized as "good–bad" and "kind–cruel." Compared to their nonaggressive peers, aggressive children consistently rated aggressive behaviors as "good" and "kind" ways of interacting with others. Furthermore, aggressive children were far more likely to select aggressive responses as behaviors they "should" exhibit.

Process 3: Evaluating Outcome Expectancy and Valuation

Distinct from one's estimates of response efficacy and response valuations, probable outcomes of the response are judged both in terms of their likelihood of occurrence and personal value to the responding individual. During *outcome expectancy*, a person estimates the likelihood that a particular outcome will result if he or she enacts a response. Each outcome that is considered to be a possible result is also appraised according to its estimated value (called *outcome valuation*). Here again, responses that are associated with particularly low outcome-related values may be fed through a feedback loop to the threshold of primary acceptability in order for them to be quickly discarded. In contrast, responses that are assigned particularly high outcome-related values may be impulsively selected, immediately ending any further response-evaluation-and-decision processing. In the example of John and George, John may be more likely to enact a response of aggressive retaliation if he believes that it will lead to recognition among his peers (outcome expectancy) and peer recognition is of great value to John (outcome valuation). Alternatively, he may be less likely to enact an aggressive response if he believes it will lead to George hurting him in a fight (outcome expectancy) and John highly values his physical safety and well-being (outcome valuation).

Similar to RED process 2, this operation requires alternative outcomes that are perceived as possible consequences of a response to pass expectancy and valuation thresholds (a process computed according to decision rules 1.1–1.3) before the response is assessed further for behavioral selection and enactment. Each outcome that is above threshold is assigned an outcome-expectancy score—that is, a quantified probability from zero to one that represents an individual's estimated likelihood that a certain outcome will result. In addition, an outcome-valuation score (or value) is attributed to each outcome possibility. These scores are used in the comparison of competing response options in order to facilitate selection of the optimal response (see Eq. 4.2 below). The product of corresponding expectancy and value scores represents the overall RED process 3 score for the outcome being considered:

$$\mathrm{OS}_i = \mathrm{Oe}_i \times \mathrm{Ov}_i, \tag{3.1}$$

where Oe_i = the expectancy score for outcome i; Ov_i = the valuation subscore for outcome i; and OS_i = the overall score for outcome i.

Empirical support for the distinction between response valuation and outcome valuation has been provided by Crick and Ladd [1990] and Fontaine et al. [2002]. Outcome expectancy as a unique component of SIP has been supported by the independent research programs of Perry [Boldizar et al., 1989; Kennedy and Perry, 1993; Perry et al., 1990] and Crick [Crick and Dodge, 1994; Crick and Ladd, 1990]. Boldizar et al. [1989], in particular, made a strong empirical argument in favor of the distinction between outcome expectations and outcome values. "Whereas an outcome expectancy is the individual's estimate of the likelihood of an outcome occurring, an outcome value is the degree to which an individual attaches importance to, or cares about, the outcome" (p. 571).

Process 3 also reflects a distinction that has been drawn by Gray [1975] and others [e.g., Quay, 1993] between systems of behavioral activation and inhibition. We propose that behavioral activation is related to expectancies and valuations of positive outcomes whereas behavioral inhibition is associated with expectancies and valuations of negative outcomes. Whereas outcomes may have both positive and negative aspects to them, the current distinction between positive and negative outcomes addresses the overall valence attributed to the outcome by the actor, a distinction that is consistent with Gray's research. Gray's work suggests that distinct components in outcome expectancy and valuation should be articulated for rewards and punishments, so the computation for corresponding outcome expectancies and valuations may be framed as follows:

$$\mathrm{OS}_i = (\mathrm{POe}_i \times \mathrm{POv}_i) - (\mathrm{NOe}_i \times \mathrm{NOv}_i), \tag{3.2}$$

where OS_i is the overall score for outcome i; POe_i is the expectancy score for positive aspects anticipated to accrue to outcome i; POv_i is the valuation score for those positive aspects of outcome i; NOe_i the expectancy score for negative aspects anticipated to accrue to outcome i; and NOv_i the valuation score for those negative aspects of outcome i. Note that

POe_i, POv_i, NOe_i, and NOv_i are all nonnegative values (i.e., the lowest score for any of these terms is zero), and therefore both multiplicative terms, $(POe_i \times POv_i)$ and $(NOe_i \times NOv_i)$, cannot be negative values.

Outcome expectancy. An outcome expectancy is the estimated likelihood that response x will result in outcome y, within a particular context. In the cognitive literature, an expectancy has been described as a specific type of neural association that, upon being stimulated by situational cues, leads a person to make inferences about the probability of certain consequences [Atkinson, 1982; MacCorquodale and Meehl, 1953]. The concept of outcome expectancy as a cognitive influence on social behavior is evident in literature of the past several decades [e.g., Bandura, 1977b, 1986; Goffman, 1969; Hilgard and Marquis, 1940; Mead, 1934; Tolman, 1938, 1951]. Huesmann [1988, p. 19] has stated that, in evaluating scripts for social behavior, "the child needs to be able to predict the consequences of utilizing" an alternative behavior before it is enacted. Outcome expectancies have been linked to both behavioral inhibition [where the expectancy is negative; e.g., Crick and Ladd, 1990; also see Atkinson, 1982] and heightened behavioral arousal [where the expectancy is positive; e.g., Perry et al., 1986].

Bandura [1986] is credited with the hypothesis that aggressive children view aggressive styles of behavior as relatively more likely to curtail unpleasant treatment by others [see Perry et al., 1990]. Empirical examinations have broadened this hypothesis to account for several other types of outcome expectancies believed to be associated with child aggression. Empirical attention to aggressogenic outcome expectancies and aggressive behavior in children have focused on favorable expectancies of aggression and their role in antisocial conduct. Compared to their nonaggressive peers, aggressive children have been found to be more likely to expect aggression to lead to favorable results for themselves as well as their victims [Deluty, 1983; also see Slaby and Guerra, 1988], tangible rewards [Perry et al., 1986], control over their victims [Kennedy and Perry, 1993], increased self-esteem [Slaby and Guerra, 1988], and a reduction of others' aversive treatment [Perry et al., 1986]. In other words, aggressive children tend to view aggressive styles of behavior in a more favorable light, in multiple ways, than do their nonaggressive peers.

Although negative expectancies of assertive behavior have been associated with behavioral inhibition [Crick and Dodge, 1989], outcome expectancies disfavoring aggression have not been linked to children's inhibition of hostility or aggression. Kennedy and Perry [1993] found that the expectancy that victims would retaliate in response to participants' aggression did not dissuade aggressive children's preference for aggressive behavior. This finding challenges the hypothesis that aggressive children selectively direct their aggressive behaviors toward submissive victims [Olweus, 1978; Perry et al., 1988, 1990]. Also, Perry and Perry [1974] found that the expectation that aggression causes suffering in victims did not disincline aggressive children from enacting aggressive behaviors in social interactions. It is this type of unexpected finding that suggests a separate criterion of outcome valuation.

Outcome valuation. In addition to identifying likely consequences of a behavior, it is hypothesized that, during *outcome valuation*, the child further assesses response alternatives by attributing values to anticipated outcomes. Thus, possible suffering in a victim will inhibit aggression only if victim suffering has negative value for the aggressor. Values vary both in their substantive nature (e.g., interests in social recognition or material possessions) and in their degree of potency (or "value weight"). Outcome valuation is of critical importance to response decision because outcome expectancies cannot have a meaningful role in response comparison and selection processes if the responses to which they correspond have not been assigned values.

Valuative domains across which responses may be assessed include, but are not restricted to, interests in social relationships (e.g., *How important is it that people like me?*), instrumental gains (e.g., *How much do I want this person's money?*), intrapersonal gains (e.g., *How will this make me feel inside?*), and punitive consequences (e.g., *How much do I dislike being held after school for detention?*). Gray's [1991] distinction between activation and inhibition neural systems suggests that expectancy and valuation of positive consequences may be orthogonal to expectancy and valuation of negative consequences. Value weights vary in magnitude and valence. If an outcome is desired, it receives a positive value weight (a positive value); if it is desired that the outcome be avoided, it is assigned a negative value weight (also a positive value); finally, the anticipated outcome that is of no interest at all is attributed a neutral value of zero. Positive and negative value weights are both positive (or, at least, nonnegative) as the negative value weight is ultimately subtracted from the positive value weight

for an overall response outcome value (see the mathematic step in Eq. 3.2). As a result, the overall response outcome value (from Eq. 3.2: OS_i) may be positive (if the positive value weight is greater than the negative value weight) or negative (when the negative value weight outweighs the positive value weight).

It is important to note that the stronger the value weight assigned to a behavior's outcome, the higher one's motivation will be to enact the behavior when the value is positive and control the behavior when the value is negative [see Bandura, 1986; Boldizar et al., 1989; for a similar argument based on behavioral attitudes, see Fishbein and Ajzen, 1975]. Of course, the total influence of an expected outcome on behavioral decision making also depends on its likelihood. Although limited, there is some empirical support for the hypothesis that, compared to other youths, aggressive children assign greater value to self-serving outcomes of aggression whereas they assign little value to negative consequences [Perry et al., 1990]. Outcomes of aggression that are of particularly great value to aggressive children include control of the victim [Boldizar et al., 1989] and injury to others [Bandura and Walters, 1959; Perry and Bussey, 1977]. Aggressive children tend to devalue negative effects of aggression such as victim suffering, victim retaliation, peer rejection, and negative self-evaluation [Boldizar et al., 1989; Kennedy and Perry, 1993; Perry et al., 1990].

Process 4: Response Comparison

Mathematical representation. After an individual has evaluated alternative responses and their expected outcomes, the overall value of each response is determined. Overall response values or "total scores" are considered relative to each other during process 4 of RED, *response comparision* by the following abbreviated mathematic term:

$$TS_i = (Re_i\, Rv_i)\,[(POe_i\, POv_i) - (NOe_i\, NOv_i)] \quad (4.1)$$

where TS_i = the total score for a single response alternative (i.e., response-option i); Re_i = the response efficacy subscore (or expected likelihood that response-option i can be successfully carried out); Rv_i = the response valuative subscore for response i (or average value of response-option i across sociomoral valuation domains); POe_i = the positive outcome expectancy subscore (or expected likelihood that positive outcomes of response-option i will result from the response); and POv_i = the positive outcome valuation subscore (or average value of all expected positive outcomes of response-option i across valuative domains); NOe_i = the negative outcome expectancy subscore; and NOv_i = the negative outcome valuation subscore.

The process by which the overall strength of a response option may be calculated is represented by the equation:

$$TS_r = \left(Re_r \times \sum_{i=0}^{n_{ri}} \frac{Rv_{ri}}{n_{ri}}\right) \times \left[\left(\sum_{j=0}^{n_{rj}} \frac{\left(POe_{rj} \times \sum_{k=0}^{n_{jk}} \frac{POv_{jk}}{n_{jk}}\right)}{n_{rj}}\right) - \left(\sum_{j=0}^{n_{rj}} \frac{\left(NOe_{rj} \times \sum_{k=0}^{n_{jk}} \frac{NOv_{jk}}{n_{jk}}\right)}{n_{rj}}\right)\right] \quad (4.2)$$

where TS_r = the total score (or overall strength) for response r; Re_r = the response efficacy subscore: expected likelihood that response r can be performed; Rv_{ri} = the response valuation subscore: value of response r for response-valuation domain i; POe_{rj} = the positive outcome expectancy subscore: expected likelihood that positive outcome j will result from response r; POv_{jk} = the positive outcome valuation subscore: value of positive outcome j for outcome-valuation domain k; n_{ri} = the total number of response-valuation domains i for response r; n_{rj} = the total number of outcomes j for response r; n_{jk} = the total number of outcome-valuation domains k for outcome j; NOe_{rj} = the negative outcome expectancy subscore: expected likelihood that negative outcomes j will result from response r; and NOv_{jk} = the negative valuation subscore: value of negative outcome j for outcome-valuation domain k. Theoretically, the response with the highest *overall strength* is selected (during RED process 5, response selection) for behavioral enactment.

This formula functions as a heuristic by which advanced response comparison processes may be understood. Unlike algebraic models common to information processing theories, this model accounts for preemptive processing by allowing for the bypassing of response-efficacy judgments, response valuations, outcome expectancies, and outcome valuations. The possibilities of bypassing steps, feedback loops to previous steps, and impulsive decision making that terminates the decision process are considered at *every* step within the RED model. In RED's mathematical form, the presented

equation may have practical research utility as a quantitative model for deriving an inclusive response decision variable from RED measurements. Of course, while it is likely that the utility of RED's mathematical form is highest with regard to evaluative, rational decision making, it is not our supposition that response decision-making in humans is typified by processing that is entirely rational and comprehensively evaluative all of the time.

Example of John and George. The following example demonstrates how the response comparison formula may be used to facilitate the selection of a single response from a pool of scripts. John, who has been physically and verbally provoked by George, may access four responses: an inept response of anxiously laughing; an assertive request to leave him alone; an internalizing act of withdrawing and walking away from the situation; and an antisocial act of physical retaliation. Depending on how these alternative responses are judged across RED processes, any of these responses may be selected for actual performance.

Competent processing during response decision would dictate that the first of these four responses (the inept response) be judged as generally irrelevant—it therefore fails to meet an average acceptability threshold and is eliminated from further evaluation. The remaining generated responses pass the initial threshold of RED process 1 and continue ahead for further processing. If all three remaining scripts are further processed, and not eliminated by an acceptability threshold following a feedback loop or impulsively selected after bypassing other response decision processes, they may be considered relative to each other during the advanced RED process of response comparison. During the computation of response efficacy and valuation scores, John might view the assertive response as the most socially appropriate way to behave but feel unconfident in his or her performance of it, thus yielding a low score for assertiveness. During the computation of outcome expectancy and valuation scores, John may view the aggressive response as the behavior most likely to lead to peer recognition (a valued outcome) but fear that it is not likely to lead to physical safety (an outcome of greater value). Thus, the assertive and internalizing response options may be assigned higher outcome subscores because, although they are not as likely to lead to peer recognition, they are perceived as far more likely to secure the highly valued outcome of physical safety. The final step in approximating the total score of a script entails combining the product scores from steps 2 (response efficacy × response valuation) and 3 (outcome expectancy × outcome valuation). The design of the response comparison formula is founded on the idea that any meaningful influence of behavioral expectancies and values on actual enactments of behavior are, by necessity, interdependent—a principle that is fundamental to expectancy–value models [e.g., Mitchell, 1982; Vroom, 1964] as well as theories of value and attitude–behavior relations [e.g., Ajzen and Fishbein, 1977; Fishbein and Ajzen, 1975; Rokeach, 1973, 1979]. In situations where more than one response needs to be processed fully and considered relative to the alternatives, response comparison allows for a "best," "strongest," or "most appropriate" response to be identified.

Process 5: Response Selection

Ultimately, a response is "selected" immediately prior to its behavioral enactment. Because the varied demands of different social situations (e.g., time) as well as individual differences in human beings (e.g., social–cognitive resources), it should be noted that the selection of a response may take place at any time in the course of RED. The roles of feedback loops, bypassing specific RED processes, and impulsivity are addressed at each step of the RED model and, due to the potential for impulse-based processing to interrupt a more evaluative decision process, response selection may occur at any time response decision-making. In the case of a social interaction in which a response selection is not prematurely or impulsively made, the RED model hypothesizes that, following a comparative analysis of behavioral schemas, the response identified as having the highest derived score (i.e., the response that is most favorably evaluated) is selected for behavioral enactment. The total score for each response option meets a final threshold of acceptability (the response-selection threshold). The process by which this threshold assessment is conducted is articulated by decision rules 1.1–1.3 above (see RED process 1). If the total score for any of the responses fails to meet the threshold of acceptability at this stage of decision making, additional scripts may be drawn from memory for consideration. Time passes, and the child is engaged in "problem solving" or contemplation. Alternatively, as time passes and social pressures to respond build, the response-selection threshold may be lowered so that the strongest of the responses already considered may be selected and behaviorally enacted. As previously explained, feedback loops allow for

responses to be reconsidered by thresholds of acceptability at any time during RED processing and, in the case where the decision-making process is a difficult one and thresholds need to be lowered in order to consider more response alternatives, it is hypothesized that feedback loops play a significant role in the ultimate selection of a response option.

Response selection marks the completion of the response decision step except in the case in which behavioral enactment of the response that is first selected is not performed successfully. A child who has limited verbal or physical skills [Dodge, 1986], or is obstructed from performance due to situational obstacles, may fail to carry out a chosen behavior. For instance, the child lacking in motor skills who misjudges the efficacy of an aggressive response may be incapable of hitting a peer in retaliation just as the child who is verbally deficient and overestimates his or her ability to verbalize his or her thoughts, may find him- or herself unable to clearly articulate an assertive response to a hostile provocateur. Upon failing to perform his or her selected response, an individual may return to previous steps of processing in order to attempt an alternative behavioral enactment. The child who is unable to perform his or her first selection of physical retaliation in response to a provocative peer may backtrack to the response decision step (an example of a feedback loop in the larger SIP model) in order to select the "next best" option—perhaps an alternative that qualifies as verbally aggressive (such as cursing or disrespecting the other child) or indirectly hostile (such as reporting the other child to a teacher or other authority figure).

It is important to note that processes 1 (primary acceptability threshold) and 5 (response selection) of RED function similarly to one another in that both serve to filter out unacceptable response options. As is the case during RED process 1, response selection may reject behavioral scripts that do not meet the criteria perceived by the responding individual as necessary for a sufficient response to be enacted (i.e., the total value of a response may not meet the final threshold of acceptability that is represented by the response selection process). Also similar to acceptability-threshold processing, the standard by which response selection accepts a processed script is not irreversibly fixed. As time passes and evaluated responses fail to meet the response selection standard, the standard may be lessened in order for a response decision to be made.

RED accounts for real-time factors in the processing of alternative behavioral responses by incorporating adjustable thresholds of response acceptability. Thresholds serve to preempt many later operations, both by eliminating some alternatives and making other alternatives the response of choice without complicated processing (impulsive response selection). It is hypothesized that multiple thresholds of response acceptability are applied across various levels of each RED process. Each threshold represents a temporal stipulation (e.g., a mood-dependent desire) or permanent standard (e.g., a moral value) that must be met by a script before the response can advance for further consideration. The responding individual continues to assess alternative scripts at original threshold levels until a response is identified to have met all thresholds and is selected for performance.

Thresholds change because of social demands that dictate that any response is better than no response or because of internal attentional limits that lead people to abandon RED processing. At this stage, scripts that had previously failed higher acceptability thresholds are accessed via working memory in order to be reconsidered for behavioral enactment. Processing that is severely abbreviated due to influences of real-time factors may often lead to impulsive decisions and maladaptive behaviors.

Working Memory and Secondary Mental Structures

Cognitions and mentally represented information that are perceived as relevant, but less than immediately necessary, to real-time processing are termed *secondary mental structures*. Secondary mental structures may be temporarily available in, and retrieved from, working memory (as opposed to long-term memory), a dimension of memory that functions as a transitional reserve for cognitive representations and is involved in real-time operations. RED processes may be distinguished from working memory in that the RED processes serve as a group of evaluative processes by which mental structures may be developed and organized and working memory acts as on-tap storage of these structures so that they may be quickly accessed and used. Cognitive structures may become available via working memory in two ways. First, as an individual continues to attend to new environmental demands, real-time cognitions that become nonessential to his or her current processing are temporarily held in working memory. Second, cognitive structures that are stored in one's long-term memory may be retrieved to become available to real-time processing via working memory. Long-term memory is a

general knowledge store for mental representations that have been constructed and well-processed during past experiences (e.g., normative beliefs and values). In other words, working memory plays an essential role in decision making by making available secondary mental structures that were either constructed by past experiences and stored in long-term memory or transported from real-time processing.

Real-time cognitions are directed to either working or long-term memory depending on their state of development and the degree to which they are perceived as relevant to real-time processing of current social activity. For example, it may be that a behavioral schema for aggression against a peer is more likely to be available via working memory at any given time if it is relevant to the social context and currently being developed on the basis of new social experiences (e.g., a peer provocation in the presence of a novel audience, such as a teacher or parent). Behavioral schemas or scripts (outlining specific behaviors), behavioral preferences (dictating a hierarchy of classes of behavior), and perceived social rules about behaviors (guiding an individual's general behavior in specific situations) are all examples of information that may be accessed via working memory (as secondary mental structures) or indefinitely stored in long-term memory.

In Figure 1, working memory has been denoted as an on-tap "database" of information. The database not only functions as a mechanism by which information that is needed for immediate real-time recall may be accessed, but it also serves as a channel between real-time processes and long-term memory. Long-term memory structures (such as social knowledge and moral values) may be accessed and ultimately play a crucial role in real-time processing. Secondary mental structures stored in the database may influence or guide decision making, which, in turn, may impact the configuration of subsequent database information as well as cognitive structures deposited in long-term memory [Crick and Dodge, 1994].

IMPULSIVE VS. EVALUATIVE PROCESSING

The RED model presents a framework for understanding behavioral decision processes that are potentially active during an individual's real-time processing of social stimuli. We do not suggest that processing is always conscious, controlled, or reflective. Because RED operations occur at an advanced level of processing, they are likely most prominent in situations that require some degree of active processing on the part of the responding individual. Evaluative decision making implies the generation of alternative behavioral schemas that are, to some degree, at conflict with each other—at least in the sense that only one behavior can be enacted at a time and a decision must be made among alternatives.

The RED model incorporates preemptive processing that bypasses extended consideration among alternatives. Several researchers have hypothesized that a child, in certain circumstances, may engage in impulsive, automatic, or script-based processing [e.g., Costanzo and Dix, 1983; Crick and Dodge, 1994; Huesmann, 1996]. Impulsive processing is characterized by primitive cognitive actions involving immediate gratification and little or no executive control (i.e., response evaluation). Aggressive children, in particular, display impulsive behavior that is directed at short-term gain and an inability to delay gratification [Boldizar et al., 1989; Patterson, 1982]. As depicted in Figure 1, it is possible that impulsive processing involves bypassing the response decision step altogether. Costanzo and Dix [1983] called this action preemptive processing because some aspect of the represented stimulus situation so strongly compels a particular behavioral response that it "preempts" all remaining cognition, reflection, and processing. This mechanism for aggression was suggested by Kendall and Wilcox [1979] who posited that impulsive aggressive children are quick to perform the first behavioral script that is generated.

In the context of SIP, strict impulsivity is characterized by the immediate behavioral enactment of a behavioral script that has been accessed from memory. Strictly impulsive decisions are not subject to constraints imposed by evaluative or otherwise discriminating criteria. According to RED, complete impulsivity is operationalized as setting the responding individual's primary acceptability threshold at zero, so that there is no restriction placed on a generated response. A response is accessed from memory and is then immediately placed into enactment. At this extreme end of the continuum, the response decision step is essentially uninvolved. Setting a zero threshold may be equated to a direct link between SIP steps 4 (response access or construction) and 6 (behavioral enactment). Strict impulsivity (i.e., an inflexible zero threshold) is uncommon; rather, it is likely that impulsivity functions along a continuum that is defined by gradations of the threshold.

Learning and Development

Social interaction demands individuals to develop ways to perceive, organize, and process social cues

that continually change over time. Real-time processing is a term that is used to describe on-line operations as they unfold in actual life scenarios. Because life events require individuals to process enormous quantities of information in "real time," taking real-time processing factors into consideration is essential to the development of a comprehensive model of on-line decision making.

In response to life events, individuals' mental activity consists of split-second cognitions and cognitive chains. Scientists' recognition of the considerable speeds at which neurons fire and cognitions unfold in the processing of information is at the core of the debate in cognitive psychology on serial (or sequential) vs. parallel (or simultaneous) processing [e.g., see Rumelhart, McClelland, and the PDP Research Group, 1986a,b]. It remains unclear whether human information processing is more accurately represented by sequential or simultaneous processing models. However, social–cognitive models that account for real-time factors need to reflect the sequential nature of processing that is necessitated by time passing. To the extent that new situational information is presented as time passes, processing that corresponds to such information must be sequential. Although it may be that continual processing of information occurs simultaneously along "parallel" paths, real time places limitations on the order in which information may be processed (as most situations entail stimulus information that is not presented in its entirety at a single point in time). A considerable amount of cognitive processing takes place at speeds that are so rapid that an individual's processing of information, although carried out sequentially in reality, may appear to be occurring simultaneously.

RED accounts for real-time factors in the processing of alternative behavioral responses by incorporating adjustable thresholds of response acceptability. It is hypothesized that multiple thresholds of response acceptability exist across various levels of each RED process. Each threshold represents a temporal stipulation (e.g., a mood-dependent desire) or permanent standard (e.g., a moral value) that must be met by a script before the response can advance for further consideration. The responding individual continues to assess alternative scripts at original threshold levels until a response is identified to have met all thresholds and is selected for performance.

In many situations, multiple response options fail to meet threshold levels. Scripts that do not meet acceptability thresholds are transported from real-time operations to working memory. As time passes and all newly accessed responses have failed acceptability thresholds, temporal thresholds (i.e., thresholds based on temporal stipulations) are lowered. Thresholds change because of social demands that dictate that any response is better than no response or because of internal attentional limits that lead people to abandon RED processing. At this stage, scripts that had previously failed higher acceptability thresholds are accessed from working memory in order to be reconsidered for behavioral enactment. Processing that is severely abbreviated due to influences of real-time factors may often lead to impulsive decisions and maladaptive behaviors.

Models of SIP have posited that latent mental structures are continually being reviewed and amended as an individual's experiences accumulate [e.g., Crick and Dodge, 1994; Huesmann, 1988]. As phenomena of learning and development, these revisions occur both during real-time processing and after enactment, upon reflection. For example, a child whose schema for aggression represents a risk-free means to instrumental gain may reconstruct this schema after an experience in which his or her aggressive act leads only to detention after school. The schema may have a different influence on processing the next time it is recalled for real-time consideration. In other words, the child has learned from past experience that aggression may neither be risk-free nor lead to the desired outcome. The child's mental representation of his or her experience (or acquired knowledge) is reflected in subsequent processing because the schema for aggression has been reconfigured on the basis of the new experience. If, in future similar situations, the child comes to employ more adaptive decision-making skills and strategies, then the child's processing of judgments and decisions has developed and the learned new behavior is a marker of this adjustment. Such reciprocal effects may have a substantial impact on development and maintenance of aggressogenic decision making.

The process by which schemas are acquired and revised is relatively obscure in scientific writing. Most theories [e.g., Huesmann, 1988] allude to the coding of experiences in memory. However, schemas obviously represent more than the mere summation of past objective experiences. At least four processes bias the nature of schemas as they are represented in long-term memory. First, the objective experience itself is necessarily encoded in an egocentric and self-referenced way because humans are participant observers of their own experiences [Sullivan, 1953]. Second, instructions by others and processing modes by the individual at the time of the initial event may alter the way in which an experience becomes

represented in memory. Some children who experience traumas such as rape, abuse, or loss of a parent by sudden violence are able to survive such experiences, whereas others become severely debilitated [Dodge et al., 1990]. It is possible that one factor in these different outcomes is the process by which this experience is interpreted and discussed (or denied) as self-caused, self-relevant, congruent with life itself, or an aberration, *during and immediately after* the experience itself.

Third, revisions of schemas are subject to biases in the temporal sequencing and weighting of past experiences. Attachment theory [Bowlby, 1969, 1988] is predicated on the idea that early life events have enduring and relatively greater influence on schemas (i.e., working models) than do later events. In fact, early events shape the manner in which later events are represented. The recency or freshness of an event may also exert a strong influence on schemas, especially with regard to their accessibility. Last night's television show depicting violence may make one kind of schema highly accessible. Experiences are also differentially weighted as a function of their density. Gurwitz and Dodge [1977] found that experiences that disconfirm a stereotypic schema are ignored if they occur dispersed among several intervening events. In contrast, identical experiences exert a change in the stereotypic schema if they are experienced in a concentrated order. Thus, the ordering and context of experience alters the impact of that experience on schema revision.

Finally, processes at the time of schema access inevitably alter the schema's nature and impact. Some schemas are never accessed (e.g., "repressed memories"), whereas others are ubiquitous. The rules governing schema access have been examined and described in social psychology [e.g., Augoustinos and Innes, 1990; Cantor and Kihlstrom, 1981; Pryor et al., 1986].

Evaluative decision making, assumes at least a minimal level of cognitive development in the child. It is unlikely that cognitive abilities in very young children are developed to the extent that their behavioral decisions and actions can be based on RED processes to similar degrees of depth and range that may be true of older children, adolescents, and adults [e.g., Anderson, 1980]. For example, Schmidt [1966] examined how children make risky decisions upon being presented with several alternative likelihoods and payoffs. Four- and 6-year-olds consistently chose the alternative with the highest payoff (regardless of its likelihood), 8-year-olds chose the most likely outcome (regardless of payoff size), and 11-year-olds chose outcomes with medium payoffs and probabilities. Schmidt concluded that only the oldest group of children were choosing alternatives based on both probability and payoff judgments (however, if winning, regardless of payoff size, was of highest value to 8-year-olds, a more accurate conclusion may be that 8-year-olds, as well, based their decisions on both outcome values and expectancies). Similar results were found by Hommers [1980], suggesting that, by the age of 11, children's integration of situational cues and problem attributes may be empirically observed.

Clearly, information-processing approaches to cognitive development have pointed to differences in degree of complexity that characterize problem-solving strategies in children of different ages [e.g., Case, 1978]. Furthermore, speed and efficiency in child decision making appear to be substantially dependent on how familiar the child is with the principal features of a particular situation [Fischer, 1980]. These constraints suggest that development of judgment and decision-making processes in the child is based on his or her type and amount of experience—a life factor that is inherently limited by the child's level of cognitive development.

Proactive vs. Reactive Aggressive Subgroups

Various social–cognitive processes comprised in RED may be helpful in distinguishing between different subclasses of aggressive youths. One distinction, based on the topography of child aggression, contrasts proactive and reactive aggressive behaviors [e.g., see Atkins et al., 1996; Dodge, 1991]. Proactive aggression is typified by cold, calculated acts of offensive aggression where the behavior is enacted for overtly instrumental reasons (e.g., robbery or bullying). Alternatively, reactive aggression is epitomized by hostile, angry aggression that takes on a defensive posture and usually involves little instrumental motivation (e.g., self-defense or angry retaliation). Little attention has been given to real-time social judgments and judgment styles and aggressive subtypes. Empirical research on SIP and aggression in children has pointed to two important ways that processing mechanisms may distinguish proactive from reactive aggressive subgroups. Reactive aggressive children are hypothesized to display hostile attributional biases, whereas proactive aggressive children are hypothesized to exhibit a response decision bias of endorsing aggressive behaviors (atypical of their reactive aggressive peers) [Crick and Dodge, 1996; Dodge and Coie, 1987; Dodge et al., 1997]. These hypotheses

are based on the idea that reactive aggression is a hostile response that is enacted, perhaps somewhat impulsively, in retaliation to a perceived provocation; whereas proactive aggression is instrumentally motivated and contingent on evaluations of consequences. Results have generally supported these hypotheses.

We hypothesize that there are further SIP mechanisms, active during the response decision step, that distinguish proactive from reactive aggressive subgroups of children. First, during the primary-acceptability-threshold process of RED, reactive aggressive youths are more likely to maintain a low threshold level through which scripts are initially evaluated. That is, we hypothesize that reactive aggressive children display characteristic impulsivity. This hypothesis is in line with reasoning by Dodge et al. [1997] that reactive aggressive youths typically exhibit an abbreviated response search, quickly accessing and enacting a schema for aggressive behavior, and with empirical findings by Dodge and Newman [1981] that socially rejected and aggressive children are ready to make behavioral response decisions more quickly and with fewer pieces of information than nonaggressive children.

Second, at process 2 of RED, response efficacy and valuation, we hypothesize that (a) proactive aggressive children are more likely to display high self-efficacy for acts of aggression, and (b) reactive aggressive children are more likely to judge acts of aggressive retaliation as sociomorally acceptable, relative to their peers. Support for hypothesis (a) has been provided by Crick and Dodge [1996] who found that proactive aggressive children are significantly more likely to report efficacy for enacting aggression in both peer-group-entry and conflict situations. With reference to hypothesis (b), Fontaine et al. [1998] reasoned that reactive aggressive youths may be more likely to endorse aggressive retaliation as sociomorally acceptable as a result of being biased toward attributing hostile intent to ambiguous provocateurs. Aggressive youths who often view others as intending them harm may judge violent retaliation to perceived wrongdoers as justifiable.

During the third stage of RED, outcome expectancies and valuations are hypothesized to distinguish proactive aggressive children in two ways. Proactive aggressive children are more likely to expect that positive outcomes result from their aggression, place positive value on the expected outcomes of aggressing (e.g., material gain or respect by others), and expect fewer negative outcomes for aggressing than their nonproactive aggressive peers. Upon being solicited, reactive aggressive children may be more likely to expect negative outcomes to result from aggressive actions. However, conceptual underpinnings of reactive aggression suggest such negative outcome expectancies may not play as strong a role in their RED making.

Lastly, at the final RED processes of response comparison and response selection, we hypothesize that three factors distinguish proactive and reactive aggressive subtypes. At the response-comparison process, reactive aggressive youths are hypothesized to (a) consider fewer response options (possibly due to restricted or narrowed accessing of response alternatives), and (b) be less likely to compare alternative responses in consideration of a "best" response option (possibly due to heightened physiological and emotional arousal, automatic processing, and impulsive selection of response scripts). At the response-selection process, reactive aggressive children are hypothesized to be more likely to select aggressive responses in conflict and provocation situations (i.e., situations that often elicit hostile attributions of others), whereas proactive aggressive youths may be more likely to select aggressive behaviors in situations that lend themselves to attaining social (e.g., peer recognition) and material (e.g., money) rewards.

Methodologies for Evaluating Validity of the RED Model

Two methodologies have been utilized in the assessment of behavioral judgment and decision processes with aggressive youth: assessment of on-line processes in specific situations [e.g., Dodge et al., 1997; Erdley and Asher, 1998; Fontaine et al., 2002; Perry et al., 1986; Slaby and Guerra, 1988] and instrument measures of a child's beliefs, attitudes, and judgments [e.g., Erdley and Asher, 1998; Huesmann and Guerra, 1997; Slaby and Guerra, 1988]. Although methodological designs in the assessment of real-time cognitive processes are limited, significant advances in research on social cognition and aggression have been afforded by studies implementing hypothetical-vignette procedures and beliefs measures.

Table I presents individual questions that are intended to represent corresponding subprocesses within each level of RED processing. It is hypothesized that a measure containing similar questions could assess children's real-time judgments and decisions about aggressive and nonaggressive

TABLE I. Assessment: Questions Representing RED Processes

Process 1: Threshold of acceptability
General relevance: Is this way of acting relevant to this kind of situation?
Situational applicability: Is it possible to act this way in this instance?
Internal congruence: Am I the type of person that could possibly act this way?
Process 2: Response efficacy and valuation
Response efficacy: How capable am I of performing this response?
Response value: How much do I like this way of acting?
Process 3: Outcome expectancy and valuation
Positive outcome expectancy: What good things will happen if I act this way?
Positive outcome valuation: How much do I like the good things that will happen?
Negative outcome expectancy: What bad things will happen if I act this way?
Negative outcome valuation: How much do I dislike the bad things that will happen?
Process 4: Response comparison
Which way of acting am I best at?
Which way of acting do I like best and approve of the most?
What is most likely to happen after I respond?
Of all possible outcomes, which am I most hopeful will occur?
Process 5: Response selection
What is the "best" way for me to act in this situation?

behaviors reliably and validly. Similar to past studies that have utilized hypothetical vignettes and assessed child cognitions in real time, a corresponding procedure may be designed in which children enter into actual or hypothetical situations (virtual reality designs may be one possibility) and answer RED questions while still interacting.

Because certain RED processes occur at nonconscious levels, they are likely to be quite difficult to measure validly [e.g., response comparison processes are highly complex and may be simultaneously (or virtually simultaneously) active at several levels in actual human processing]. One issue, in particular, that is important to recognize has to do with measuring a child's real-time evaluation of a behavior independent from his or her judgment of the behavior's likely outcomes. Past studies of behavioral judgments and decisions have not dealt with this problem, largely because behaviors and their outcomes were not distinguished [e.g., Crick and Ladd, 1990; Deluty, 1983].

Computer simulations of real-time decision making. One method that has proved useful in neural modeling research [e.g., Levine, 1991], cognitive psychology [e.g., Rumelhart et al., 1986a], and management science [e.g., Pidd, 1988] is computer simulation of mental processes such as decision making and problem solving. After a theoretical model of the system of interest is developed, a computer program is written that characterizes the model and uses a computer, instead of human participants, to imitate the system's activity when constrained by rules that typically apply to the system's behavior in reality [Pidd, 1988]. Computer simulation is an obvious candidate for testing the RED model, but it requires both some additional precision in the specification of the model and collecting of relevant data that could be predicted by the simulation.

Experiments. A seldom-used but obviously crucial method to test relations between decision-making processes and aggressive behavior is the laboratory experiment. Using social games, hypothetical stimuli, and rigged interpersonal exchanges, it is possible to manipulate RED parameters to test their effects. For example, following from the finding of Dodge and Newman [1981] that decision-making time is negatively correlated with aggressive behavior, one might experimentally manipulate decision-making time constraints to determine whether aggressive children would mimic the RED patterns of nonaggressive children if they were forced to slow down. Conversely, one could test whether nonaggressive children begin to mimic the RED patterns of aggressive children under conditions that force rapid responding.

Other parameters of RED could be manipulated, as well. The response outcomes of aggression could be manipulated (obviously), but a more important test would be to manipulate positive outcomes independently of negative outcomes in order to test the relevance of each of these parameters. Other aspects of impulsivity, as noted above, are also candidates for experimental manipulation.

Yet another test of the roles of RED processes can occur during experimental interventions with aggressive youth [e.g., Conduct Problems Prevention Research Group, 1992]. If RED processes mediate aggressive behavior, they might also mediate intervention effectiveness. Structural equation modeling can test whether aggressive behavior outcome differences between an intervention group and a control group (or within the intervention group) are statistically accounted for by changes in RED processes.

In their review of laboratory paradigms for studying aggression, Tedeschi and Quigley [1996] pointed out that more empirical attention needs to be placed on examining participants' aggressogenic motivations in experimental settings. At present,

dominant laboratory paradigms for studying aggression are not designed to test many social–cognitive processes associated with aggression and coercion [Tedeschi and Felson, 1994]. Causal designs, in particular, are needed to test real-time processes such as behavioral judgments and decisions in order to build upon past correlational work.

CONCLUSION

RED is a heuristic for understanding judgment and decision processes that take place prior to aggressive behavioral responses to social situations. The proposed model incorporates real-time sequential processes that may be represented by mathematical operations to describe the process of making a decision to engage in aggression. Due to the correlational nature of most of the empirical work reviewed, causal paths may not yet be drawn between the real-time processes discussed and specific behaviors or behavioral patterns. However, it appears that several response decision operations, such as response efficacy and valuation, evaluating outcome expectancy and valuation, and response selection, may have causal roles in aggressive behavior and contribute incrementally to the prediction and comprehensive explanation of variability in antisocial behavior. Future research needs to develop designs addressing cause and eliminating alternate explanations for correlations so that the validity of RED processes may be tested and the model of real-time behavioral judgments and decisions can undergo further refinement.

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