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Development of Response Evaluation and Decision (RED) and Antisocial Behavior in Childhood and Adolescence

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Abstract

Using longitudinal data on 585 youths (48% female; 17% African American; 2% other ethnic minority), we examined the development of social response evaluation and decision (RED) across childhood (Study 1; kindergarten-Grade 3) and adolescence (Study 2; Grades 8 and 11). Participants completed hypothetical-vignette-based RED assessments, and their antisocial behaviors were measured by multiple raters. Structural equation modeling and linear growth analyses indicated that children differentiate alternative responses by Grade 3, but these RED responses were not consistently related to antisocial behavior. Adolescent analyses provided support for a multi-domain model of RED and showed strong relations between aggressive response evaluations, nonaggressive response evaluations, and antisocial behavior. Findings indicate that RED becomes more differential and is increasingly related to youths' antisocial conduct across development.

Keywords

SOCIAL INFORMATION PROCESSING; DECISION MAKING; ANTISOCIAL BEHAVIOR; CHILD DEVELOPMENT; ADOLESCENCE

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Numerous social cognitive structures (e.g., beliefs about aggression; Huesmann, 1998) and on-line processing operations (Dodge, Coie, & Lynam, 2006) have been linked to aggressive conduct problems in youth. One domain of processing that appears to be critical is response decision making—that is, processes by which youths evaluate behavioral alternatives and decide how to respond to challenging social situations (see Fontaine & Dodge, 2006). These processes have been well-studied in adult models of rational choice (Becker, 1978), but, compared to other social cognitive domains, such as knowledge structures, normative beliefs, and attributional style, response decision-making has been understudied as a factor in aggressive behavior problems in children. Reasons for the relative lack of empirical inquiry may be that social developmentalists have presumed that decision-making processes are primitive in young children, difficult to measure reliably, and not strongly correlated with aggressive behavior. The purposes of the present studies were to examine developmental growth across childhood and adolescence in: 1) youths' ability to differentially evaluate alternative behavioral responses during challenging social interactions; and 2) the correlation between youths' response evaluations and their antisocial behavior.

Response Evaluation and Decision (RED)

As a component of social information processing (SIP; Crick & Dodge, 1994; Fontaine & Dodge, in press; also, see Mize & Pettit, in press, for a recent review), *response evaluation and decision* (RED) concerns the set of decision processes by which alternative responses are evaluated, assigned outcome expectancies, and compared and prioritized for ultimate response selection. Fontaine, Burks, and Dodge (2002) empirically distinguished two dimensions of RED: *response valuation*, which is defined by on-line sociomoral appraisals of aggressive response options, and *outcome expectancy*, which is captured by questions that relate to participants' online estimations of outcome likelihoods with respect to aggressive response options. They demonstrated that these domains significantly and uniquely incremented the prediction of adolescents' externalizing behavior, suggesting that RED may be a multi-dimensional construct. Note that whereas response *evaluation* refers to the global appraisal of behavioral options across multiple domains, response *valuation* is the process by which the sociomoral qualities of a behavior are specifically considered.

Fontaine and Dodge (2006) proposed a model of response evaluation and decision (RED) by which several decision-making processes were proposed: 1) *response valuation*: the appraisal of the social and moral qualities of a response (see Astor, 1994); 2) *response efficacy*: the estimation of how easy or hard it is to behaviorally enact a response (see Bandura, 1982; Cuddy & Frame, 1991); and multiple types of 3) *outcome expectancy*: the anticipation or likelihood that a particular outcome will result from the behavior (see Cuddy & Frame, 1991; Feather, 1982). There are numerous different types of outcome expectancy including positive (or desired) versus negative (or aversive), intrapersonal (e.g., emotional) versus extrapersonal (e.g., societal), and instrumental (or goal-driven) versus social (or interpersonal). RED hypothesizes that a multitude of different outcome expectancies are potentially at play during an individual's response decision making.

Empirical evidence has supported the hypothesis that each domain is significantly correlated, at the bivariate level, with aggressive behavior during adolescence (see Fontaine, 2006b; Fontaine & Dodge, 2006). However, little is known about the early development of RED and how it relates to antisocial behavior across childhood and adolescence. In addition, it is unknown as to when children develop the ability to activate RED, even at a basic or general level, in their behavioral evaluation and social decision making.

Development of Executive Function

The period from early school years through late adolescence is marked by remarkable growth in social and nonsocial cognition (see Flavell, Miller, & Miller, 1993). Because RED processes require mental representation of the anticipated consequences and value of possible behaviors, it was hypothesized that internal consistency and response-specific differentiation of these processes would not be present in early childhood but would develop during middle childhood years. This hypothesis is supported by considerable theory and science in developmental psychology, stemming primarily from scientific research on the development of executive function (e.g., Séguin & Zelazo, 2005; Zelazo & Müller, 2002). The role of RED in youth social-cognitive processing was hypothesized to develop in multiple ways, including internal consistency of responding, specificity (i.e., differentiation among domains), and concurrent relation to antisocial behavior.

It is well-established that children develop skills in executive function—typically defined as one's "self-regulation of thought, action, and emotion" (Séguin & Zelazo, 2005, p. 307)—including cognitive activities such as decision making and perspective taking, across childhood (see Zelazo & Müller, 2002). Children begin to demonstrate executive abilities as early as one year of age, and most abilities have become active by year 8 (Ardila & Rosselli, 1994; Case,

1992; De Luca et al., 2003; Luciana & Nelson, 1998). There remains some uncertainty as to individual differences in the onset and development of specific executive skills, and social evaluation and response decision-making functions are no exception. Further impetus for examining early RED processing and antisocial behavior is the current trend to associate delays or other problems in executive function development with a variety of social problems and clinical syndromes, including disruptive behavior disorders, in early childhood (De Luca et al., 2003; Trembley et al., 2005; Zelazo & Müller, 2002).

Early adolescence is marked by increases in a number of advanced cognitive abilities, including self-regulatory cognitive processes, abstract reasoning, deductive reasoning, and information processing (Cobb, 1992; Keating, 1980, 2004; Steinberg, 2005). Social judgment and decision making develop considerably as children enter adolescence, as well. Early adolescence brings increased ability to consider risks and alternative consequences in social situations, take the perspectives of others, and consider hypothetical scenarios (Keating, 1980, 2004; Steinberg, 2005). In the last decade, scientific attention to behavioral decision making in adolescence has increased, particularly with respect to antisocial behavior and criminal culpability (e.g., Cauffman & Steinberg, 2000; Fried & Reppucci, 2001; Miller & Byrnes, 1997; Steinberg & Cauffman, 1996). The present studies were conducted to test the hypotheses that RED processing would increase in internal consistency across childhood, increase in differentiation of complexity during adolescence, and increase in relation to antisocial behavior during adolescence.

Study 1: Childhood

Dodge and Price (1994) hypothesized, and found evidence suggesting, that (a) SIP skills, and (b) relations between SIP patterns and behavior increase with age as youths develop. Guided by basic social-developmental research, the reasoning underlying these hypotheses was that, although some elementary cognitive processes may be innate, via ongoing individual-environment transactions, children's social cognitive abilities and interpersonal strategies become more complex as a function of normal development. Consistent with this rationale, it was hypothesized in Study 1 of the present research that young children's RED processing is basic and relatively unsophisticated. Basic RED processing was operationalized as the ability to assess the overall "goodness" or "badness" of alternative social behaviors and was assessed across kindergarten through third grade.

Hypotheses

Two hypotheses guided this investigation. First, we examined the relation children's evaluations (or endorsements) of aggressive response options (called "aggressive RED") and nonaggressive response options (called "nonaggressive RED"). Namely, we were interested in whether children evaluate their own possible behavioral responses to provocation reliably and differentially across early school years. Psychometric reliability was operationalized as internal consistency across items. Differential responding was operationalized as significant differentiation between aggressive RED and nonaggressive RED. It was hypothesized that children's RED would become more reliable across time, and that differentiation between children's aggressive and nonaggressive RED would increase across development. Second, we investigated the degree to which children's aggressive and nonaggressive RED were associated with their antisocial behavior across development. We hypothesized that aggressive RED becomes more positively related, and nonaggressive RED becomes more negatively related, to antisocial behavior as children get older.

Method

Participants—Two cohorts of children entering kindergarten and their families were recruited to participate in a longitudinal investigation of the development of conduct problems in April of 1987 and 1988 (Child Development Project; see Dodge, Bates, & Pettit, 1990; Dodge et al., 2003; Pettit, Bates, & Dodge, 1997). Participants were drawn from three geographic regions: Bloomington, Indiana, and Knoxville and Nashville, Tennessee. Bloomington is a small, Midwestern town of approximately 50,000 residents, many of whom migrated from Appalachia. Its neighborhoods range from trailer parks to planned developments. Knoxville is an Appalachian metropolitan area of approximately 200,000 residents with neighborhoods that range from rural to suburban. Alternatively, Nashville is a mid-South metropolitan area of over one million people, with a broad economic base and neighborhoods that range from federally subsidized housing projects to affluent suburbs.

Children were randomly selected at preregistration for kindergarten and asked to participate in the study. Approximately 15% of the children at targeted schools did not preregister, thus this proportion of the sample was recruited by mail or telephone. Approximately 75% of those recruited agreed to participate. The total sample in the first year (kindergarten) of the Child Development Project consisted of 585 children (48% female; 81% Caucasian; 17% African American; 2% minority from other ethnic backgrounds), each from a different family. All participants spoke English; the percentage of families for which English was not the primary language is unknown, though it is estimated to be small. The Hollingshead (1979) index of families' socioeconomic status (SES) showed a range from 11 to 66 with a mean in the low-middle class range ($M = 39.59$, $SD = 13.96$). Assessments for the current study were conducted at kindergarten and Grades 1 ($n = 537$, 92% of the original sample), 2 (517, 88%), and 3 (498, 85%).

Response Evaluation and Decision (RED) Procedure and Protocol—RED assessment was administered as part of a larger SIP protocol (see Dodge, Pettit, Bates, & Valente, 1995; Weiss, Dodge, Bates, & Pettit, 1992) during each of the first four years (kindergarten through Grade 3) of the Child Development Project. Participants viewed a series of 24 randomly-ordered video vignettes of benign, ambiguous, and hostile provocation situations that are relevant to child life during early school years. Each vignette involved four video segments. The first segment presented the social stimulus, half of which were provocations (e.g., being hit in the back with a ball) and half of which were rebuff from peer group entry (e.g., being excluded from joining a sports team). The final three segments presented alternative responses (aggressive, nonaggressive/competent, and nonaggressive/inept responses), in randomly varied order, to the stimulus. Actors were given scripts written to depict responses, for which multiple "takes" were video-recorded. Pilot youth and adult viewers selected the versions that most clearly and realistically depicted the intended behaviors. Only the aggressive and nonaggressive/competent response alternatives were examined in this study. Participants were asked to imagine themselves as the protagonist in the situation (i.e., the individual who has suffered a negative outcome due to the peer's behavior) prior to viewing each segment of all 24 video vignettes. Following each video response, participants were asked to evaluate the response ("Do you think that's a good thing or a bad thing to say or do?") on a pictorial scale that ranged from 1 (very bad) to 4 (very good). An *aggressive response valuation* variable was computed by taking the average score for this question that corresponded to the video-recorded aggressive response across all 24 vignettes; likewise, a *nonaggressive/competent response valuation* variable was computed by taking the average score for this question with respect to the nonaggressive/competent response across the 24 vignettes.

Antisocial Behavior—The Child Behavior Checklist (CBCL; mother report) and Teacher Report Form (TRF) measures of *Externalizing* problems (comprised of *Aggressive* and *Delinquent* conduct problem subscales) were administered and collected in Grades K through 3 (Achenbach, 1991a, 1991b, 1991c). *Aggressive* (bullies, fights, threatens, etc.) and *Delinquent* (lies, steals, vandalizes, etc.) subscale items were rated according to frequency on a zero to two metric. The reliability and validity of these measures have been established to be excellent in numerous empirical investigations. Reliability has been repeatedly demonstrated to be high, based on strong 1-week test-retest coefficients. In addition, comparative reviews of alternative instruments that measure youth conduct problems have noted that Achenbach measures of *Externalizing* problems are among the strongest with respect to convergent, discriminant, and predictive validity, and recommended the CBCL, in particular, as the preferred instrument to assess youth behavioral competencies and problems (Wells, 1995). We herein use the terms antisocial behavior and externalizing problems synonymously.

Analysis Plan—Note that this section provides both the general analysis plan that was followed for Studies 1 and 2 (and is referenced below in the specific analysis plan for Study 2), as well as the specific analysis plan for Study 1. Structural equation modeling (SEM; M*plus* 4.1, Muthén & Muthén, 1998–2006) was used to test all hypotheses. Missing values were handled with the full information maximum likelihood estimation in M*plus*, where missingness was treated as a function of available observed covariates and outcome variables. As preliminary analyses, CFAs of the *aggressive response valuation* and *nonaggressive response valuation* constructs were conducted separately for each wave of data to ensure unidimensionality. Measurement invariance of RED scales from kindergarten through Grade 3 and from Grade 8 through Grade 11 was examined via CFA by comparing a model without equality constraints on the factor loadings and other models with such constraints, in terms of Chi-square difference and degree of freedom difference. Because of the large number of indicators (24) in the RED measure, the model for the first wave (kindergarten) was paired with each of the three additional waves (Grades 1–3) to test invariance of factor loadings. Models without equality constraints on the factor loadings across waves served as baseline models in each case. In addition, composite scores of each scale items were used as a single indicator of a latent construct. Factor loading λ was obtained by taking the square root of reliability ω ($\lambda = \sqrt{\omega}$), and error variance of each scale was partitioned out ($1-\omega$) in subsequent SEM of RED. In a measurement model with a single indicator, the variance of the latent construct is equivalent to the squared factor loading ($\omega = \lambda^2$), a notion that is analogous to the squared regression coefficient (β) in a regression model with a single independent variable. The reliability coefficient (ω_j) for a particular scale *j* was calculated using the formula: $\omega_j = (\sum\lambda_j)^2/[(\sum\lambda_j)^2 + \sum\psi^2]$, where $(\sum\lambda_j)^2$ stands for the square of the sum of factor loadings and $\sum\psi^2$ represents the sum of unique variances (McDonald, 1999, p. 88), which was more appropriate for ordinal scales.

With desirable measurement properties, a measurement model with both aggressive and nonaggressive evaluation and antisocial constructs were specified for the first and the second study, exclusively to test the concurrent correlations between aggressive and nonaggressive RED constructs. The invariance of the correlations over time was tested by comparing this model with others that had equality constraints on the correlations, in terms of Chi-square difference and degree of freedom difference. Next, a cross-lagged model with growth trajectory intercepts and slopes was specified to examine: (a) stability of RED constructs through their autoregressive paths, and (b) relations of RED to antisocial constructs across time while controlling for each other. Equivalence of corresponding paths over time was also tested by comparing models without and with equality constraints, in terms of Chi-square and degree of freedom differences. As is demonstrated in Study 2 below, a similar model was used to examine the developmental trends of the aggressive RED and nonaggressive RED difference scores (aggressive RED – nonaggressive RED) and their developmental relation with antisocial

constructs across adolescence in the same fashion. The results reported were based on the final model with equality constraints that were proved by model comparisons.

Results

Measurement Properties of RED Constructs—Standardized factor loadings of aggressive and nonaggressive RED are listed in Table 1. The reliability coefficient ω is listed under the factor loadings, all of which were above .93, denoting that internal consistency was uniformly high. A series of invariant measurement tests indicated that most items had similar factor loadings from kindergarten to Grade 2. The majority of loadings in Grade 3 were found to be different but improved in measurement quality from their corresponding reference items in Grade 1.

Relations Among RED Constructs—The measurement model fit the data well (χ^2 = 519.15, df = 181, $p < .01$, CFI = .95, TLI = .92, and RMSEA = .06) and revealed the following findings. The aggressive RED construct was positively correlated with the nonaggressive RED construct at ϕ_1 = .48 (CI = .40~.55, $p < .01$) in kindergarten, and at ϕ_2 =.29 (CI = .20 ~ .39, $p < .01$) in Grade 1. In Grade 2, these two constructs were not significantly correlated at ϕ_3 = .05 (CI = −.06 ~ .16, $p > .05$). In Grade 3, the two constructs were negatively correlated at ϕ_4 = −.53 (CI = −.61 ~ −.45, $p < .01$). Chi-square difference tests based on model comparison confirmed that the correlations changed not only in magnitude over time, but also in sign, with $\phi 1 \neq \phi 2$ (χ^2_{dif} = 12.75, df_{dif} = 1, $p < .01$), ($\phi 2 \neq \phi 3$ (χ^2_{dif} = 21.41, df_{dif} = 1, $p < .01$), and $\phi 3 \neq \phi 4$ (χ^2_{dif} = 64.99, df_{dif} = 1, $p < .01$). These findings indicate that children shifted from a general response bias to a pattern of differentiation between aggressive and nonaggressive RED alternatives across the developmental period from kindergarten to Grade 3. The zero-order intercorrelations of the constructs, listed in Table 2, show that nonaggressive RED was correlated with antisocial constructs at certain grades. However, these correlations and predictive relations are better depicted in the cross-lagged model depicted in Figure 1.

Predictive Relations Between RED and Antisocial Behavior—The cross-lagged model (see Figure 1) fit the data well (χ^2 = 605.60, df = 223, $p < .01$, CFI = .94, TLI = .93, and RMSEA = .05) and revealed the following findings concerning the stability and predictive relations. First, both aggressive and nonaggressive RED were relatively stable from kindergarten through Grade 2, as indicated by the moderate and statistically equivalent autoregressive coefficients for aggressive RED (β = .47, CI = .39 ~ .54, p < .01) from kindergarten to Grade 1, (β = .57, CI = .50 ~ .65, $p < .01$) from Grade 1 to Grade 2; and for nonaggressive RED (β = .52, CI = .44 ~ .60, $p < .01$) from kindergarten to Grade 1, (β = .51, CI = .43 ~ .59, $p < .01$) from Grade 1 to Grade 2. Second, aggressive RED underwent notable changes from Grade 2 to Grade 3, as indicated by the low autoregressive coefficient (β = .32, CI = .23 ~ .40, $p < .01$) for aggressive RED. Chi-square difference tests showed that the autoregressive coefficients were significantly different from previous ones (χ^2_{dif} = 5.38, df_{dif} = 1, $p < .05$) for aggressive.

The cross-lagged model also revealed that nonaggressive RED had a weak but significant relation to the antisocial construct over time, as indicated by the negative correlation between nonaggressive RED and antisocial behavior in kindergarten (ϕ = −.10, CI = −.20 ~ −.01, $p < .05$), the path coefficient from nonaggressive RED at kindergarten to antisocial behavior at Grade 1 (β = −.05, CI = −.10 ~ −.00, $p < .05$), from nonaggressive RED at Grade 1 to antisocial behavior at Grade 2 (β = −.04, CI = −.08 ~ −.00, $p < .05$), and from nonaggressive RED at Grade 2 to antisocial behavior at Grade 3 (β = −.05, CI = −.08 ~ −.00, $p < .05$). In contrast, aggressive RED was not significantly related to antisocial behavior from kindergarten to Grade 3.

The last finding from the cross-lagged model was that antisocial behavior became more stable over time, as shown by the increasing autoregressive path coefficient of the antisocial construct from kindergarten to Grade 1 (β = .79, CI = .73 ~ .85, $p < .01$), from Grade 1 to Grade 2 (β = .90, CI = .85 ~ .96, $p < .01$) and from Grade 2 to Grade 3 (β = .93, CI = .88 ~ .98, $p < .01$). A Chi-square difference test showed that the three coefficients were significantly different from one another ($\chi^2_{dif} = 9.28$, $df_{dif} = 2$, $p < .01$). This model explained 23%, 33%, and 10% variance of the aggressive RED construct at Grades 1, 2, and 3, respectively, 28%, 26%, and 12% variance of the nonaggressive RED construct at Grades 1, 2, and 3, respectively, and 63%, 82%, and 87% variance of the antisocial construct at Grades 1, 2, and 3, respectively.

Gender and Ethnic Differences in the Cross-lagged Model—Gender differences were found in the predictive paths from aggressive and nonaggressive RED at Grade 2 to antisocial behavior at Grade 3 ($\chi^2_{dif} = 10.13$, $df_{dif} = 2$, $p = .01$), which suggested stronger relations in males. Interpretation was omitted here due to a suppressor effect. Ethnic differences in stability of both aggressive and nonaggressive RED constructs from Grade 2 to Grade 3 were detected ($\chi^2_{dif} = 8.99$, $df_{dif} = 2$, $p = .05$). The stability in aggressive RED (β = .58, CI = .40 ~ .75, $p < .01$) and in nonaggressive RED (β = .59, CI = .40 ~ .78, $p < .01$) in the ethnic minority group were much stronger than stability in aggressive RED (β = .25, CI = .15 ~ .35, $p < .01$) and in nonaggressive RED (β = .20, CI = .09 ~ .32, $p < .01$) in the white group.

Discussion

Development of Response Evaluation and Decision Processes—Beginning with kindergarten, children's response evaluation and decision (RED) processes were found to be highly internally consistent. High reliability of responding to both aggressive and nonaggressive stimuli suggests that, at kindergarten at the latest, children evaluate aggressive and nonaggressive responses to provocations consistently. However, the relation between responses to aggressive stimuli and responses to nonaggressive stimuli changed drastically from kindergarten to Grade 3. In kindergarten we found evidence in favor of a generic *response style*, in that responding to both kinds of stimuli were significantly positively correlated. Children were prone to evaluate responses, regardless of whether the response was aggressive or nonaggressive, in a similar manner. In other words, children tended to evaluate *both* aggressive and nonaggressive responses with some degree of favor, neutrality, or disfavor. This pattern decreased significantly from kindergarten to Grade 1, although a response style effect remained in Grade 1, as well. By Grade 2, the response style effect had disappeared, and we found that there was no relation between responding to aggressive and nonaggressive stimuli.. Further differentiation was observed in children's transition from Grade 2 to Grade 3, as we found that valuations of aggressive and nonaggressive responses became correlated in the negative direction. By Grade 3, individual differences had developed in children's propensity to evaluate aggressive responses more favorably than nonaggressive responses. This trend suggests that early school years are critical to the child's developing ability to discern socially meaningful differences between alternative responses to varied provocation situations. Children appear to have little ability to distinguish the acceptability of aggressive versus nonaggressive responses to provocations in kindergarten and Grade 1. Instead, their responses reflect an internal propensity to evaluate any response as good or poor. By Grade 3, they judge these response alternatives to be quite different, and even in direct opposition to each other. Furthermore, age trends indicated that children gradually rated aggressive responses more negatively and nonaggressive responses more favorably. RED processing requires the child to hold a hypothetical behavior in mind while evaluating its associated consequences, a task that requires more advanced Piagetian skills (Piaget, 1929, 1965). Consistent with Piaget's seminal work, results from the first four years of this study suggest that this level of processing does not become coherent until later in development (i.e., no earlier than middle childhood).

Development of the Relation between RED and Antisocial Behavior—The relation between RED and antisocial behavior during early school years was limited. RED in response to aggressive stimuli was not significantly related to antisocial behavior at any grade (kindergarten through Grade 3). Modest negative correlations between RED in response to nonaggressive stimuli and antisocial behavior were observed at kindergarten and Grade 1, but not at Grades 2 and 3. In addition, RED difference scores were correlated with antisocial behavior at kindergarten and Grade 1, but not at Grades 2 and 3. Although RED in response to nonaggressive stimuli was related to antisocial conduct during kindergarten and Grade 1 in the expected direction, it is unclear why this pattern did not persist through Grades 2 and 3. It may be that more aggressively behaving children had learned that nonaggressive responses are more socially favorable by Grade 2 and thus did not evaluate these responses in significantly different ways from nonaggressive children. Overall, results of this study did not suggest that RED plays a substantial role in the development of antisocial conduct problems during early school years.

Study 2: Adolescence

Dodge and Price (1994) hypothesized that social-information processing patterns (e.g., encoding skills, attributions, response generation) are more sophisticated among older than younger children as a reflection of growth in executive function skills. Results supported this developmental hypothesis, and the authors concluded that “as skill in a processing task increases across age, it becomes more relevant to individual differences in behavior” (p. 1395). However, Dodge and Price did not examine multiple dimensions of response decision making or the association between response decision-making dimensions and antisocial behavior.

Subsequent research by Fontaine et al. (2002), empirically distinguished theoretically distinct domains of RED, providing strong evidence that, by adolescence, RED processing is more complex than is represented by a basic appraisal of a response’s overall goodness or badness. Drawing from numerous, independent programs of social cognitive and social developmental research, Fontaine and Dodge (2006) provided a detailed account of qualitatively differentiable evaluative domains by which attributes of alternative behaviors and their associated outcomes may be assessed. Among the hypothesized domains that were stressed as most important were alternative types of outcome expectancy and behavioral efficacy—however, most investigations have been limited in that they have only conceptualized and measured these constructs as latent cognitive structures (e.g., Crick & Ladd, 1990; Cuddy & Frame, 1991; Perry, Perry, & Rasmussen; also, see Bandura, 1977, 1982). The current study reports the first known effort to assess aspects of the multi-dimensionality of RED patterns, that is, the internal consistency of responding within dimensions, the differentiation across dimensions, and the relation between these patterns and aggressive behavior across adolescence. Based on Fontaine and Dodge’s (2006) framework, it was hypothesized that, by adolescence, advanced, differentiable social-cognitive operations—namely, response efficacy, emotional outcome expectancy, and social outcome expectancy—that define RED processing become relevant to conduct problem behaviors.

This study was comprised of social cognitive and behavioral assessments of adolescent participants at Grades 8 and 11. Consistent with our hypotheses in Study 1, we investigated the internal consistency of aggressive and nonaggressive RED and change in their relation across time. We hypothesized that RED processing is sufficiently developed by adolescence that qualitatively distinct domains of responding to aggressive and nonaggressive stimuli are empirically differentiable. We tested the hypothesis that there are distinct domains of RED that contribute to adolescents’ social functioning, both within and across grades. Second, we tested correlations between evaluative responses to aggressive and nonaggressive stimuli and antisocial behavior. We hypothesized a positive relation between aggressive RED, and a

negative relation between nonaggressive RED, and antisocial behavior, that become stronger across adolescence.

Method

Participants—Study 2 assessments were conducted when participants in the Child Development Project were in Grades 8 (n = 394, 67% of the original sample), and 11 (418, 71%).

Response Evaluation and Decision (RED) Procedure and Protocol—An adolescent version of the social-information processing video assessment was designed and administered in Grades 8 and 11, and the RED protocol was expanded to include questions that were hypothesized to represent qualitatively distinct domains of response decision making. Participants watched each of six video vignettes of hypothetical ambiguous provocation situations that are relevant to everyday adolescent life. Participants were instructed to imagine themselves as the protagonist (the responding individual who has suffered a negative outcome as a result of another's actions) in each social situation. Each vignette was presented in three segments. The first segment presented an ambiguous provocation situation in which the protagonist suffered a negative outcome. For example, in one of the vignettes, participants imagined themselves as the protagonist approaching an apparently abandoned backpack in a school hallway. Upon picking up the backpack to inspect it, the ambiguous provocateur walks up to the protagonist and states, with neutral affect and intonation, "That's my backpack." In the second segment of each vignette, participants were asked to imagine themselves as the protagonist responding aggressively toward the ambiguous provocateur. In the backpack example, participants were asked to imagine themselves responding by saying, in an overtly hostile manner, "Look, I didn't know whose it was. I was just looking at it, okay?!?!" In the third segment of each vignette, participants were asked to imagine themselves as the protagonist responding nonaggressively/competently toward the ambiguous provocateur. In the backpack example, participants were asked to imagine themselves responding by saying "Oh, okay. I was just about to take it to 'Lost and Found.'"

Following each segment, participants answered questions that represent theoretically distinguished domains of RED. Questions were displayed on the video monitor as they were read aloud by the narrator. In addition, a paper copy of the questions was presented and participants circled answers from a list of scaled choices that corresponded to each question. Three questions, each representing a theoretically distinct domain of RED, followed each of the six aggressive stimuli: (a) *How easy would it be for you to act like this?* ("response efficacy"; answered according to a five-point continuous scale from *very easy* to *very hard*); (b) *If you acted this way, how would you feel about yourself?* ("emotional outcome expectancy"; five-point scale from *very good* to *very bad*), and (c) *How much would other people like you if they saw you acting like this?* ("social outcome expectancy"; five-point scale from *very much* to *not at all*).[1] Six scores (response efficacy, emotional outcome expectancy, and social outcome expectancy, for each of the aggressive and nonaggressive stimuli) were computed by taking the average score across the six vignettes for each question.

[1]A fourth RED question was asked that was designed to assess participants' *instrumental* outcome expectancy. Unlike the other RED questions, which were framed identically across vignettes, the instrumental outcome expectancy question was framed specific to the content of the vignette. For example, in the backpack vignette, participants were asked "Would acting this way cause the other girl to be mean later if she saw you with something of hers again?" In this way, the instrumental goal was presumed for participants in each vignette. The internal consistency of this question across the six vignettes was low in both Grades 8 (α = .30) and 11 (α = .07); as a result, it was not included in subsequent analyses. Asking a uniform and nonspecific instrumental-outcome expectancy question such as "How likely is it that acting this way would help you to get what you want?" would have allowed participants to answer the question with their own instrumental goals in mind and may have resulted in higher internal consistency. Also, in Grade 11, two additional RED questions were asked that were not included in this study in order to maintain consistency in measurement of the RED latent construct across Grades 8 and 11.

Antisocial Behavior—The Child Behavior Checklist (CBCL; mother report) and Youth Self-Report (YSR) measures of *Externalizing* problems were administered at Grades 8 and 11 (Achenbach, 1991a, 1991b, 1991d). A more detailed description of Achenbach measures of *Externalizing* problems is provided in Study 1.

Analysis Plan—The specific plan for this study is as follows. First, a measurement model of the two aggressive and nonaggressive RED constructs and an antisocial construct was estimated for both Grades 8 and 11, which served as a baseline model. Composite scores of the original items of each construct were used as indicators. Measurement invariance over time was tested by comparing the baseline model with another model that had equality constraints on factor loadings over time, in terms of Chi-square differences. The equivalence of correlation between aggressive and nonaggressive RED across time was also tested by comparing the baseline model with another model that had the correlations constrained to be equal. Second, a cross-lagged model with invariant measurement was specified to estimate the predictive relations aggressive and nonaggressive RED constructs and antisocial constructs across time.

Results

Measurement Properties of and Interrelations among RED Constructs—The measurement model of RED constructs with equality constraints on the factor loadings across time fit the data well (χ^2 = 407.90, df = 142, p < .01, CFI = .95, TLI = .93, and RMSEA = .06). The factor loadings are listed in Table 3. Measurement invariance over time was found for the RED constructs (χ^2_{dif}= 6.36, df_{dif} = 4, p > .05). Measurement of antisocial constructs improved, especially with respect to self-report indices (χ^2_{dif}= 33.68, df_{dif} = 3, p < .01). This model showed that the correlation between aggressive and nonaggressive RED increased in magnitude from ϕ = −.41 (CI = −.51 ~ −.38, p < .01) in Grade 8 to ϕ = −.70 (CI = −.75 ~ −.64, p <.01) in Grade 11, as confirmed by a model comparison (χ^2_{dif}= 12.28, df_{dif}= 1, p < .01). The zero-order intercorrelations of the constructs listed in Table 4 show the grade-specific correlations between aggressive and nonaggressive RED and antisocial behavior. However, the predictive relations are better depicted by the cross-lagged model graphic (see Figure 2).

Predictive Relations of Cognitive and Antisocial Constructs—The cross-lagged model for estimating the predictive relations between RED constructs and antisocial behavior (shown in Figure 2) fit the data well, with χ^2 = 443.66, df = 144, p < .001, CFI = .94, TLI = .93, and RMSEA = 06. The model revealed the following findings. First, antisocial behavior was stable from Grade 8 to Grade 11, as indicated by the path coefficient γ = .94 (CI = .85 ~ 1.02, p < .01). Second, antisocial behavior at Grade 8 was predictive of aggressive RED β = .20 (CI = .07 ~ .32, p < .01) and nonaggressive RED β = −.33 (CI = −.45 ~ −.22, p < .01) at Grade 11. Third, when controlling for antisocial behavior at Grade 8, aggressive and nonaggressive RED were no longer predictive of antisocial behavior at Grade 11. This model explained 88% variance of the antisocial construct, 21% variance of the aggressive RED construct, and 10% variance of the nonaggressive RED construct.

Gender and Ethnicity Differences—Gender and ethnicity differences in levels and intercorrelations of the development of RED were tested. We focused tests on concurrent relations between RED and antisocial behavior (see Figures 3) and found no significant gender (χ^2_{dif} = 13.43, df_{dif} = 7, p = .06) or ethnicity (χ^2_{dif} = 9.02, df_{dif} = 7, p = .25) differences in adolescence.

Discussion

Development of Response Evaluation and Decision Processes—The negative relation between aggressive and nonaggressive RED that was first observed between participants' general RED processing of these alternative responses in Grade 3 (in Study 1)

was observed across specific domains of RED in adolescence, as well. All aggressive RED domains were negatively correlated with their corresponding nonaggressive RED domains at both Grades 8 and 11, as expected. Although RED constructs were found to be distinct at Grades 8 and 11, we did not observe any significant differences in the negative correlations between corresponding aggressive and nonaggressive RED domains from Grade 8 to Grade 11, with the exception of emotional outcome expectancy. By Grade 11, adolescents were significantly more likely to expect different emotional outcomes from aggressive versus nonaggressive outcomes than they were in Grade 8. In other words, the difference between adolescents' expectations of negative emotions to result from behaving aggressively and positive emotions to be experienced by responding nonaggressively increased across adolescence.

These child and adolescent trends of aggressive versus nonaggressive RED functioning were further evident in our analyses of RED difference scores (aggressive minus nonaggressive RED values). From childhood through adolescence, there was a steady increase in the difference between evaluations of aggressive versus nonaggressive. This suggests that, as youths develop, their tendency to favor one response style over another increases from middle childhood through late adolescence.

Results support the hypothesis that the specified domains of aggressive and nonaggressive RED—namely, response efficacy, emotional outcome expectancy, and social outcome expectancy—are distinct in adolescence. Models that treated these six domains (three domains of both aggressive and nonaggressive RED) as two inclusive dimensions (i.e., aggressive versus nonaggressive RED) fit the data less well than more differentiated models, with respect to statistically accounting for variability in adolescent response decision making that is captured by treating the domains separately. The magnitude of most intercorrelations among specific aggressive and nonaggressive RED domains did not change across adolescent assessment waves, and results did not support the notion that there was significantly greater differentiation between RED domains from Grade 8 to Grade 11. Collectively, these results support a model of RED that distinguishes evaluative domains. Furthermore, findings support multi-process hypotheses made by Fontaine and Dodge (2006) including distinctions between (a) evaluating actions and behavioral responses separately from anticipating outcomes of responses, and (b) acknowledging different types of outcome expectancies (such as identifying social versus emotional outcomes of a considered behavior) as distinct RED processes.

Development of the Relation between RED and Antisocial Behavior—We found that the pattern of results in children's general RED processing of aggressive versus nonaggressive responses (in Study 1) is considerably different from adolescents' RED processing across specific domains (in Study 2). By Grade 8, all aggressive RED domains were moderately-to-highly correlated with antisocial behavior in the positive direction. In contrast, all nonaggressive RED domains were negatively correlated with antisocial conduct. In addition, RED domain difference scores (aggressive RED domains minus their corresponding nonaggressive RED domains) were significantly correlated with antisocial behavior at Grades 8 and 11. This pattern of results emerged in Grade 11, as well. Findings suggest that early adolescence, opposite relations between aggressive and nonaggressive RED and antisocial conduct problems are distinctive and that these relations are stable across adolescent development. Adolescents who evaluate aggressive responses to ambiguous provocations in favorable ways tend to be characterized by antisocial behavior; alternatively, nonaggressive adolescents are more likely to endorse nonaggressive responses and devalue aggressive response options during ambiguous provocation interactions. These findings are consistent with past literature that provided initial evidence for the relevance of aggressive and nonaggressive RED in the development of antisocial conduct problems. We did not, however, find any significant differences between the relations of any of the aggressive or nonaggressive

RED domains from Grade 8 to Grade 11. Likewise, no relations between RED domain difference scores and antisocial conduct were significantly different across adolescent measurement waves. These results suggest that any change in variability in RED and behavior across adolescence was similar across these domains of functioning.

In contrast, we found that adolescents' aggressive RED, across all domains, as well as their antisocial behavior, decreased significantly from Grade 8 to Grade 11. That is, as adolescents developed, they were less likely to both evaluate aggressive responses favorably across RED domains and engage in antisocial behavior. In addition, adolescents' nonaggressive RED, across all domains, increased across adolescence—that is, as adolescents developed they were more likely to favorably evaluate socially competent responses across RED domains. Taken together, these results suggest a collective increment in social maturity.

The observed pattern of the relation between RED and antisocial behavior is consistent with other research that has found that social cognition becomes more related with actual behavior across development (Davis-Kean et al., 2007) and that children's aggressive behavior may be predicted by their beliefs about behaving aggressively after eight years of age (Huesmann & Guerra, 1997). Also, this study extends findings from previous analyses in the Child Development Project that examined SIP steps at a macroprocess level (early versus late SIP-step problems) in relation to youths' externalizing behavior (Lansford et al., 2006). Whereas Lansford and her colleagues examined how SIP steps act in conjunction with one another and how corresponding SIP profiles may be used to differentiate groups of children and adolescents, the present study focused on the advanced step of RED at a microprocess level in order to investigate how youths' response decision making becomes internally consistent, differentiated, and related to concurrent antisocial behavior across childhood and adolescence.

General Discussion

Empirical studies of normative developmental changes in SIP have been few (Orobio de Castro, 2004; Mize & Pettit, in press). In addition, even in studies that have examined longitudinal data, developmental changes in SIP are normally not the scientific impetus (Orobio de Castro, 2004). For these and other reasons, scientists have increasingly been calling for studies that utilize longitudinal data to examine the relation of social cognition and antisocial behavior across time (e.g., Crick & Dodge, 1994; Fontaine, 2006a, 2007; Fontaine & Dodge, 2006; Egan, Monson, & Perry, 1998; Musher-Eizenman et al., 2004). In response, the present studies examined the development of aggressive and nonaggressive response decision-making and externalizing behavior problems in a sample of 585 boys and girls across childhood (Study 1) and adolescence (Study 2).

Overall findings in Study 1 suggested that, although RED is internally consistent by kindergarten, at no time during childhood was RED found to be related to conduct problem behaviors. In the earliest of school years, children appear to have a general response style, by which they evaluate different types of behaviors similarly across contexts (i.e., some children may evaluate aggressive and nonaggressive responses favorably, whereas others assess both types of responses less favorably). By Grade 3, though, differentiation of RED processing of alternative responses emerged, marked by a negative correlation of aggressive and nonaggressive RED.

In Study 2, our assessment of specific domains of RED processing—that is, response efficacy, emotional outcome expectancy, and social outcome expectancy—showed that a negative correlation of aggressive and nonaggressive RED persisted throughout adolescence. RED was represented as a multi-process construct and hypothesized RED domains were empirically differentiated. In addition, across all RED domains, RED was strongly associated with

antisocial behavior, providing support for the notion that, although RED may not play a strong role in social functioning in childhood, its potential role in adolescent antisocial conduct is notable. Finally, Study 2 findings suggested that by Grade 11, adolescents' antisocial functioning, at both social cognitive and behavioral levels, declines.

Collectively, these findings are important to understanding the development of SIP, and, more specifically, RED, in childhood and adolescence, and the contribution that evaluating alternative types of responses to situations that pose social challenges may have in one's social and behavioral maturation. In addition, findings support the SIP hypothesis that advanced steps of processing not only become more developed and relevant as children enter and continue through adolescence, but become may account for social cognitive and behavioral variability in ways that are important to understanding how adolescents make decisions in real time to enact certain behaviors over others. In this way, findings provide a critical step toward understanding the relevance and differentiation of RED as a multi-process construct in youth antisocial development.

In general, empirical study of the development of social information processing has been limited (Crick & Dodge, 1994; Mize & Pettit, in press). Although various issues related to the development of RED have received notable theoretical attention in recent years (e.g., Fontaine, 2008; Fontaine & Dodge, 2006), the role of development in children's and adolescents' evaluative judgments and decisions about alternative social behaviors remains in similar need of empirical examination. Scientific examination of the emergence, maturation, and differentiation of RED is critical not only to the specific interest of understanding a step of SIP that appears to be critical in adolescence, but to the general interest of better understanding the development of executive function, including moral judgment and reasoning.

Much empirical inquiry in moral development, exemplified by research guided by moral domains models in the Piagetian tradition (1965), has focused on social cognitive development. In contrast, much SIP research has been focused on the role of social cognitive operating in the development of social competence and aggressive behavior (for further discussion, see Arsenio & Lemerise, 2004; Dodge & Rabiner, 2004). Critical to the scientific study of moral development, though, are investigations that examine various aspects of moral development (i.e., social cognition and behavior) simultaneously across time. In this way, the studies reported herein may serve as a framework by which subsequent investigations that focus specifically on moral evaluation, decision making, and behavior may assess and analyze the emergence and development of children's on-line response judgments and decisions in situations that are unclear as to their moral implications (i.e., ambiguous provocations).

Limitations

Some limitations of this investigation should be recognized. First, this study was based on early conceptualizations of the response decision step of social information processing theory (see Crick & Dodge, 1994; Dodge, 1986; Mize & Pettit, in press). Early models of RED did not capture the range of processes that recent scholarship attributes to this level of SIP functioning (Fontaine & Dodge, 2006). As a result, this study did not assess multiple RED processes that may be critical to a complete test of the development of RED and its relation to antisocial behavior. This point is particularly valid with respect to the child assessments, as only one RED question was administered to participants during the first for years of this study. The response valuation question may not attend to response decision making processes that may be relevant to children's social cognitive processing and aggressive conduct during early school years. Although additional RED questions were asked of participants during adolescence, a fuller range of RED processes was not assessed until Grade 11, leaving certain questions about RED development and differentiation unanswerable at present.

Second, this study may have benefited from administering a consistent set of RED questions across all youth years. As Orobio de Castro and his colleagues found, it is difficult to compare data from studies of different age groups and the inconsistent patterns that emerge pose problems for interpretation (Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). The response valuation question, assessed in childhood (kindergarten through Grade 3, in Study 1) was not assessed during adolescence, which limited our ability to assess developmental issues with respect to general RED processing of aggressive versus nonaggressive responses. Similarly, the RED questions that were asked across adolescent assessment waves (Grades 8 and 11, in Study 2), representing specific RED domains, had not been asked during child years. As a result, whereas both Studies 1 and 2 were longitudinal, differences in their respective methodologies limited our ability to interpret developmental patterns of results to doing so within each study.

Third, this study may be improved by timing assessment waves evenly across youth years or, at least, assessing RED and behavior more regularly after Grade 3. This study began by assessing RED and antisocial behavior on a yearly basis, which we believe was necessary due to the rapid growth in psychological functioning and social cognitive skills, more specifically, that occurs in children during these early school years. However, assessing RED and behavior on a biyearly basis after Grade 3 may have allowed us to more comprehensively answer developmental questions about RED and the relation between RED and antisocial behavior with respect to later childhood and adolescence.

Another limitation is the correlational nature of the research design, which restricts the certainty of conclusions about the role of RED in causing antisocial behavior outcomes. Future research that utilizes an experimental design may be informed by findings from the present set of studies, including the developmental window during which manipulation of youths' RED processing may be worth examining. Clearly, both types of investigation are critical to a more conclusive developmental picture.

Finally, it should be recognized that participants' responses in the RED assessment may reflect processes other than on-line evaluative judgments of alternative behaviors. Participants' ratings may reflect their evaluations of videotaped responses, the social acceptability of the different types of behaviors shown, or how they would expect that they would judge such behaviors if they were engaged in similar interpersonal situations in the future. As such, findings should be interpreted in light of these alternative meanings.

Future Directions for Basic Science

Some future directions for research stem directly from the limitations discussed in the previous section. For example, future studies of the development of RED may be guided by more recent, comprehensive models of RED processing, as discussed by Fontaine and Dodge (2006), assess the same set of RED domains across time, and measure RED and antisocial behavior more regularly across child and adolescent years. These adjustments may provide future studies with a greater potential to answer complicated developmental questions about the onset and differential maturation of RED domains during childhood.

However, other research directions more specifically follow from findings of the present study. For example, investigations of moral cognitive development in children may examine the degrees to which children are able to account for moral differences in alternative responses during provocation and other types of challenging and potentially stressful and threatening social interactions. One empirical question that remains unanswered involves when children become able to evaluate the degrees to which alternative responses are excusable and justifiable, given certain perceptions of benign, ambiguously provocative, and unambiguously provocative cues. Another developmental question asks when children begin to evaluate

alternative responses across multiple domains, and what domains may be included in children's developing pool of evaluative domains.

Other research may investigate the degree to which RED accounts for variability in nonaggressive maladaptive outcomes, such as internalizing patterns that involve anxious and depressive problems (e.g., low self-esteem and loneliness) and passive and avoidant behavioral problems. Research has suggested that SIP theory is useful in accounting for individual differences in internalizing problems (e.g., Garber, Quiggle, Panak, & Dodge, 1991; Ingram, 1984; Quiggle, Garber, Panak, & Dodge, 1992), but no studies have examined the role of RED in the development of this form of maladjustment. Specifically, future studies may assess children's and adolescents' response decision making with respect to responses of withdrawal and submission in order to discern the role of RED in the development of internalizing problems and mood disorders.

Future Directions for Intervention

Findings from the present study may have considerable relevance for prevention and clinical intervention. At the prevention level, children might be taught social-cognitive skills by which they can more positively evaluate and appreciate nonaggressive/competent responses to provocation situations and realize the negative aspects and consequences of aggressive retaliation and, more generally, acting in antisocial ways. In addition, children may become more behaviorally comfortable and skilled by practicing nonaggressive/competent behaviors during provocative and hostile social interactions, both with peers and adults. Learning these social cognitive and behavioral skills during early school years appears to be critical as it is during these years that present findings suggest RED plays less of a role in the child's developing antisocial behavioral style.

At the intervention level, the same principles may be applied. However, antisocial behavior has been demonstrated to be particularly stable during adolescence (Adams, Bukowski, & Bagwell, 2005; Loeber & Hay, 1997; Olweus, 1979), so the clinician's expectation as to the degree to which behavioral change will take place should be kept in perspective. Cognitive behavioral treatments that incorporate strong behavioral decision making and social-behavioral role playing components, though, may be relatively more effective. Of course, these are empirical questions that should be tested via experimental intervention science.

Conclusion

The present set of longitudinal studies represents the first to examine relations between executive function processes (i.e., alternative response evaluation and decision making) and externalizing conduct problems across both childhood and adolescence. Findings support a developmental model that posits that as RED becomes more internally consistent and differentiated over time, its association with antisocial behavior grows. These developmental trends may have important implications for social cognitive theory of aggression, as well as clinical intervention, as is herein discussed.

References

Achenbach, TM. Integrative guide for the 1991 CBCL/4–18, YSR, and TRF profiles. Burlington, VT: University of Vermont Department of Psychiatry; 1991a.

Achenbach, TM. Manual for the Child Behavior Checklist/4–18 and 1991 Profile. Burlington: University of Vermont Department of Psychiatry; 1991b.

Achenbach, TM. Manual for the Teacher's Report Form and 1991 Profile. Burlington: University of Vermont Department of Psychiatry; 1991c.

Achenbach, TM. Manual for the Youth Self-Report and 1991 Profile. Burlington: University of Vermont Department of Psychiatry; 1991d.

Adams RE, Bukowski WM, Bagwell C. Stability of aggression during early adolescence as moderated by reciprocated friendship status and friend's aggression. International Journal of Behavioral Development 2005;29:139–145.

Ardila A, Rosselli M. Development of language, memory, and visuospatial abilities in 5- to 12-year-old children using a neuropsychological battery. Developmental Neuropsychology 1994;10:97–120.

Arsenio WF, Lemerise EA. Aggression and moral development: Integrating social information processing and moral domain models. Child Development 2004;75:987–1002. [PubMed: 15260859]

Astor RA. Children's moral reasoning about family and peer violence: The role of provocation and retribution. Child Development 1994;65:1054–1067.

Bandalos DL. The effects of item parceling on goodness-of-fit and parameter estimates in structural equation modeling. Structural Equation Modeling 2002;9:78–102.

Bandalos, DL.; Finney, SJ. Item parceling issues in structural equation modeling. In: Marcoulides, GA.; Schumacker, RE., editors. Advanced structural equation modeling: New development and techniques in structural equation modeling. Mahwah, New Jersey: Lawrence Erlbaum Associates; 2001.

Bandura A. Self efficacy: Toward a unifying theory of behavioral change. Psychological Review 1977;84:191–215. [PubMed: 847061]

Bandura A. Self-efficacy mechanism in human agency. American Psychologist 1982;37:122–147.

Becker, GS. The economic approach to human behavior. Chicago: University of Chicago Press; 1978.

Case R. The role of the frontal lobes in the regulation of cognitive development. Brain and Cognition 1992;20:51–73. [PubMed: 1389122]

Cauffman E, Steinberg L. (Im)maturity of judgment in adolescence: Why adolescents may be less culpable than adults. Behavioral Sciences and the Law 2000;18:741–760. [PubMed: 11180420]

Cobb, NJ. Adolescence: Continuity, change, and diversity. Mountain View, CA: Mayfield Publishing Co.; 1992.

Crick NR, Dodge KA. A review and reformulation of social information-processing mechanisms in children's social adjustment. Psychological Bulletin 1994;115:74–101.

Crick NR, Ladd G. Children's perceptions of the consequences of aggressive behavior: Do the ends justify being mean? Developmental Psychology 1990;26:612–620.

Cuddy ME, Frame C. Comparison of aggressive and nonaggressive boys' self-efficacy and outcome expectancy beliefs. Child Study Journal 1991;21:135–151.

Davis-Kean, PE.; Huesmann, LR.; Collins, WA.; Welland, JB.; Bates, JE.; Lansford, JE. Changes in the relation of beliefs and behaviors during middle childhood. 2007. Manuscript submitted for publication

De Luca CR, Wood SJ, Anderson V, Buchanan J, Proffitt TM, Mahony K, et al. Normative data from the Cantab. I: Development of executive function over the lifespan. Journal of Clinical and Experimental Neuropsychology 2003;25:242–254. [PubMed: 12754681]

Dodge, KA. A social information processing model of social competence in children. In: Perlmutter, M., editor. The Minnesota symposia on child psychology: Vol. 18. Cognitive perspectives on children's social and behavioral development. Hillsdale, NJ: Erlbaum; 1986. p. 77-125.

Dodge KA, Bates JE, Pettit GS. Mechanisms in the cycle of violence. Science 1990;250:1678–1683. [PubMed: 2270481]

Dodge, KA.; Coie, JD.; Lynam, D. Aggression and antisocial behavior in youth. In: Damon, W.; Eisenberg, N., editors. Handbook of child psychology: Vol. 3. Social, emotional, and personality development. 6th ed.. New York: Wiley; 2006. p. 719-788.(Series Ed.) (Vol. Ed.)

Dodge KA, Lansford JE, Burks VS, Bates JE, Pettit GS, Fontaine R, et al. Peer rejection and social information-processing factors in the development of aggressive behavior problems in children. Child Development 2003;74:374–393. [PubMed: 12705561]

Dodge KA, Pettit GS, Bates JE, Valente E. Social information-processing patterns partially mediate the effect of early physical abuse on later conduct problems. Journal of Abnormal Psychology 1995;104:632–643. [PubMed: 8530766]

Dodge KA, Price JM. On the relation between social information-processing and socially competent behavior in early school-aged children. Child Development 1994;65:1385–1397. [PubMed: 7982356]

Dodge KA, Rabiner DL. Returning to roots: On social information processing and moral development. Child Development 2004;75:1003–1008. [PubMed: 15260860]

Egan SK, Monson TC, Perry DG. Social-cognitive influences on change in aggression over time. Developmental Psychology 1998;34:996–1006. [PubMed: 9779745]

Feather, NT. Expectancy-value approaches: Present status and future directions. In: Feather, NT., editor. Expectations and actions: Expectancy-value models in psychology. Hillsdale, NJ: Erlbaum; 1982. p. 395-420.

Flavell, JH.; Miller, PH.; Miller, SA. Cognitive development. 3rd ed.. Upper Saddle River, NJ: Prentice-Hall; 1993.

Fontaine RG. Applying systems principles to models of social information processing and aggressive behavior in youth. Aggression and Violent Behavior 2006a;11:64–76.

Fontaine RG. Evaluative behavioral judgments and instrumental antisocial behaviors in children and adolescents. Clinical Psychology Review 2006b;26:956–967. [PubMed: 16920240]

Fontaine RG. Toward a conceptual framework of instrumental antisocial decision-making and behavior in youth. Clinical Psychology Review 2007;27:655–675. [PubMed: 17350739]

Fontaine RG. On-line social decision making and antisocial behavior: Some essential but neglected issues. Clinical Psychology Review 2008;28:17–35. [PubMed: 17916400]

Fontaine RG, Burks VS, Dodge KA. Response decision processes and externalizing behavior problems in adolescents. Development and Psychopathology 2002;14:107–122. [PubMed: 11893088]

Fontaine RG, Dodge KA. Real-time decision making and aggressive behavior in youth: A heuristic model of response evaluation and decision (RED). Aggressive Behavior 2006;32:604–624.

Fontaine, RG.; Dodge, KA. The transactional development of individual social-information processing and aggressive behavior. In: Sameroff, AJ., editor. Transactional development: Operationalizing a dynamic system. Washington, DC: American Psychological Association; (in press)

Fried CS, Reppucci ND. Criminal decision making: The development of adolescent judgment, criminal responsibility, and culpability. Law and Human Behavior 2001;25:45–61. [PubMed: 11276861]

Garber, J.; Quiggle, NL.; Panak, W.; Dodge, KA. Aggression and depression in children: comorbidity, specificity, and cognitive processing. In: Cicchetti, D.; Toth, S., editors. Rochester symposium on developmental psychopathology: Vol. 2. Internalizing and externalizing expressions of dysfunction. Hillsdale, NJ: Erlbaum; 1991. p. 225-264.

Hollingshead, AA. Four-factor index of social status. New Haven, CT: Yale University; 1979. Unpublished manuscript

Huesmann, LR. The role of social information processing and cognitive schema in the acquisition and maintenance of habitual aggressive behavior. In: Geen, RG.; Donnerstein, E., editors. Human aggression: Theories, research, and implications for social policy. San Diego, CA: Academic Press; 1998. p. 73-109.

Ingram RE. Toward an information-processing analysis of depression. Cognitive Therapy and Research 1984;8:443–477.

Keating, DP. Thinking processes in adolescence. In: Adleson, J., editor. Handbook of Adolescent Psychology. New York: Wiley; 1980. p. 211-246.

Keating, DP. Cognitive and brain development. In: Lerner, RJ.; Steinberg, LD., editors. Handbook of Adolescent Psychology. 2nd ed.. New York: Wiley; 2004. p. 45-84.

Lansford JE, Malone PS, Dodge KA, Crozier JC, Pettit GS, Bates JE. A 12-year prospective study of patterns of social information processing problems and externalizing behaviors. Journal of Abnormal Child Psychology 2006;34:709–718.

Loeber R, Hay D. Key issues in the development of aggression and violence from childhood to early adulthood. Annual Review of Psychology 1997;48:371–410.

Luciana M, Nelson CA. The functional emergence of prefrontally-guided working memory systems in four- to eight-year-old children. Neuropsychologia 1998;36:273–293. [PubMed: 9622192]

McDonald, RP. Test theory: A unified treatment. Mahwah, New Jersey: Lawrence Erlbaum Associates; 1999.

Miller D, Byrnes J. The role of contextual and personal factors in children's risk taking. Developmental Psychology 1997;33:814–823. [PubMed: 9300214]

Mize, J.; Pettit, GS. Social information-processing and the development of conduct problems in children and adolescents: Looking beneath the surface. In: Sharp, C.; Fonagy, P.; Goodyer, I., editors. Social cognition and developmental psychopathology. Oxford University Press; (in press)

Musher-Eizenman DR, Boxer P, Danner S, Dubow EF, Goldstein SE, Heretick DML. Social-cognitive mediators of the relation of environmental and emotion regulation factors to children's aggression. Aggressive Behavior 2004;30:389–408.

Muthén, LK.; Muthén, BO. *M*plus User's Guide. Los Angles, CA: Muthén & Muthén; 1998–2006.

Newsom JT. A multilevel structural equation model of dyadic data. Structural Equation Modeling 2002;9:431–447.

Olweus D. Stability of aggressive patterns in males: A review. Psychological Bulletin 1979;86:852–875. [PubMed: 482487]

Orobio de Castro B. The development of social information processing and aggressive behaviour: Current issues. European Journal of Developmental Psychology 2004;1:87–102.

Orobio de Castro B, Veerman JW, Koops W, Bosch JD, Monshouwer HJ. Hostile attribution of intent and aggressive behavior: A meta-analysis. Child Development 2002;73:916–934. [PubMed: 12038560]

Perry DG, Perry LC, Rasmussen P. Cognitive social learning mediators of aggression. Child Development 1986;57:700–711. [PubMed: 3720399]

Pettit GS, Bates JE, Dodge KA. Supportive parenting, ecological context, and children's adjustment. Child Development 1997;68:908–923.

Piaget, J. The child's conception of the world. New York: Harcourt, Brace; 1929.

Piaget, J. The moral judgment of the child. New York: Free Press; 1965.

Quiggle NL, Garber J, Panak WF, Dodge KA. Social information processing in aggressive and depressed children. Child Development 1992;63:1305–1320. [PubMed: 1446554]

Séguin, JR.; Zelazo, PD. Executive function in early physical aggression. In: Tremblay, RE.; Hartup, WW.; Archer, J., editors. Developmental origins of aggression. NY: Guilford; 2005. p. 307-329.

Steinberg L. Cognitive and affective development in adolescence. Trends in Cognitive Sciences 2005;9:69–74. [PubMed: 15668099]

Steinberg L, Cauffman E. Maturity of judgment in adolescence: Psychosocial factors in adolescent decisionmaking. Law and Human Behavior 1996;20:249–272.

Traub, RE. Reliability for the social sciences. Thousand Oaks, CA: Sage; 1994.

Tremblay RE, Nagin DS, Séguin JR, Zoccolillo M, Zelazo PD, Boivin M, et al. Physical aggression during early childhood: Trajectories and predictors. Canadian Child and Adolescent Psychiatry Review 2005;14:3–9. [PubMed: 19030494]

Weiss B, Dodge KA, Bates JE, Pettit GS. Some consequences of early harsh discipline: Child aggression and a maladaptive social information processing style. Child Development 1992;63:1321–1335. [PubMed: 1446555]

Wells, KC. Rating scales. In: Sholevar, GP., editor. Conduct disorders in children and adolescents. Washington, DC: American Psychiatric Publishing, Inc.; 1995.

Zelazo, PD.; Müller, U. Executive function in typical and atypical development. In: Goswami, U., editor. Handbook of childhood cognitive development. Oxford: Blackwell; 2002. p. 445-469.

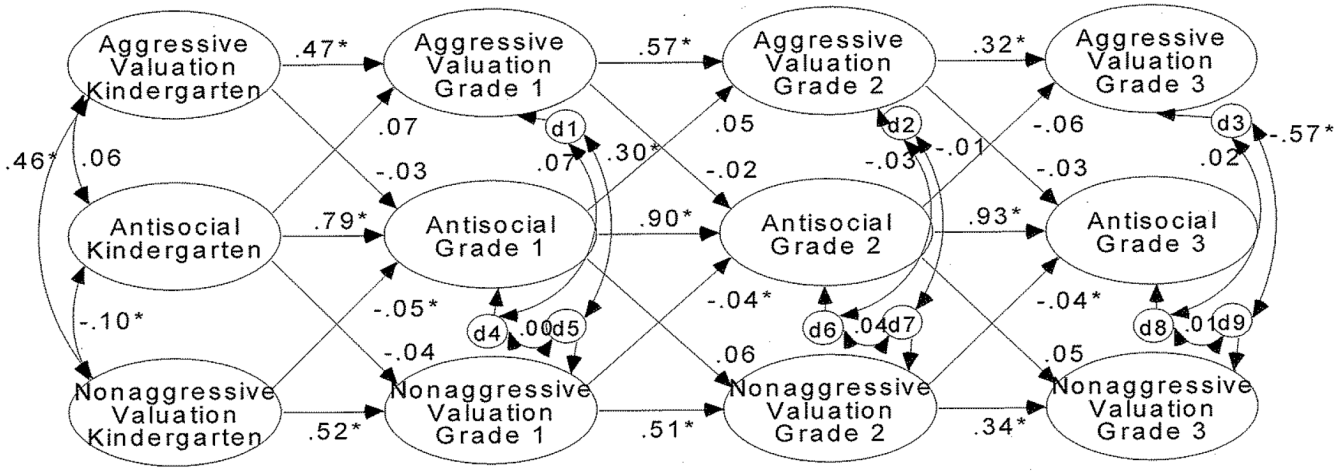

Figure 1.
Cross-lagged model of aggressive RED, nonaggressive RED, and antisocial behavior constructs in childhood.

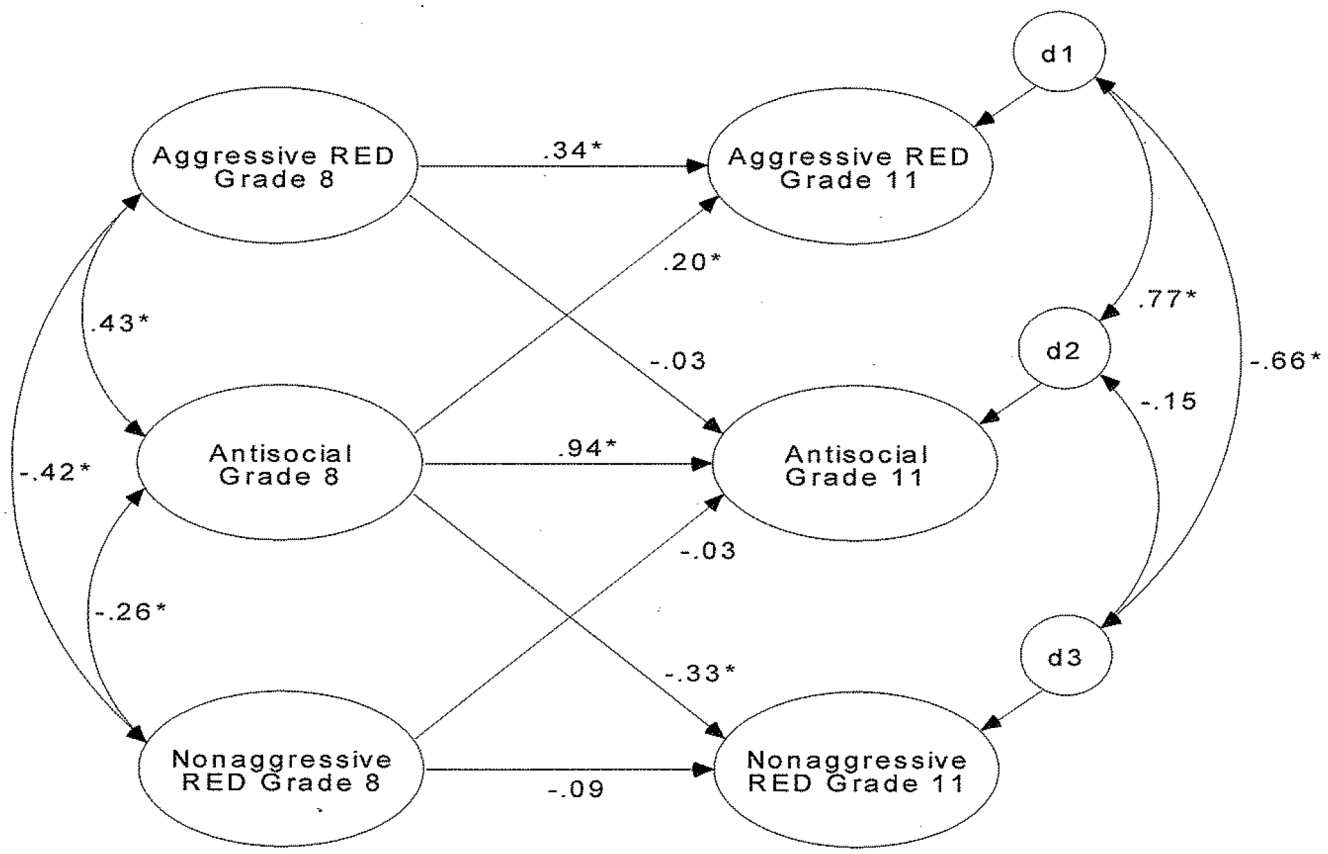

Figure 2.
Cross-lagged model of aggressive RED, nonaggressive RED, and antisocial behavior constructs in adolescence.

Table 1

Measurement properties of aggressive and nonaggressive RED constructs in childhood, reliability, and model fit indices

Grade	Kindergarten		Grade 1		Grade 2		Grade 3	
Item /Vignette #	Aggr	Nonaggr	Aggr	Nonaggr	Aggr	Nonaggr	Aggr	Nonaggr
1	.47	.44	.59	.57	.62	.57	.74	.56
2	.61	.51	.67	.55	.75	.64	.71	.85
3	.55	.40	.69	.59	.72	.54	.77	.70
4	.64	.54	.66	.59	.70	.58	.78	.71
5	.69	.57	.77	.60	.73	.55	.82	.70
6	.66	.48	.74	.58	.77	.57	.80	.54
7	.73	.51	.75	.62	.73	.56	.63	.36
8	.63	.63	.69	.63	.75	.64	.71	.39
9	.72	.60	.70	.57	.79	.39	.85	.47
10	.74	.70	.71	.65	.77	.55	.80	.62
11	.71	.66	.75	.69	.76	.66	.72	.78
12	.67	.64	.74	.67	.72	.69	.86	.85
13	.64	.65	.76	.58	.77	.59	.86	.78
14	.72	.62	.72	.52	.81	.60	.77	.70
15	.69	.58	.78	.65	.78	.58	.68	.40
16	.75	.64	.73	.67	.77	.67	.77	.71
17	.71	.65	.80	.62	.80	.58	.73	.37
18	.66	.65	.80	.70	.79	.76	.76	.70
19	.63	.58	.76	.68	.68	.66	.47	.44
20	.72	.69	.75	.64	.72	.67	.77	.75
21	.65	.63	.77	.71	.62	.73	.80	.83
22	.68	.67	.73	.71	.77	.71	.77	.86
23	.67	.56	.75	.56	.71	.49	.60	.55
24	.62	.58	.75	.74	.70	.67	.59	.50
Reliability ω	.95	.93	.97	.94	.97	.94	.97	.94

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Grade	Kindergarten		Grade 1		Grade 2		Grade 3	
Item /Vignette #	Aggr	Nonaggr	Aggr	Nonaggr	Aggr	Nonaggr	Aggr	Nonaggr
Model Fit	χ^2 = 671.87 df = 197 p < .01 CFI = .86 TLI = .95 RMSEA = .06		χ^2 = 487.81 df = 135 p < .01 CFI = .90 TLI = .96 RMSEA = .06		χ^2 = 335.13 df = 124 p < .01 CFI = .94 TLI = .97 RMSEA = .06		χ^2 = 581.95 df = 102 p < .01 CFI = .92 TLI = .95 RMSEA = .09	

Note: Aggr = Aggressive RED, Nonagg = Nonaggressive RED

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Table 2

Zero order intercorrelations of RED and antisocial constructs from kindergarten through Grade 3

	AntiSoc K	**AntiSoc G1**	**AntiSoc G2**	**AntiSoc G3**	**ARED K**	**ARED G1**	**ARED G2**	**ARED G3**	**NRED K**	**NRED G1**	**NRED G2**	**NRED G3**
AntiSoc K	1.00											
AntiSoc G1	.81**	1.00										
AntiSoc G2	.76**	.99**	1.00									
AntiSoc G3	.65**	.86**	.99**	1.00								
ARED K	.06	−.02	−.03	−.01	1.00							
ARED G1	.09	.08	.07	−.04	.44**	1.00						
ARED G2	.09	.06	.06	.03	.36**	.56**	1.00					
ARED G3	−.02	−.01	−.04	−.04	.17**	.29**	.33*	1.00				
NRED K	−.10*	−.15*	−.26**	−.22**	.48**	.25**	.12*	.12*	1.00			
NRED G1	−.09	−.15*	−.18**	−.07	.10	.29**	.08	.09	.54**	1.00		
NRED G2	−.04	.02	−.02	−.03	.07	.13*	.05	−.02	.35**	.55**	1.00	
NRED G4	.08	.04	.01	.03	−.06	−.05	−.06	−.53**	.02	.10	.32**	1.00

Note: AntiSoc = Antisocial, ARED = Aggressive RED, NRED = Nonaggressive RED, K-kindergarten, G1 = Grade 1, G2 = Grade 2. G3 = Grade 3.

Table 3

Measurement model structure of aggressive and nonaggressive RED constructs in adolescence

Item/ Vignette	Standardized Factor Loadings: Aggressive						Standardized Factor Loadings: Nonaggressive					
	Grade 8			Grade 11			Grade 8			Grade 11		
	RE	EOE	SOE	RE	EOE	SOE	RE	EOE	SOE	RE	EOE	SOE
1	.42	.54	.51	.70	.67	.63	.54	.38	.45	.56	.55	.68
2	.66	.66	.59	.79	.77	.71	.35	.43	.39	.60	.66	.70
3	.64	.64	.67	.77	.77	.73	.61	.58	.67	.74	.75	.80
4	.78	.74	.63	.74	.78	.70	.56	.52	.61	.70	.74	.78
5	.70	.69	.64	.61	.71	.64	.44	.48	.53	.63	.67	.76
6	.72	.61	.71	.76	.65	.75	.58	.64	.68	.62	.78	.79
Reliability ω	.82	.81	.79	.87	.87	.85	.69	.67	.73	.81	.85	.89

Table 4

Zero order intercorrelations of RED and antisocial constructs at Grade 8 and Grade 11

	AntiSoc G8	AntiSoc G11	ARED G8	ARED G11	NRED G8	NRED G11
AntiSoc G8	1.00					
AntiSoc G11	.93**	1.00				
ARED G8	.40**	.39**	1.00			
ARED G11	.30**	.53**	.57**	1.00		
NRED G8	−.25**	−.30**	−.41**	−.32**	1.00	
NRED G11	−.28**	−.32**	−.41**	−.70**	.10	1.00

Note: AntiSoc = Antisocial, ARED = Aggressive RED, NRED = Nonaggressive RED, G8 = Grade 8, G11 = Grade 11.