

The Interactive Influences of Friend Deviance and Reward Dominance on the Development of Externalizing Behavior During Middle Adolescence

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Abstract This study investigated the interactive effects of friend deviance and reward dominance on the development of externalizing behavior of adolescents in the Child Development Project. Reward dominance was assessed at age 16 by performance on a computer-presented card-playing game in which participants had the choice of either continuing or discontinuing the game as the likelihood of reward decreased and the likelihood of punishment increased. At ages 14 and 16, friend deviance and externalizing behavior were assessed through self-report. As expected, based on motivational balance and response modulation theories, path analysis revealed that age 14 friend deviance predicted age 16 externalizing behavior controlling for age 14 externalizing behavior. Reward dominance was a significant moderator of the relationship between friend deviance and externalizing behavior. The contributions of deviant friends to the development of externalizing behavior were enhanced by adolescents' reward dominance.

Keywords Externalizing · Adolescence · Peers · Behavior problems · Adjustment · Friendship

Advances in the understanding of the origins of aggressive behavior and delinquency are of societal importance. One advance involves improved understanding of the etiological role of deviant peers (Dishion, McCord, & Poulin, 1999; Dishion, Spracklen, Andrews, & Patterson, 1996). Another advance involves improved understanding of the role of individual dispositions in impulsivity (Olson, Schilling, & Bates, 1999). Increasingly, theory and research have advanced by considering possible interactions between individual dispositions and environmental factors (Bates, Pettit, Dodge, & Ridge, 1998; Lynam et al., 2000; O'Connor & Dvorak, 2001; Pettit, Bates, Dodge, & Meece, 1999; Prinzie et al., 2003; Wills, Sandy, & Yaeger, 2002).

From an interactional perspective, externalizing behavior problems develop in a system of mutually dependent influences rather than functionally isolated ones (Hinshaw, 2002). An individual disposition can serve as a protective, neutral, or risk factor, depending on its relations with the biological, dispositional, and social-contextual factors with which it co-exists. Wachs (2000) has extensively argued the centrality of the concept of functional interdependence between individual and environment. Neither influence in isolation can sufficiently explain developmental process.

Previous research has shown that both individual differences in reward dominance and deviant friendships, considered separately, are related to adolescents' externalizing behavior. The current study, however, may be the first to ask whether reward dominance moderates the developmental link between deviant friend groups and externalizing behavior.

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Reward dominance

Disinhibition is a heterogeneous concept with important links to many forms of psychopathology. The concept has both personality/temperament and cognitive/information processing elements (Nigg, 2000). We define disinhibition and infer trait-like cognitive and motivational properties from its behavioral manifestations. Disinhibition describes a failure to pause and reflect, and a consequent tendency to repeat a previously rewarded behavior after the behavior no longer produces reward but instead produces punishment (Patterson & Newman, 1993). According to Newman and Wallace (1993), greater sensitivity to reward than to punishment, or reward dominance, is one of several factors that reduce the likelihood of interrupting goal-directed behavior to evaluate its potential negative consequences. The ability to interrupt goal-directed behavior in response to peripheral information that contraindicates one's goal-directed behavior is important for regulating impulsive behavior. This ability enables a person to evaluate the suitability of the behavior in the immediate situation and to associate the behavior with punishment and other forms of negative feedback so that it is more likely to be inhibited in the future. Conversely, a failure to pause and reflect interferes with such learning and leads to overestimation of the positive consequences and underestimation of the negative consequences produced by a given behavior. This reward dominance increases the likelihood that an individual will repeat his or her reward-seeking behavior in future situations, even if it is maladaptive.

According to Gray (1991), reward dominance reflects the prevailing influence of the behavioral activation system (BAS) over the behavioral inhibition system (BIS). The BAS and BIS are relatively independent circuits of the brain that process and generate responses to motivational cues, and aberrations in the balance of these systems contribute to individual differences in behavior under motivational conditions that involve choices with a mixture of negative and positive consequences. Although attempts have been made to discriminate between BAS and BIS influences on behavior, (e.g. BIS/BAS scales; Carver & White, 1994), it sometimes may be advantageous to measure the overall balance of these systems given the joint presence of both inhibitory and anticipatory cues, and subsequently, the joint involvement of the BAS and BIS, in most natural environments.

The card perseveration (CP) task (Newman, Patterson, & Kosson, 1987) has been a popular tool for measuring impulsive behavior. It is designed to assess an individual's ability to adjust a previously rewarded behavioral response to a decreasing rate of reward and increasing rate of punishment. The simplicity of the task, the evolving contingency pattern, the standardization of rewards and punishments, and the minimal instructions are intended to capture individuals' dispositional response to changes in probabilities of pun-

ishment and reward. It is not clear to what degree CP task performance is uniquely influenced by BIS or BAS activity. We speculate that performance reflects their joint contribution, which may differ substantially between individuals. The advantage of using a task such as the CP task rather than a questionnaire is the avoidance of reporting bias.

Using the CP task and similar decision-making tasks, numerous studies have demonstrated a relationship between reward dominance (continued card playing in the face of increasing punishment) and externalizing forms of maladjustment. These studies have differentiated adult psychopaths, adolescents with psychopathic tendencies, and oppositional defiant and conduct disordered children and adolescents from normal controls (Fisher & Blair, 1998; Fonseca & Yule, 1995; Matthys, Van Goozen, Vries, Cohen-Kettenis, & Van Engeland, 1998; Newman & Kosson, 1986; Newman, Patterson, Howland, & Nichols, 1990; Newman et al., 1987; Newman & Schmitt, 1998; O'Brien & Frick, 1996; Séguin, Arseneault, Boulerice, Harden, & Tremblay, 2002; Shapiro, Quay, Hogan, & Schwartz, 1988; Thornquist & Zuckerman, 1995; van Goozen et al., 2004).

Studies utilizing the CP and related tasks have focused primarily on reward dominance among males. This trend may in part be due to research showing that the relationship between performance on these tasks and disordered conduct is less consistent for females. In contrast to findings for males, incarcerated females scoring high on a measure of psychopathy did not play more cards on the CP task than nonpsychopathic incarcerated females (Vitale & Newman, 2001). Similarly, adolescent girls from the current sample who scored high on a measure of psychopathy did not persevere on another laboratory measure of impulsivity, the passive avoidance task (Vitale et al., 2005). In addition, Hartung, Milich, Lynam, and Martin (2002) found a relationship between conduct disorder symptoms during adolescence (mean age 15 years) and performance on the passive avoidance task for males only. Hartung et al. suggested that reward dominant behavior may be related to impulsivity among both girls and boys, yet may be less central to the development of externalizing behavior for girls than for boys. In short, there is mounting evidence that differences in reward dominance on the CP task and related tasks are associated with conduct problems. However, there may be other factors, such as gender, that moderate this link or contribute to conduct problems separately from reward dominance.

Friend deviance

Relationships with antisocial peers are associated with the emergence of externalizing behavior (Elliott, Huizinga, & Ageton, 1985; Laird, Jordan, Dodge, Pettit, & Bates, 2001;

Lansford, Criss, Pettit, Dodge, & Bates, 2003; Simons, Wu, Conger, & Lorenz, 1994), especially when these relationships are close friendships (Huey, Henggeler, Brondino, & Pickrel, 2000; Laird, Pettit, Dodge, & Bates, 1999; Morgan & Grube, 1991). This association may result both from friends' deviance causing increased antisocial behavior and one's own externalizing behavior tendencies resulting in the formation of deviant friendships (Deater-Deckard, 2001). In the present study, we are most interested in the former process, but we consider the latter in our analysis.

According to deviancy training theory (Dishion, Eddy, Haas, Li, & Spracklen, 1997; Dishion et al., 1996), deviant friend groups provide selective, positive reinforcement for deviant behavior. Dishion and colleagues (1996), studying pairs of fourteen-year-old boys, observed deviant friend dyads providing positive verbal and nonverbal affective responses for deviant talk, but not for normative talk. In contrast, nondeviant and mixed friend dyads rewarded normative, but not deviant talk. Moreover, friends' positive responses resulted in an increase in the preceding kind of behavior, and non-responses led to a reduction of the preceding behavior. Observed rates of deviant talk were linked not only to concurrent levels of antisocial behavior (Dishion, Andrews, & Patterson, 1990), but also to antisocial behavior 2 years after the assessment of peer deviancy training (Dishion et al., 1996).

Exploring an interactive relationship between reward dominance and friend deviance

The current study's primary goal was to investigate whether friend deviance and reward dominance interact to predict externalizing behavior beyond the effects of earlier externalizing behavior. Theoretical accounts and empirical findings have suggested the likelihood of such an interaction. Rothbart and Bates (1998) pointed out that individual differences in susceptibility to punishment and reward could affect the way in which individuals respond to social cues. They explained that identical social cues could be interpreted and acted on in different ways depending on one's motivational sensitivities, and that these individual differences could influence long-term social development. Likewise, Derryberry and Reed (1994) argued that a child's internal motivational states may serve to organize the meaning of social experiences.

Research findings support the idea that reward dominance may influence one's interpretation and response to social events. Lynam and colleagues (2000) found that impulsivity, as assessed with a battery that included the CP task, had a stronger relationship to juvenile offending in poor neighborhoods than in more affluent neighborhoods. Lynam and colleagues suggested that their finding was due to poor neighborhoods' lack of external constraints on the behavior of

those with limited internal control. This difference in external control may have been expressed in between-neighborhood differences in reward and punishment contingencies (Beyers, Bates, Pettit, & Dodge, 2003). Poor neighborhoods may have presented greater rewards for antisocial behavior, fewer rewards for prosocial behavior, and fewer punishments for antisocial behavior than affluent neighborhoods. Individuals who were highly responsive to reward may have been especially influenced by this difference.

Hypotheses for the present study

The present study considered the development of externalizing behavior in a moderately large, community sample of youths. On the basis of the empirical evidence and theoretical models described above, we postulated that reward dominant youths would be differentially responsive to the effects of having deviant friends. Youths' reward dominance would increase the power of reward-based deviancy training to cultivate their antisocial behavior and/or reduce the inhibiting effects of the negative consequences of deviant behavior. As a result, not only would reward dominant teens be highly responsive to rewards provided by friends for participating in antisocial behavior, their inability to detect or appropriately process peripheral punishment cues (such as a victim's distress or an authority figure's intervention) would prevent them from inhibiting their antisocial behavior even when these punishments outweigh the rewards. In contrast, we postulated that nonreward dominant youths would be less sensitive to reward and more sensitive to punishment. Thus, for these youths, the rewards that peers provide for antisocial behavior would be less effective in cultivating antisocial behavior, and/or the punishments resulting from deviant behavior would be more effective in inhibiting their antisocial behavior.

Therefore, for the present study, we hypothesized that the relationship between friend deviance and externalizing behavior would be an interactive function of reward dominance on the CP task, with youths who played many cards being more strongly influenced by friend deviance than those who played few cards. In addition, based on findings that the association between reward dominance and externalizing behavior is more apparent for males than females, we expected that the moderating effect of reward dominance would be more evident for males than females.

Method

Participants

This study included adolescent participants of the longitudinal Child Development Project (CDP). A total of 321 teens

Table 1 Descriptive statistics, missingness, and *t*-tests for gender differences

	% Missing	Mean values		Standard deviations		<i>t</i>	Sig. (2-tailed)
		Males	Females	Males	Females		
Number of cards played	32.3	51.51	57.80	24.56	24.97	−2.275	.024
YSR externalizing age 14	29.7	10.25	9.89	6.00	7.15	.493	.622
YSR externalizing age 16	23.2	10.96	11.07	7.00	6.78	−.145	.885
Friend deviance age 14	28.2	1.79	1.79	0.60	0.74	−.023	.982
Friend deviance age 16	20.9	2.22	2.09	0.69	0.70	1.747	.082

(55% of the original CDP sample of 585) had complete data. Complete data for individual measures ranged between 68% and 77% of the original CDP sample (see Table 1). CDP participant families were originally recruited from three cities (Nashville and Knoxville, TN, and Bloomington, IN) during kindergarten preregistration in 1987 and 1988. Data collection began the summer before the participants entered kindergarten (at around age 5), and follow-up collections have been conducted on a yearly basis.

The original CDP sample included 585 children (52% male; 81% European American, 17% African American, and 2% other ethnic groups; 26% living in single parent households). The sample was representative of the three communities in socioeconomic status (median Hollingshead 4-factor score of SES = 38.5), and 26% of the families were classified in the lowest two of the five Hollingshead classes (Pettit, Laird, Dodge, Bates, & Criss, 2001). Non-participation in subsequent years was due primarily to families living too far away to conveniently come to the lab at age 16, lack of interest, or lack of availability. The 321 participants with complete data and the excluded CDP participants did not differ significantly on year 1 (age 5) mother-reported externalizing behavior ($t(565) = .157, p = .877$), year 1 mother-reported attention problems ($t(565) = .611, p = .611$), or year 1 mother-reported unmanageability ($t(554) = .744, p = .457$). However, the subsample had a higher average socioeconomic status than the participants excluded from the current study ($t(568) = 2.190, p = .05$).

Analyses were conducted both on the sample with complete data ($N = 321$) and on the sample with incomplete data included ($N = 585$). The full information maximum likelihood (FIML) procedure was used to accommodate missing data for the latter analysis. Because results from both analyses were equivalent, results from the FIML procedure are presented in the text.¹

¹ FIML produces less biased estimates than listwise deletion when data are not missing completely at random. FIML can also produce biased estimates when data are mistakenly assumed to be missing at random when they are actually missing nonignorable. However, Schafer and Graham (2002) note that in many situations, departures from MAR do not prevent FIML from producing valid estimates.

Procedures and measures

At ages 14 and 16 follow-up interviews and questionnaires were administered to youths, usually at their homes and in the summer. At age 16, typically about 6 months after the main follow-up interview, tasks designed to assess core impulsive tendencies were administered to the youths in laboratory settings.

Measure of reward dominance

Siegel's (1978) card playing (CP) task was adapted by Newman et al. (1987). This is a computer-presented form of the CP task in which participants play cards to win money. In our version, before beginning, participants were told that if a face card was turned over, they would win 25 cents, and if a number card was turned over, they would lose 25 cents. In addition, they were told that they could stop the game at any point and keep their winnings. Although the participants were informed that they were not playing with a normal deck of cards, they were not told that the probability of winning systematically decreased by 10 percent after every 10 cards played. There was a 90% probability of winning when the game began, and a 0% probability of winning when the game ended. Participants began with \$2.50 and won the greatest amount of money (\$7.75) if they quit the game after playing approximately half the cards, before the probability of losing became greater than the probability of winning. If the participants played all 100 cards, they lost all of their winnings, including the \$2.50 with which they began the task. After introducing the task, the examiner limited his or her interaction with the participants to adding or removing quarters from their winnings (which were visible to the participants at all times throughout the game). The CP task was presented on a laptop computer with a 14" display and an attached 2-button response box. Number of cards played was the variable of interest for this study, representing reward dominance.

Although our measure of reward dominance was from only one point in time, at age 16, we assume that it is likely to reflect a relatively stable disposition operating at least from early adolescence onward. Quay (1993) has argued that the CP task performance captures an underlying

reward dominance that is also evident in psychophysiological and biochemical functioning, and Kindlon et al. (1995) have shown temporal stability in CP performance over a 3.5 month period. Although the evidence for temporal stability was modest, Kindlon et al. noted that temporal stability is very difficult to assess in the CP task because participants are likely to remember the overall pattern of rewarded and nonrewarded responses and adjust their behavior accordingly. However, the previously reviewed studies that showed an association between card playing and externalizing behaviors demonstrate external validity and thus provide additional indirect support for a trait interpretation of CP performance.

Ideally, a moderating variable would be assessed concurrent with or prior to the assessment of the variable it is believed to moderate (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). In our case, the moderator was assessed two years after the assessment of the moderated variable. This time lag in assessment had the potential for reducing our ability to detect the moderating influence of reward dominance because youths' reward dominance at age 16 may have changed since age 14, when the effect of friend deviance was believed to be moderated. The time lag in assessment could lead to misinterpretation of the interaction effect, especially if reward dominance was correlated with either the outcome of interest, externalizing behavior, or the variable it was believed to moderate, friend deviance. In our case, reward dominance was not strongly correlated with either variable. We would argue that the loss in measurement fidelity due to the time lag in our measure of friend deviance at age 14 and card playing performance at age 16 worked against our ability to detect moderation, thus making for a more difficult test of our hypotheses, rather than biasing toward the detection of a moderation effect.

Measures of externalizing behavior

The externalizing factor of the Youth Self Report (YSR), including delinquent and aggressive behaviors, was assessed at ages 14 and 16. This empirically derived measure of externalizing behavior has shown adequate levels of reliability and validity (Achenbach, 1991a, b, c), and was internally consistent in our sample (Cronbach's alphas = .87 at both ages).

Measures of friend deviance

The Behavior of Friends Questionnaire (BFQ) was administered at ages 14 and 16. It was designed to assess the delinquent behaviors of the participants' friend groups. Respondents were asked whether the target adolescents' friends use drugs, steal, lie to parents, get in trouble at school, and

get into fights. Responses were based on a five-point scale, ranging from never to very often.

At ages 14 and 16 this measure was completed by the adolescents. Responses to 9 questions were averaged within each year. Alphas for the BFQ scales ranged from .87 to .88. The Pearson correlation between the age 14 and 16 BFQs was .54 ($p < .01$), indicating moderate stability in friend group deviance across this time period.

There were a few differences between the BFQ at age 14 and the BFQ at age 16. The BFQ at age 14 included questions related to friends' antisocial behaviors and nonantisocial leisure activities, but the BFQ at age 16 only included questions related to friends' antisocial behaviors. In addition, the wording of two of the antisocial behavior questions differed between the BFQ at age 14 and the BFQ at age 16. For example, the question related to drinking behavior at age 14 asked "How often do your friends drink beer or wine?," and the question related to drinking behavior at age 16 asked "How often do the kids in your group of friends drink alcohol?" These content differences are not major. However, it is possible that these differences might have biased the estimate of the association between friend deviance at ages 14 and 16. However, because this relationship was not central to our hypotheses, bias in this estimate did not have an effect on our ability to accurately test our primary hypotheses.

Results

Preliminary analyses

Gender differences were examined with *t*-tests (Table 1). Girls played more cards than boys ($t(394) = -2.87$, $p < .01$). In addition, boys scored higher at a trend level on the age 16 BFQ friend deviance measure ($t(325) = 1.730$, $p < .10$). Bivariate correlations were computed between all measures of friend deviance, cards played, and externalizing behavior, separately for boys and girls (Table 2). Measures of externalizing behavior were significantly positively correlated across all years. Measures of friend deviance were also significantly positively correlated across all years. Measures of friend deviance were significantly positively correlated with measures of externalizing behavior across all years.

Path analysis

In order to test the longitudinal effects of the interaction between card playing, friend behavior, and gender, a cross-lagged panel analysis was conducted with Mplus (Muthen & Muthen, 1998) using maximum likelihood estimation with robust standard errors. We were interested in the possibility that youths might select deviant peers in accord with their own externalizing tendencies, and that deviant peers at

Table 2 Bivariate correlations among continuous variables

	1	2	3	4	5
1 Number of cards played	—	.02	.05	-.14	-.08
2 YSR externalizing age 14	-.12	—	.71**	.52**	.43**
3 YSR externalizing age 16	.01	.57**	—	.44**	.56**
4 Friend deviance age 14	-.03	.72**	.43**	—	.54**
5 Friend deviance age 16	.08	.38**	.56**	.53**	—

Note. Results above the diagonal for boys; below for girls.

**Significant at the .001 level (2-tailed).

one age might influence levels of externalizing behavior in youths at a later age. Our analytic approach provided the benefit of simultaneously estimating selection and socialization effects, while taking into consideration both the stability of friend deviance and externalizing behavior across years.

Age 14 friend deviance, age 14 externalizing behavior, and cards played were centered to reduce multicollinearity (Jaccard & Turrisi, 2003). The interactions between cards played and friend deviance and among cards played, friend deviance, and gender were explored by creating multiplicative terms and including them in the cross-lagged model. All tests of the statistical significance of parameter estimates were two-tailed.

The model regressed age 16 externalizing behavior on age 14 externalizing behavior, age 14 friend deviance, age 16 cards played, gender, the interaction between friend deviance and cards played, and the interaction among friend deviance, cards played, and gender. In addition, the model regressed age 16 friend deviance on age 14 friend deviance, age 14 externalizing behavior, age 16 cards played and gender. Finally, the model covaried the predictor variables as well as the criterion variables.

Age 14 externalizing behavior ($\beta = .61$), age 14 friend deviance ($\beta = .11$), and the interaction between age 14 friend behavior and age 16 cards played ($\beta = .12$) were statistically significant predictors of age 16 externalizing behavior ($ps < .05$). Also, cards played was a trend level predictor of age 16 externalizing behavior ($\beta = .06, p = .09$). Age 14 friend deviance ($\beta = .51$) and gender ($\beta = -.10$) were statistically significant predictors of age 16 friend deviance ($ps < .05$). In addition, age 14 externalizing behavior was a trend level predictor of age 16 friend deviance ($\beta = .12, p = .08$). Friend deviance and externalizing behavior were significantly correlated at both age 14 and age 16 ($ps < .001$). The model explained 45.7% of the total variance in age 16 externalizing behavior and 35.7% of the total variance in age 16 friend deviance.²

² Analyses were also conducted using age 15 friend deviance instead of age 14 friend deviance as a predictor of age 16 externalizing behavior. The results of this analysis were equivalent to those reported for age 14

The procedure described by Jaccard and Turrisi (2003) was used to better understand the interaction between friend deviance and cards played. This procedure involved estimating the effect of friend deviance on externalizing behavior for youths who were punishment-dominant (playing a low number of cards), nonreward dominant (playing a moderate number of cards), and reward dominant (playing a high number of cards). The model as previously estimated, with cards played centered at its mean (54.54 cards), provided an estimate of the effect of friend deviance on externalizing behavior for nonreward dominant youths: $\beta = .11, p < .05$. The model with cards played centered at one standard deviation above the mean (78.91 cards) provided an estimate of the effect of friend deviance on externalizing behavior for reward dominant youths: $\beta = .17, p < .05$. Finally, the model with cards played centered at one standard deviation below the mean (30.17 cards) provided an estimate of the effect of friend deviance on externalizing behavior for punishment-dominant youths: $\beta = .02, p > .05$. See Fig. 1 for a summary of model parameters. Also see Fig. 2 for a visual depiction of the moderating effect of reward dominance on the association between friend deviance and externalizing behavior.

Discussion

Age 14 friend deviance was predictive of age 16 externalizing behavior as a function of cards played, controlling for age 14 externalizing behavior. This finding provides support for our prediction that friend deviance is more strongly related to later externalizing behavior for reward dominant than nonreward dominant individuals. Friend deviance had a significant effect at both mean and high number of cards played, but not at low number of cards played. The interaction between friend deviance and cards played was not a function of gender, however. This finding does not support our prediction that the moderating effect of reward dominance would be stronger for boys than for girls.

friend deviance, including the interaction between friend deviance and cards played.

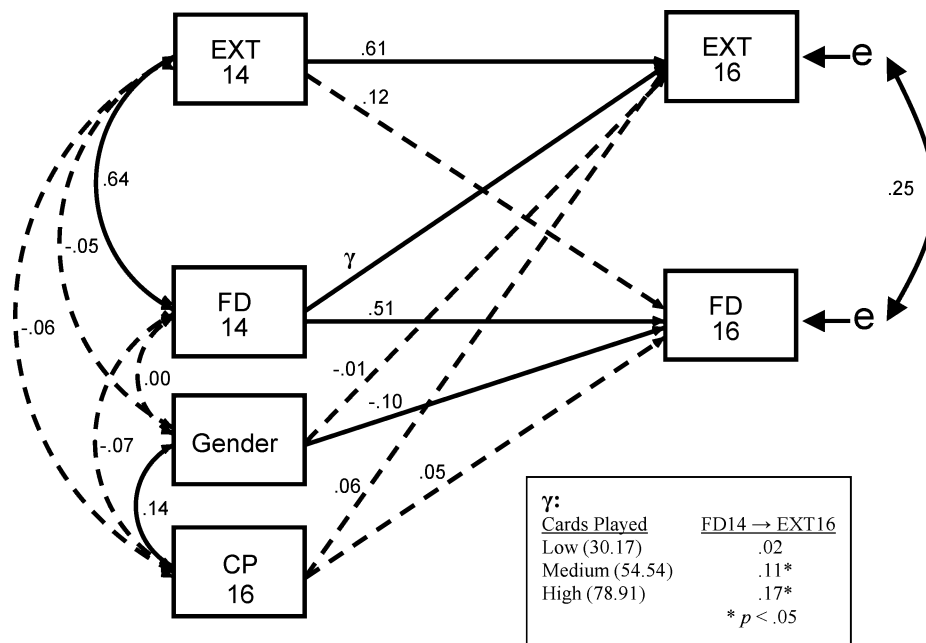


Fig. 1 Path model showing standardized estimates of the effects of gender, age 14 externalizing behavior, age 14 friend deviance, and age 16 reward dominance on age 16 externalizing behavior and age 16 friend deviance. Significant paths are shown as solid lines ($p < .05$); nonsignificant paths are shown as dashed lines. Friend deviance is abbreviated as FD, externalizing as EXT, and reward dominance as CP.

Gamma (γ refers to the relationship between age 14 friend deviance and age 16 externalizing behavior evaluated at mean number of cards played, high number of cards played (+1 SD), and low number of cards played (-1 SD). This approach illustrates the moderating influence of reward dominance on the association between friend deviance and externalizing behavior

Gardner and Dishion (2005) have recently replicated our findings using a questionnaire assessment of effortful control. Deficits in effortful control impair the ability to regulate goal-directed behavior (Rothbart & Bates, 1998) and thus are conceptually related to reward dominance. Gardner and Dishion found that at age 17 deviant friends exerted a

greater negative influence on youths low in effortful control than youths high in effortful control. The enhanced negative influence of deviant friends on youths low in effortful control was apparent in both self-reported and court-reported antisocial behavior, for both boys and girls. We interpret their findings as providing support for our primary finding: that youths exhibiting poor regulatory abilities are especially susceptible to the negative socializing influence of deviant friends.

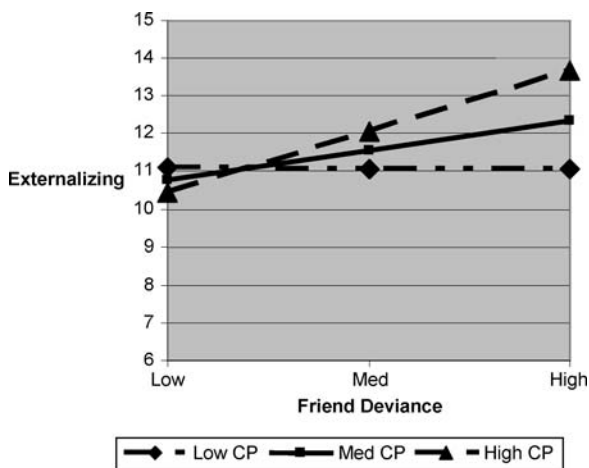


Fig. 2 Depiction of effect of age 14 friend deviance on age 16 externalizing behaviors for low (+1 SD), medium, and high (+1 SD) number of cards played

Our results are consistent with a developmental process in which reward dominant teens are more likely to associate antisocial behaviors with the rewards provided by deviant friends than to associate antisocial behaviors with the punishments provided by parents, teachers, and others, and thus are more likely to show increasing levels of externalizing problems over time. We believe that playing more than an optimal number of cards on the CP task reflects reward dominance (in accordance with Gray’s theory), or a more general inability to attend to peripheral cues while pursuing reward (in accordance with Newman’s theory), and that playing less than an optimal number of cards reflects punishment dominance or over-attention to peripheral cues while pursuing reward. We also believe that although the CP task was completed two years after the assessment of age 14 friend deviance, individuals’ performance on the CP task reflect long-term dispositions present well before the assessment.

We suggest that these motivational and/or attentional biases might account for the effects of CP behavior on the link between deviant peer affiliation and adolescents' behavior problems.

Several unexpected findings and nonfindings emerged in our analyses. Surprisingly, girls played more cards than boys on the CP task. It is possible that boys and girls approached the CP task in different ways, meaning that their performances on these tasks were related to different underlying causes. However, no other study to our knowledge has found this difference using the CP task. Furthermore, there was only weak evidence for an association between our measure of reward dominance and externalizing behavior. The bivariate correlation between CP performance and externalizing behavior was nonsignificant, and CP task performance had a very modest, trend-level effect on age 16 externalizing behavior in the path analysis. Our inability to detect a clear relationship between CP performance and externalizing behavior may have been due to differences in the composition of the current sample and the samples of other studies that have explored this relationship. Whereas our study used a representative, community sample with relatively low levels of conduct problems, most other studies have compared groups of children with high and low levels of conduct problems. The discrete group design better captures the upper end of the conduct problem distribution, and thus may be better suited for detecting an effect of reward dominance. Finally, we did not find a gender difference in externalizing behavior, unlike many other published studies of behavior problems in adolescence. These inconsistencies imply a need for replication of our findings in other samples.

The current study had additional limitations that merit consideration. One limitation concerns our inference of deviancy training. Rather than conduct direct observations of the peer groups' deviancy training process, we inferred this process from self-report of peer group deviance. It is possible that performance on the CP task interacted with a correlate of reported friend deviance instead of the deviancy training process itself.

A second limitation concerns the timing of the CP task, which was administered two years after our assessment of age 14 friend deviance. Although the CP task has demonstrated external validity and modest short term reliability, it is nearly impossible to accurately assess the reliability of a measure that includes a component of deception. Therefore, it is possible that reward dominance at age 16 is not entirely reflective of reward dominance at earlier ages. However, if true, we argue this would have made it less likely that the data would support our hypotheses. It is also possible that, rather than reward dominance interacting with friend deviance at age 14, reward dominance interacted with friend deviance later in time, closer to the age 16 assessment of

friend deviance. However, regardless of whether the interaction occurred closer in time to age 14 or age 16, the effect conveys the same developmental process.

A third limitation concerns our inability to determine whether the observed effects of reward dominance were the result of motivationally-based reward dominance or an executive attention-based response modulation deficit. Séguin (2002) and Newman and Lorenz (2002) have suggested that some reward dominant individuals do not process punishment cues or reward cues in a balanced fashion, whereas others are unable to attend to peripheral cues while engaging in goal-directed behavior, regardless of the valence of these cues. It is possible that some participants' card playing performance reflected reward dominance, and other participants' card playing performance reflected response modulation deficits. However, it is also possible that some participants' card playing performance reflected their ability to understand probabilities. Any one or a combination of these factors could explain an increased susceptibility to the influence of deviant peer affiliation.

A fourth limitation concerns significant attrition in our sample. Only 55% of the original CDP sample provided complete data. Because we could not assume that data was missing completely at random (MCAR), we chose to use FIML rather than listwise deletion to accommodate missing data. As described above, this approach results in less bias than listwise deletion when data is not MCAR. Nonetheless, FIML is an imperfect remedy, especially when there is substantial missing data and when data is missing nonignorable. This limitation further necessitates replication of our findings.

A final limitation concerns our inability to infer causality from correlational data. Nevertheless, the longitudinal effects of friend deviance derived from the path models are consistent with an interpretation of causality (Finkel, 1995). As Finkel notes, time-lags between factors eliminates the possibility that later occurring factor could cause earlier occurring factors, thus providing more information about causal relationships than can be obtained from cross-sectional data. However, one cannot rule out that time-lagged relationships between variables are caused by an unmeasured variable. In addition, although friend deviance was measured antecedent to age 16 externalizing behavior, reward dominance was assessed concurrent with age 16 externalizing behavior.

It would be useful to explore whether the functional relationship between reward dominant tendencies and mixed-contingency socialization processes extends beyond deviant friendships. For example, if it is susceptibility to reward and insensitivity to punishment that drives the observed interactions, the same kind of interaction effect might be found between individual differences in parents' use of positive reinforcement and punishment and a young child's reward dominant tendencies in predicting immediate compliance

and internalization of a caregiver's socialization efforts. It might be expected that reward dominant children, given their hypothetical reward dominance, would be most compliant when their parents predominately used positive reinforcement strategies rather than punishments to guide their behavior. Kochanska's (1997) finding that relatively fearless toddlers showed more signs of conscience when they had warm, positive relations with their mothers, is consistent with this prediction. In addition, assuming that prosocial behavior, like deviant behavior, is socialized through positive reinforcement, it would be expected that reward dominant adolescents would be more responsive to the positive influence of prosocial friends than more inhibited adolescents. To the degree that friend deviance is inversely related to friend prosocial behavior, and externalizing behavior is inversely related with prosocial behavior, our findings would suggest that prosocial behavior is more strongly influenced by friends' prosocial behavior for reward dominant than non-reward dominant youths. However, prosocial and antisocial behavior, though inversely associated, could be partially distinct constructs. Thus, determining whether reward dominance moderates the association between friend behavior and youths' prosocial behavior would necessitate the more direct assessment of prosocial behavior.

Knowledge of person-environment interactions such as the one emerging from this study may someday contribute to the development of interventions that are tailored to individuals' environmental, dispositional, and cognitive configurations. Taking a systems perspective, these individually-tailored interventions would focus on preventing or decreasing problem behavior by manipulating the most amenable elements of an interdependent system of factors, thus giving practitioners several options for promoting change. For example, Chamberlain and Reid (1998) showed the effectiveness of therapeutic foster care over traditional interventions for boys' delinquency and speculated that one factor in its success was removing the boys from deviant peer groups. Such interventions might be especially important for teens high in reward dominance. Experimental research would provide a compelling test of the practical implications of our findings. For example, one could test whether reward dominant youth benefit more than nonreward dominant youth from interventions that focus on altering the contingencies thought to maintain delinquent and aggressive behaviors.

Although there is need for further replication and extension of the current results, this study is an important step in the ongoing search for interactions between social influences and personal characteristics as they relate to maladaptive behavioral outcomes. The results of the current study suggest that the influence of deviant friends in the development of a youth's externalizing behavior are enhanced by the youth's reward dominant tendencies.

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