

Understanding delinquency during the teenage years: Developmental pathways of antisocial decision making among disadvantaged youth

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Executive Summary

Aim

In an effort to inform treatment and prevention of youth delinquency in Australia, this project explored several key questions in relation to developmental change in adolescents' delinquency involvement. We focused on the role of perceived rewards of antisocial behaviour, self-control, and emotions in driving youthful antisocial decision making, longitudinally over years and over days.

Methods

We leveraged two existing data sets focused on socio-economically disadvantaged youth in Australia to explore these questions. First, we used latent growth models to map developmental change in delinquency and perceived antisocial rewards over several years of high-school, and explored self-control (in the form of conscientiousness), as a moderator of these associations. Second, we used hierarchical linear modeling to assess within-person change in emotion, stressful events, and antisocial behaviour, and assessed whether reward bias and delinquency involvement conditioned these associations. We further explored our findings with an advisory panel of law enforcement personnel who helped provide an initial interpretation of results for informing delinquency prevention efforts for high-risk Australian youth.

Results

Our findings point to a relatively robust positive relation between reward sensitivity and delinquency in the early adolescent years. There was also some evidence that up-ticks in delinquency over the high-school years lead to subsequent increased reward perceptions. Self-

control further conditioned these associations. In particular, low self-control (in the form of low conscientiousness) coupled with high perceived antisocial rewards represented a risk for especially high delinquency involvement. In addition to a robust predictive effect of rewards, our findings also highlighted emotional inflexibility as a risk factor for adolescent delinquency. Youth with a strong reward bias tended to engage in antisocial behaviour, regardless of their emotional states; whereas youth with low reward bias were “swayed against” antisocial choices on days they were especially worried. That said, they were also more likely to engage in antisocial behaviour on days they were particularly bored. Further, highly delinquent youth reported less variability in their emotional states, but simultaneously demonstrated increased reactivity to stressful events and set-backs. Thus, these youth tended to get “stuck” in negative emotions, while also over-reacting emotionally to hassles and challenges.

Conclusion

Including components to prevention programs that help youth weigh-up both the costs and benefits of delinquent behaviour may be especially important prior to and at the start of high-school. Low self-control (in the form of low levels of conscientiousness) coupled with high perceived antisocial rewards may be an especially salient risk, and youth who manifest poor self-organization and strong reward cognitions may require special consideration. Intervention and prevention programs that target emotional flexibility among at-risk and delinquent youth may be especially efficacious. Ideally, these programs might help youth to recognize their emotions, respond adaptively to different contextual demands, and, when appropriate, use their emotions to guide them away from problematic choices.

From the perspective of police personnel, findings suggest that intervention approaches which seek to balance law-enforcement with assisting youth and reconnecting them with local support systems may be especially important. Specifically, leveraging support from families, schools, and communities to improve youth decision making and emotion regulation may be useful front-end engagements. These types of preventative operations can help to divert youth from antisocial pathways early on, and as a result, should reap substantial monetary and social benefits.

Introduction

Adolescent delinquency and violence carry heavy social and economic costs in Australia (Williams et al., 2005). Individuals are far more likely to engage in antisocial behaviour during adolescence than any other period of their life. In fact, in Australia, the offending rate for adolescents is almost three times the rate of all other age groups (AIC, 2012). Unfortunately, these problems also tend to be particularly insidious among low income youth. Illustratively, in our own work in Western Australia (WA) of roughly 700 low SES youth surveyed, approximately 30% report having engaged in violent behaviour and over 21% admit to destroying public property within the last six months (Modecki et al., 2012).

The importance of considering social structure, including low economic status and ethnic heterogeneity, in relation to delinquency and crime is widely recognized within the criminology literature (Sampson, 1997; Sampson, Morenoff, & Gannon-Rowley, 2002). Social disorganization, increased exposure to community violence and stressors, diminished resources, and other hazards linked to settings characterized by low socio-economic status are well known risk factors for delinquency (Sampson et al., 2002), and relative to youth living in more advantaged settings, those living in disadvantaged settings are at increased likelihood of engaging in illegal activities (Bongers, Koot, van der Ende, & Verhulst, 2004; Grant et al., 2003). Consequently, it is pertinent for research that explores delinquency and its associated hazards among Australian youth to focus its lens within these structural contexts which are known to compound and perpetuate risk (Edwards et al., 2007). This is especially the case for delinquency prevention, where targeting known risk factors at a universal or selected level of intervention during late childhood and adolescence is a strategic investment (Guerra, Modecki, & Cunningham, 2014).

That said, society's limited ability to reduce adolescent antisocial behaviour underscores a fundamental reality-in order to effectively prevent delinquency, we must adequately understand its causes. One important avenue for facilitating such understanding is capitalizing on emerging findings in developmental psychology. This research points to a confluence of biological and brain-based changes that exacerbate risk for initiation and escalation of antisocial behaviour during adolescence.

For example, significant up-ticks in delinquency during the teenage years appear to be associated with developmental deficits in administrative control capacities within the adolescent brain (Luciana, 2013). Innately tied to decision making, these capacities allow for administrative control over impulses and behaviour. During adolescence, control capacities must work to rein-in developmentally-salient impulses, including a motivational draw towards antisocial activities, which are perceived as highly rewarding, and a need for strong emotional arousal, both of which can impel youth to "act out." These developmental changes mean that adolescents rely on different information from that considered by either children or adults when deciding to offend, and social rewards and emotions tend to catalyse their choices.

It is worth noting here that our paramount tool for characterizing development of delinquency and its associated risk factors is longitudinal data-that is, data on the same youth that are captured repeatedly over time (Farrington, 1988). These types of data facilitate scholars' ability to map change in behaviors over the course of development, and critically for the research undertaken here, facilitate our ability to track increases, decreases, and stability in these behaviors and associated risk within-person (Duncan & Duncan, 2009). This is important, because cross-sectional data which compare individuals at different age-groups can only speak to between-person differences in risk factors that are found among adolescents and adults, for

instance, and cannot speak to “what develops” or “when it develops.” Yet it is these essential questions-around contributors to delinquency and the timing of these influences-that are of greatest salience to youth prevention and intervention programming (Farrington, 1988).

Consequently, this project explored several key questions in relation to developmental change, in an effort to inform treatment and prevention of youth delinquency in Australia. In so doing, we leveraged two comprehensive longitudinal data sets (one from an annual, long-term study, one from an intensive momentary study) from socio-economically disadvantaged Australian adolescents. Based on current understanding of adolescent development, we aimed to explicate how rewards and emotions functioned to drive youthful antisocial decision making, longitudinally over years and over days. Subsequently, we sought expert commentary from police and juvenile justice professionals, to provide recommendations based on our findings, regarding types of developmentally-informed programming that may be most effective to prevent and reduce youth delinquency in Australia.

Review of Past Research and Literature

In order to effectively prevent adolescents from engaging in antisocial activities, it is essential to establish why and how youth make decisions to participate in delinquent and violent behaviours that negate their long term interest. High delinquency rates in Australia and abroad necessitate that researchers augment and update treatment approaches based on current understanding of etiology of youth delinquency and violence.

Indeed, criminal justice scholars, legal practitioners, and policy makers have a stake in understanding antisocial decision-making among adolescents and its etiology. This is because developmental models of antisocial behaviour provide critical insight for informing prevention

and treatment of juvenile crime (Shulman & Cauffman, 2013). In fact, the integration of psychological and criminological sciences represents one of the most important approaches for explicating why adolescents choose to engage in antisocial behaviour and how they mature into better, more law-abiding decision-makers (e.g. Centifanti & Modecki, 2013; Rebellon, & Modecki, 2014).

Namely, dual-systems theories suggest adolescents' antisocial choices are driven by physiological, biological, and socio-emotional inputs unique to the developmental period (Luciana, 2013; Steinberg, 2008). With puberty, neural circuitry associated with youth's appetitive, approach system undergoes accelerated development. As a result, youth are developmentally "hard wired" to pursue social and emotional rewards inherent in antisocial behavioural choices. They are also more emotionally labile than children or adults. Unfortunately, these socio-emotional inputs are not offset by the cognitive control system during adolescence. Areas of the adolescent brain associated with deceleration and control are not yet fine-tuned, so that mechanisms for regulating problematic behaviour do not come "on-line" as rapidly or as regularly as does the reward system (Crone & Dahl, 2012). As a result of these developmental changes, adolescents' decisions to offend are couched in potential rewards and intense emotions.

Perceptions of delinquency as especially rewarding. Increasingly, adolescent's disproportionate involvement in antisocial behaviour has been attributed to their heightened sensitivity to rewards. Adolescents are predisposed to engage their appetitive, emotional reward system, which emboldens their antisocial choices (Galván et al., 2007; Modecki, 2009). Illustratively, adolescents perceive sizable social and emotional rewards from engaging in problem behaviour and are activated to "approach" novel and risky settings. The idea here is that

adolescents are behaviourally disposed towards attaining rewards relative to any other age group (Galván et al., 2007; Modecki, 2009).

Indeed, a growing literature has identified rewards of problem behaviour as particularly influential to youthful antisocial decision making (Fagan & Piquero, 2007; Smith et al., 2012). In fact, recent research indicates perceived rewards are a stronger predictor of offending than perceptions of risks, at least among juvenile offenders (Loughran et al., 2009). Based on this research, it appears youth may desist from antisocial behaviour during early adulthood perhaps in tandem with experiencing declines in antisocial rewards (Modecki, 2009; Shulman & Cauffman, 2013). Conversely, for some youth, developmental increases in antisocial rewards may perpetuate and sustain delinquency. That is, as youth “carry forward” the belief that antisocial behaviour is highly rewarding, this belief may translate to increased and accumulating criminal activity. The current project sought to examine these proposed links between antisocial rewards and delinquency, based on the notion that perceived rewards lead to delinquency involvement, and the reverse -delinquency itself could lead to perceptions that antisocial behaviour is rewarding.

For whom? The role of self-control. It is well-established in the criminology field that youth characterized by low self-control are particularly likely to engage in delinquency and antisocial behaviour (Gottfredson & Hirschi, 1990). Developmentally, too, physiological and psychosocial changes during adolescence mean that youth have poorer emotional temperance and control relative to other age-groups, although significant variability also exists (Cauffman & Steinberg, 2000; Modecki, 2008). That is, adolescents as a group have relatively low temperance/self-control relative to adults or children, but some adolescents are still better able to temper their emotions than others. It may be that such variability in self-control interacts with

other facets of development in ways that serve to increase (or decrease) adolescents' risk for antisocial behaviour. As a result it is essential to examine more closely the interrelationships among self-control and developmental factors, such as perceived rewards, that contribute to delinquency (Cauffman, et al., 2005).

Given complex changes that occur in neural regions during the teenage years, it may be that deficits in self-control trigger dynamic developmental processes that “carry forward” further behavioural difficulties, even as biological-based decision making systems have matured (Osgood, 2005). Thus, youth with low self-control early on may manifest escalated trajectories of delinquency, because they are unable to exert behavioural control that might typically contribute to their desistance from delinquency and violence later in the teenage years. Likewise, youth with low self-control are arguably challenged to restrain their rewarding impulses towards delinquency and violence. These youth may then experience feedback effects from their delinquency, such that strong reward motives unconstrained by self-control become an “amplifying loop” in which delinquency is experienced as especially rewarding, which then creates more positive expectancies (Thornberry, 2005). Such possibilities further suggest that low self-control could interact with delinquency and reward perceptions in ways that might render youth especially vulnerable to acting out, but such possibilities have not yet been adequately explored.

Etiology and developmental change. Because these theories seek to help explain etiology of delinquency, they are necessarily rooted within a developmental frame of reference (Modecki, 2008). Consequently, associated research embedded within developmental psychopathology and developmental criminology frameworks seeks to characterize adolescents' underlying maturation across time and how such change underpins youthful pathways towards or

away from delinquency (e.g. Luciana, 2013). The idea here is that youths' development makes a fundamental contribution to their delinquency engagement; thus understanding (and mitigating) factors that lead to juvenile crime requires a clear picture of a) when risks are most likely to emerge and b) when these, in turn, exert the most detrimental effects (Modecki, Zimmer-Gembeck, & Guerra, 2017). Scholars' ability to address these questions hinges on longitudinal data-information which facilitates our tracking of adolescents' shifting risks, protections, and behaviours. Unfortunately, a great deal of criminological and psychological research to date has relied on cross-sectional "snap shots" of youth at different age-spans to investigate causes and correlated of youth crime. While constructive for providing useful overviews (e.g. mean trends in adolescents' delinquency and associated risks at different age-spans), these approaches tell us little about timing, strength, or change in degree of impact which these risks exert over time (Farrington, 1988). Instead, longitudinal data are needed to chart development of delinquency over the course of adolescence, and to parse risk factors and their changing impact across different points of development.

This project explored these questions in order to speak to possible developmental targets for interventions that could help to offset criminological deficits in decision making. Based on the premise that early control deficits could set the stage for further problems, we examined early self-control as a predictor of both delinquency and perceived rewards. Likewise, we assessed the possibility that early self-control could interact with these developmental liabilities to render increased risk for antisocial problems over time.

Importantly, we investigated these questions using detailed longitudinal survey data from a representative sample of Western Australian youth. Moreover, here, we leveraged comparisons between our mapping of within-person developmental change in adolescent delinquency and risk

(e.g. average developmental trajectories and individual differences in those trajectories across time) with some of the more traditional developmental criminology approaches to these questions (e.g. ANOVA, where only mean changes are analyzed and so valuable information about “change” or “development” is neglected) (Duncan & Duncan, 2009). The benefit of this juxtaposition (beyond perhaps an interesting statistical primer) is to highlight the essential import of developmental change to characterizations of adolescents’ delinquency. Put another way, we and others have argued that juvenile delinquency is, in large part, a developmental phenomenon (e.g. Cauffman & Steinberg, 2000; Modecki & Uink, 2017; Modecki, 2017). Consequently, in order to prevent juvenile delinquency, scholars must necessarily map its developmental course and attend to questions of underlying maturation in relation to risk and protective factors. Here, we aim to take several steps towards doing so.

Emotions and delinquency. Adolescence is also a developmental period characterized by difficulties with emotion (Hollenstein & Loughheed, 2013). Youths’ emotional contexts can inform their engagement in antisocial behaviour in multiple ways. First, adolescents who are emotionally inflexible may be especially likely to engage in delinquency. Illustratively, youth who get “stuck” in their emotional states lack a repertoire of accommodative responses to situations and contexts, and as a result, tend to respond in less adaptive ways (Uink, Modecki, Correia, & Barber, 2016). In fact, youth who engage in delinquency may be especially likely to “carry-forward” their negative emotions (Uink et al., 2016). Such strong emotional “inertia” means that delinquent youth have a difficult time up-regulating negative emotional states on their own. Consequently, when these youth find themselves in situations that negatively impact their emotions, they may find it harder to alter their emotional state-and could turn to acting out as a way to change their mood. If this is the case, then scaffolding youth in emotional flexibility or

adaptability could be a useful strategy for intervention. This project tested proposed links between adolescents' delinquency involvement and their emotional inflexibility across the day and across the week.

Second, adolescents wrestle with intense emotional reactivity as they encounter set-backs and challenges. This emotional reactivity creates strain on adolescents' administrative functions, and makes it even more difficult for adolescents to exert cognitive control and tamp down on anti-social tendencies (Galván & McGlennen, 2012). Difficulties in constraining emotional responses may translate to increased likelihood that youth will "act out" their impulses in the form of antisocial behaviour (Fine & Sung, 2014; Luciana, 2013). Thus, strong emotional responses to stressors and hassles may be linked to delinquency involvement. For example, preliminary research shows that adolescents make riskier decisions on days they experience high levels of stress than on low stress days (Galván & McGlennen, 2012). This project assessed this notion by examining links between adolescents' emotional responding to stressful days and their overall level of delinquency involvement.

Third, emotional experiences themselves may alter decision making, and may help to guide youth towards or away from negative outcomes (Cooper et al., 2000). For instance, some developmental models of decision making argue that "gut" or intuitive feelings may be especially beneficial for keeping youth out of harm's way, because adults tend to avoid problems largely through an immediate "gist" or gut sensation that a behaviour is a "bad idea" (Reyna & Farley, 2006). As a result, adolescents who rely on "feeling" may actually make better decisions than those who weigh-up rewards and costs of problem behaviour, especially when rewards take precedence. What this suggests is that youth who consult their emotional experiences to guide their behavioural choices may be more risk-averse, because negative emotions sway them away

from problematic situations. On the other hand, adolescents who perceive antisocial behaviour as especially rewarding may fail to tap into any intuitive notions that some decisions are a “bad idea” and this could contribute to their delinquency involvement. As one example, youth who are heavily biased towards rewards likely have a higher emotional threshold for eschewing antisocial choices, so that feeling worried, for instance, may fail to signal them away from risk. In all, theory and preliminary data indicate that adolescents’ antisocial behaviour is tied to their emotional experiences and reward perceptions, which may further interact to drive negative choices. The current project examined this idea by assessing whether perceptions of antisocial rewards moderated links between adolescents’ daily emotions and problem behaviour involvement.

Summary. This project sought to address several gaps in understanding of adolescents’ delinquency during the teenage years. We explored the roles of rewards, self-control and emotion in adolescent delinquency among samples of youth living in economically disadvantaged settings, and thus at increased risk for problems. The following sections leverage two sets of data to explore these questions. First, we use rich longitudinal data that follows a relatively large sample of disadvantaged youth over five years. Second, we provide findings from a comprehensive study of adolescents’ “in the moment” experiences and antisocial behaviour, using experience sampling data to assess “in vivo” reports of youth living in socio-economic disadvantage.

Methods-Rewards, Self-Control, and Delinquency

Sample

Data were taken from multiple waves of the Australian Research Council funded Youth Activity Participation Survey (YAPS) study (see Modecki, Barber, & Eccles, 2014; Modecki, Barber & Vernon, 2013 for study descriptions). Within the larger YAPS project, a sample of over 1,300 Western Australian students recruited from 39 schools throughout the state. Participants were originally recruited from high schools (21 government, 18 non-government), selected to represent the metropolitan and regional school districts across Western Australia. The number and type of schools (government, nongovernment) selected within each district was determined by the high school student enrolment rate for each district. Participating schools were recruited to include a range of socio-economic statuses (SES), and schools were placed on a numerical scale that described their comparative socioeconomic advantage.

Data reported here are from 15 schools that were at the median or below the state average based on the socio-economic index computed annually by the WA Department of Education. The socio-economic index (ICSEA) is calculated with data from the Australian Bureau of Statistics, based on the addresses of all students attending each school (Australian Curriculum, Assessment & Reporting Authority, 2013). Here we report on students with average or below ICSEA, representing the bottom half of the spectrum of educational background, ($n = 480$). Thus, our first set of analyses draw from a sample of youth representing average to extremely disadvantaged backgrounds.

Among YAPS participants, requisite longitudinal data from lower SES youth were available for a younger cohort across five years in total (grades 8-12; age range 12-18 years). Mean age_{Grade 8} = 13.50(SD = .29), Mean age_{Grade 9} = 14.43(SD = .30), Mean age_{Grade 10} = 15.40(SD = .62), Mean age_{Grade 11} = 16.45(SD = .30), Mean age_{Grade 12} = 17.44 (SD = .29). The sample was 43.1% male. Ethnicity of the sample was 48.7% Caucasian, 4.9% Aboriginal or

Torres Strait Islander, 9.6% Asian, 4% African, 1.2% Middle Eastern and 31.6% did not nominate an ethnicity.

Procedure

Ethics approval to conduct research was obtained from the university Human Research Committee, the Education Department, and the Catholic Education Office. Study participation required active informed parent and student consent. In return for their participation, participants were entered into an immediate small prize draw (e.g. posters, vouchers) at the school level and were also included in a final prize draw (e.g. iPod). The survey was administered annually, using 20 wireless-laptop computers, connected to a Web server, over a 45-min session. An alternative paper survey was provided if requested. Students were logged onto the computer survey using a unique identification (ID) number to maintain confidentiality and link their responses to previous years. Participants were told that the survey was confidential, that participation was entirely voluntary, and that completed surveys would not be available to their teachers, school, or parents.

For this cohort, we recruited participants in 2010. Some follow-up recruitment of this cohort in 2011 targeted regional and disadvantaged schools. For our current sample we used participants who participated in at least one wave and who had sufficient data for calculations in Mplus (e.g., at least one measure of delinquency in Year 9, 10, 11, or 12).

Measures

Perceived antisocial rewards. Rewards were assessed at four waves using items from a valid construct which has successfully tapped rewards associated with problematic decision making in adolescents (Benthin et al.,1993). This measure has been used widely in adolescent

delinquency research in the US and abroad (e.g. Duell et al., 2016 in 11 countries) and is positively associated with experimental indices of risk taking and negatively linked to experimental indices of self-control and planning. For this study, adolescents were asked to indicate how many advantages or benefits there were to doing four illegal behaviours, including shoplifting, illegal drug use, and illegal driving behaviours. Responses ranged from 0(no benefits/advantages) to 8(a lot of benefits/advantages). Reliability of the measures in this sample at each wave was wave 5 $\alpha = .94$; wave 6 $\alpha = .83$; wave 7 $\alpha = .78$; wave 8 $\alpha = .81$

Self-control. The self-control construct was assessed using one item from the TIPI conscientiousness sub-scale adapted from Gosling, Rentfrow, and Swann (2003). This item loads highest of the TIPI items on Big 5 measures of conscientiousness, and is thus a strong indicator of impulse control. Previous research has linked TIPI lack of conscientiousness to the “dark triad” of personality and behavior problems-psychopathy, narcissism, and Machiavellianism (Jonason & Webster, 2010). Adolescents were asked to indicate how much they agreed with the statement (reverse coded) “I see myself as...careless, disorganized.” Responses ranged on a five-point scale from Strongly Disagree (1) to Strongly Agree (5).

Delinquency. The study measured delinquency across five waves in total with a reliable (wave 4 $\alpha = .69$; wave 5 $\alpha = .78$; wave 6 $\alpha = .77$; wave 7 $\alpha = .78$; wave 8 $\alpha = .91$) and valid construct adapted from Fredericks and Eccles (2006). Four items tapped delinquency and aggressive behaviours and were measured on an eight point scale from (1) None to (8) 31 or more times. Items included “In the past 6 months how often have you gotten in a physical fight with another person?,” “have you damaged public property;” “have you taken something from a shop without paying for it;” “have you had contact with police for something you did or something they thought you did?”

Analysis plan. Analyses were conducted using latent growth curve modeling (LGM) in Mplus 7.1 (Muthén and Muthén 2013) using Full Information Likelihood estimation and robust standard errors. Preliminary latent growth curve models (LGM) examined overall patterns of change for each variable of interest. Unconditional models determined the average pattern of change over time and whether there was significant variability within the sample in level (intercept) and change over time (slope). Predictor or outcomes variables were then added.

We first explored delinquency trajectories, with rewards as a predictor and then as an outcome. We subsequently tested the conditioning role of early self-control on the relation between early rewards and delinquency involvement. Next, we explore reward trajectories, first with delinquency as a predictor and then as an outcome. Finally, we assessed early self-control as a moderator of the early delinquency-perceived rewards relation.

Throughout this section we juxtapose trajectories (e.g. latent growth curve models, featured throughout our AIC funded work), which have the critical attribute of modeling whether and when risk factors exert effects on rate of developmental change in delinquency (and associated constructs), with more typically used methods which explore only mean change-and treat youth as largely homogeneous (e.g. repeated measures ANOVA) (Duncan & Duncan, 2009). Our intention throughout is to provide these juxtapositions to usefully illustrate the need for criminology scholars and practitioners alike to consider developmental processes that contribute to delinquency escalation as well as desistance.

Descriptive Results

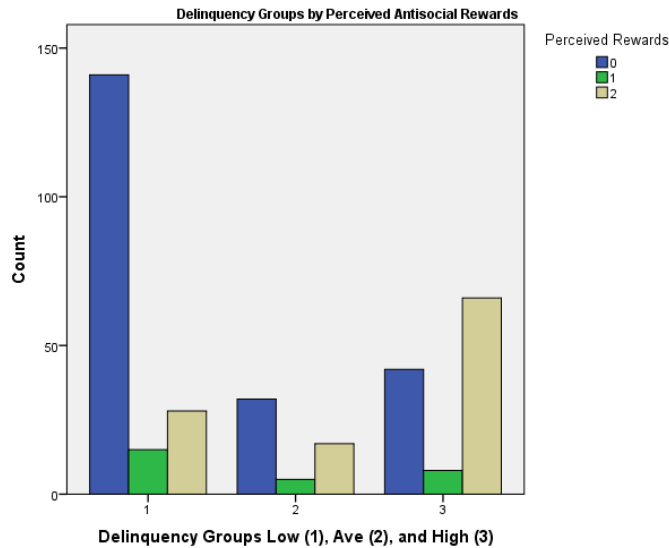
In order to provide a feel for general characteristics of youth in the sample and of youth that we categorized into subsequent groupings (e.g. high perceived rewards and low self-

control), we first include several descriptives based on grade 8 data. First, in grade 8, 57.7% of youth had not engaged in any of the four delinquent behaviours of interest within the last 6 months; 22.1% had engaged in either destruction or stealing of property, physical fight, or had police contact within the past 6 months; and 7% had engaged in at least two of these behaviours. Notably, 9% of youth reported recent police contact. Physical fights were the most common reported behavior, with 15% of youth reporting once, 7.8% reporting 2-3 times, and 3% of youth reporting at least once a month.

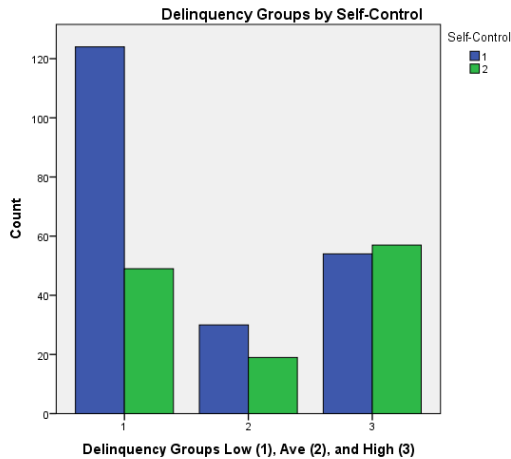
Somewhat surprisingly, there were no significant gender differences across groupings, that is between low, medium, and high delinquency groups ($\chi^2 (2) = 3.88, p = .14$), between perceived rewards groups ($\chi^2 (2) = 5.03, p = .08$), or between self-control groups ($\chi^2 (1) = 1.76, p = .185$). This lack of differences may be attributable to our sample's composition of only low SES youth, where shared structural risk may have mitigated gender differences sometimes found in relation to delinquent behavior. We did not explore differences based on ethnicity, because our sample was largely Caucasian and ethnic minority subgroups were neither large enough (e.g. less than 10% of youth reported belonging to any one ethnic minority group) nor well-defined enough (e.g. more than 30% of youth did not nominate ethnicity) for us to have confidence in any subsequent findings. We did however test grade 8 delinquency group differences (low, average, or high) in relation to the two key delinquency risks explored here-rewards and self-control.

Generally, low perceived rewards youth were most likely to be represented in low delinquency groupings (65.6%) and relatively less likely to be represented within average (14.9%) or high (19.5%) groupings. By the same token, high perceived rewards youth were most

likely to be categorized as high delinquency youth (59.5%), and relatively less likely to be categorized as average (15.3%) or low (25.2%) in delinquency. $\chi^2(4) = 58.87, p < .001$.



Likewise, youth characterized by high self-control were most likely to be represented within the low delinquency grouping (59.6%), rather than the average (14.4%) or high (26%) delinquency groupings. Low self-control youth tended to be characterized as high in delinquency (45.6%) but were also characterized as low (39.2%) and average (15.2) in delinquency $\chi^2(2) = 15.33, p < .001$. These descriptive suggest that low anticipated rewards tends be protective and high rewards a risk for delinquency engagement; whereas high self-control is protective, and low self-control may be a risk for delinquency, but there is also heterogeneity among low self-control youth and thus risk may be exacerbated in association with certain characteristics or circumstances.



Main Results- Rewards, Self-Control, and Delinquency

We next examined latent (within-person) trajectories of delinquency, rewards, and self-control in order to map these factors' underlying development across the course of adolescence, as well as the relative timing and influence of their predictors. Thus, our primary focus with these analyses was to describe a) mean initial levels (intercept) of these characteristics within our sample and variability around this average as well as b) mean levels of developmental change (slope) and individual differences in development (variability). Thus, we seek to characterize whether on average, early levels of delinquency and associated risks are significantly different from zero (e.g. statistically significant intercept) and whether change in time in these characteristics differs from zero (e.g. statistically significant slope). Moreover, we then test whether early levels of risk are associated with, for instance, early levels of delinquency (e.g. whether a given construct has a significant effect on delinquency intercept), and whether early levels of risk are associated with significant rates of change in delinquency over time (e.g. whether a given construct has a significant effect on delinquency slope). In an effort to contrast findings derived from more traditional criminological approaches, in which only mean changes

between time points are examined, we also include representative figures for “between person” analyses as a comparison. Our objective in juxtaposing these summaries is to emphasize the advantages of explicitly considering (and modeling) developmental change in relation to adolescents’ delinquency and the potent information that can and should be derived for crime prevention and intervention efforts.

Four-year, later delinquency trajectory predicted by early rewards. Results for the unconditional model describing four years of delinquency are in Table 1, Model 1. On average, delinquency (spanning grades 9-12) underwent curvilinear change across the four years, following a u-shaped curve. On average, there were significant linear reductions in delinquency across the early years of high school (linear slope), followed by non-significant increases during the later years (quadratic slope). There was also significant inter-individual variation in early levels of delinquency in grade 9 (intercept, random effects).

Results for the conditional model with covariates and predictors are seen in Table 1, Model 2. At a trend-level, male adolescents engaged in marginally more delinquency in grade 9 than female adolescents (intercept). High early perceived rewards was associated with higher early levels of delinquency involvement (intercept). High level of perceived antisocial rewards was also associated with subsequent declines in delinquency over the first few years (linear slope) followed by trend-level increases over the last few years (quadratic slope). Figure 1a. further describes the interaction between time and early perceived rewards on delinquency, and shows delinquency trajectories at different levels of early perceived antisocial rewards. That is, the significant effect of antisocial rewards on the linear slope indicates that youth with different levels of perceived antisocial rewards undergo different rates of early developmental change,

whereas the trend-level effect of rewards on the quadratic slope point to trend-level differences in rates of later developmental change based on levels of early perceived antisocial rewards.

As described in Figure 1a, youth who perceived high levels of antisocial rewards early on were already engaging in high levels of delinquency. These youth declined in their delinquency involvement over the next few years of high school, followed by a slight upturn in grade 12. Despite declines in delinquency over four years of high school, the sub-set of youth who perceived many rewards from crime in 9th grade remained the most delinquency involved, at a rank-level, across all years. Youth who perceived low level of antisocial rewards early on were engaging in the least delinquency in 9th grade. They showed slight curvilinear increases over the remaining four years, but throughout maintained relatively little involvement in delinquency.

Figure 1a. Delinquency trajectories for youth at high, mean, and low levels of perceived antisocial rewards.

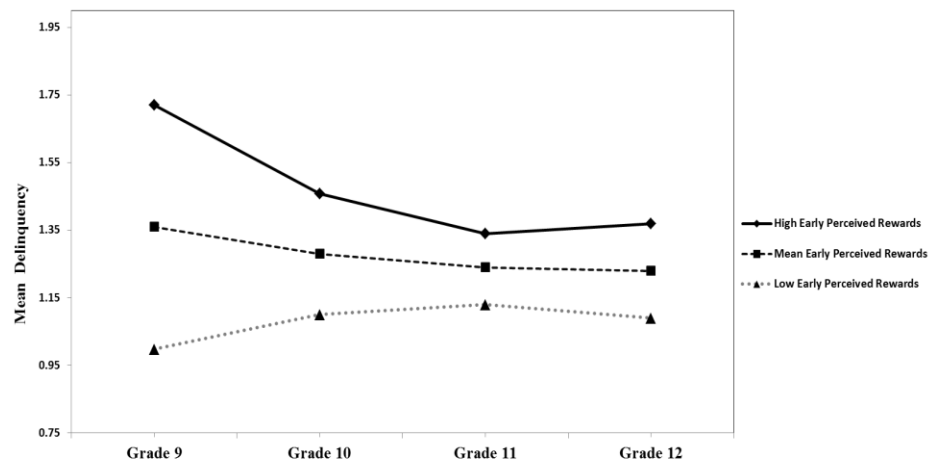
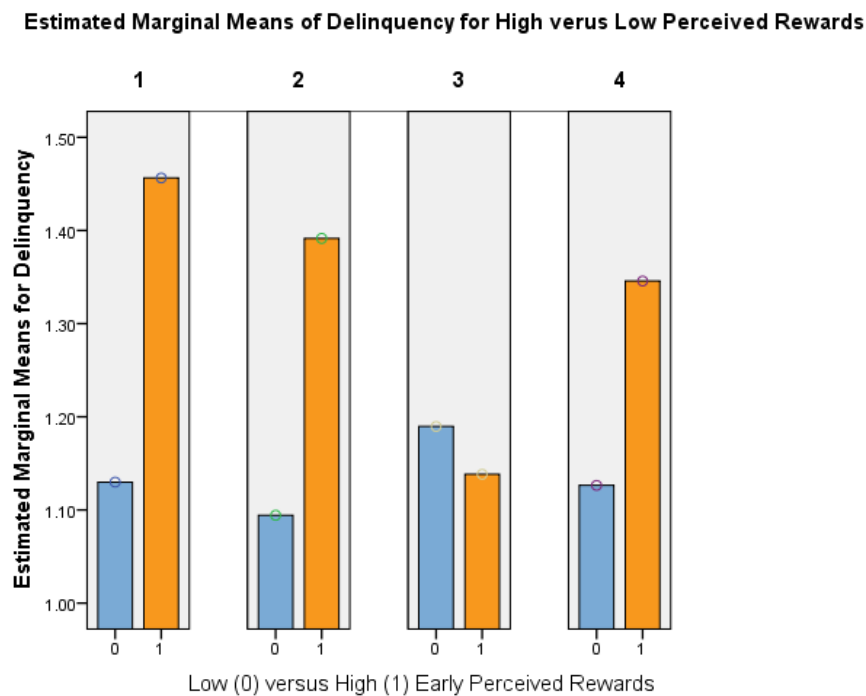


Figure 1b. provides an alternative, mean-level snapshot to the above data and describes estimated mean levels of delinquency at each grade (wave) for the two focal groups-youth who anticipated low versus high levels of rewards for antisocial behavior. Figure 1b. illustrates how

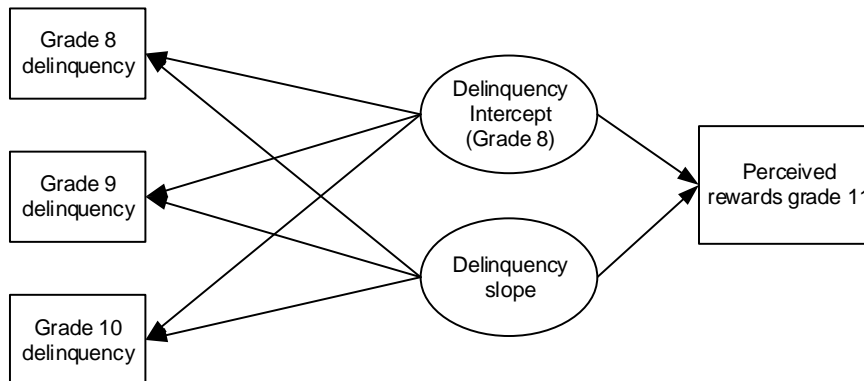
an examination of only the average levels of delinquent behavior (or associated risk factors) from year to year can mask developmental nuances that maybe especially important for youth prevention efforts. Looking at mean levels, there appears to be a critical “dip” in delinquency during grade 11th for youth high in perceived rewards. However, the trajectory results in Figure 1a. make clear that this mean-level low is the result of a rapid de-escalation in delinquency which begins in 9th grade and levels-off at 11th grade. Thus, rather than discerning delinquency engagement as “bouncing around” from year to year, leveraging trajectory findings, we can better characterize developmental declines in delinquency which youth high in rewards undergo across the teenage years. The translatable knowledge that we might take from these findings is that for youth who are engaging in high levels of delinquency in the early high school years, prevention efforts that speak to cost/benefits of crime likely need to be dispatched much earlier- during the elementary school years. Those interventions that do take place during high school might instead be better served by working with youth to critically question their perceptions about crime rewards, whether these are realistic, and whether such rewards might themselves come with their own “costs” (e.g. If you get caught shoplifting, will you still look cool to your friends? If you shoplift now mainly to impress your friends, is this only going to escalate with risk, problems, and crime in order for you to maintain that popularity?).

Figure 1b. Estimated means for delinquency at high and low levels of perceived rewards.



Three-year, early delinquency trajectory predicting subsequent rewards. Results for the unconditional model describing three years of delinquency are in Table 2, Model 1. On average, delinquency (spanning grades 8-10) showed non-significant linear increases across the three early years. There was significant inter-individual variation in early levels of delinquency in grade 8 (intercept, random effects). Results for the conditional model in which the delinquency trajectory served as the independent variables and later perceived rewards in grade 11 served as the dependent variable (see Figure 2, below) are in Table 2, Model 2.

Figure 2. Conditional model of early delinquency trajectory predicting later rewards.



High early levels of delinquency in grade 8 predicted higher perceived rewards in grade 11 (intercept), controlling for change in delinquency in the intervening years. Youth who showed steeper increases in delinquency across grades 8-11 reported higher perceived rewards in grade 11 (slope) at a trend-level.

Results for the conditional model in which the delinquency trajectory served as the independent variables and later perceived rewards in grade 12 served as the dependent variable are in Table 2, Model 3. High early levels of delinquency in grade 8 again predicted higher perceived rewards in grade 12 (intercept), controlling for change in delinquency across grades 8-10.

Rewards X self-control predicting four-year delinquency trajectory. Results for the unconditional model describing four years of delinquency are in Table 3, Model 1 (and parallel results in Table 1, Model 1). As described earlier, on average, delinquency (spanning grades 9-12) underwent curvilinear change across the four years, following a u-shaped curve. On average, there were significant linear reductions in delinquency across the early years of high school (linear slope), followed by non-significant increases during the later years (quadratic slope).

There was also significant inter-individual variation in early levels of delinquency in grade 9 (intercept, random effects).

Results for the first conditional model with covariates and predictors are seen in Table 3, Model 2. Youth who perceived greater antisocial rewards in grade 9 engaged in higher levels of delinquency in grade 9 (intercept). Youth with low levels of self-control in grade 9 also engaged in higher levels of delinquency in grade 9 (intercept), but in the later years of high school, these youth showed steeper declines in delinquency at a trend-level (quadratic slope). The form of this interaction is shown in Figure 3a., below.

Figure 3a. Delinquency trajectories for youth at high, mean, and low levels of self-control.

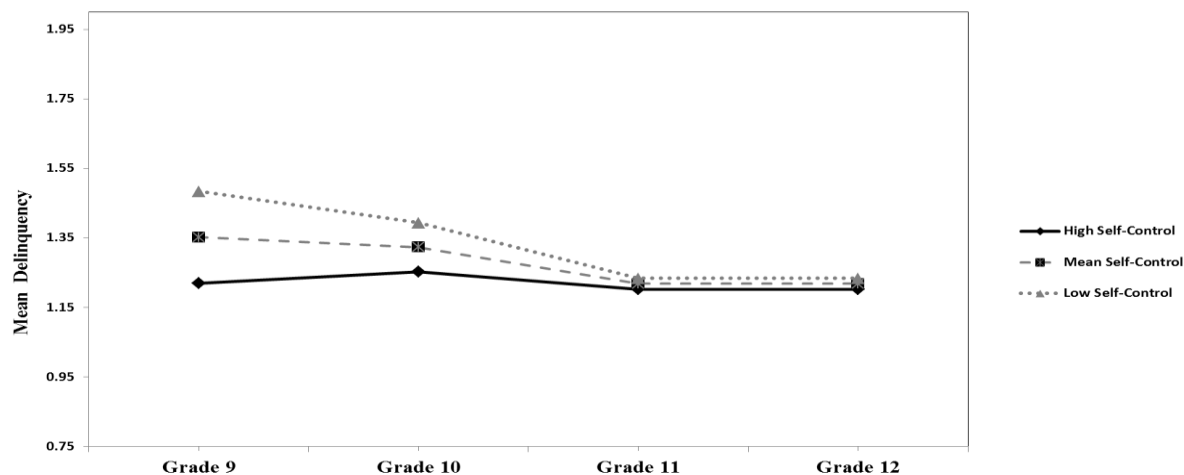
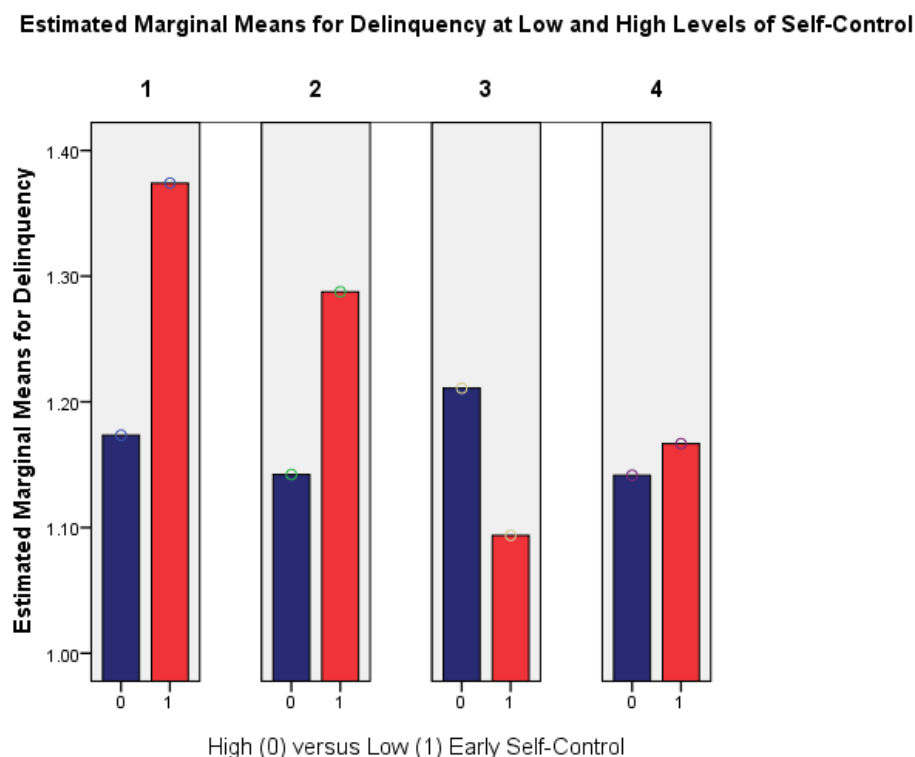


Figure 3b., below, provides an alternative snapshot to our developmental models and instead uses means at each grade-level to estimate average delinquency from one time point to the next. While informative in showing that youth low in self-control generally engage in higher levels of delinquency at most time points, again, here we seek to highlight what these models can miss in regards to adolescents' delinquency. Because there is an underlying element of developmental change that underscores behavior problems during the teenage years, methods

that do not explicitly consider delinquency's developmental course can miss important details for prevention and intervention. In this case, our developmental trajectory models indicate that delinquency appears to undergo fairly similar rates of decline for youth with both high and low levels of self-control, but that low self-control youth engage in particularly high levels of delinquency early on. The take-away from these models is that self-control appears to exert some of its most salient effects on delinquency early on, at the start of high school. Thus, programmatic enhancements of youth self-control (e.g. working towards delay of gratification, “stop and think” for delayed decision making, etc.) would make the most sense for youth during the late elementary school years or at the transition to high school.

Figure 3b. Estimated means for delinquency at low and high levels of early self-control.



Results for the second conditional model with the addition of the perceived rewards X self-control interaction term are in Table 3, Model 3. The conditional main effect for perceived antisocial rewards was significant on the intercept, indicating youth who perceived greater rewards in grade 9 engaged in more delinquency in grade. 9, controlling for the interaction between rewards X self-control. Self-control was also significant on the intercept, indicating higher levels of self-control were associated with lower levels of delinquency in grade 9, when the interaction between self-control and rewards is accounted for. At a trend-level, boys underwent more rapid increases in delinquency than girls in the later years of high school (quadratic slope) and higher self-control was also associated with greater later increases in delinquency (quadratic slope), controlling for a rewards X self-control interaction.

The interaction between rewards and self-control was significant on the intercept and at a trend-level predicted the quadric slope of delinquency. This was further probed and plotted. Probing at high and low values of self-control showed that at high values of self-control, there was a significant positive effect ($p < .01$) of perceived benefits on the intercept of delinquency and at low values of self-control, there was a significant positive effect of rewards on the intercept ($p < .05$) and a trend-level negative effect of rewards on the quadratic slope ($p = .05$) of delinquency. The form of the interaction is shown below in Figures 4a1 and 4b1.

For youth high in self-control (Figure 4a1), high early perceived antisocial rewards was associated with greater delinquency early on, but rewards were not associated with differential changes over time in delinquency. In general, high self-control youth with high and mean levels of perceived rewards engaged in relatively little delinquency relative to their low self-control counterparts (described in Figure 4b1).

Among low self-control youth, high early perceived antisocial rewards was associated with high delinquency involvement. But this was followed by significant, steep declines in delinquency overtime time. Youth who perceived low levels of rewards early on engaged in very little delinquency over all, although they showed increases in delinquency during the latter part of high school.

Figure 4a1. Delinquency trajectories for high self-control youth at high, mean, and low levels of perceived rewards.

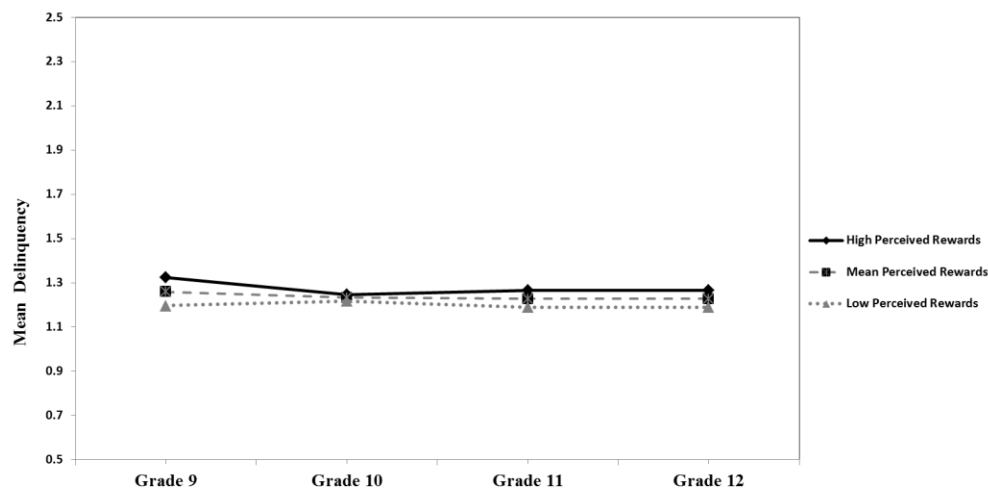
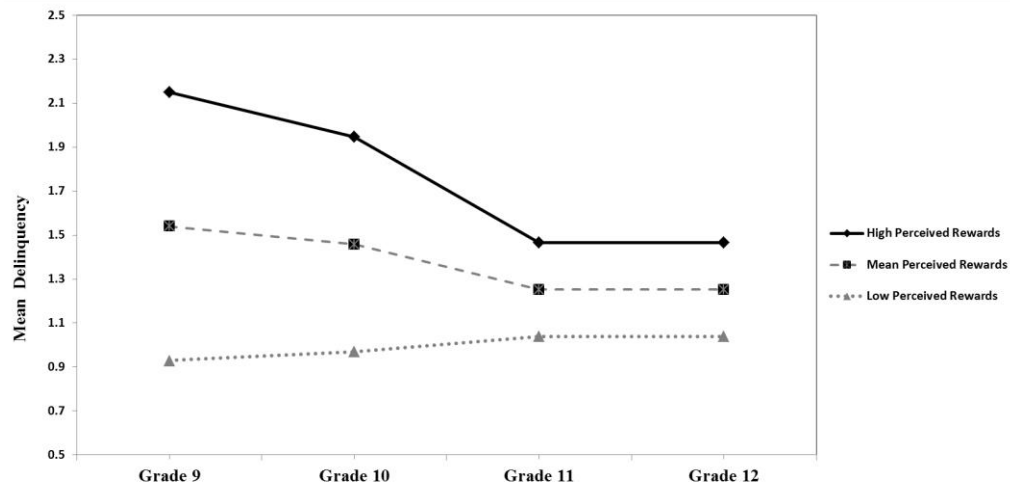


Figure 4b1. Delinquency trajectories for low self-control youth at high, mean, and low levels of perceived antisocial rewards.



Again, we also include mean-level figures to provide an overall snapshot of these data and how averages from year-to-year converge with developmental trajectory findings (Figure 4a2 and Figure 4b2, below). The figures below nicely convey the “double whammy” effect of low self-control and high perceived antisocial rewards. That said, mean levels of delinquency for youth at high levels of self-control are, arguably, somewhat misleading. The additional information provided from layering these within a developmental trajectory framework makes clear that the downward developmental trend is all but *absent* among youth high in self-control. Put another way, rate of change is important-and rate of change in delinquency among youth high in self-control is quite stable, regardless of perceived rewards. Thus, considerations of timing and salience of programming should be valuable in this regard-with an acknowledgment that different youth are likely to benefit in fairly diverse ways in terms of themes and timing of program delivery.

Figure 4a2. Estimated delinquency means for youth high in self-control, at high and low levels of perceived antisocial rewards.

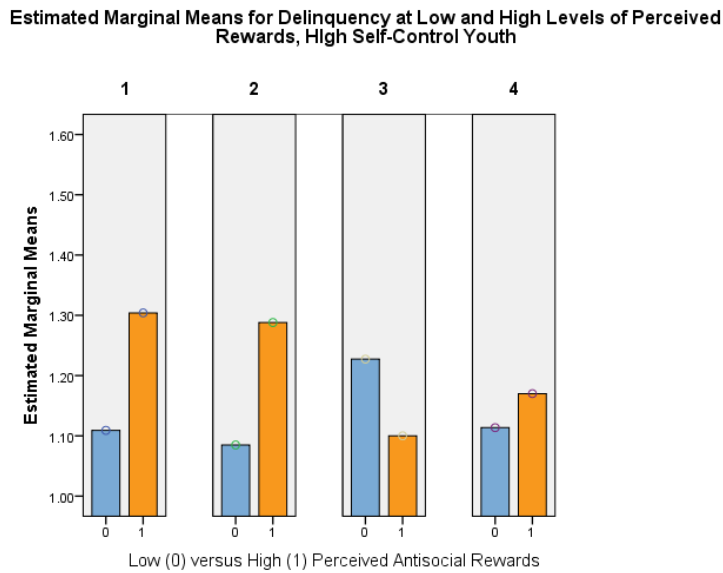
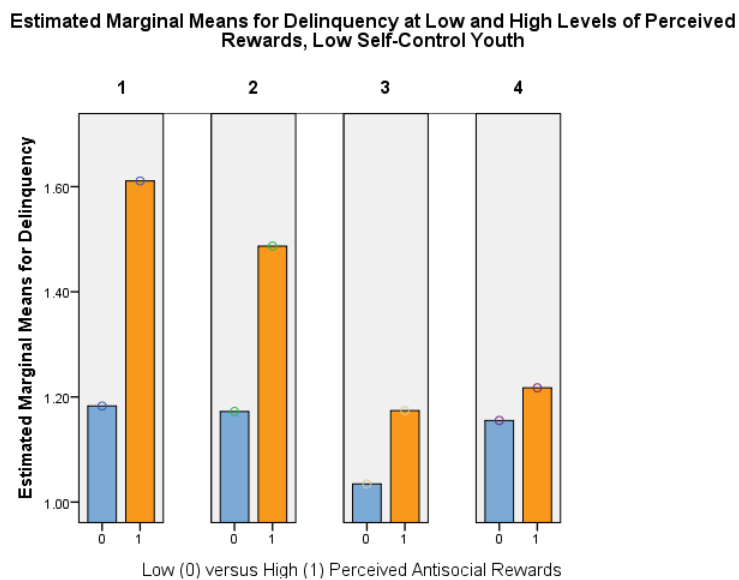


Figure 4b2. Estimated delinquency means for youth low in self-control, at high and low levels of perceived antisocial rewards.



Parallel process model, four-year trajectories of delinquency and rewards. Preliminary latent growth models were run for delinquency and perceived rewards to determine best fitting models. Next, a parallel process model was run to assess associations between the paired trajectories. That is, the parallel process model was estimated to evaluate correlations among early levels (intercepts) and growth (slopes) in delinquency and reward trajectories (see Figure 5, below).

Figure 5. Parallel process model of delinquency and perceived reward trajectories.

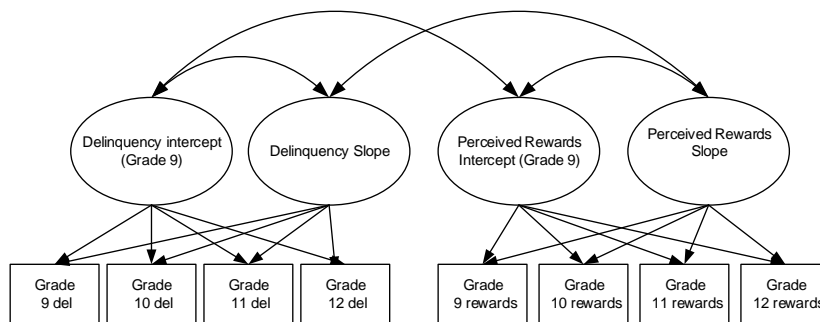
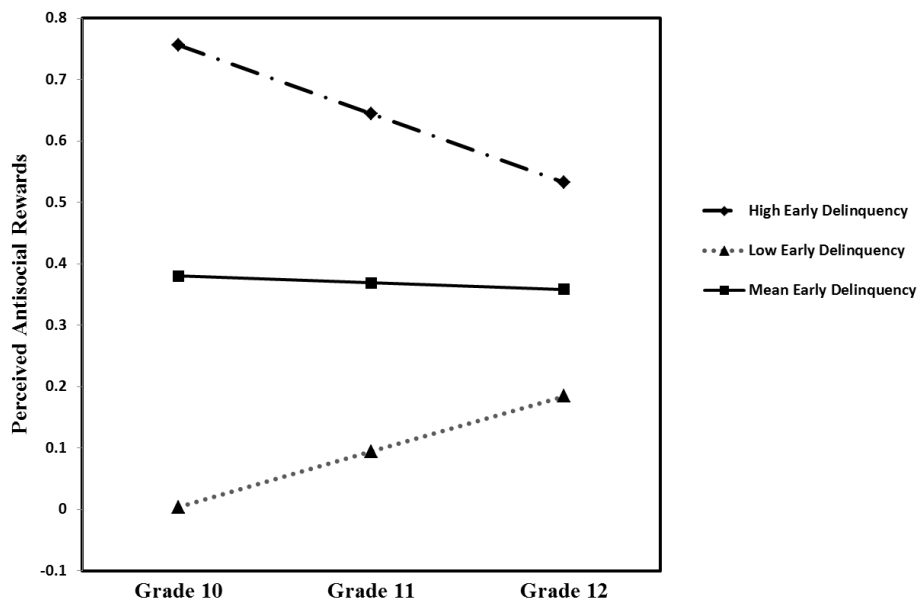


Table 4 presents intercept-to-intercept and slope-to-slope standardized correlation coefficients for the model. There was a large correlation ($r = .57$) between early levels (intercepts) of delinquency and perceived rewards, indicating that high levels of delinquency in 9th grade corresponded with relatively higher levels of perceived rewards in ninth grade, net of any subsequent change in either variable. Further, there was a trend-level small correlation ($r = .14$) between the linear slopes. This indicates that changes in delinquency in the early years of high school (grades 9-10) corresponded somewhat with changes in rewards in the early years of high school, in that early increases in delinquency paralleled early increases in rewards.

Three-year, reward trajectory predicted by early delinquency. Results for the unconditional model describing three years of perceived rewards are in Table 5, Model 1. On

average, rewards (spanning grades 10-12) underwent non-significant linear declines across the three years. There was trend-level inter-individual variation in early levels of rewards in grade 10 (intercept, random effects). Results for the conditional model with covariates and predictors are seen in Table 5, Model 2. In grade 10, younger youth perceived greater antisocial rewards relative to older youth (intercept) and higher prior involvement in delinquency in grade 9 was also associated with higher perceived antisocial rewards in grade 10 (intercept). However, higher levels of delinquency involvement in grade 9 was also associated with steeper declines in perceived rewards over grades 10-12. Figure 6a. describes this relation.

Figure 6a. Trajectories of perceived antisocial rewards for youth at high, mean, and low levels of early delinquency.

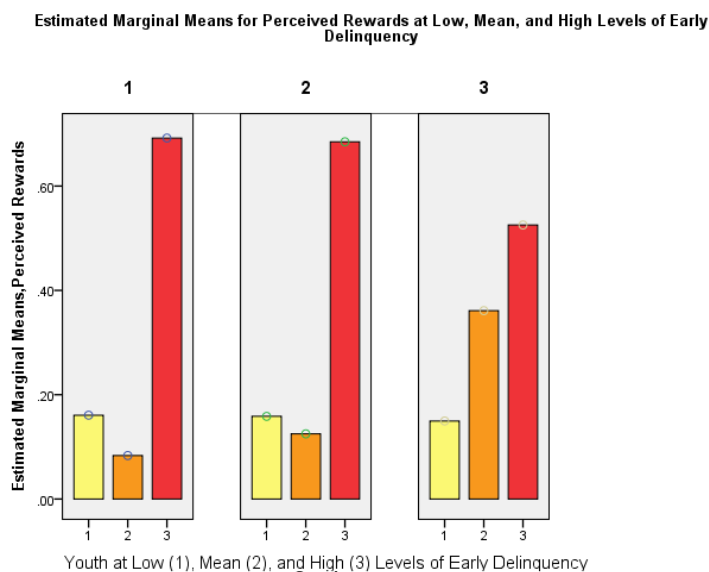


As described in Figure 6a, the effect of delinquency on rewards indicates that for youth who engaged in high levels of delinquency early-on grade 9, rewards seem to have reached a ceiling-effect. Even so, these youth with high levels of early delinquency involvement still

perceived antisocial behaviour as most rewarding, at a rank-level, across the three years. For youth who engaged in low levels of delinquency early-on in grade 9, rewards increased over the subsequent three years. However, these youth still perceived antisocial behaviour as least-rewarding, at a rank-level, across the years. Even by the end of high school, the different categories of early-delinquency youth failed to converge in their perceived antisocial rewards.

Mean levels of anticipated rewards are shown below in Figure 6b, below. Here, mean levels do make clear the downward developmental trend in rewards for high delinquency youth. However, the slight acceleration in perceived rewards for low delinquency youth is less apparent when rate of change (e.g. development) is no longer modeled.

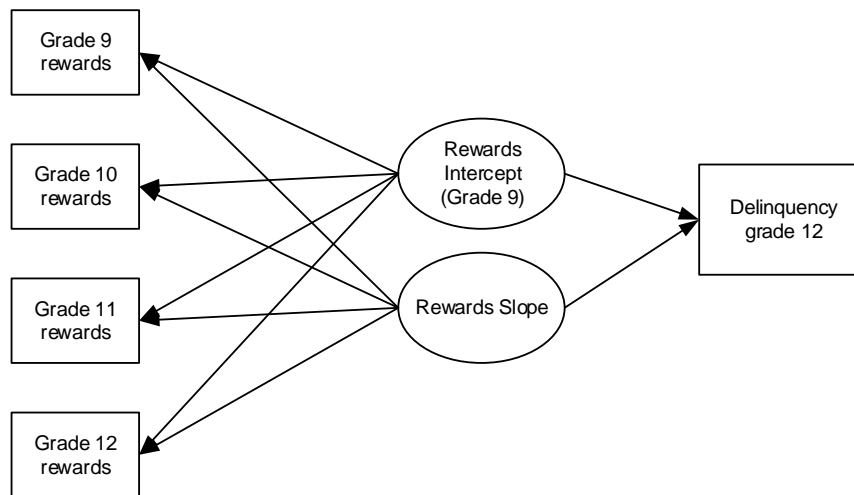
Figure 6b. Estimated reward means for youth at low, mean, and high levels of early delinquency.



Four-year reward trajectory predicting subsequent delinquency. Results for the unconditional model describing four years of rewards are in Table 6, Model 1. On average, rewards (spanning grades 9-12) was relatively stable over the four years. There was significant

inter-individual variation in early levels of rewards in grade 9 (intercept, random effects). Results for the conditional model in which the reward trajectory served as the independent variable and delinquency in grade 12 served as the dependent variable (see Figure 7, below) are in Table 6, Model 2. High early levels of perceived rewards in grade 9 predicted higher levels of delinquency in grade 12 (intercept), controlling for change in perceived rewards across the intervening years.

Figure 7. Conditional model of perceived rewards predicting delinquency.



Delinquency X self-control predicting four-year reward trajectory. Results for the base, unconditional model describing four years of rewards are provided in Table 7, Model 1.

Results for the first conditional model with covariates and predictors are seen in Table 7 Model 2. At a trend-level, girls perceived greater antisocial rewards than boys (intercept). However, boys showed relatively greater increases in rewards over four years relative to girls (slope). This relation represents an interaction between time and gender, and the form of perceived antisocial rewards trajectories by gender is shown in Figures 8a.

In order to better highlight advantages of our modeling individual growth (as in Figure 8a), estimated marginal means are also provided in Figure 8b. Figure 8b again highlights the importance of conceptualizing underlying adolescent developmental change when exploring predictors of delinquency. That is, here, a conceptually comparable modeling of mean change in perceived rewards by gender (e.g. repeated measure ANOVA), but without modeling starting points or rates of change, would suggest that at a mean level, girls generally perceive higher levels of rewards over time. Yet, modeling rate of change within individuals over time (e.g. trajectories) makes clear that while girls start higher on rewards early on, their developmental trend fundamentally differs from that of boys. Thus, interventions focused on male adolescents should arguably work to stem their marked increases in crime reward perceptions over the course of high school. Whereas for girls, such an approach is unlikely to be especially effective for preventing delinquency, given that rewards decline among female adolescents during this time, generally, on their own accord.

Figure 8a. Perceived antisocial rewards trajectories by gender.

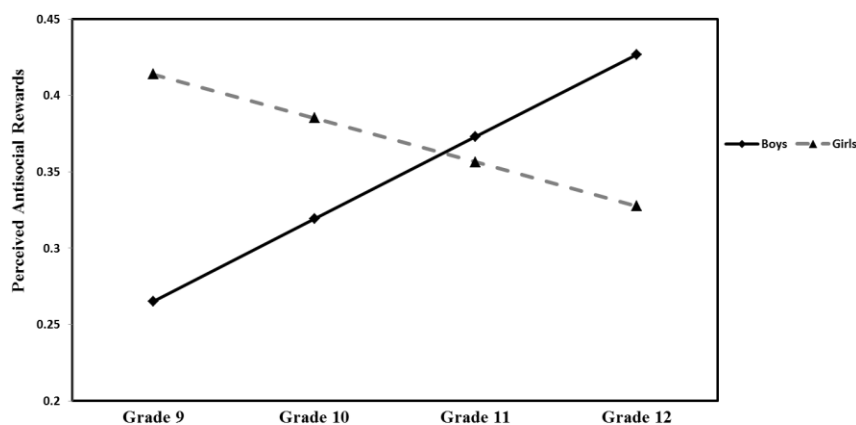
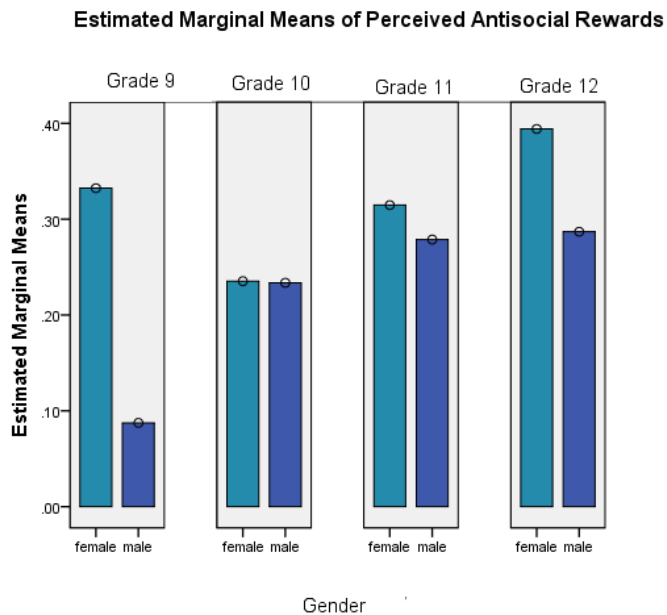


Figure 8b. Estimated means, perceived antisocial rewards by gender at each grade.



Results for the second conditional model in which the delinquency X self-control interaction term was entered into the model are in Table 7, Model 3. The conditional main effect for self-control was significant on the intercept, indicating higher levels of self-control were associated with higher levels of perceived antisocial rewards in grade 9, when the interaction between self-control and delinquency is accounted for. At a trend-level, girls perceived more antisocial rewards than boys in grade 9 (intercept), but boys showed relatively greater increases than girls over four years (slope), again with the delinquency X self-control interaction in the model.

The interaction between delinquency and self-control was significant on the intercept and at a trend-level predicted the slope of perceived antisocial rewards. This was further probed and

plotted. Probing at high and low values of self-control showed that at high values of self-control, there was a significant positive effect ($p < .05$) of delinquency on the intercept of perceived antisocial rewards and at low values of self-control, there was a significant positive effect of delinquency on the intercept ($p < .001$) and a significant negative effect of delinquency on the slope ($p \leq .001$) of perceived antisocial rewards. The form of the interaction is shown below in Figures 9a and 9b. Again, estimated marginal means for high and low self-control groups are displayed in Figure 9c1 and 2.

For youth high in self-control (Figure 9a), high early delinquency was associated with higher perceived rewards. Youth who engaged in high levels of delinquency in grade 9 generally increased in their reward perceptions over time. Whereas for youth who engaged in low levels and mean levels of delinquency in grade 9, perceived rewards were fairly stable over time. In general, however, high self-control youth engaging in high and mean levels of delinquency perceived relatively fewer antisocial rewards in comparison to their low self-control counterparts (described in Figure 9b).

Among low self-control youth, high early delinquency was associated with relatively high levels of perceived antisocial rewards. But this was followed by steep declines in rewards over time, pointing to a “topping out” of perceived rewards of antisocial behaviour early-on. Among youth who engaged in low levels of delinquency early on, there were few perceived rewards of antisocial behaviour, but these youth showed steady increases in perceived rewards over time.

Figure 9a. Delinquency predicting trajectories of perceived antisocial rewards for youth high in self-control.

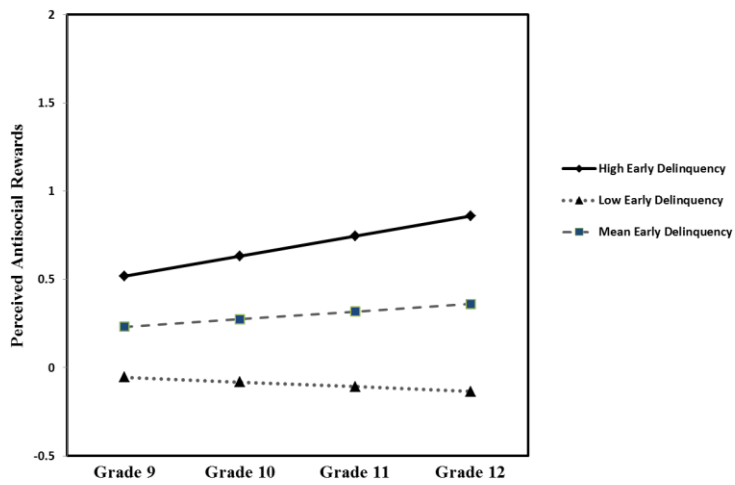
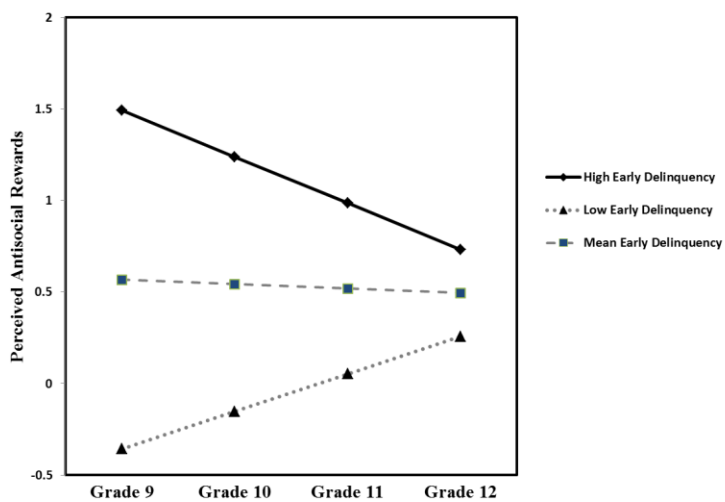


Figure 9b. Delinquency predicting trajectories of perceived antisocial rewards for youth low in self-control.



Again, the added benefits of considering underlying development in relation to self-control, rewards, and delinquency is demonstrated by our inclusion, below, of figures highlighting more traditional approaches to discerning mean differences between grade-levels (here in relation to levels of anticipated rewards over time). This is demonstrated by plotting of the estimated means for antisocial rewards at high and low levels of self-control. For high self-control youth, patterns are fairly similar to trajectory models and mean patterns generally show that high early-delinquency individuals maintain high levels of perceived rewards. However, this is not the case for low self-control youth. Rather, an examination of means for low self-control youth would point to these youth generally increasing in perceived rewards from one grade level to the next. Yet, mapping of within-person change made clear there is a fundamentally different developmental course for these youth, depending on early levels of delinquency engagement. Thus, our trajectory findings highlight the need for continued application of developmental approaches to delinquency research and prevention. In particular, trajectory results indicate that low self-control youth whom have not yet engaged in delinquency at the start of high school are among those most likely to benefit from prevention approaches which aim to stem cumulative increases in reward perceptions across high school. For youth low in self-control, whom have already engaged in delinquency, rewards appear to ebb on their own, and so these youth may perhaps benefit more from alternative approaches such as those emphasizing short and long term costs.

Figure 9 c1. Estimated marginal means for perceived antisocial rewards by early delinquency for high self-control youth.

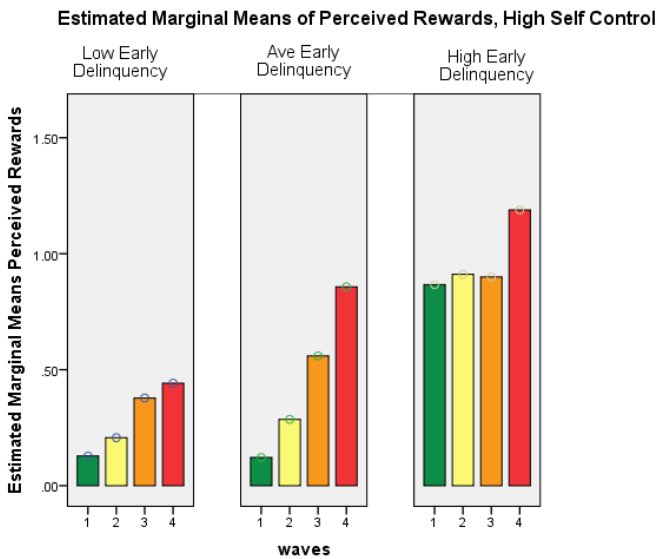
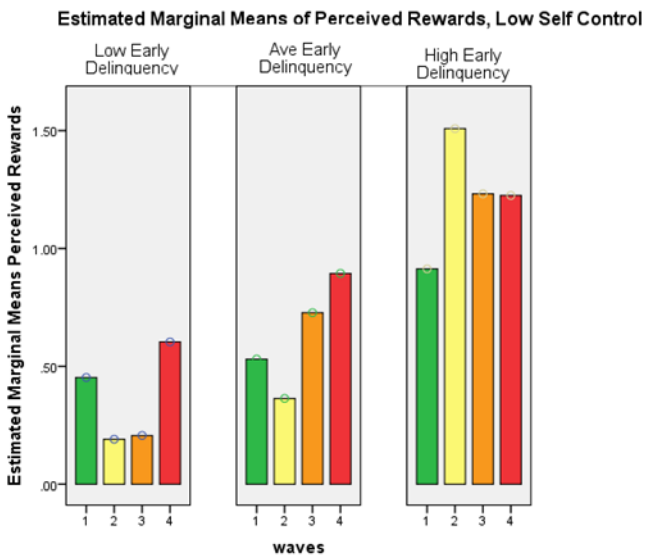


Figure 9c2. Estimated marginal means for perceived antisocial rewards by early delinquency for low self-control youth.



Brief Discussion- Rewards, Self-Control, and Delinquency

As a set, these analyses demonstrate that perceived rewards and delinquency are closely linked among Australian youth living in disadvantaged settings. Critically, these links appear to be most robust early in high-school, pointing to the importance of *timing* for preventive interventions targeting adolescents' antisocial reward perceptions.

The most robust effects of rewards in predicting delinquency appear to be early in the high school years. Across a number of analyses, high early rewards were associated with high early delinquency involvement (and with later delinquency involvement, net of change in rewards). But there were few effects of high perceived rewards on *changing* delinquency. When rewards influenced delinquency, results generally showed that youth with high early perceived rewards were declining or desisting from high levels of delinquency involvement. Thus programs and policies timed at or before the transition to high-school in order to improve antisocial decision making may prove most efficacious for prevention.

Delinquency also influenced rewards, and this effect was slightly more robust. Again, high early delinquency was associated with high early rewards, but this generally represented a ceiling-effect and high delinquency youth then declined in their perceived rewards later on. That said, there was some evidence that more rapid increases in delinquency predicted higher subsequent rewards later on—which points to the possibility that youth who are increasing their delinquency engagement are “collecting” rewarding experiences. These results highlight that youthful antisocial choices can serve to reinforce their positive assessments of delinquency, and again points to a need for programming that integrates critical appraisals of possible risks and benefits of antisocial behaviour.

As expected, low self-control (also described as low conscientiousness) was associated with higher levels of early delinquency, but again, these effects were not lasting. Low self-control youth rapidly declined in their delinquency later-on in the high school years. However, low self-control coupled with high or moderate perceived antisocial rewards was associated with the highest levels of delinquency across time-indicating that together these represent a paired-risk. Likewise, low self-control coupled with high early delinquency was also associated with high perceived rewards over the course of high school. That said, low self-control youth who perceived low levels of antisocial rewards engaged in the lowest levels of delinquency overall. Similarly, low self-control youth who engaged in very low levels of delinquency perceived the least antisocial rewards over time. Thus, low self-control in the form of lack of conscientiousness was not, in and of itself, a risk factor for delinquency involvement or for high perceived antisocial rewards. Rather, in combination with either early delinquency or early high rewards, low self-control represented a salient risk.

All told, these results point to the need for prevention approaches that work to reduce perceived rewards of delinquency among adolescents. Plausibly, by highlighting the short-term nature of rewards (e.g. excitement is not lasting), the possible costs associated with rewards (e.g. social reputation based on rule-breaking), and the possible consequences associated with costs (e.g. spending time in a juvenile facility) program leaders and clinicians can help to reduce the salience of rewards in adolescents' antisocial decision making (e.g. Modecki, 2016).

Practical implications. Youthful delinquency cannot be pinned to a single internal liability. Rather, adolescents' internal liabilities, including high anticipated antisocial rewards and low self-control, interact with other characteristics that are both internal (e.g. cognitive functioning) and external (e.g. family functioning and peer norms) to determine behavioural

outcomes. That said, in order to be effective prevention efforts should be based on “small theories” of program effects, in which escalations in delinquency are theorized to manifest as an outgrowth of risk-factors, which are *modifiable* and targeted via program change. Thus, our focus here is on adolescent reward perceptions and self-control as modifiable risks which can be targeting through programmatic efforts. How can programs and policies usefully harness these findings?

First, a focus on reducing perceived antisocial rewards-rather than simply increasing the salience of potential punishment and costs (e.g. deterrence) is called for here, especially during early adolescence and the transition to high school. Reducing perceived rewards means reducing the status, importance, and/or significance of benefits that at-risk teens discern as deriving from engaging in delinquent acts. Among these, the most frequently cited by both detained and non-detained youth are impressing peers, short-terms benefits such as channelling anger, generating excitement and reducing boredom, and tangible momentary rewards (e.g. from stealing or robbery) (Modecki, 2007; 2009). Consequently, youth workers would do well to acknowledge these and other perceived benefits, while also engaging in discussions with youth around the temporary nature of such rewards.

Youth also need reminding as to the costs that are associated with perceived antisocial rewards (e.g. there are costs associated with relying on delinquency to mitigate boredom rather than generating better options such as joining a sports team). Indeed, for youth to consider the possibility of generating better options (with even stronger potential for rewards) rather than engaging in delinquency, they may require enhanced valuing of prosocial goals. Illustratively, research has shown that enhanced perceptions of the importance of accomplishing adult goals-including employment- is associated with decreased delinquency at a future time-point (Iselin,

Mulvey, Loughran, Chung, & Schubert, 2012). This suggests that “changing the goal posts,” and perhaps the associated rewards that youth are seeking, could be a useful strategy. Finally, a third possible option for reducing perceived antisocial rewards may be to work with youth to enhance their counterfactual thinking. That is, within the health psychology field, scholars have begun to deploy interventions to induce individuals to consider the good *and* the bad that has resulted from their risky behaviours (Nasco & Marsh, 1999; Norman & Conner, 2006). The goal with counter-factual tasks is to induce self-conscious emotions such as regret, which brings negative consequences to the forefront, and arguably may lead youth to alter their behavioural intentions into the future (Smallman & Roese, 2009). Indeed, to date neither scholars nor practitioners have sufficiently acknowledged rewards (both perceived and experienced) associated with adolescents' problem behaviours. As a result, targeting reductions in anticipated rewards has generally been overlooked as a programmatic component for prevention and intervention, to date.

Although low self-control was not, in and of itself, the primary developmental risk contributing to delinquency in these analyses, it is worth briefly considering how programs might seek to apply the findings unearthed here. Low self-control or conscientiousness is likely best targeted through evidenced-based programs that enhance emotional control and decision making. A good example of such a program is the PATHS program, Promoting Alternative Thinking Strategies Program (Greenberg, Kusche, Cook, & Quamma, 1995), which targets internal and external regulation and affective-cognitive control, among other linked skills. There is considerable empirical evidence of long-term effects for PATHS as well as its cost-effectiveness (see Modecki, Zimmer-Gembeck, & Guerra, 2017). Likewise, Viewpoints is another well-known program that has been shown to improve decision-making skills among incarcerated youth and

invoke encouraging short-term reductions in externalizing (Guerra & Slaby, 1990). These and other well-regarded interventions are promising avenues for improving facets of self-control among youth and mitigating risk.

Methods-Emotions and Delinquency

Sample

Data were taken from one school cohort ($n = 109$; $M_{\text{age}} = 14.7$ years; $S.D. = .91$) of the “How do you feel?” project, an experience sampling study with low SES adolescents in Western Australia supported by the Young and Well Co-operative Research Centre established under the Australian Government’s Cooperative Research Centres Program (see Uink, Modecki, & Barber, 2017 for study description). From this cohort, 112 adolescents commenced participation; however, two participants withdrew consent during the study and another did not commence the experience sampling method (ESM) phase (see below).

The school was recruited for the study based on a) location within the Perth metropolitan area (e.g. a non-rural setting) and b) falling within the lower-half of the state SES, determined by an Index of Community and Socio-Education Economic Disadvantage (ISCEA; Australian Curriculum, Assessment & Reporting Authority, 2013). As described earlier, ISCEA values are determined based on the school’s geographical location, parental education and occupational levels and percentage of Indigenous and non-English speaking background students. Hence, this was a non-rural school with low relatively low levels of parental education and occupation and relatively higher percentage of Indigenous and ethnic-minority students. Illustratively, more than half of students reported low levels of parental education-25% of participants did not know maternal education level, 26% of participants’ mothers had not finished high school, 32.3% had

finished high school, and 13.5% had finished university. The majority of participants reported their ethnicity as Caucasian (71.6%); other ethnicities were 7.3% Maori, 3.7% African, .9% Asian, .9% Aboriginal or Torres Strait Islander, and 11.0% “other”. 4.6% of participants did not report their ethnicity. There was no significant gender difference in age, $t(91) = .136$, $p = .892$; girls $M_{age} = 14.72$ years, boys $M_{age} = 14.73$ years.

.Procedure

Original data collection took place over the 2 weeks in the final school term of 2013 and over 3 weeks in the first term of 2014. Data were collected in two time periods due to a limited number of smartphones, although data from both periods was combined for the final sample. Adolescents and their parents were invited to participate in the study and gave written consent prior to participating. Approval for the study was granted by the University Human Ethics Committee. Participants did not receive any financial compensation for participation in the study, but were loaned a new-model iPhone with call and data plans for their use for one week, with which to complete surveys.

Baseline and post-ESM phase. Prior to the ESM phase, participants completed a computerized baseline survey (Time 1 survey) containing questions about demographics (e.g. age, gender, parental education level), delinquency and other psychological variables (e.g. internalizing symptoms). Immediately after completing the ESM phase, participants completed the same computerized survey (Time 2 survey). The survey was given twice in order to establish the stability of proposed traits measured in the survey.

ESM phase. The ESM phase consisted of youth receiving text-message links to a web-based survey five times a day for seven days. The goal of ESM is to assess “in situ” emotions,

experiences, and decisions as they occur, in the context of adolescents' day-to-day life (Modecki & Mazza, 2017). For this phase of the research, adolescents were provided an iPhone 5, which they used to complete the ESM surveys. Throughout this phase adolescents were sent links to the web-based surveys and were instructed to click on the link and complete the survey as soon as it was sent or at a time of nearest convenience (e.g. if they were currently occupied in another activity). Each survey closed to responses within an hour after the text message was sent. The time period of an hour has been used in previous ESM studies to minimize retrospective bias (Silk et al., 2003). The iPhones were equipped with free data plans so that participants were able to access the internet to complete the ESM surveys. Surveys were sent five times a day (between the hours of 7:00 am and 10:30pm) for 7 days (Monday lunch-following Monday morning), resulting in a total of 35 sampling moments. Survey times were piloted in a separate sample of adolescents and found to be suitable based on participant feedback. The exact survey times were randomized within the allocated timeframes to prevent participants from habituating to a set response time. A researcher was on site at the school each day to help adolescents with any technical issues they had with the phones or survey. Participants returned the smartphones to researchers at the end of the ESM phase.

Pre-Post Measures

Delinquency. Delinquency was assessed with 15 items which asked adolescents how often they had engaged in delinquent, aggressive, deceitful and risky behaviours in the last 6 months (e.g. "About how often in the last 6 months have you used drugs?", "...gotten in a physical fight with another person?"; 0 = none, 7 = 31 or more times). Internal reliability at Time 1 and Time 2 was excellent ($\alpha = .85$, $\alpha = .90$). Adolescents' scores from Time 1 and Time 2 surveys were averaged to create a delinquent behaviour variable. Delinquency scores were

positively associated with number of major life stressors within the last six months ($r = .44, p < .01$) and negatively associated with self-esteem ($r = -.32, p < .01$). Delinquency was not associated with depression status ($r = .01, p > .05$), but was positively associated with social anxiety ($r = .25, p < .05$).

On average, the sample reported engaging in delinquency once in the past six months. Examining frequency, roughly 80 % (78.7%) of youth had engaged in at least one delinquent behaviour in the last six months, and 50% of youth had engaged in three or more behaviours in the last six months. The top quartile of the distribution reported engaging in 6-12 of these behaviours in the last six months. Here, we used a median-split to define high and low delinquency youth, so that low delinquency youth on average reported engaging in only one of the possible delinquent behaviours over the past six months, whereas high delinquency youth reported on average engaging in seven of the fifteen possible behaviours. There were no significant gender differences between the high and low delinquency groups ($\chi^2(1) = 1.25, ns$). We did not explore delinquency group differences based on ethnicity because our sample was largely Caucasian and ethnic minority subgroups were not large enough (e.g. less than 15% of youth reported belonging to any one ethnic minority group) for us to have confidence in findings.

Perceived antisocial rewards. Perceived antisocial rewards was assessed using six items from a valid construct tapping rewards associated with problematic decision making in adolescents (Bentlin et al., 1993). This measure has shown good validity in international samples, including most recently in samples of adolescents across 11 different countries (e.g. Duell et al., 2016 in 11 countries) and correlates with self-report and experimental indicators of risk taking and sensation seeking. Adolescents were asked to indicate how many advantages or benefits there were to doing six illegal behaviours, including shoplifting, binge drinking, illegal

drug use, carrying a knife or weapon, and illegal driving behaviours. Responses ranged from 0 (no benefits/advantages) to 8 (a lot of benefits/advantages). Reliability of the measures in this sample at time 1 was $\alpha = .92$ and at time 2 was $\alpha = .93$. Adolescents' scores from Time 1 and Time 2 surveys were averaged to create a reward-sensitivity variable.

Depression. Adolescents completed the Reynolds Adolescent Depression Scale 2nd edition (RADS-2; Reynolds, 2002). The RADS-2 assesses for risk of a diagnosis of clinical depression by measuring levels of anhedonia, dysphoric mood, negative self-evaluation and somatic symptoms (e.g. "How often do you feel...sorry for myself"; 1 = Almost never, 4 = Most of the time.) The measure is a clinical assessment widely used internationally and has demonstrated validity within Australian samples (Hayes, Boyd, & Sewell, 2011). Internal reliability at Time 1 and 2 was high ($\alpha = .82$, $\alpha = .87$). Participants were coded as at risk for depression if they scored above a clinical cut-off value at either Time 1 or Time 2 ($n = 16$). In multi-level models, depending on the research question, youth above the clinical cut-off value for depression were either excluded (antisocial behaviour analyses), or the clinical cut-score was entered as a control variable at level 2 (emotion analyses).

ESM Measures

Daily antisocial behaviours. At each sampling moment adolescents responded to the question "Since the last message, did you do anything risky or dangerous?". A day-level risk behaviour variable was created, dummy coded so that 0 = no risk behaviour that day, 1 = risk behaviour that day. "Yes" daily risk responses ranged from 9% to 25% of sample, depending on day, and within-person consistency was $\alpha = .58$.

Daily stressors and positive events. At each sampling moment adolescents responded to the question “Since you were last messaged has anything bad/good happened to you?” This question format has been used previously in ESM studies (Schneiders et al., 2006). Adolescents were also asked to describe the event, and give an appraisal of the event (1 = “not so good/not so bad”, 5 = very good/bad”). Only events that were rated 3 or more on the appraisal item were included here. Separate variables for positive events and hassles were created, dummy coded so that 0 = no stressor/positive event that day, 1 = ≥ 1 stressor /positive event(s) that day.

Emotions. Adolescents rated how happy, bored, angry, excited, sad, worried, jealous and lonely they were feeling on a 5-point Likert scale (1 = “Not at all”, 5 = “Very Much”), at each sampling moment. The primary emotions of happy, sad and angry were used in the current analysis. Excitement and loneliness were also examined as additional positive and negative emotions. An individual’s scores for each emotion were averaged across the day to create day-level variables, used for multi-level analyses. Internal consistencies for daily happiness, excitement, anger, sadness and loneliness were high ($\alpha = .88$, $\alpha = .93$, $\alpha = .91$, $\alpha = .95$, $\alpha = .96$).

Plan of Analyses

We first examined adolescents’ variability in emotion across the 35 time points based on level of delinquency using adolescent’s root mean square successive difference (RMSSD) score. RMSSD scores represent the square root of mean square successive difference scores, adjusted for positive skew. Importantly, higher RMSSD scores suggest greater emotional variability.

Next, we ran two sets of analyses using multilevel modelling (MLM). First, we examined day-level emotions in relation to experiencing a daily stressful event, and whether this relation was moderated by person-level delinquency. Second, we examined day-level emotions in

relation to engaging in a daily antisocial behaviour, and whether this relation was moderated by person-level reward sensitivity. In these analyses, because repeated measures of stressors, antisocial behaviours, and emotions were nested within individuals, we used MLM which provides unbiased estimates of clustered or nested data, and allows for non-independence between repeated measures (Hox, 2010). For each set of analyses, unconditional models for each emotion were run prior to main analysis to test for level of variance in each emotion at the within-person level (level 1) and at the between-person level (level 2). Analyses were conducted in Mplus 7.0 (Muthén and Muthén 2013) using Full Information Maximum Likelihood estimation.

Results-Emotion and Delinquency

Emotional variability and delinquency. We calculated a RMSSD score for each participant based on their emotion reports across the week. RMSSD scores represent how much an individual's emotion varies from one time point to the next, as well as how dependent an individual's current emotion score is on their previous level of emotion (Jahng, Wood, & Trull, 2008). Thus, higher RMSSD scores suggest greater variability in emotion, which is attributable to greater deviations from an adolescent's typical level of emotion for the week.

Adolescents' delinquency scores were entered into a single-level multiple regression model, with average level of emotion across the week, depressive symptoms and social anxiety symptoms as co-variates and RMSSD score for each emotion as the dependent variable. Results indicated that adolescents who engaged in high levels of delinquency had significantly *less* variability in emotions examined (happiness, anger, sadness, and loneliness; Table 8), with the exception of excitement.

These results indicate that youth who engage in high levels of delinquency generally report more stable emotions from one time point to the next, indicating a lack of variability and flexibility in emotional responding. Figures 10A and 10B show this relation graphically for anger as a means to illustrate the ebb-and-flow of emotions from one time point to the next, as well as highlight typical variability found among youth at low and high levels of delinquency. As seen in Figure 10A, below, for a randomly selected youth scoring above the median on delinquency involvement, momentary anger across 35 time points is generally more fixed (as seen by points more closely clustered together and clustered around the individual's average anger for the week). However as seen in Figure 10B, for a randomly selected youth scoring below the median on delinquency involvement, momentary anger across the 35 time points is more irregular, though generally lower.

Figure 10A. A randomly selected youth scoring above the median on delinquency involvement, momentary anger across 35 time points.

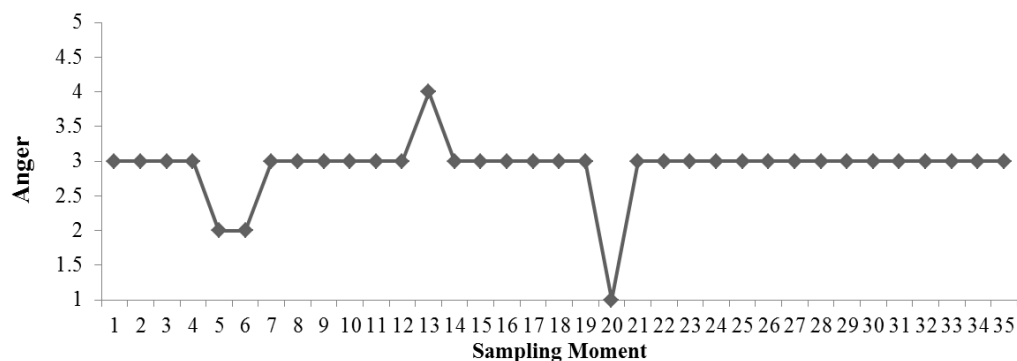
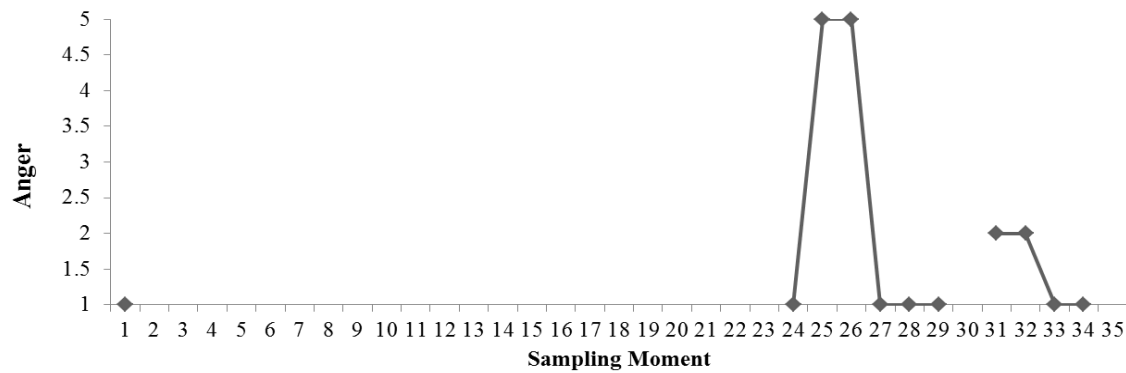


Figure 10B. A randomly selected youth scoring below the median on delinquency involvement, momentary anger across 35 time points.



Figures 11A and 11B show this relation graphically for happiness. As seen in Figure 11A, below, for a randomly selected youth scoring above the median on delinquency involvement, momentary happiness across 35 time points is again generally more stable, and lower. However as seen in Figure 11B, for a randomly selected youth scoring below the median on delinquency involvement, momentary happiness across the 35 time points is more variable, and generally higher.

Figure 11A. A randomly selected youth scoring above the median on delinquency involvement, momentary happiness across 35 time points.

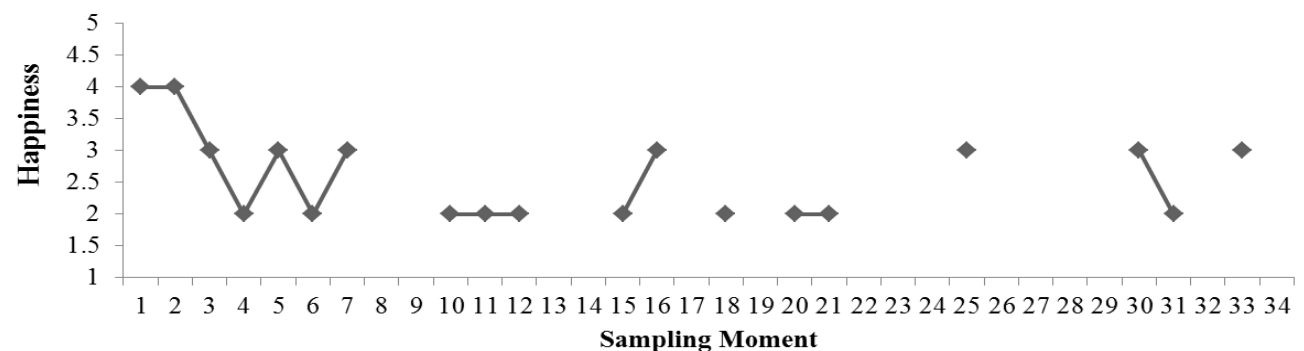
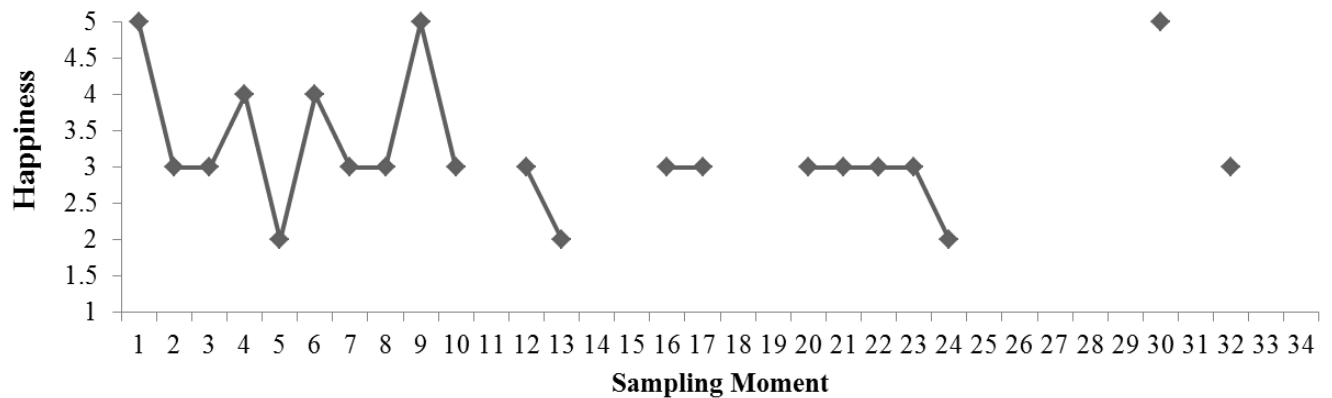


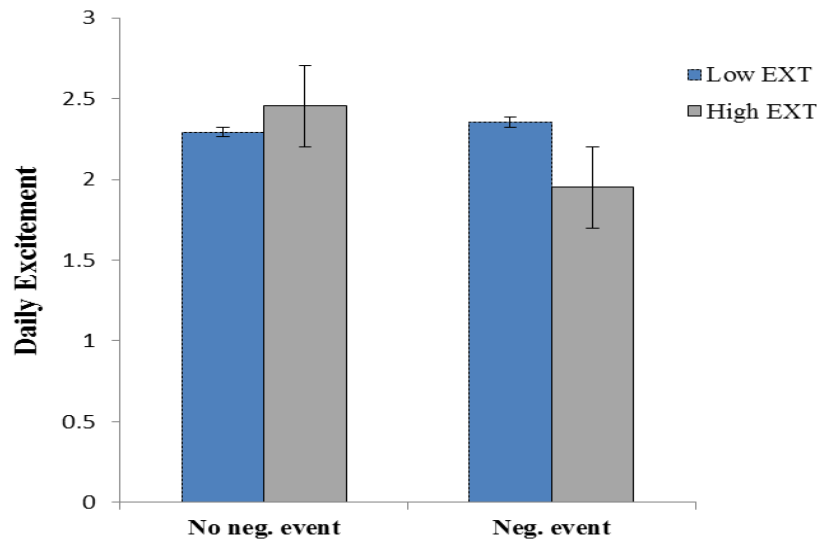
Figure 11B. A randomly selected youth scoring below the median on delinquency involvement, momentary happiness across 35 time points.



Emotional responding to negative events. Table 9 reports the results of analyses testing the cross-level interaction between experience of a stressor X delinquency on average daily emotion. There were no main effects for delinquency on emotion across any of the emotions tested. However, there were significant cross-level interactions between stressor X delinquency on daily emotion for excitement, anger, and loneliness. All significant interactions were plotted and probed.

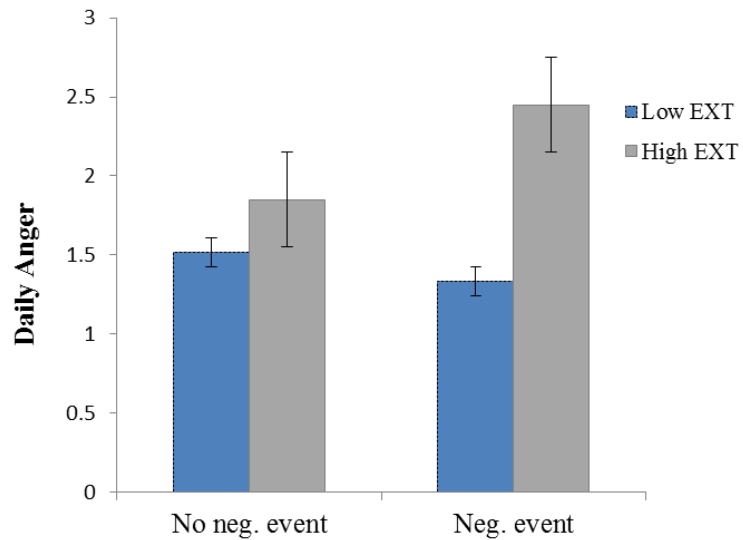
For excitement, the form of the interaction is shown graphically below in Figure 12. Probing of simple slopes showed that youth high in externalizing (delinquency) had significant dips in excitement on days with stressors relative to days without ($b = -.501, p < .05$); whereas youth low in externalizing (delinquency) did not show significant change in daily excitement on days with stressor ($b = .061, p > .05$).

Figure 12. Simple slopes of daily excitement on days with and without a stressful event for youth high and low on delinquency.



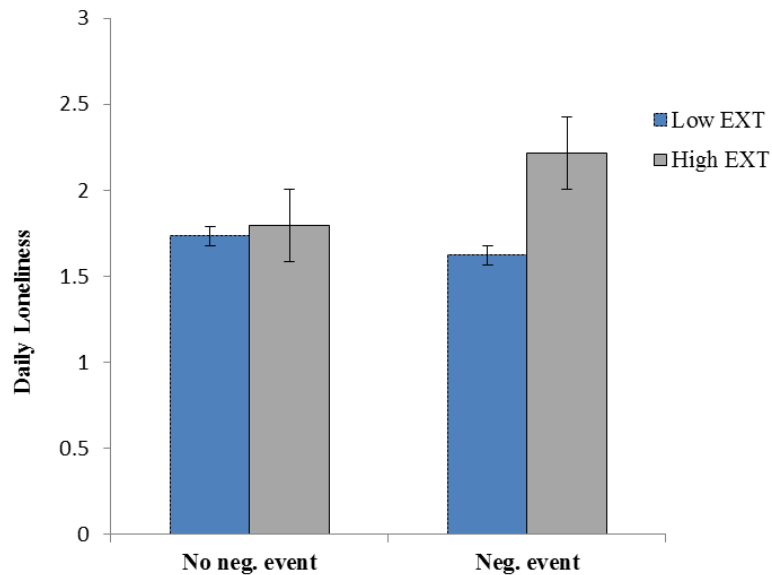
For anger, the form of the interaction is shown graphically below in Figure 13. Probing of simple slopes showed that youth high in externalizing (delinquency) had significant surges in anger on days with stressors relative to days without ($b = .61, p < .001$); whereas youth low in externalizing (delinquency) did not show significant change in daily anger on days with stressors ($b = -.176, p > .05$).

Figure 13. Simple slopes of daily anger on days with and without a stressful event for youth high and low on delinquency.



For loneliness, the form of the interaction is shown graphically below in Figure 14. Probing of simple slopes showed that youth high in externalizing (delinquency) had significant surges in loneliness on days with stressors relative to days without ($b = .425, p < .05$); whereas youth low in externalizing (delinquency) showed significant decreases in daily loneliness on days they experienced a stressor ($b = -.110, p < .001$).

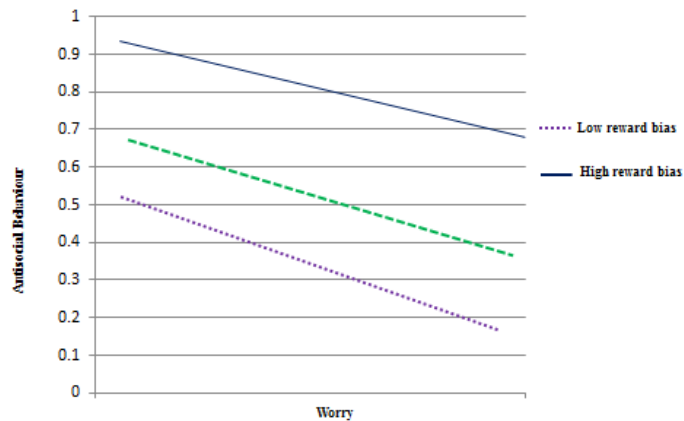
Figure 14. Simple slopes of daily loneliness on days with and without a stressful event for youth high and low on delinquency.



Emotion X reward bias predicting antisocial behaviours. Table 10 reports the results of analyses testing the cross-level interaction between reward-bias and daily emotion on average daily engagement in antisocial behaviour. There were no main effects for emotion on antisocial behaviour across any of the emotions tested. However, there were significant cross-level interactions between daily emotion X reward bias predicting daily antisocial behaviour for the emotions of worried and bored.

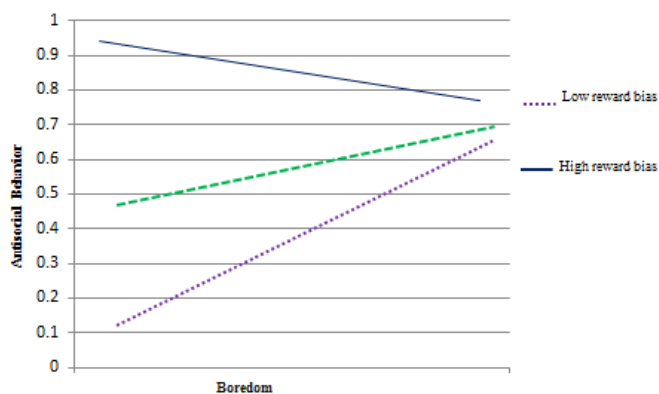
For worry, examination of simple slopes revealed that both high and low reward bias youth were less likely to engage in antisocial behaviour on days when they were more worried than usual. This relation was stronger for youth low in reward bias, as shown in Figure 15.

Figure 15. Simple slopes of daily worry predicting daily antisocial behaviour for youth high and low on reward-bias.



For bored, examination of simple slopes revealed that all youth were more likely to engage in antisocial behaviour on days when their boredom was higher than their usual. However, as shown in Figure 16, this relation was stronger for youth lower in reward-bias.

Figure 16. Simple slopes of daily boredom predicting daily antisocial behaviour for youth high and low on reward-bias.



Brief Discussion-Emotions and Delinquency

These findings point to the salience of adolescents' daily emotional experiences to their delinquency involvement and highlight the need for continued research on the role of affective states in antisocial decision making.

First, youth who were highly delinquent tended to report more "fixed" emotional states. Overall these youth tended to "carry forward" their negative emotions from moment-to-moment. In contrast, youth who engaged in relatively little delinquency appeared to be more emotionally flexible, and reported a wide variety of emotional experiences across their week. These findings suggest that programs designed to help youth identify their emotional states may be especially important during adolescence. Services designed to help youth form emotional responses that are flexible in relation to various contexts and settings could help them to adapt more effectively to their environment. Such programs could arguably help protect delinquent youth from being ensnared in negative emotions and situations that further instigate and perpetuate their antisocial behaviour involvement.

Second, youth who were highly delinquent also tended to react in more extreme ways to stressful events, again pointing to a lack of emotional adaptability among this group of adolescents. Intense reactions to setbacks render youth less-able to problem solve, cope, and respond effectively to challenges and hassles. Consequently, these youth will arguably find it challenging to navigate everyday difficulties that emerge in the course of day-to-day-life. Lacking the ability to react with emotional "moderation," highly delinquent youth may contribute to the manifestation of increased stressors and problems, as they over-respond to

challenges and hassles. Again, these findings point to the need for programs and services that help youth to identify and moderate their emotional experiences.

Finally, emotional experiences appeared to help certain youth to avoid problematic acting out, but this was the case only for young people who generally perceived few antisocial rewards, overall. That is, for youth who generally found antisocial activity relatively “unrewarding” emotional over-arousal in the form of worry worked to navigate youth away from problematic choices. However, under-arousal in the form of boredom worked to navigate these youth towards problematic decisions. By contrast, for youth high in reward bias, daily antisocial behaviour tended to occur regardless of emotional experiences. High reward bias youth chose to engage in antisocial behaviour, whether they experienced especially high or low levels of boredom or worry relative to their norm. These findings highlight a role for working with youth to use their “gist” emotional experiences of worry to guide them away from problems. Further, too, they point to the powerful role of perceived rewards in adolescent delinquency, again speaking to the need to focus on rewards as well as costs of crime within juvenile justice policy and programming.

Practical implications. Given the “in situ” nature of these findings, there are several practical implications that might be derived. First, flexible emotional responding is a key skill that seems to be protective among at-risk youth. While research continues to work to pinpoint the characteristics that undergird such emotional flexibility (Zimmer-Gembeck et al, under review), there are several promising avenues for intervention worth considering in the meantime. First, mindfulness meditation programs have shown effectiveness for improving emotion regulation and reducing externalizing among children (Bögels, Hoogstad, van Dun, de Schutter, & Restifo, 2008). These and other programs aimed at improved regulation (e.g. social-emotional learning

programs) may represent a useful strategy for helping at-risk youth navigate problems, especially when combined with decision making and other key skills required for positive long-term outcomes (Durlak et al, 2011; Williamson, Modecki, & Guerra, 2015).

Second, youth require assistance with their intense reactions to stressful events, and maladaptive coping, including disengagement coping, and emotional suppression, avoidance, and denial are associated with higher levels of psychopathology symptoms (Compas et al., 2017). There exists good evidence for the effectiveness of several distinct family-based programs for improving coping and emotion-regulation skills and, in turn, decreasing youthful externalizing (Compas et al., 2010; Family Bereavement Program-Tein, Sandler, Ayers, & Wolchik, 2006). While these programs are generally designed to work with youth and their parents in relation to their experiencing of major-life stressors (e.g. parental bereavement), learning these skills in coping and affect regulation might arguably enhance outcomes for youth experiencing daily stressors (e.g. discrimination, community violence) as well.

Third, these findings again highlight the role of perceived rewards in problem behavior—here in relation to reward bias. Because reward-biased youth do not appear to “tune in” to their emotional experiences, it is worth considering how youth personnel might help to mitigate this bias. One interesting possibility that is potentially worth exploring is to consider targeting youths’ over confidence, that is, their flawed perceptions of their ability to “get away” with problematic behaviours. Flawed self-assessment means that as youth “get away” with crimes, they attribute this to their own skills, and this is especially likely to be the case early in their criminal careers (Loughran, Paternoster, Piquero, & Fagan, 2013). Thus, practitioners and programs might work with youth to assess the accuracy of their perceptions of potential success, and whether brushing off affective signals is a useful strategy for navigating decisions with

serious long-term consequences. To the extent that adolescents are over-confident, this may enable them to tune-out fear and worry, emotions that can help shape risk-aversion and prosocial behavior.

Methods-Advisory Panel

In order to further our translational study aims, a small advisory panel was formed from police and youth personnel whom connected with study authors through the Youth Violence: Cutting to the Core 2015 conference in Brisbane, QLD. Throughout the award period, panel members received updates on chapters and papers written as part of the Criminology Research Grant, and were asked to provide law-enforcement perspective and context for preliminary findings, prior to finalizing of the report. An intensive group conference call was held to discuss study analyses and a first draft of the report, and members highlighted important take-homes from the perspective of corrections and police personnel. These have been integrated throughout the report, as have suggested ideas for future research possibilities. Notably, all panel members expressed enthusiasm for continued links between criminology researchers and practitioners, as in the project described here. It was noted that far too often, practical exchange of information can be “lost in translation” between researchers and practitioners (and vice-versa). All panel members provided valuable insight to the project. Sergeant Victoria Lewis and Inspector Corey Allen, in particular, dedicated substantial effort to adding additional context to study findings and linking-back to their own police-based experiences and recommendations.

Conclusion

In contrast to a developing empirical focus on rewards and emotions as instigators of adolescents’ antisocial choices, intervention and prevention programs implemented to date

typically target youths' "cold" risk perceptions for deterrence. At present, cognitive-behavioural treatments represent our most effective tool for decreasing youth delinquency and violence (Izzo & Ross, 1990; Wilson et al., 2001). However, rates of delinquency and violence remain high in Australia and around the world, signaling a need for researchers to enhance this treatment approach. To do so, practitioners and program developer require an accurate picture of youth's decision process, one that recognizes the highly activating influence of rewards and emotions on adolescents' behaviour (Guerra, Williams, Tolan, & Modecki, 2008).

In contrast to programs focused on "cold" cognitions, over-arching capacities that help regulate youths' behaviour during times of salient environmental reward and heavy emotion have been labeled "hot" executive functions (Zelazo, & Carlson, 2012). Findings from two distinct data sets in this project indicate a role of sensitivity to the perceived rewards of delinquent behaviour and a role of deficits in emotional processing in contributing to youths' antisocial decision making. Hence, findings from this project point to programming needs that focus on assisting youth with these "hot" executive functions in a bid to reduce engagement in delinquent behaviour.

The leveraging of a relatively large longitudinal data set in this project allowed us to map trajectories of delinquent behaviour across the high-school years. This is important, because characteristics presumed to develop or otherwise be affected by chronological age and/or stage of life (e.g. adolescence) must be charted in order to facilitate understanding of what is developmentally normative, as well as how maturational changes contribute to desistance. Such charting reaches critical significance to the crime and justice field where children and youth are concerned. Indeed, youth crime prevention and intervention programming are, by definition, designed with the intent to change youths' developmental course. In order to do so, researchers

and practitioners must have a fundamental understanding of what this course (trajectory) looks like. Armed with this knowledge, policy makers and service providers can make most efficient use of resources, choosing which programs to deploy and when in an effort to prevent and reduce juvenile crime.

Simultaneously, we were able to trace parallels in changes in reward sensitivity and delinquency, and examine the conditioning effects of self-control. Our findings point to a positive relation between reward sensitivity and delinquency in the early adolescent years. Thus, including components to prevention programs that help youth weigh-up both the costs and benefits of delinquent behaviour may be especially important prior to and at the start of high-school. As alluded to earlier, cognitive behavioural programs are an important therapeutic approach to help youth develop thinking skills to assist in this process (Izzo & Ross, 1990). With practice and scaffolding, adolescents can be assisted to deploy flexible thinking skills during times of high environmental reward (e.g. with their peer group).

The use of rich experience sampling data in the second dataset allowed us to tap into youths' in-the-moment emotions and recent engagement in antisocial behaviour. Again, our leveraging of these detailed data from a sample of at-risk Australian youth provided a unique opportunity to chart within-person change and assess fundamental differences in emotion flexibility and reactivity based on youths' delinquency engagement. Findings from these data suggest an intricate relation between daily emotions, antisocial behaviour and reward sensitivity. Youth who engage in delinquent behaviours demonstrate a unique emotion profile, characterized by reduced emotional variability but heightened emotional reactivity to daily stress. These findings can be best understood in terms of these youths' inability to shift out of negative emotion states, but also a reactive, negative affective response to challenges and hassles. Overall,

these results point to a broader deficit in emotional flexibility among highly delinquent youth. Thus, programs aimed at improving the emotional wellbeing of youth who engage in delinquent behaviours should seek to enhance emotional flexibility skills. For instance, mindfulness techniques can help shift youths' attention away from negative emotions (Chambers, Gullone, & Allen, 2009). Mindfulness techniques may also assist youth in "tuning into" less intense emotions they experience in-the-moment, rather than becoming overwhelmed with the most intense emotion at present. In this way, youth can be prompted listen to their "gut," so to speak, which may guide them away antisocial behaviour.

Furthering future research. There are several areas of study that are worth considering for future research. First, further research examining gender differences in the development of delinquency would be beneficial, and might help determine whether gender-specific interventions would be useful. It may be the case that boys perceive differential antisocial rewards than girls, that low self-control manifests differently for boys versus girls, or that emotional flexibility is underpinned by overlapping, but different skill-sets for boys versus girls. Future research should explore these and other possibilities.

Second, there is a need to examine in more detail the different programs offered throughout states and territories (including whether they have a program logic, established theory of change, the research underpinning them) in order to better determine what programming is already in place, and how it might benefit from add-on components to address factors described here.

Third and finally, research is needed that examines specific interventions and programs using these concepts. One essential step towards facilitating such work will be research that provides service providers with tools to better understand how each individual offender thinks,

responds to events, and emotionally self-regulates. Any one of these tools would prove extremely valuable.

Bridging to Programs and Services

Translating our psychological understanding of adolescent development to youth prevention and rehabilitation represents a strategic investment. As research continues to elucidate the pathways by which youth are lead to initiate and escalate their delinquency, policy and programs can only serve to benefit.

Our findings highlight a need for programs and services that focus on improved decision making and emotional flexibility in order to help facilitate youth resilience and prevent delinquency. Current programs to reduce youthful delinquency and aggression could arguably improve their effectiveness by expanding their focus to reducing adolescents' reward sensitivity, helping youth to cope flexibly with their emotions, and increasing their engagement of "hot" executive functions (e.g. Eisenberg, Spinrad, & Eggum, 2010; Riggs, Greenberg, Kusché, & Pentz, 2006). One example of the manner in which these might be targeted is via "add on" modules to existing cognitive-behavioural programs which are already known to be relatively effective.

In terms of front-end services provided by law-enforcement personnel in the community, holistic approaches that model procedural justice with high-value groups of at-risk youth may be an especially useful crime-prevention strategy. These approaches need to balance law-enforcement with assisting youth and reconnecting them with supports from families, schools, and communities. Thus, diverting high-value, at-risk youth from crime may be best achieved through access to a range of community-based support services that are provided within an open-

door framework. Because youth require sustained relationships with adults who can mentor them, offer non-adversarial advice, and provide follow-up, these types of supports may be most effectively delivered vis a vis partnering with respected community members. Youth-workers are one notable asset in this regard, as respected adults who can simultaneously acknowledge cultural and community norms, and offer cooperative, non-judgmental approaches to diverting youth from crime. In all, because offending among mid-to-late adolescents tends to be especially costly for society (Piquero, Jennings, & Farrington, 2013), these types of front-end engagements to divert youth from antisocial pathways early on should reap substantial monetary and social benefits.

References

- Australian Bureau of Statistics. (2007). *Schools* (No. 4221.0). Retrieved from <http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf>.
- Australian crime: Facts & figures: 2013. ISSN 1836-2249. Canberra: Australian Institute of Criminology, July 2014.
- Australian Curriculum, Assessment & Reporting Authority. (2013). ACARA: Australian curriculum, assessment and reporting authority. Retrieved from <http://www.acara.edu.au/default.asp>
- Benthin, A., Slovic, P., & Severson, H. (1993). A psychometric study of adolescent risk perception. *Journal of Adolescence*, 16(2), 153-168.
- Blomfield, C. J., & Barber, B. L. (2011). Developmental experiences during extracurricular activities and Australian adolescents' self-concept: Particularly important for youth from disadvantaged schools. *Journal of Youth and Adolescence*, 40(5), 582-594.
- Bögels, S., Hoogstad, B., van Dun, L., de Schutter, S., & Restifo, K. (2008). Mindfulness training for adolescents with externalizing disorders and their parents. *Behavioural and Cognitive Psychotherapy*, 36(2), 193-209.
- Bongers, I.L., Koot, H.M., van der Ende, J., & Verhulst, F.C. (2004). Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development*, 75(7), 1523-1537. doi: 0.1111/j.1467-8624.2004.00755.x
- Cauffman, E., Steinberg, L., & Piquero, A. R. (2005). Psychological, neuropsychological and physiological correlates of serious antisocial behavior in adolescence: The role of self-control. *Criminology*, 43(1), 133-176.

- Cauffman, E., & Steinberg, L. (2000). (Im) maturity of judgment in adolescence: Why adolescents may be less culpable than adults. *Behavioral Sciences & the Law*, 18(6), 741-760.
- Chambers, R., Gullone, E., & Allen, N.B. (2009). Mindful emotion regulation: An integrative review. *Clinical Psychology Review*, 29(6), 560–572
- Centifanti L.M., & Modecki, K.L. (2013). Throwing caution to the wind: Callous-unemotional traits and risk taking in adolescents. *Journal of Clinical Child & Adolescent Psychology*, 42(1) 106-119.
- Compas, B. E., Champion, J. E., Forehand, R., Cole, D. A., Reeslund, K. L., Fear, J., ... Roberts, L. (2010). Coping and parenting: Mediators of 12-month outcomes of a family group cognitive-behavioral preventive intervention with families of depressed parents. *Journal of Consulting and Clinical Psychology*, 78, 623–634. doi:[10.1037/a0020459](https://doi.org/10.1037/a0020459)
- Compas, B. E., Jaser, S. S., Bettis, A. H., Watson, K. H., Gruhn, M. A., Dunbar, J. P., Williams, E., & Thigpen, J. C. (2017, June 15). Coping, emotion regulation, and psychopathology in childhood and adolescence: A meta-analysis and narrative review. *Psychological Bulletin*. Advance online publication. <http://dx.doi.org/10.1037/bul0000110>
- Cooper, M. L., Agocha, V. B., & Sheldon, M. S. (2000). A motivational perspective on risky behaviors: The role of personality and affect regulatory processes. *Journal of Personality*, 68(6), 1059-1088.
- Crone, E. A., & Dahl, R. E. (2012). Understanding adolescence as a period of social-affective engagement and goal flexibility. *Nature Reviews Neuroscience*, 13(9), 636-650.

- Duell, N., Steinberg, L., Chein, J., Al-Hassan, S. M., Bacchini, D., Lei, C., ... & Lansford, J. E. (2016). Interaction of reward seeking and self-regulation in the prediction of risk taking: A cross-national test of the dual systems model. *Developmental Psychology*, 52(10), 1593-1605.
- Duncan, T. E., & Duncan, S. C. (2009). The ABC's of LGM: an introductory guide to latent variable growth curve modeling. *Social and Personality Psychology Compass*, 3(6), 979-991.
- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405-432.
- Edwards, J., Hemphill, S. A., Tresidder, J., Humphreys, C., Toumbourou, J. W., & Murray, D. (2007). Mental health promotion and socioeconomic disadvantage: lessons from substance abuse, violence and crime prevention and child health. *Health Promotion Journal of Australia: Official Journal of Australian Association of Health Promotion Professionals*, 18(3), 184.
- Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual Review of Clinical Psychology*, 6, 495.
- Fagan, J., & Piquero, A. R. (2007). Rational choice and developmental influences on recidivism among adolescent felony offenders. *Journal of Empirical Legal Studies*, 4(4), 715-748.
- Farrington, D. P. (1988). Advancing knowledge about delinquency and crime: The need for a coordinated program of longitudinal research. *Behavioral Sciences & the Law*, 6(3), 307-331.

- Fine, J. G., & Sung, C. (2014). Neuroscience of child and adolescent health development. *Journal of Counseling Psychology, 61*, 521.
- Fredricks, J. A., & Eccles, J. S. (2006). Is extracurricular participation associated with beneficial outcomes? Concurrent and longitudinal relations. *Developmental Psychology, 42*(4), 698.
- Galván A., Hare, T., Voss, H., Glover, G., & Casey, B. J. (2007). Risk-taking and the adolescent brain: who is at risk?. *Developmental Science, 10*(2), F8-F14.
- Galván, A., & McGlennen, K. M. (2012). Daily stress increases risky decision-making in adolescents: A preliminary study. *Developmental Psychobiology, 54*(4), 433-440.
- Gottfredson, M. R., & Hirschi, T. (1990). A general theory of crime. Stanford University Press.
- Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality, 37*(6), 504-528.
- Grant, K. E., Compas, B. E., Stuhlmacher, A. F., Thurm, A. E., McMahon, S. D., & Halpert, J. A. (2003). Stressors and child and adolescent psychopathology: Moving from markers to mechanisms of risk. *Psychological Bulletin, 129*(3), 447-466. doi:10.1037/0033-2909.129.3.447
- Greenberg, M. T., Kusche, C. A., Cook, E. T., & Quamma, J. P. (1995). Promoting emotional competence in school-aged children: The effects of the PATHS curriculum. *Development and Psychopathology, 7*, 117–136. doi:10.1017/S0954579400006374
- Guerra, N., Modecki, K., & Cunningham, W. (2014). Developing social-emotional skills for the labor market: PRACTICE model. World Bank Policy Research Working Paper (7123).

- Guerra, N. G., & Slaby, R. G. (1990). Cognitive mediators of aggression in adolescent offenders: II. Intervention. *Developmental Psychology*, 26, 269–277
- Guerra, N., Williams, K., Tolan, P., & Modecki, K.L. (2008). Theoretical and research advances in understanding youth crime. In R.D. Hoge, N. Guerra, & P. Boxer (Eds.), *The Juvenile Offender: Treatment Approaches*. New York: Guilford Press.
- Hayes, L., Boyd, C. P., & Sewell, J. (2011). Acceptance and commitment therapy for the treatment of adolescent depression: A pilot study in a psychiatric outpatient setting. *Mindfulness*, 2(2), 86-94.
- Hollenstein, T., & Loughed, J.P. (2013). Beyond storm and stress: typicality, transactions, timing, and temperament to account for adolescent change. *American Psychologist*, 68(6), = 444-454
- Hox, J. J. (2002). *Multilevel analysis: Techniques and applications*. Psychology Press.
- Izzo, R. L., & Ross, R. R. (1990). Meta-analysis of rehabilitation programs for juvenile delinquents. A brief report. *Criminal Justice and Behavior*, 17(1), 134-142.
- Iselin, A. M. R., Mulvey, E. P., Loughran, T. A., Chung, H. L., & Schubert, C. A. (2012). A longitudinal examination of serious adolescent offenders' perceptions of chances for success and engagement in behaviors accomplishing goals. *Journal of Abnormal Child Psychology*, 40(2), 237-249.
- Jahng, S., Wood, P. K., & Trull, T. J. (2008). Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. *Psychological Methods*, 13(4), 354.

- Jonason, P. K., & Webster, G. D. (2010). The dirty dozen: a concise measure of the dark triad. *Psychological Assessment*, 22(2), 420.
- Landenberger, N. A., & Lipsey, M. W. (2005). The positive effects of cognitive-behavioral programs for offenders: A meta-analysis of factors associated with effective treatment. *Journal of Experimental Criminology*, 1, 451-476.
- Loughran, T. A., Paternoster, R., Piquero, A. R., & Fagan, J. (2013). "A good man always knows his limitations" The role of overconfidence in criminal offending. *Journal of Research in Crime and Delinquency*, 50(3), 327-358.
- Loughran, T. A., Piquero, A. R., Fagan, J., & Mulvey, E. P. (2009). Differential deterrence: Studying heterogeneity and changes in perceptual deterrence among serious youthful offenders. *Crime & Delinquency*.
- Luciana, M. (2013). Adolescent brain development in normality and psychopathology. *Development and Psychopathology*, 25, 1325-1345.
- Modecki, K.L. (2017). Adolescent development and clinical and legal implications. In W.D. Murphy & S. Righthand (Eds.), *Safer Society Book on Adolescents who Sexually Abuse*.
- Modecki, K.L. & Uink, B. (2017). How can developmental psychopathology influence social and legal policy? Adolescence, mental health, and decision making. In D. Williams & L. Certifanti (Eds.), *The Wiley-Blackwell Handbook of Developmental Psychopathology*.
- Modecki, K.L. (2016) Do risks matter? Variable and person-centered approaches to adolescents' problem behavior. *Journal of Applied Developmental Psychology*, 42, 8-20.

- Modecki, K.L. (2009). "It's a rush": Psychosocial content of antisocial decision making. *Law and Human Behavior*, 33, 183-193.
- Modecki, K.L. (2008). Addressing gaps in the maturity of judgment literature: Age differences and delinquency. *Law and Human Behavior*, 32(1), 78-91.
- Modecki, K. L. (2007). *Underlying processes of antisocial decisions: adolescents versus adults*. ProQuest.
- Modecki, K.L., Barber, B.L., Eccles, J.E. (2014). Binge drinking trajectories across adolescence: Extra-curricular activities are protective for youth with early pubertal development. *Journal of Adolescent Health*, 54 (1), 61-66.
- Modecki, K.L., Barber, B.L., & Vernon, L. (2013). Mapping developmental precursors of cyber-aggression: trajectories of risk predict perpetration and victimization. *Journal of Youth and Adolescence*, 42(5), 651-661.
- Modecki, K.L., Barber, B.L., & Vernon, L. (2012, Nov). Cyber-aggression perpetration and victimization in the context of adolescent trajectories of problem behaviour. (in Modecki, chair: Prediction of violence across adolescence). Paper presented at the 32 annual congress of the Australian and New Zealand Association of Psychology, Psychiatry and Law, Melbourne.
- Modecki, K.L., & Mazza, G. (2017) Are we making the most of ecological momentary assessment data? A comment on Richardson, Fuller-Tyszkiewicz, O'Donnell, Ling, & Staiger, 2017. *Health Psychology Review*. doi: 10.1080/17437199.2017.1347513. [

- Modecki, K. L., Zimmer-Gembeck, M. J., & Guerra, N. (2017). Emotion regulation, coping, and decision making: three linked skills for preventing externalizing problems in adolescence. *Child Development*, 88(2), 417-426.
- Muthén, L., & Muthén, B. (2013). Mplus User's Guide. 1998-2013. Los Angeles, CA.
- Nasco, S. A., & Marsh, K. L. (1999). Gaining control through counterfactual thinking. *Personality and Social Psychology Bulletin*, 25(5), 557-569.
- Norman, P., & Conner, M. (2006). The theory of planned behaviour and binge drinking: Assessing the moderating role of past behaviour within the theory of planned behaviour. *British Journal of Health Psychology*, 11(1), 55-70.
- Osgood, D. W. (2005). Making sense of crime and the life course. *The Annals of the American Academy of Political and Social Science*, 602(1), 196-211.
- Piquero, A. R., Jennings, W. G., & Farrington, D. (2013). The monetary costs of crime to middle adulthood: findings from the Cambridge study in delinquent development. *Journal of Research in Crime and Delinquency*, 50, 53-74.
- Rebellon, C.J. & Modecki, K.L. (2014) Accounting for projection bias in models of delinquent peer influence: The utility and limits of latent variable approaches. *Journal of Quantitative Criminology*, 30(2), 163-186.
- Reyna, V. F., & Farley, F. (2006). Risk and rationality in adolescent decision making implications for theory, practice, and public policy. *Psychological Science in the Public Interest*, 7(1), 1-44.

- Reynolds, W. M. (2004). Reynolds adolescent depression scale. In M. Hersen, D. L. Segal (Vol. Eds.), & M. J. Hilsenroth (Ed-in-Chief), *Comprehensive handbook of psychological assessment, Vol. 2: Personality assessment* (pp. 224–236). New York, NY: John Wiley & Sons.
- Riggs, N. R., Greenberg, M. T., Kusché, C. A., & Pentz, M. A. (2006). The mediational role of neurocognition in the behavioral outcomes of a social-emotional prevention program in elementary school students: Effects of the PATHS curriculum. *Prevention Science, 7*, 91-102.
- Sampson, R. J. (1997). Collective regulation of adolescent misbehavior: Validation results from eighty Chicago neighborhoods. *Journal of Adolescent Research, 12*(2), 227-244.
- Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing “neighborhood effects”: Social processes and new directions in research. *Annual Review of Sociology, 28*(1), 443-478.
- Schneiders, J., Nicolson, N. A., Berkhof, J., Feron, F. J., van, Os., V. J., & deVries, M. W. (2006). Mood reactivity to daily negative events in early adolescence: Relationship to risk for psychopathology. *Developmental Psychology, 42*, 543–554.
- Shulman, E. P., & Cauffman, E. (2013). Reward-biased risk appraisal and its relation to juvenile versus adult crime. *Law and Human Behavior, 37*(6), 412.
- Silk, J. S., Steinberg, L., & Morris, A. S. (2003). Adolescents' emotion regulation in daily life: Links to depressive symptoms and problem behavior. *Child Development, 74*(6), 1869-1880.

- Smallman, R., & Roese, N. J. (2009). Counterfactual thinking facilitates behavioral intentions. *Journal of Experimental Social Psychology*, 45(4), 845-852.
- Smith, D. G., Xiao, L., & Bechara, A. (2012). Decision making in children and adolescents: Impaired Iowa Gambling Task performance in early adolescence. *Developmental Psychology*, 48(4), 1180.
- Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, 28(1), 78-106.
- Tein, J. Y., Sandler, I. N., Ayers, T. S., & Wolchik, S. A. (2006). Mediation of the effects of the Family Bereavement Program on mental health problems of bereaved children and adolescents. *Prevention Science*, 7, 179–195. doi:[10.1007/s11121-006-0037-2](https://doi.org/10.1007/s11121-006-0037-2)
- Thornberry, T. P. (2005). Explaining multiple patterns of offending across the life course and across generations. *The Annals of the American Academy of Political and Social Science*, 602(1), 156-195.
- Uink, B. N., Modecki, K. L., & Barber, B. L. (2017). Disadvantaged youth report less negative emotion to minor stressors when with peers An experience sampling study. *International Journal of Behavioral Development*, 1(1), 41-51. DOI: 10.1177/0165025415626516
- Uink, B. Modecki, K.L., Correia, H., & Barber, B. (2016). Getting “stuck” in negative emotions: Links between emotional inertia, expressive suppression and adolescents’ delinquent and aggressive behaviour. Paper presented at Challenging the Mental Illness-Violence Nexus Conference, Queensland, Australia.

- Williams, J., Toumbourou, J. W., McDonald, M., Jones, S., & Moore, T. (2005). A sea change on the island continent: frameworks for risk assessment, prevention and intervention in child health in *Australia. Children & Society, 19*(2), 91-104.
- Williamson, A.A., Modecki, K.L., & Guerra, N.G. (2015). Evidence-based programming in diverse settings: high school. In J. Durlak, T. Gullotta, C. Domitrovich, P. Goren, & R. Weissberg (Eds.), *The Handbook of Social and Emotional Learning*.
- Wilson, D. B., Gottfredson, D. C., & Najaka, S. S. (2001). School-based prevention of problem behaviors: A meta-analysis. *Journal of Quantitative Criminology, 17*(3), 247-272.
- Zelazo, P.D., & Carlson, S.M. (2012). Hot and cool executive functions in childhood and adolescence: Development and plasticity. *Child Development Perspectives, 6*(4), 354–360.
- Zimmer-Gembeck, M., Skinner, E., Modecki, K.L., Webb, H., & Rapee, R. (under review) Measuring deployment of a coping “Toolbox”: A new measure of coping flexibility in relation to emotional adjustment.

Table 1. Effects of Perceived Rewards on Four-Year Delinquency Trajectory

	Delinquency	
	Model 1	Model 2
Fixed Effects		
Intercept (Grade 9 Mean)	1.36 (.04)***	1.86(1.16)
Gender		.13(.08)+
Age		-.01(.08)
Perceived Benefits		.27 (.10)**
Linear Slope (Time)	-.10(.05)*	.31(1.32)
Gender		-.06(.11)
Age		-.02(.09)
Perceived Benefits Grade 9		-.18(.09)*
Quadratic Slope (Time ²)	.02(.02)	.15(.41)
Gender		.02(.04)
Age		-.01(.03)
Perceived Benefits Grade 9		.04(.03) ⁺
Random Effects		
Intercept (Grade 9 mean)	.26(.12)*	.17(.08)*
Linear slope (Time)	.02(.03)	.01(.03)
χ^2	(7) = 7.63, p = .37	(10) = 10.38, p = .41
CFI	.96	.99
RMSEA	.015	.010

Note. + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Gender: 0 = female; 1 = male.

Table 2. Three-Year Delinquency Trajectory Predicting Later Perceived Rewards

	Delinquency		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept (Grade 8 Mean)	1.31(.03)***	1.32(.03)***	1.31(.03)***
Linear Slope (Time)	.02(.03)	.02(.03)	.02(.03)
Grade 11 Perceived Rewards			
Intercept (Grade 8 Mean)		1.08(.28)***	
Linear Slope (Time)		1.62(.91)+	
Grade 12 Perceived Rewards			
Intercept (Grade 8 Mean)			.77(.38)*
Linear Slope (Time)			.75(.69)
Random Effects			
Intercept (Grade 8 mean)	.19(.08)*	.19(.08)*	.19(.08)*
Linear slope (Time)	.07(.05)	.07(.05)	.07(.05)
χ^2	(3) = 1.23, p = .75	(4) = 1.68, p = .79	(4) = 1.53, p = .82
CFI	1.0	1.0	1.0
RMSEA	.00	.00	.00

Note. +p < .10; *p < .05; ***p < .001.

Table 3. Effect of Rewards X Self-Control on Four-Year Delinquency Trajectory

	Delinquency		
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept (Grade 9 Mean)	1.36(.04)***	2.01(.95)*	1.93(.89)*
Gender		.07(.07)	.04(.06)
Age		-.07(.07)	-.06(.06)
Rewards Grade 9		.27(.11)*	-.22(.11)*
Self-Control Grade 9		-.12(.03)***	-.06(.03)*
Rewards X Self-Control			-.17(.06)**
Linear Slope (Time)	-.10(.05)*	2.99(2.25)	.75(1.40)
Gender		.09(.19)	.03(.13)
Age		-.20(.15)	-.04(.09)
Rewards Grade 9		-.05(.14)	.06(.14)
Self-Control Grade 9		.06(.10)	.07(.06)
Rewards X Self-Control			.07(.06)
Quadratic Slope (Time2)	.02(.02)	.23(.25)	.18(.11)
Gender		.01(.02)	.01(.01)+
Age		-.01(.02)	-.01(.01)

Rewards Grade 9		-.05(.02)*	.02(.01)
Self-Control Grade 9		.03(.01)***	.01(.00)
Rewards X Self-Control			.01(.01)+
Random Effects			
Intercept (Grade 9 mean)	.26(.12)*	.13(.04)**	.10(.04)**
Linear slope (Time)	.02(.03)	.69(.76)	.24(.29)
χ^2	(3) = 7.63, p = .37	(11) = 21.46, p = .03	(12) = 25.79, p = .02
CFI	.96	.90	.90
RMSEA	.015	.05	.06

Note. +p < .10; *p < .05; **p < .01; ***p < .001.

Gender: 0 = female; 1 = male.

Table 4. Factor Correlations for Parallel Process Model of Delinquency and Perceived Rewards

Factors	Delinquency		
	Intercept	Linear Slope	Quadratic Slope
Perceived Rewards			
Intercept	.57***		
Linear Slope		.14+	
Quadratic Slope			-----

Note. +p < .10; ***p < .001.

Table 5. Effect of Early Delinquency on Three-Year Reward Trajectory

	Perceived Rewards	
	Model 1	Model 2
Fixed Effects		
Intercept (Grade 10 Mean)	.42(.06)	1.93(1.31)
Gender		.14(.11)
Age		-.17(.09)*
Delinquency Grade 9		.66(.15)***
Linear Slope (Time)	-.03(.04)	-.70(.97)
Gender		-.07(.08)
Age		.07(.06)
Delinquency Grade 9		-.18(.09)*
Random Effects		
Intercept (Grade 10 mean)	.66(.39)+	.33(.31)
Linear slope (Time)	.08(.16)	.05(.16)
	χ^2 (3) = .143, p = .99	(6) = 1.29, p = .97
CFI	1.0	1.0
RMSEA	.00	.00

Note. +p < .10; *p < .05; **p < .01; ***p < .001.

Gender: 0 = female; 1 = male.

Table 6. Four-Year Reward Trajectory Predicting Delinquency

	Perceived Rewards	
	Model 1	Model 1
Fixed Effects		
Intercept (Grade 9 Mean)	.38(.06)***	.39(.06)***
Linear Slope (Time)	-.01(.03)	-.01(.03)
Grade 12 Delinquency		
Intercept (Grade 9 Mean)		-1.73(.70)*
Linear Slope (Time)		-3.71(2.83)
Random Effects		
Intercept (Grade 9 mean)	.68(.30)*	.70(.02)*
Linear slope (Time)	.07(.05)	.07(.05)
χ^2	(7) = 4.39, p = .73	(9) = 4.67, p = .86
CFI	1.0	1.0
RMSEA	.00	.00

Note. *p < .05; ***p < .001.

Table 7. Effect of Delinquency X Self-Control on Four-Year Reward Trajectory

Perceived Rewards			
	Model 1	Model 2	Model 3
Fixed Effects			
Intercept (Grade 9 Mean)	.38(.06)***	-1.39(1.43)	-.58(1.45)
Gender		-.15(.09)+	-.14(.09)+
Age		.05(.10)	.06(.10)
Delinquency Grade 9		.79(.14)***	.03(.27)
Self-Control Grade 9		-.03(.05)	.25(.08)**
Delinquency X Self-Control			-.22(.06)**
Linear Slope (Time)	-.01(.03)	.39(.60)	.02(.65)
Gender		.08(.04)*	.08(.04)*
Age		-.02(.04)	-.02(.04)
Delinquency Grade 9		-.14(.08)+	.20(.16)
Self-Control Grade 9		.01(.02)	-.12(.07)
Delinquency X Self-Control			.10(.06)+
Random Effects			
Intercept (Grade 9 mean)	.68(.30)*	.26(.20)	.23(.20)
Linear slope (Time)	.07(.05)	.04(.04)	.04(.04)
	χ^2 (7) = 4.39, p = .73	(15) = 12.70, p = .63	(17) = 13.93, p = .67
CFI	1.0	1.0	1.0
RMSEA	.00	.00	.00

Note. + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Gender: 0 = female; 1 = male.

Table 8. Emotional Variability based on Delinquency Involvement

	Happy	Excited	Angry	Sad	Lonely
Delinquency	-.132 [-.15,-.11]*	.008[-.02,.04]	-.222[-.24,-.20]*	-.121[-.15,-.10]*	-.123[-.15,-.10]*
Ave. Emotion	-.346[-.37,-.32]*	.034[.00,.07]	.266[.23,.31]*	.338[.31,.36]*	.552[.53, .57]*
Depression	-.161[-.20,-.13]*	-.297[-.33,-.26]*	.139[.10,.18]*	-.101[-.14,-.06]*	-.184[-.22,-.15]*
R ² Value	.139 (.01), p <.01	.008[-.02,.04]	.179 (.12), p <.01	.139 (.10), p <.01	.317(.01), p <.01

*Notes: Analyses also control for social anxiety. N = 109. *p <.01.*

Table 9. Random Intercept and Random Slope Models for Negative Event X Delinquency Interaction on Daily Emotion

	Happy (b,S.E)	Excited (b,S.E)	Angry (b,S.E)	Sad (b,S.E)	Lonely (b,S.E)
Level 1 Variance	.385(.05)**	.531(.08)**	.313(.07)**	.248(.06)**	.237(.04)**
Level 2 Variance	.374(.07)**	1.05(.18)**	.501(.17)**	.517(.17)**	.460(.14)**
Level 1					
Neg. Event	-.093(.10)	-.247(.10)**	.259(.11)*	.314(.08)**	.157(.07)*
Pos. Event	.271(.07)**	.297(.90)**	-.115(.07)	-.117(.06)*	-.135 (.07) *
Previous Days' Emotion	-.027(.06)	.114(.06)	.050(.10)	.022(.07)	-.149 (.07)*
Day of Study (weekday)	.063(.07)	.230(.08)**	-.083(.06)	-.039(.05)	-.022(.06)
Level 1 Residual Variance	.325(.03)**	.449(.06)**	.285(.05)**	.223(.04)**	.242(.04)**
Level 2					
Delinquency	.170(.10)	.111(.15)	.173(.13)	.186 (.14)	-0.001 (.17)
Depressed (non-dep)	-.211(.20)	.338(.33)	.004 (.06)	.499 (.37)	.699 (.30)*
Gender (male)	.003(.17)	-.263(.01)	-.094 (.19)	.131 (.19)	-0.242 (.18)
Model Fit	-478.773 (N= 94)	-541.474 (N= 90)	-426.254(N=90)	-410.703(N= 91)	-407.189 (N =88)
<hr/>					
Negative Event X Del.	-.335(.23)	-.397(.16)*	.557(.24)*	.379(.29)	.378(.11)**
<hr/>					
Model Fit	-472.491 (N = 93)	-541.633 (N = 90)	-420.96 (N =90)	-406.250 (N=90)	-402.768 (N = 88)

Note. Analyses also control for social anxiety. Neg. Event = negative event. Pos. Event = positive event. Del = delinquency. Model fit

based on - 2 Log Likelihood.

* $p < .05$, ** $p < .01$

Table 10. Random Intercept and Random Slope Models for Emotion X Rewards Bias Interaction on Daily Antisocial Behaviour

Random Intercept Models		Random Slope Models		
β _a [95% CI (Lower, Upper)]				
Level 1 Co-variates	Antisocial Behaviour	Var. in Level 1 Slope	Emotion x Reward Bias	Model Fit
Happy	.111[-.04,.26]	.886[-2.3,4.1]	.190[-.24,.62]	-136.595
Jealous	.141[-.28,-.01]	.002[-.01,.01]	.959[.34,1.6]	-125.492
Worried	.005[-.08,.07]	.149[-.04,.33]	0.512[.24,.78]*	-126.568
Bored	.019[-.56,.68]	1.83[-.76,4.4]	.513[-1.1,-.12]*	-127.673
Level 2 Co-variates				
Gender (male)	.093[-.19, -.00]	--	--	--
Reward Bias	.044[.02,.07]*	--	--	--

Notes. N (Level 2) = 82- 87. Co-efficients for Level 1 co-variates on risk behaviour represent odds ratios. Var. = variance. Variance in antisocial behaviour (level 1) = .083[.06,.10]**, (level 2) = .033[.01,.05]**. Model fit statistics (-2 log likelihood) are for random slopes models.

a.Undstandardized co-efficients are presented for level 1 slope variance.

* $p < .05$, ** $p < .001$

Appendix 1.

Research outputs generated with support from AIC funding.

Conference Presentations

Modecki, K.L., Uink, B., Barber, B.L., Correia, H., Guerra, N. (2017, April). *Peer contexts buffer youth high in externalizing against emotion reactivity to stressful events in everyday life* (in Modecki, chair: Emotion dynamics in context: Experience sampling research of real-world social and affective factors in adolescent psychopathology). Paper to be presented at the Biennial Meeting of the Society for Research in Child Development, Austin, Texas.

Modecki, K.L. (2015, Nov) with Loughran, T., Oudekerk, B.A., Rebellon, C.J., & Centifanti, L. in Modecki, chair: *How can we best approach research on antisocial decision making during adolescence?* Roundtable presented at the annual meeting of the American Society of Criminology, Washington, D.C.

Modecki, K.L., Uink, B., & Barber, B.L. (2015, March). *Worth their while? Using ESM to investigate adolescents' reward bias, daily emotion, and risk behavior* (in **Modecki**, chair: Notions of emotion: Diverse emotion and reward pathways in adolescent risk taking). Paper presented at the Biennial Meeting of the Society for Research in Child Development, Philadelphia, PA.

Uink, B., Modecki, K.L., Correia, H., & Barber, B. (2016, July). *Getting "stuck" in negative emotions: Links between emotional inertia, expressive suppression and adolescents' delinquent and aggressive behaviour* (in Modecki, chair: Youth Research Symposium). Paper presented at the Challenging the Mental Illness-Violence Nexus Conference, Queensland, Australia

Uink, B., Modecki, K.L., & Barber, B. (2015, July). *Are delinquent and aggressive adolescents more emotionally reactive to daily hassles? An experience sampling study with economically disadvantaged adolescents*. Paper presented at Youth Violence: Cutting to the Core Conference, Queensland, Australia.

Book Chapters

Modecki, K.L. (2017). Adolescent development and clinical and legal implications. In W.D. Murphy & S. Righthand (Eds.), *Safer Society Book on Adolescents who Sexually Abuse*.

Modecki, K.L. & Uink, B. (2017). How can developmental psychopathology influence social and legal policy? Adolescence, mental health, and decision making. In D. Williams & L. Centifanti (Eds.), *The Wiley-Blackwell Handbook of Developmental Psychopathology*.

Journal Articles

Uink, B., Modecki, K.L., Correia, H. & Barber, B (under review). Carry-forward the bad: Youth with externalizing symptoms have strong emotional inertia for negative emotions.

Uink, B., Modecki, K.L., Barber, B.L., & Correia, H. (under review). Disadvantaged adolescents with elevated externalizing show heightened emotional reactivity to daily stress: An experience sampling study.

Modecki, K.L., Zimmer-Gembeck, M., & Guerra, N. (2017). Emotion regulation, coping and decision-making: Three linked skills for preventing externalizing problems in adolescence. *Child Development*, 88(2). doi:10.1111/cdev.12734. Impact Factor = 4.24

McCabe, K., Modecki, K.L., & Barber, B.L. (2016). Participation in organized activities protects against adolescents' risky substance use, even beyond development in conscientiousness. *Journal of Youth & Adolescence*, 45, 2292-2306. Impact Factor = 2.78

Associated Media

Adolescents need multiple skills for decisions, emotions, and stress. Child and Family Blog from the University of Cambridge and Princeton University.
<https://childandfamilyblog.com/adolescent-skills-development/>