Maturity in Adolescent and Young Adult Offenders: The Role of Cognitive Control

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Abstract This study examined the role of cognitive control in explaining the psychosocial maturity of adolescent (n = 43) and young adult male (n = 40) offenders. We separated psychosocial maturity into prosocial and criminal components, which were statistically unrelated and were explained by different variables. Individuals with higher levels of prosocial maturity were older, had better reactive cognitive control, and had better short-term memory than those with lower levels of prosocial maturity. Individuals with higher levels of criminal maturity were older and had better proactive cognitive control than those with lower levels of criminal maturity. We discuss the implications of these findings with regard to juvenile justice policy and practice.

Keywords Maturity · Adolescent antisocial behaviors · Reactive and proactive cognitive control

Adolescence is a period of transitions, including rapid biological maturation, expanding societal responsibilities, changes in personal relationships, and individual identity exploration. There is an opportunity during adolescence to move into positive adult roles, while at the same time there are potential vulnerabilities that may cause developmental trajectories to take adverse paths. The creation of a separate juvenile justice system acknowledged the potential of adolescents to develop either prosocially or antisocially. The juvenile justice system was designed specifically to help adolescents by putting in place interventions that would redirect them toward prosocial pathways and productive adult lives (Zimring, 2005). It was believed that while children may engage in legal transgressions, they typically lacked criminal intent and culpability because of their young age. There is rapidly increasing support for this belief from empirical evidence that important developmental changes within the brain occur throughout adolescence and into young adulthood (Casey, Galvan, & Hare, 2005; Durston et al., 2006).

The biological maturation of the brain during adolescence has been linked to the development of goal-directed behaviors (Spear, 2000), which are key to achieving adult-like maturity. Such behaviors include the regulation of impulses, the reliance on internal standards when making decisions, and the ability to weigh costs and benefits of future actions. The vast majority of the research on these abilities in adolescents and adults has focused on the normative development of these skills. However, the same maturity skills that enable some to behave in a positive manner are used by others to improve their abilities to commit crimes. Some emerging research suggests that there are different expressions of maturity (Leistico & Salekin, 2003). To better understand the construct of maturity among individuals who engage in antisocial behaviors, the current paper examines how two aspects of psychosocial maturity relate to two aspects of cognitive control. Cognitive control refers to people’s ability to engage in deliberate goal-directed behaviors by effectively using goal-relevant...
information and not being influenced by irrelevant or habitual influences that may contradict their goal. In this sense, cognitive control is an important component of “executive functioning,” which is a person’s ability to set and attain future goals (Pennington & Ozonoff, 1996).

DEFINING MATURITY WITHIN LEGAL AND DEVELOPMENTAL CONTEXTS

The importance of maturity to criminal culpability was first documented in the case Kent v. United States (1966), a landmark legal decision that outlined the factors to be considered in juvenile transfers to adult court. These factors included: (a) legal criteria (e.g., prosecutorial merit), (b) offense characteristics (e.g., violent, premeditated), (c) the youth’s level of sophistication-maturity (e.g., emotional and environmental), (d) the youth’s treatment and delinquency history, and (e) the prospective threat to public protection as well as the youth’s degree of treatment amenability. Thirty-six state statutes on juvenile transfers to adult court make reference to the legal construct of maturity. These states commonly use the definition from Kent v. United States (1966) which suggests that the sophistication and maturity of the juvenile be determined by consideration of the juvenile’s home, environment, emotional attitude, and pattern of living.

Expert opinions suggest that the most important characteristics of maturity are the nature and degree of youth’s planning and foresight, their behavioral intentions, their understanding of societal norms and morals, and their decision-making patterns (Ewing, 1990; Salekin, 2001; Salekin, Rogers, & Ustad, 2001; Salekin, Yff, Neumann, Leistico, & Zalot, 2002). Clinical forensic researchers have also described mature youth as having some degree of self-reflective thought, future-orientation, self-regulation, and the capacity to anticipate the consequences of their behaviors (Leistico & Salekin, 2003; Salekin et al., 2001, 2002). Mature youth understand the risks and benefits associated with their actions, and consider this information when evaluating current and future behaviors. These findings suggest that mature youth are likely to use information gleaned from past behaviors to inform their future decision making.

Within the developmental literature, psychosocial maturity has been defined as comprising three facets: responsibility, perspective, and temperance (Cauffman & Steinberg, 2000). Although using a different conceptualization, these three aspects of psychosocial maturity parallel the previously noted definitions of maturity from the forensic literature. Responsibility includes skills such as self-reliance and making autonomous decisions, perspective includes skills such as anticipating and weighing short- and long-term consequences of behaviors within varying temporal contexts, and temperance includes skills such as self-restraint and thinking before one acts (Cauffman & Steinberg, 2000).

Much of the previous research on maturity has focused on understanding how it develops in typical adolescents (e.g., Cauffman & Steinberg, 2000; Galambos, Barker, & Tilton-Weaver, 2003; Galambos & Tilton-Weaver, 2000). Recent research, however, has examined maturity within delinquent samples, finding that the responsibility facet of psychosocial maturity is predictive of the ability to understand legal proceedings and individual rights and to apply this knowledge (Colwell et al., 2005). Other researchers have found that serious juvenile offenders had difficulties in self-restraint (i.e., temperance) and considering others’ perspectives (Cauffman, Steinberg, & Piquero, 2005). Modecki (2008) found that individuals with higher self-reported delinquency scores had lower scores on self-restraint (i.e., temperance) and balancing short- and long-term consequences of behaviors (i.e., perspective). Cruise et al. (2008) similarly found that lower levels of self-restraint were related to higher levels of engagement in delinquent behaviors. Finally, Robbins and Bryan (2004) found that among juvenile offenders, higher levels of maturity were related to lower levels of sensation seeking and risky behaviors.

Legal statutes on juvenile transfers to adult court define maturity in its broadest sense, without specifying whether these attitudes and behaviors are prosocial, antisocial, or both. Furthermore, researchers have focused predominantly on the positive aspects of maturity rather than the use of such maturity skills to engage in illegal behaviors. In the current paper, we chose to examine the possibility that people can use their maturity skills in such negative ways. We use the term “prosocial maturity” to describe maturity skills that are used to achieve socially accepted goals, such as when an individual prioritizes academic performance and abstains from drug and alcohol use to obtain a socially accepted career. We use the term “criminal maturity” to describe maturity skills that are used to achieve illegal goals, such as when an individual carefully plans a burglary by monitoring the site of the burglary, identifies the best time to execute it, and then carefully hides any incriminating evidence. Offenders can have skills in both prosocial and criminal maturity, which may have different implications for treatment interventions and risk assessments.

LINKING MATURITY TO COGNITIVE CONTROL

To better understand the development of maturity skills through adolescence and into young adulthood, it may be beneficial to consider evidence from cognitive neuroscience.
on brain development. Many protracted developmental changes in late adolescence occur within a neural circuitry to and from the prefrontal cortex (PFC; Casey et al., 2005; Casey, Giedd, & Thomas, 2000; Giedd, 2004). Gray matter volume in the PFC increases with age until adolescence, after which it decreases (Gogtay et al., 2004), which may indicate that connections within this circuitry are becoming more refined and focused (Caviness, Kennedy, Richelme, Rademacher, & Filipek, 1996). White matter volume appears to increase in tandem with decreases in gray matter, with the largest increases occurring in the PFC (Reiss, Abrams, Singer, Ross, & Denckla 1996). Increases in white matter volume suggest that the transmission of information within the PFC circuitry is being strengthened and better regulated (Casey, Tottenham, Liston, & Durston, 2005; Luna & Sweeney, 2004). These developmental changes that occur through adolescence result in the operation of the PFC becoming more focused and efficient.

This expansive neural circuitry to and from the PFC is most directly responsible for cognitive control skills such as memory, attention, and inhibition (e.g., Liston et al., 2006; Luna et al., 2001). Extensive changes to this brain circuitry during adolescence have been linked to improvements in cognitive control (e.g., Casey, Tottenham, & Fossella, 2002; Luna, Garver, Urban, Lazar, & Sweeney, 2004; Luna & Sweeney, 2004; Luna et al., 2001). Given the evidence on age-related changes in cognitive control as well as the evidence that maturity typically improves with age (e.g., Cauffman & Steinberg, 2000; Cruise et al., 2008), we suspected that maturity would be related to cognitive control skills. There is some preliminary evidence in support of this supposition. In typical adolescents, Galambos, MacDonald, Naphtali, Cohen, and de Frias (2005) found that cognitive skills such as intelligence and executive functioning were related to psychosocial maturity, as defined by scores on measures of subjective age, problem behavior, self-reliance, identity, and work orientation.

Braver, Gray, and Burgess (2007) have recently proposed two distinct cognitive control processes that individuals use to guide their goal-directed behaviors: proactive and reactive control. Proactive control uses contextual cues to create and actively retain a mental image of behaviorally relevant information. These mental representations internally guide behaviors that occur in decision-making situations. Reactive control, on the other hand, relies on contextual information provided by the environment of the decision-making situation, externally activating goal-related information at the point a decision is required. This contextual information directly influences the individual’s decision regardless of what mental representations are being maintained.

Real-life examples help to illustrate the difference between reactive and proactive cognitive control. Consider for a moment your most common behavioral response to a yellow stoplight. If you are like most people, your natural response to seeing a yellow light is to speed up to clear it before it turns red. Now imagine that you are going to dinner with your colleagues, and you are driving in front of them to show them the way. En route to the restaurant, you encounter a yellow light. What do you do? If you remember that your colleagues are following you, you restrain yourself from speeding up and stop at the yellow light. In this case, you have used proactive control because you retained the knowledge that your colleagues were behind you, and used this to affect your decision about what to do at the light. If, however, you are daydreaming and forget about your colleagues, you may run through the yellow light and leave them behind. In this case you have failed to use proactive control because you only considered the contextual information from your immediate environment (i.e., presence of a yellow light), which led you to engage your natural response to that contextual information (i.e., to speed up and clear the intersection).

Now consider a situation in which you are driving along with no one following you. You luckily encounter a series of nine yellow lights in a row, each of which causes you to speed up to clear the intersection before the light turns red. The tenth light, however, quickly turns red. If you correctly use the information from the immediate environment, you will stop. This response results from the engagement of reactive control. In this scenario, however, your recent experience with yellow lights may create an expectation that the appropriate response to the upcoming light is to speed up through the intersection, causing you to accidentally run the red light. This response results from the failure to engage reactive control, because you based your decision solely on your memory of the recent string of yellow lights and did not incorporate contextual information from your immediate environment (i.e., that the current light was red).

The concepts of proactive and reactive control can be specifically applied to offenders. Consider an aggressive youth whose dominant response to provocation is to fight (e.g., Tremblay & Belchemski, 2004). This boy’s probation officer told him that if he ever gets caught for fighting he would have to go to a group home, which is something this boy wants to avoid. If the boy retains, recalls, and uses the probation officer’s warning to refrain himself from fighting, he would be engaging proactive control. Failing to recall and use the probation officer’s warning would result in the boy relying on his dominant and reinforced response to the immediate situation (i.e., fighting) because he failed to engage proactive control. Now consider an adolescent who is walking down the street while being followed by a member from a rival gang. If the individual successfully uses information from the current environment (i.e., that
the person is unfamiliar and has taken an aggressive stance) to quickly react and get away from his assailant, then he has successfully used reactive control. If, however, he fails to identify this person as a threat, the adolescent may be attacked because he failed to engage reactive control.

Using a combination of proactive and reactive control strategies is most advantageous to the individual because reliance on a single strategy may lead to erroneous decisions (Braver et al., 2007). Each strategy serves a distinct cognitive function, so both are necessary to optimally use goal-related contextual information. One reason that it is important to use both cognitive control strategies is that the two strategies differ in terms of the information they use. Proactive control uses previously observed contextual information to prepare for and anticipate a behavioral response. Reactive control, on the other hand, determines a behavioral response using goal-related contextual information from the immediate environment. Therefore, for an individual to use all the information available to them when making a decision, they must engage both proactive and reactive control.

Another reason that it is important to use both proactive and reactive control is that the two strategies differ in the amount of cognitive resources they require. Preparing for and anticipating a response places high demands on one's cognitive resources because goal-related contextual information must be actively retained over time (Braver et al., 2007). Proactive control is therefore costly in terms of the amount of cognitive resources it expends, and it is not cost-effective (in cognitive terms) when resources are at a premium (e.g., when an individual is under high cognitive demands). Reactive control, on the other hand, determines a behavioral response immediately after receiving goal-related contextual information. This demands fewer cognitive resources because contextual information does not need to be retained over time and is rather only transiently activated in the moment. Reactive control is therefore more cost-effective when cognitive resources are limited. Shifts between using reactive or proactive control are thus necessary to optimally use one's available cognitive resources.

First, reactive and proactive control skills have been linked to distinct and meaningful neurobiological structures in the brain (Braver et al., 2007; DePisapia & Braver, 2006). It is possible that developmental changes or disruptions in one neurobiological structure influence a single facet of cognitive control, which may then potentially only affect a single aspect of psychosocial maturity.

Separating cognitive control into reactive and proactive components will also let us make more precise claims about the relations between specific facets of cognitive control and psychosocial maturity. It is likely that individuals with higher levels of prosocial maturity will exhibit different cognitive control skills than those individuals with lower levels of prosocial maturity. It is also likely that individuals with higher levels of criminal maturity will exhibit different cognitive control skills than those with lower levels of criminal maturity. However, there may or may not be a match between the cognitive control skills of those high on prosocial maturity and the cognitive control skills of those high on criminal maturity. We do not believe that individuals with higher levels of criminal maturity lack all cognitive control, given that goal-related behaviors must engage some degree and type of cognitive control whether they are criminal or prosocial. We believe instead that individuals with higher levels of criminal maturity will rely more on reactive control given that it places fewer demands on cognitive resources.

These propositions have clear clinical implications, since knowing how cognitive control and psychosocial maturity relate helps scientists and clinicians identify more precise points for remedying both cognitive and psychosocial deficits. For instance, if we determined that proactive control was related to prosocial maturity, it would suggest that improving people's abilities to access previously stored goal-relevant information and prepare to engage in goal-appropriate behaviors could improve their prosocial maturity skills.

METHOD

Participants

Participants were adolescent male offenders from a juvenile detention center (n = 44) and young adult offenders from a medium-security adult correctional center (n = 41). This is the same sample of offenders from Iselin & DeCoster (in press). The adolescent sample had an average age of 15.70 years (SD = 1.67) and were predominantly African-American (65%; 35% were White). The young adult sample had an average age of 20.86 years (SD = 1.47) and were predominantly African-American as well (73%; 27% were White). Table 1 displays other relevant demographic statistics.
Table 1 Sample demographic statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Detention sample (n = 43)</th>
<th>Prison sample (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>15.70</td>
<td>20.86</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.67</td>
<td>1.47</td>
</tr>
<tr>
<td>Range</td>
<td>(12.24, 18.60)</td>
<td>(18.09, 23.01)</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>35% (n = 15)</td>
<td>27% (n = 11)</td>
</tr>
<tr>
<td>Black</td>
<td>65% (n = 28)</td>
<td>73% (n = 29)</td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>3.04</td>
<td>2.90</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.70</td>
<td>0.91</td>
</tr>
<tr>
<td>Range</td>
<td>(2, 4)</td>
<td>(1, 5)</td>
</tr>
<tr>
<td>RSTI-Prosocial maturity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>14.37</td>
<td>15.48</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>5.58</td>
<td>5.11</td>
</tr>
<tr>
<td>Range</td>
<td>(4, 27)</td>
<td>(6, 26)</td>
</tr>
<tr>
<td>RSTI-Criminal maturity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.98</td>
<td>5.30</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.92</td>
<td>4.79</td>
</tr>
<tr>
<td>Range</td>
<td>(0, 10)</td>
<td>(0, 21)</td>
</tr>
<tr>
<td>K-BIT 2 composite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>95.84</td>
<td>102.03</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>14.44</td>
<td>12.18</td>
</tr>
<tr>
<td>Range</td>
<td>(61, 135)</td>
<td>(68, 128)</td>
</tr>
<tr>
<td>Drug &amp; alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.09</td>
<td>10.63</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>4.55</td>
<td>3.52</td>
</tr>
<tr>
<td>Range</td>
<td>(0, 14)</td>
<td>(0, 16)</td>
</tr>
</tbody>
</table>

Note: SES Socio-Economic Status, K-BIT 2 Kaufman Brief Intelligence Test-Second Edition

We coded participant characteristics regarding the types of documented charges, number of documented charges, severity of worst charge, and number of felony charges. All the data were coded based on documented file information. The most common charges for the detained adolescent participants were violations (e.g., court orders, probation, or aftercare; 22.0%), thefts (10.3%), domestic violence (9.4%), and drug offenses (6.3%). The most common charges for the young adult prisoners were thefts (12.5%), drug offenses (10.1%), robbery (8.8), and traffic offenses (8.6%).

Adolescent participants engaged in an average of three total offenses and an average of one felony offense. Young adult participants engaged in an average of nine total offenses and an average of four felony offenses. The difference between samples on the average number of total offenses was significant ($F [1, 82] = 15.05, p < .001$). We used categories outlined in the state criminal code to represent offense severity, resulting in the following codes:

1 = Violations/Fines (e.g., criminal trespass III, public intoxication), 2 = Class C misdemeanors (e.g., criminal trespass II, disorderly conduct), 3 = Class B misdemeanors (e.g., menacing, resisting arrest), 4 = Class A misdemeanors (e.g., assault III, criminal trespass I), 5 = Class C Felonies (e.g., burglary III, escape II), 6 = Class B Felonies (e.g., manslaughter, rape II), 7 = Class A Felonies (e.g., murder, rape I). Young adult participants had an average offense severity score for their worst offense of 6.60 ($SD = 0.71$), while adolescents had an average of 4.72 ($SD = 1.72$). This difference was significant ($F [1, 82] = 41.29, p < .001$).

Measures

Maturity

The 15-item sophistication subscale of the Risk, Sophistication, and Treatment Inventory (RSTI; Salekin, 2004) was used to provide measures of prosocial and criminal maturity. The RSTI is an interview-based assessment of personality and behavioral characteristics relevant to juvenile transfers to adult court and justice system case dispositions (see Salekin, Salekin, Clements, & Leistico, 2005 for a detailed description of this measure, including a full listing of items and subscale descriptions). The RSTI interview asks detailed questions regarding how individuals make decisions in their lives with regard to both prosocial goals (e.g., going to college, getting a stable job) and criminal goals (e.g., whether they plan their crimes in advance, how they commit crimes). Sample items from the sophistication scale include “Able to Identify Alternative Actions,” “Internal Locus of Control,” and “Able to Delay Gratification.” Research has found that the sophistication subscale has adequate internal consistency with an alpha coefficient of 0.76 and item-to-total correlations ranging from 0.25 to 0.48 (Salekin, 2004).

The RSTI measures maturity based on how well an individual’s traits and skills match detailed item descriptors for each of the items. Ratings are based on detailed information gathered from a standardized, semi-structured interview that lasts approximately 90 min as well as a review of each individual’s institutional file. Two types of maturity, prosocial and criminal, can be created based on the structure of the RSTI items. Sophistication items are first scored on the extent to which the individual exhibits the traits and skills presented in the item descriptor. Items are scored using the following three-point scale: 0 = absence of the characteristic/ability, 1 = subclinical/moderate, and 2 = presence of the characteristic/ability. If the individual exhibits the traits and skills described in the item descriptor to a moderate or high degree (i.e., receives a score of 1 or 2), the rater then determines whether the
person’s traits and skills are used for criminal means. Our measure of prosocial maturity was the sum of the sophistication level scores for only those skills that were not used in a criminal way, providing a continuous measure ranging from 0 to 45. Our measure of criminal maturity was the sum of the sophistication level scores for only those skills that were identified as being used in a criminal way, also providing a continuous measure ranging from 0 to 45. The number of items included in the prosocial maturity score will therefore vary between 0 and 15. The number of items included in the criminal maturity score will also vary between 0 and 15, and will always be equal to 15 minus the number of items included in the prosocial maturity score. The internal consistency for the current study was 0.76 and 0.83 for criminal and prosocial maturity, respectively.

One principal research administrator gathered all the principal data. The primary research administrator was a fifth-year clinical psychology student who had several years of experience testing incarcerated participants and administering the measures included in this study, especially the RSTI. Ten of the RSTI interview protocols in the current study were randomly selected and independently scored by a second trained rater who observed the interviews in person to obtain inter-rater reliability. The second rater was an advanced undergraduate honors student who had completed basic training in the scoring of the RSTI (completed ratings for five RSTIs based on in-person interviews). Intra-class correlation coefficients (a measure of inter-rater reliability) were 0.93 for prosocial maturity and 0.45 for criminal maturity, calculated using average ratings and based on a two-way random effects model using a consistency definition (as opposed to an absolute definition) of agreement. This model is appropriate in our case because we want to generalize our reliability estimate across both participants and raters (McGraw & Wong, 1996).

The low reliability for criminal maturity is possibly due to this being the first time the measure was rated using clinical interview information (previous research used archival, file data only). Given that the two coders had good reliability for prosocial maturity, we suspect that the poor reliability for criminal maturity indicates that the RSTI’s scoring of criminal maturity leaves the values somewhat ambiguous. This suggests that the low reliability is the result of a large amount of random error in the measure. The presence of this random error will make it more difficult to find significant relations with criminal maturity, so that nonsignificant results may only reflect poor measurement and not a true null effect. However, it will not lead to spuriously significant results (Cohen, Cohen, West, & Aiken, 2003), so we should be able to trust any significant findings we observe. Having poor reliability in many ways parallels the effect of having a low sample size (Zuckerman, Hodgins, Zuckerman, & Rosenthal, 1993) in that it will increase the likelihood of a Type II error (claiming that there is no relation when there really is one) but does not increase the likelihood of a Type I error (claiming that there is a relation when one truly does not exist). As stated by Cohen and Cohen (1983, p. 70), “Unreliability... is a sufficient reason for low correlations: it cannot cause correlations to be spuriously high.”

**Cognitive Control**

The AX-Continuous Performance Test (AX-CPT; Rosvold, Mirskey, Sarason, Bransome, & Beck, 1956) was used to provide a measure of each participant’s proactive and reactive cognitive control. Each trial on the AX-CPT task consists of a cue-probe sequence containing two consecutive letter combinations (e.g., presentation of the cue “A” followed by presentation of the probe “J”). Letters are individually and sequentially displayed on the screen with an intervening period between the cue and probe (the probe delay) as well as an intervening period between each cue-probe combination (the inter-trial interval). Participants are told to respond to the letter “X,” but only when it is preceded by the letter “A.” This is referred to as an “AX trial,” and represents the only circumstance where it is correct for participants to respond. There are three other types of trials where it is incorrect to respond: “BX trials,” where any non-A letter precedes the letter X; “AY trials,” where A precedes any non-X letter; and “BY trials,” where any non-A letter precedes any non-X letter.

Participants completed a modified version of the AX-CPT specifically used by prior researchers (e.g., Barch, Carter, MacDonald, Braver, & Cohen, 2003; Barch et al., 2004; Braver, Satpute, Rush, Racine, & Barch, 2005) to assess reactive and proactive control. In this modified task, the AX cue-probe combination occurs in 70% of the trials, creating a strong tendency to respond to “X” whenever it appears (Braver & Cohen, 2001). The remaining 30% of the trials are non-AX conditions (i.e., BX, AY, and BY). Furthermore, the probe delay was manipulated to be either 1 or 5 s. Increasing the probe delay places demands on memory because participants must actively retain information from the cue over the delay period to determine the appropriate response to the probe. We controlled for the influences of general performance factors such as the amount of time spent on the task, frequency of responding, and task pace by inversely balancing inter-trial intervals (ITI) across probe delay conditions, resulting in 5- s ITIs for 1-s probe delay conditions and 1-s ITIs for 5-s probe delay conditions. Letters appeared on the computer screen for 300 ms in 24-point upper case Helvetica font. Beginning with stimulus onset, participants had a 1,300 ms interval in which to respond. Participants were given auditory feedback on correct and incorrect responses.

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The task consisted of 400 trials run in 4 blocks of 100 trials each. Each block had either all long probe delay or all short probe delay trials. The order of blocks was counterbalanced across participants. Participants took breaks as needed between blocks. Responses and response times were recorded via mouse button presses. Participants were required to attain 75% accuracy on 20 practice trials (10 short probe delays and 10 long probe delays) before beginning test trials to ensure that they understood the task.

In the AX-CPT task, mental representations of cue-related information must be maintained and updated in memory on a trial-by-trial basis to execute accurate responses to the probe. Misuse of cue-related information creates two types of errors. The first type of error occurs when cue-related information is an invalid predictor of a response (Braver et al., 2005). These errors occur in AX trials, where activation from the mental representation of the cue could lead individuals to respond to the probe even though it is not an X. Errors occurring in the AX condition were therefore our measure of reactive control, since they represent the failure of immediate contextual information to appropriately influence a decision. Individuals with worse reactive control are expected to have more AX errors. The second type of error occurs when dominant response tendencies to a probe are not inhibited (Braver et al., 2005). The automatic tendency to respond to X (given that it occurs in 70% of the trials) must be inhibited on BX trials, and errors occur when this response tendency is not inhibited. Errors occurring in the BX condition were therefore our measure of proactive control, since they represent the failure of information stored in memory to appropriately influence a decision. Individuals with worse proactive control are expected to have more BX errors.

Short-term Memory

We used the digit span subtest on the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) to measure short-term memory. Digit span forward trials required participants to recall random sequences of numbers in the same order as the administration. Digit span forward sequences ranged from two to nine digits with two trials given at each digit length. Digit span backward trials required participants to recall random sequences of numbers in the reverse order of the administration. Digit span backward sequences ranged from two to eight digits with two trials given at each digit length. The WAIS-III digit span has good reliability ($r = .84$ to .93; Sattler, 2001). The largest number of digits correctly recalled forward and the largest number of digits correctly recalled backward was summed to create a composite score.

We acknowledge that the WAIS-III was normed using only adult samples, and thus its scaled scores are difficult to interpret with adolescents. We were, however, interested in examining only raw scores and did not plan to examine scaled scores. Because we were only interested in raw scores, we believed it was more important that participants in both samples received the exact same stimuli. We therefore chose to use the WAIS-III digit span for both the adolescent and young adult samples to ensure consistency in measurement, allowing us to appropriately interpret raw short-term memory scores.

Intelligence

The Kaufman Brief Intelligence Test-Second Edition (K-BIT 2; Kaufman & Kaufman, 2004) was used to assess participants' intelligence. The K-BIT 2 is a short (15–30 min) assessment of an individual's verbal and nonverbal intelligence. It comprises three subtests: vocabulary knowledge, matrices, and riddles. The vocabulary knowledge subtest required participants to identify the picture (out of several options) that best represented the word or best answered the question provided by the examiner. In the matrices subtest, participants were presented with a group of pictures that correspond to each other according to a rule, configuration, or relationship among the pictures. Participants were asked to choose the response that followed the rule, pattern, or relationship of the group of pictures. The riddles subtest required participants to provide one-word responses that correctly solved verbal puzzles.

Total scores on the K-BIT 2 have yielded excellent internal consistency, reliability, and construct validity. Kaufman and Kaufman (2004) found internal consistency coefficients ranging from 0.92 to 0.95 and test–retest reliabilities ranging from 0.89 to 0.92 for the composite IQ in samples of individuals 12–21 years old. The K-BIT 2 composite IQ correlates highly with full-scale IQs on the WISC-IV ($r = .77$) and the WAIS-III ($r = .89$). Individuals' composite IQs on the K-BIT 2 were analyzed in the current study.

Drug and Alcohol Use

We measured the frequency and amount of drugs and alcohol participants used during their entire life, using a modified version of the Center for Substance Abuse Prevention (CSAP; SAMHSA, 1999) youth survey. We created a composite score that indicates how many days a month the individual used tobacco, alcohol, marijuana, or inhalants.

Distractions

Testing sessions did not always occur in a distraction-free environment because of the nature of the facilities. We used a standardized observation sheet to record the number
of distractions that occurred during the AX-CPT task (e.g.,
people passing by the testing window, the telephone
in the room ringing). The total number of distractions that
occurred during the AX-CPT (summed across all blocks of
testing) was included in all analyses to see if distractions
influenced performance on the cognitive control tasks.

Procedure

Detained adolescents were recruited through direct contact
while they were with their parent(s) during visitation hours
at the institution. All youth at this institution are allowed to
participate in visitation hours. A trained research assistant
informed the youth and his parent(s) about the purpose and
procedures of the study. Informed consent from a parent/
guardian and informed assent from the youth were obtained
before initiating the study. Youth were tested within one
week after obtaining informed consent and assent. Par-
cipants were paid $10 for their time.

Young adult prisoners were recruited through direct
contact with the institution’s treatment supervisor who has
personal contact with all inmates at the facility. Particip-
ants who expressed an interest in participating in the study
met with the research assistant on the day of testing, where
the purpose and procedures of the study were reviewed
with the individual. Interested individuals provided
informed consent and began the study immediately. Insti-
tutional regulations precluded the payment of these
participants. Two participants (one from the detained
adolescent sample and one from the young adult prisoner
sample) decided to stop participation in the study after it
had already begun (dropout rate of 2%).

All participants included in the study (detained adolescent
sample N = 43, young adult prison sample N = 40) were
tested individually by the primary research administrator. The
AX-CPT was administered on a laptop computer using
E-Prime (2002). All other assessments (i.e., short-term
memory, drug and alcohol use, and intelligence) were
administered in person by the primary research administrator.
Testing took place in a private room located away from main
hallways and rooms at both facilities, although there were still
occasional distractions as noted above. All participants used
equivalent stimulus response devices (e.g., laptop computer
location, mouse position) and had equivalent testing set-ups
(e.g., levels of comfort, ease of responding).

RESULTS

Preliminary Analyses

Histograms of the unstandardized residuals for all depen-
dent variables (for each model analyzed) indicated that the
residuals were normally distributed and met the assump-
tions for regression. No outliers were found. All analyses
are based on complete data from 83 participants (detained
adolescent sample N = 43, young adult prison sample
N = 40). Criminal and prosocial maturity were not sig-
ificantly related to each other (r = .09, p = .43).

Knowing an individual’s level of prosocial maturity
appears to tell us very little about their likely level of
criminal maturity. This suggests that prosocial and criminal
maturity are independent dimensions and are likely deter-
mined by different factors. We therefore chose to analyze
these two variables separately.

The possibility of nonlinear relations between age and
our measures of maturity were considered because research
has found that the maturity skills of older adolescents
appear more similar to those of adults, suggesting that the
relation between age and maturity may plateau in older
participants (Cauffman & Steinberg, 2000). Scatterplots
indicated the presence of quadratic relations between age
and both prosocial and criminal maturity (see Fig. 1). We
therefore included linear and quadratic terms for age in all
regression analyses.

Bivariate Relations with Prosocial and Criminal
Maturity

The relations of the explanatory variables with prosocial
and criminal maturity are presented in Table 2. Older
participants tended to have higher scores on prosocial
and criminal maturity, although this linear relation was only
significant for prosocial maturity (we examine the qua-
dratic relation of age to maturity in our regression
analyses). Significant findings from this analysis indicate
that individuals who scored high on criminal maturity used
drugs and alcohol more frequently and were more likely to
be in the adult prison. Furthermore, participants who
scored higher on prosocial maturity were more likely to use
proactive control, whereas participants who scored higher
on criminal maturity were more likely to use reactive
control. Another significant finding suggests that partici-
pants who scored higher on prosocial maturity showed
better short-term memory performance. Intelligence was
not significantly related to either prosocial or criminal
maturity.

Multiple Regression Analyses Predicting Prosocial
and Criminal Maturity

We examined a total of four different multiple regression
models. The first two models determined whether our
cognitive control variables (reactive and proactive control)
could explain variability in prosocial and criminal matu-
rity. The second two models determined whether the
Note: The models for prosocial and criminal maturity separately. We examined the distribution of our residuals and their relation to our predictor variables in all of our models, and found that the assumptions of normality and homoscedasticity were met. One of the potential problems of using a measure with low reliability is that it can increase the likelihood that the analytic assumptions are violated (Shrout & Fleiss, 1979). However, we did not find evidence that the residuals from the models predicting criminal maturity substantially violated any of the assumptions.

### Table 2: Zero-order correlations relating prosocial maturity and criminal maturity to all variables of interest

<table>
<thead>
<tr>
<th>Variables</th>
<th>Prosocial maturity</th>
<th>Criminal maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.24*</td>
<td>0.17</td>
</tr>
<tr>
<td>Drug &amp; alcohol use</td>
<td>-0.08</td>
<td>0.33*</td>
</tr>
<tr>
<td>Sample</td>
<td>(1, 81) = 0.88</td>
<td>(1, 81) = 7.21**</td>
</tr>
<tr>
<td>BX errors (reactive)</td>
<td>-0.47**</td>
<td>-0.08</td>
</tr>
<tr>
<td>BX errors (proactive)</td>
<td>-0.23*</td>
<td>-0.34**</td>
</tr>
<tr>
<td>Short-term memory</td>
<td>0.40**</td>
<td>0.03</td>
</tr>
<tr>
<td>Intelligence</td>
<td>0.15</td>
<td>-0.03</td>
</tr>
</tbody>
</table>

Note: N = 83; * p ≤ 0.05; ** p ≤ 0.01

* Detained adolescents versus incarcerated young adults

### Table 3: Multiple regression models for prosocial and criminal maturity

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>SE</th>
<th>t(1)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prosocial maturity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1: Cognitive control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY Errors (reactive)</td>
<td>-2.35</td>
<td>1.35</td>
<td>-1.73</td>
<td>.09</td>
</tr>
<tr>
<td>BX Errors (proactive)</td>
<td>-4.67</td>
<td>1.02</td>
<td>-4.58</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 2: Cognitive control and alternative explanation variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY Errors (reactive)</td>
<td>-2.15</td>
<td>1.35</td>
<td>-1.59</td>
<td>.12</td>
</tr>
<tr>
<td>BX Errors (proactive)</td>
<td>-2.99</td>
<td>1.08</td>
<td>-2.77</td>
<td>.007</td>
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<tr>
<td>Short-term memory</td>
<td>1.31</td>
<td>0.48</td>
<td>2.73</td>
<td>.008</td>
</tr>
<tr>
<td>Drug &amp; alcohol use</td>
<td>-0.23</td>
<td>0.13</td>
<td>-1.86</td>
<td>.07</td>
</tr>
<tr>
<td>Distractions</td>
<td>-0.11</td>
<td>0.10</td>
<td>-1.06</td>
<td>.29</td>
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<tr>
<td>Sample</td>
<td>3.09</td>
<td>2.11</td>
<td>1.47</td>
<td>.15</td>
</tr>
<tr>
<td>Total number of offenses</td>
<td>-0.11</td>
<td>0.07</td>
<td>-1.50</td>
<td>.14</td>
</tr>
<tr>
<td>Severity of worst offense</td>
<td>0.79</td>
<td>0.45</td>
<td>1.75</td>
<td>.09</td>
</tr>
<tr>
<td>Age (linear)</td>
<td>1.35</td>
<td>0.97</td>
<td>1.39</td>
<td>.17</td>
</tr>
<tr>
<td>Age (quadratic)</td>
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<td>0.58</td>
<td>-2.38</td>
<td>.02</td>
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<tr>
<td><strong>Criminal maturity</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Model 3: Cognitive control</td>
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<td></td>
</tr>
<tr>
<td>AY Errors (reactive)</td>
<td>-3.50</td>
<td>1.12</td>
<td>-3.12</td>
<td>.003</td>
</tr>
<tr>
<td>BX Errors (proactive)</td>
<td>-0.27</td>
<td>0.85</td>
<td>-0.32</td>
<td>.75</td>
</tr>
<tr>
<td>Model 4: Cognitive control and alternative explanation variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AY Errors (reactive)</td>
<td>-2.32</td>
<td>1.13</td>
<td>-2.06</td>
<td>.04</td>
</tr>
<tr>
<td>BX Errors (proactive)</td>
<td>-0.32</td>
<td>0.91</td>
<td>-0.35</td>
<td>.73</td>
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<tr>
<td>Short-term memory</td>
<td>-0.14</td>
<td>0.40</td>
<td>-0.36</td>
<td>.72</td>
</tr>
<tr>
<td>Drug &amp; alcohol use</td>
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<td>0.11</td>
<td>2.31</td>
<td>.02</td>
</tr>
<tr>
<td>Distractions</td>
<td>-0.08</td>
<td>0.09</td>
<td>-0.91</td>
<td>.37</td>
</tr>
<tr>
<td>Sample</td>
<td>-4.21</td>
<td>1.76</td>
<td>-2.39</td>
<td>.02</td>
</tr>
<tr>
<td>Total number of offenses</td>
<td>0.22</td>
<td>0.06</td>
<td>3.55</td>
<td>.001</td>
</tr>
<tr>
<td>Severity of worst offense</td>
<td>0.18</td>
<td>0.38</td>
<td>0.47</td>
<td>.64</td>
</tr>
<tr>
<td>Age (linear)</td>
<td>-2.15</td>
<td>0.81</td>
<td>-2.66</td>
<td>.01</td>
</tr>
<tr>
<td>Age (quadratic)</td>
<td>-1.05</td>
<td>0.49</td>
<td>-2.14</td>
<td>.04</td>
</tr>
</tbody>
</table>

* Dummy code for detained adolescent participants—incarcerated young adults

Note: N = 83

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Fig. 1 Scatter plots of age with raw prosocial maturity and criminal maturity scores with quadratic reference lines. Note: Examination of the prosocial and criminal maturity residuals from our predictive model indicated that there were no outliers. Thus, scores that appear to be outliers in this figure are actually scores that would be expected given participants' scores on the other variables included in the model.
Our first model predicted prosocial maturity from AY errors (representing reactive control) and BX errors (representing proactive control). Only proactive control was significantly related to prosocial maturity, such that individuals with better proactive control scored significantly higher on prosocial maturity than those who had worse proactive control. Our second model predicted prosocial maturity from proactive and reactive control as well as the variables representing possible alternative explanations described above. Proactive control was able to predict a significant amount of the variability in prosocial maturity above and beyond the effects of other variables. Furthermore, short-term memory also uniquely and significantly predicted variability in prosocial maturity, such that individuals with better short-term memory skills scored higher on prosocial maturity than those who had worse short-term memory skills. There was a marginally significant relation between drug and alcohol use and prosocial maturity, such that individuals with less drug and alcohol use scored higher on prosocial maturity than those with more drug and alcohol use. There was a significant curvilinear relation with age, suggesting that prosocial maturity scores increased quickly with age in detained adolescents, but these scores remained relatively constant with increases in age among the young adult prisoners.

The third model predicted criminal maturity from AY errors (representing reactive control) and BX errors (representing proactive control). Only reactive control was a significant predictor of criminal maturity, such that individuals with better reactive control scored higher on criminal maturity than those who had worse reactive control. The fourth model predicted criminal maturity from proactive and reactive control as well as the variables representing possible alternative explanations. Reactive control was able to predict a significant amount of the variability in criminal maturity above and beyond the effects of the other variables. Furthermore, drug and alcohol use, total number of offenses, and sample also uniquely and significantly predicted variability in criminal maturity. Individuals with more drug and alcohol use and more total offenses scored higher on criminal maturity than those with less drug and alcohol use and fewer total offenses. Young adult prisoners scored higher on criminal maturity than detained adolescents. There was a significant curvilinear relation between age and criminal maturity, suggesting that, like prosocial maturity, criminal maturity scores increased quickly with age in detained adolescents, but these scores remained relatively consistent with increases in age among the young adult prisoners. Even though our findings were significant, the results regarding criminal maturity should be interpreted cautiously because the low reliability of the scale prevents us from making confident assessments of its validity.

DISCUSSION

This study related prosocial and criminal maturity to measures of cognitive control, while also examining potential alternative explanations for these relations. The relation between prosocial and criminal maturity was small and nonsignificant, indicating that individuals who scored high on one component were equally likely to be high or low on the other component. Consistent with our predictions, prosocial maturity and criminal maturity were differentially related to cognitive control and other explanatory variables. Individuals with higher levels of prosocial maturity had better proactive control, were older, and had better short-term memory than those with lower levels of prosocial maturity. Individuals with higher levels of criminal maturity had better reactive control, were older, more likely to be incarcerated in the adult prison, used drugs and alcohol more frequently, and had more documented offenses than those with lower levels of criminal maturity.

Our finding that individuals with better proactive control scored higher on prosocial maturity than those with worse proactive control is consistent with the notion that prosocial maturity requires that individuals be able to regulate emotions, make autonomous decisions, and balance the risks and benefits of behavioral decisions. These skills require that individuals attend to and maintain mental representations of information that dictate appropriate behavioral responses. In other words, prosocial maturity skills require that individuals actively remember their long-term goals over time and adjust their behaviors within this time period to optimally complete these goals, which is consistent with theories on proactive control (Braver et al., 2007). Proactive control also requires that individuals suspend automatic responses, which would assist them in focusing on both the risks and the benefits of their behaviors rather than focusing entirely on the benefits. Short-term memory also had an independent effect on prosocial maturity above and beyond proactive control. Short-term memory, as measured in the current study, assessed individuals’ abilities to attend to verbally presented information, process and manipulate this information in memory, and create a verbal response. Prosocial maturity therefore appears to rely on goal-related memory skills as well as more general working memory abilities, which is consistent with previous findings (Caufman et al., 2005).

Age was also a robust predictor of prosocial maturity, such that maturity skills appear to increase steeply until approximately the age of 18, after which point they level off. This pattern was found even after controlling for other variables, including whether the individuals were from the detained adolescent sample or the young adult prisoner sample. This result is consistent with previous research that found that older adolescents and young adults had similar
decision-making skills but were better than younger adolescents at appraising the impact of risks, recognizing future consequences, making decisions based on logical reasons, and attending to future outcomes (Crone, Vendel, & van der Molen, 2003; Grisso et al., 2003; Weithorn & Campbell, 1982).

Although our measure of criminal maturity had low reliability, we believed that it was important to examine how this construct related to theoretically meaningful variables to further our understanding of criminal maturity and how it should be measured. The current paper was the first attempt to examine criminal maturity as measured by the RSTI, providing preliminary but not definitive evidence on the nature of this construct. The conclusions we make regarding reactive control should therefore be considered with caution until further research replicates or refutes them.

Reactive control was a strong predictor of criminal maturity, which suggests that individuals with higher levels of criminal maturity are better at using environmental contextual cues from triggering events to activate mental representations that guide their behavioral decisions. These individuals may therefore be more likely to rely on external events to adjust their behaviors to effectively accomplish their goals. Accomplishing goals in this way requires effective reactivation of individuals’ mental representations, which rely on triggering events that are important and relevant to individuals’ goals (Braver et al., 2007). Criminal behaviors have more severe potential consequences (e.g., arrest and imprisonment) than most behaviors people perform during their everyday life. This may explain the relation between criminal maturity and reactive control, in that a criminally mature individual will need to quickly and accurately react to triggering events. The observed relation between criminal maturity and reactive control is also consistent with the proposition that criminally mature individuals are more reliant on processes that are less demanding of cognitive resources. It is possible that their reliance on reactive control results from poorly developed proactive cognitive control skills. Individuals who find it difficult to actively retain goal-related information may instead come to rely on information that is immediately available to them at the point when they are making a decision.

We did not find a significant relation between criminal maturity and proactive control. The low reliability of our measure of criminal maturity prevents us from claiming that this means that criminal maturity and proactive control are truly unrelated. However, we do have evidence to claim that criminal maturity is more strongly related to reactive control than it is to proactive control.

Age was also an independent predictor of criminal maturity, such that criminal maturity slowly increased until the age of 18 and leveled off thereafter. The total number of documented offenses was a unique predictor of criminal maturity, such that individuals who were charged with more offenses scored higher on criminal maturity than those charged with fewer offenses. This finding suggests that an individual’s past experience with the justice system successfully predicts criminal maturity. Perhaps what is most interesting is that both experience with the justice system and cognitive control skills were able to uniquely predict criminal maturity, suggesting these variables explain different aspects of this construct. Drug and alcohol use was also a unique predictor of criminal maturity, such that individuals who used more drugs and alcohol scored higher on criminal maturity than those using fewer drugs and alcohol. This finding suggests that criminal maturity may be related to the engagement in illegal behaviors beyond what is captured by documented offenses. Young adults in prison scored higher on criminal maturity than did adolescents in the detention center. There are therefore variables that distinguish these two samples that had effects above and beyond those factors we measured in the current study, which included the total number of documented charges and age of the participants. Given this evidence future research could examine the influence of variables not measured in the current study, which may include employment, family characteristics, or the nature of the index offense.

Our findings indicate important differences between prosocial and criminal maturity. Prosocial maturity was related to the ability to emphasize the long-term consequences of one’s behaviors, to remember, manipulate, and recall information, and to actively retain behaviorally relevant information for use in decisions made at a later point in time. Based on this, we would expect prosocially mature individuals to thoughtfully plan out their behaviors and use their past experiences to determine the possible consequences of their actions. Criminal maturity, on the other hand, was related to the ability to use environmental cues of behaviorally relevant information, which influence decisions made in the moment that such information is provided. Based on this, we would expect criminally mature individuals to have an accurate understanding of their current environment and appropriately respond to changes as they occur.

Our findings enhance the existing literature base on psychosocial maturity in several ways. To date, much of the research evidence on the maturity and cognitive control skills of adolescents is based on data gathered from typically developing adolescents, which greatly limits our understanding of these constructs in antisocial youth. Our findings expand the growing evidence on maturity in individuals who engage in antisocial behaviors, showing that within such samples, prosocial and criminal maturity are each best explained by distinct variables, with only age being predictive of both types of maturity. Our study also highlights the importance of examining different types of
cognitive control to better understand maturity. Prosocial maturity was most strongly related to the ability to engage more cognitive resources such as those requiring the active maintenance of mental representations. Criminal maturity, on the other hand, was most strongly related to the ability to directly perceive and interpret environmental cues, which is done without engaging many cognitive resources because it does not require the active maintenance of mental representations. This suggests that successfully performing prosocially mature, rule-guided behaviors may require more consideration before the decision-making situation occurs, while the skills most needed for criminally mature behavior may require the ability to draw successful inferences from the situation at hand.

Legal definitions of maturity are broad and vague, aggregating both prosocial and criminal maturity into one construct. Furthermore, previous research has indirectly examined criminal maturity by measuring maturity (defined without separating the skills into prosocial and criminal components) in delinquent and antisocial samples. This research has found that serious juvenile offenders had lower scores on measures of maturity (e.g., Cauffman et al., 2005). We have shown that offenders may differentially evidence prosocial and criminal maturity, necessitating the separation of maturity into these two components. Dissociating maturity gives more specific information about where to best intervene with individual offenders. If the offender has low prosocial maturity skills but high criminal maturity skills, the individual already possesses some level of maturity, which then needs to be generalized to socially appropriate maturity skills. Previous models of maturity (which do not separate maturity into prosocial and criminal components) would have measured this individual as having a moderate level of maturity skills, and thereby overlooked a potential avenue for treatment. Separating maturity also gives more specific information about areas of concern when assessing risk for future offending. That same offender who has low prosocial skills but high criminal maturity skills may pose the greatest risk for future offending, given that his maturity skills are used primarily in the pursuit of antisocial outcomes. The previous model of maturity (again, which does not separate maturity into prosocial and criminal components) would predict that the individual has maturity skills, thereby failing to identify an individual who poses a great risk for future offending.

Our examination of cognitive control has implications for understanding maturity within the context of brain development in adolescence. Reactive and proactive control are related to unique types of dopamine transmission, have unique PFC circuitries, and make use of unique pathways to and from other brain regions (Braver et al., 2007). Disruptions in brain development during adolescence may occur in the nature of the refinement of neural circuitries as well as in the transmission and regulation of information within neural circuitries. Such developmental disruptions may lead to difficulties with either proactive or reactive control, and consequently impairments in either prosocial or criminal maturity. These propositions may guide interpretations of and generate novel questions about the rapidly growing empirical evidence from the magnetic resonance imaging of adolescents who engage in antisocial behaviors (e.g., Vloet, Konrad, Huebner, Herpertz, & Herpertz-Dahlmann, 2008).

There are particular aspects of the current study that deserve mention to highlight its limitations. Results from the current sample are based on male offenders only. It is unclear whether or how these results will extend to female samples. There is some empirical evidence that females are more psychosocially mature than males in adolescence and young adulthood, but that males and females have similar levels of psychosocial maturity in later adulthood (e.g., Cauffman & Steinberg, 2000). It would be important to examine this finding in more detail by investigating possible gender differences in prosocial and criminal maturity. Another limitation was that our measure of criminal maturity had low reliability. Although this low reliability does not call into question our significant findings (since its effect is to make it more difficult to obtain significant results; Cohen et al., 2003), it does highlight a need for more research on and possibly the additional development of measures of criminal maturity.

The outcomes of interest in the current study were limited to interview-based clinical assessments of maturity. Additional research examining real-life decision making and behavioral outcomes is also needed. Future research could examine how individuals make decisions in natural environments such as schools, detention facilities, or with peers. While there have been investigations of decision making in natural environments (e.g., Ambuehl & Rappaport, 1992; Lewis, 1980), more research using diverse naturalistic settings is needed.

It is also important to note that the cognitive model we used is quite circumscribed, clarifying only the micro-level cognitive processes that may underlie one component of goal-directed behaviors. Understanding these micro-level cognitive processes is crucial for understanding the complex construct of maturity. There are, nonetheless, a multitude of other important processes and influences (e.g., such as affect regulation and peer influences) that remain to be examined to better understand the intricacies of the construct of maturity.

**Implications for Juvenile Justice Research and Practice**

While maturity is likely linked to biologically based changes in adolescence, there is also a rapidly growing
literature on neural behavioral training (see Siegle, Ghinassi, & Thase 2007). The objective of such training is to change or “remediate” poorly functioning cognitive processes associated with specific psychopathologies (Siegle et al., 2007). It may therefore be possible to influence the neurobiology underlying the developmental trajectory of antisocial adolescence with cognitive training programs. Specifically, we believe that tasks designed to provide training in proactive control could be used to improve the prosocial maturity of delinquent adolescents. The evidence on neurobehavioral training is promising, but the field is still in its infancy. It nonetheless provides an intriguing empirically based theory on brain-behavior relations that may be useful for intervening with antisocial adolescence in a truly multifaceted manner.

Findings from the current study highlight several avenues for future investigations on maturity. The cross-sectional nature of the current study prohibits us from making causal statements about the relation between maturity and cognitive control. Nonetheless, it is quite possible that this relation is reciprocal, with change in one ability causing change in the other. Future research could implement a training program that attempts to improve individuals’ maturity skills through techniques that develop attention to behaviorally relevant information, maintenance of this information, and inhibition of inappropriate automatic responses. The influence of such training could be measured by examining changes in the targeted cognitive control abilities as well as changes in individuals’ levels of maturity. A different intervention could target individuals’ abilities to regulate emotions, view themselves as responsible for decisions, and anticipate the consequences of their behaviors. The influence of this intervention could be measured by examining changes in targeted prosocial maturity skills as well as changes in their cognitive control processes. Measurement of environmental changes, such as peer selection, and measurement of behavioral changes, such as engagement in or avoidance of antisocial behaviors, would also be crucial to examine in both of these proposed intervention studies.

Longitudinal designs would provide important information on the stability and change of prosocial and criminal maturity over time. Tracking changes in cognitive control skills, prosocial maturity, and criminal maturity over time would allow researchers to identify when and at what level certain individuals’ trajectories plateau. Intervention studies could impose environments with varying demands on cognitive control and then measure changes in maturity over time. It would also be important for future research to examine behavioral outcomes that might be related to prosocial and criminal maturity. Such outcomes could include undocumented offenses, self-reported delinquent behaviors, institutional infractions, and behaviors in treatment sessions.

The mounting empirical evidence related to juvenile offending strongly points toward the importance of considering individual differences when making legal decisions that apply to delinquent youth. Findings from the current study indicate the importance of examining psychosocial maturity as being composed of prosocial and criminal components, since these constructs had different relations to important cognitive and individual difference variables. It is hoped that the preliminary knowledge gained from this study will eventually expand our understanding of young offenders, empirically informing policies and interventions for these youth, ideally creating pathways out of delinquency for youth who find themselves in trouble with the law.

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