

Effortful Control, Social Competence, and Adjustment Problems in Children at Risk for Psychopathology

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This study explored the factor structure and developmental trajectory of effortful control (EC), its relations with child adjustment, and the moderating role of age and gender in 75 4- to 6-year-old children at risk for psychopathology. Confirmatory factor analyses revealed two subcomponents of effortful control: Suppress/Initiate (the ability to inhibit a dominant response while initiating a new response) and Motor Control (inhibiting fine and gross motor activity). EC performance improved with age, and both subcomponents were associated with greater social competence at all ages. Associations with internalizing problems were moderated by child age such that greater EC was linked to fewer problems at age 4 but did not relate to problems at ages 5 or 6.

The growing ability to voluntarily inhibit a dominant response to initiate a subdominant response, or effortful control (EC), is a hallmark of early childhood development (Kochanska, Murray, & Harlan, 2000; Rothbart & Bates, 1998; Rothbart & Rueda, 2005). High EC is associated with enhanced emotional and social competence (Bjorklund & Kipp, 1996; Derryberry & Rothbart, 1997; Eisenberg et al., 2003; Kochanska, Murray, & Coy, 1997; Kopp, 1982, 1989) and with reduced internalizing and externalizing problems (Eisenberg, Gershoff, et al., 2001; Eisenberg et al., 2004; Eisenberg et al., 2003). Despite documented links between EC and child adjustment, relatively little is known about these associations in children at risk for psychopathology. In addition, although EC is multifaceted, involving a number of behavioral and neurobiological systems (Kindlon, Mezzacappa, & Earls, 1995; Murray & Kochanska, 2002; Nigg, 2000; Olson, Schilling, & Bates, 1999), most studies examine EC as a unitary construct. Consequently, there is a limited empirical basis on which to explore the developmental consequences of subcomponents of EC.

Effortful Control and Subcomponents

EC is among the early-developing individual differences that fall into the category of temperamental regulation (Derryberry & Rothbart, 1997; Eisenberg, Sadovsky, et al., 2005; Eisenberg, Zhou, et al., 2005; Posner & Rothbart, 2000). In contrast to temperamental reactivity or affective arousal, regulation refers to voluntary control of behavior and attention and serves to modulate emotional reactivity. Although most studies document coherence among measures of effortful control, EC comprises potentially dissociable domains of inhibitory control, attentional control, modulation of motor activity, and delay of gratification, all of which may have unique implications for adjustment (Kindlon et al., 1995; Mezzacappa, Kindlon, Saul, & Earls, 1998; Nigg, Goldsmith, & Sachek, 2004; Olson et al., 1999; Rothbart & Rueda, 2005).

Kochanska and colleagues (Kochanska et al., 1997; Kochanska, Murray, Jacques, Koenig, & Vandegest, 1996) have made notable progress in facilitating research on EC by developing a comprehensive behavioral assessment battery, the Effortful Control (EC) Battery. It assesses the suppression of dominant responses in the motor, vocal, and cognitive domains. Across studies using the EC Battery, distinct sets of tasks are used

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depending on child age and study goals. However, the most commonly used tasks measure the ability to suppress one behavior in favor of another one (e.g., the game Simon Says and whispering on demand), fine and gross motor control (e.g., walking a line slowly and drawing slowly), and delay of gratification (e.g., waiting to open a wrapped gift and verbally choosing a toy rather than touching it). In the only factor analytic study of the battery (Murray & Kochanska, 2002), factors varied slightly depending on child age (2–6) and tasks used, although two components consistently emerged: motor control, including both gross and fine motor control tasks, and suppress/initiate behavior in response to a signal. An attentional control subcomponent, however, did not emerge, perhaps because it supports multiple EC domains (Posner & Rothbart, 2000).

Although previous research has combined parental report and observation to examine aspects of EC such as inhibitory and attentional control in children at risk for problems (e.g., Eisenberg, Cumberland, et al., 2001), the Murray and Kochanska (2002) study provided the first evidence confirming this multidimensional conceptualization of EC using only a behavioral assessment battery. It did not, however, examine whether these dimensions of EC uniquely related to measures of child adjustment. Instead, EC as a single construct was associated with greater social competence but also greater internalizing problems (Murray & Kochanska, 2002). Thus, it is unclear whether subcomponents of EC derived from the EC Battery differentially predict child competencies and problems, particularly in children at risk for psychopathology.

Developmental Trajectory of EC

EC shows predictable increases across the preschool and early school-age years (Eisenberg et al., 2003; Kochanska, 1997; Kochanska et al., 2000). In addition to these developmental changes, there is evidence suggesting that there are relatively stable individual differences in the relative level of EC in childhood (Kochanska et al., 1997; Kochanska et al., 1996). Longitudinal studies with low-risk children suggest that a single EC factor is relatively stable during the preschool and early school-age years, ranging from .58 (Kochanska et al., 1996; Kochanska et al., 2000) to .80 at 33 to 45 months of age (Kochanska, Coy, & Murray, 2001). The limited work on stability of EC subcomponents using the EC Battery suggests variability with development. For example, Suppress/Initiate is stable from toddler to later

ages (ranging .22–.40) but not from preschool to early school age (.02; Murray & Kochanska, 2002). Information about the stability of EC subcomponents in children at risk for psychopathology is lacking.

EC and Child Outcomes

Studies examining associations between EC and child adjustment show mixed results. Whereas some studies report few associations between EC and psychopathology (Oosterlaan & Sergeant, 1996), there is a growing body of evidence suggesting that both high and low levels of EC are linked to a range of problems. For example, high EC, as measured through maternal report and observed attentional and inhibitory control, predicts fewer internalizing problems (Eisenberg, Cumberland, et al., 2001; Eisenberg et al., 2004; Eisenberg et al., 2003). Other research, however, shows that high EC predicts greater internalizing problems (Eisenberg et al., 2000; Kochanska et al., 2000; Murray & Kochanska, 2002). One explanation for the divergent findings is that EC reflects characteristics that can create risk for internalizing problems, such as behavioral inhibition, over-control, or nonadaptive delay of gratification (Derryberry & Rothbart, 1997; Funder & Block, 1989), particularly in children prone to fearfulness, withdrawal, and social inhibition (Eisenberg, Cumberland, et al., 2001; Kagan, 1999). This divergence in findings may also be associated with age differences across studies, ranging from toddler to school age. EC could be linked to internalizing problems in older age groups because of the cumulative impact of risk or because internalizing symptoms tend to emerge in later childhood given increasing social and emotional demands placed on children (Murray & Kochanska, 2002).

EC also has been linked to reduced externalizing problems such as impulsivity and disruptive behaviors (Eisenberg, Gershoff, et al., 2001; Eisenberg et al., 2000; Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996; Lengua, West, & Sandler, 1998; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Pennington & Welsh, 1995). For example, in a study of 220 3-year-olds, high versus low levels of EC (as measured by maternal report and observed child attentional and behavioral control) were negatively related to specific parent- and teacher-reported disruptive behaviors such as hyperactivity (Olson et al., 2005). In another study, high levels of maternal-reported child EC (a combination of inhibitory control, attention shifting, and attention focusing) mediated the link between high levels of positive

parenting and low levels of parent-rated externalizing problems (Eisenberg, Zhou, et al., 2005).

A considerable number of studies document positive links between EC and social competence (e.g., Eisenberg et al., 2000; Kieras, Tobin, Graziano, & Rothbart, 2005; Kochanska et al., 2000; Kochanska et al., 1997; Kochanska, Tjebkes, & Forman, 1998; Liew, Eisenberg, & Reiser, 2004). Preschool children showing high versus low levels of EC show greater observed compliance and cooperation (Kochanska et al., 2001; Kochanska et al., 1997; Kochanska et al., 1998). In another study, maternal report and observations of child EC (combined measures of inhibitory control, attentional control, and persistence) predicted greater maternal and teacher report of child ego resiliency (Eisenberg et al., 2004).

This Study

Despite this compelling body of evidence, there remain several open questions and inconsistencies. First, it is not clear how objectively rated EC, such as scores derived from the EC Battery, operates in a group of children at elevated risk for psychopathology. In groups with relatively low levels of psychopathology, associations between EC and internalizing and externalizing problem behaviors may be missed (Murray & Kochanska, 2002). Second, sample characteristics such as age, gender, and IQ may moderate associations between EC and outcomes (for some notable exceptions, see Kochanska et al., 1997; Valiente et al., 2003). For example, EC may account for more variance in child adjustment during the preschool versus early school-age period (Kochanska et al., 1997), or EC could be associated with poor adjustment in one age group and positive adjustment in another age group (Murray & Kochanska, 2002). In addition to age effects, several studies document higher levels of EC among girls versus boys (Eisenberg et al., 2003; Kochanska et al., 1997; Kochanska et al., 2000), although it is unknown whether EC predicts adjustment differently for boys versus girls. IQ has also been linked to greater EC but has not, to our knowledge, been examined as a moderator of the association between EC and adjustment (Funder & Block, 1989). Third, few studies have assessed whether subcomponents of EC show distinct associations with child adjustment. One study (Eisenberg, Cumberland, et al., 2001) found that children at risk for internalizing problems showed low attentional control, whereas children at risk for externalizing problems showed reduced effortful control of motor behavior. However, other studies have suggested that multiple

aspects of EC are associated in similar ways with problems (Rothbart, Ellis, Rueda, & Posner, 2003).

Based on these limitations and inconsistencies in past research, the goals of our study were to address four specific questions:

1. Do subcomponents of EC detected in low-risk samples using the EC Battery emerge when administered to children at high risk for psychopathology?
2. Does EC show both stable individual differences and age-related changes in an at-risk group of children?
3. Does EC relate to adjustment problems and social competence during the preschool period?
4. Do associations between EC and adjustment differ depending on child age, gender, or IQ?

Method

Participants

Participants were 75 children, aged 4 to 6 years ($M = 5.54$ years, $SD = .80$). This was a subsample of children ($N = 99$) enrolled in a preventive intervention trial for preschoolers at risk for psychopathology (Brotman et al., 2005; Brotman et al., 2007). Only those children who were administered the EC Battery were included in our study. Children were the younger siblings of youths adjudicated in New York City Family Court from 1996 to 2001.

The high-risk status of the full sample of preschoolers and their families is described elsewhere (Brotman, Gouley, O'Neal, & Klein, 2004). Although children were targeted for a conduct problems prevention trial based on sibling antisocial behavior, there were also high rates of maternal anxiety and depression (Brotman et al., 2004), suggesting that the preschoolers were at high risk for both externalizing and internalizing psychopathology. Our study sample ($N = 75$) included 64% African American, 25% Latino, and 11% children from mixed/other ethnicities. Fifty-five percent were girls, and 56% lived in households with a family income of less than \$15,000 per year. The average child IQ score based on cognitive testing at baseline (Differential Ability Scales; Elliott, 1990) was 83.38 ($SD = 12.29$); 15% exhibited clinically elevated externalizing problem scores, and 7% exhibited clinically elevated internalizing problems according to parent report (T scores of 63 or higher on the Child Behavior Checklist; Achenbach, 1999). Most caregivers (81%) were the child's biological mothers.

Procedure

The prevention trial was approved by the New York University School of Medicine Institutional Review Board. Five cohorts of children were enrolled over a 5-year period. Assessments were completed at baseline (prior to intervention), 8 months, 16 months, and 24 months postbaseline. Signed informed consent was obtained during a visit to the research center or the family's home. At each assessment, parents reported on child behavior problems (e.g., internalizing and externalizing problems) and social competence. Parent-rated questionnaires were completed during an interview with a trained research assistant at the research center or home. EC was assessed based on a laboratory procedure conducted at the research center. The assessments for the full trial also included observations of parent–preschooler interactions, the home environment, and child behavior (not considered in our study). Parents received \$100 for the baseline assessment, \$50 for each subsequent assessment, and reimbursement for travel.

The EC Battery was introduced approximately 1 year after the start of the study; therefore, children varied systematically in the number of EC assessments that they were asked to complete (ranging from 1–4). A few cases moved out of state or were lost to follow-up prior to the introduction of the EC Battery. In addition, there were several cases in which children completed the primary study assessment but did not complete the EC Battery due to time constraints. This resulted in 75 of 99 children participating in the full study with at least one EC assessment. Because we were interested in examining age-related changes in our study, we decided to categorize data for EC and child outcomes by child age (ages 4, 5, and 6). Study assessments were conducted approximately 8 to 9 months apart, so it was possible for children to receive more than one assessment per age (within a 12-month period). To include only one assessment per age, the EC assessment conducted when the child's age was closest to the mean of the age group was used in analyses. Four assessments were excluded at age 4, 9 excluded at age 5, and 7 excluded at age 6. The final sample included 38 children assessed at age 4 (51%; 20 boys, 18 girls), 55 at age 5 (73%; 21 boys, 34 girls), and 37 at age 6 (49%; 14 boys, 23 girls). Thirty-one children (41%) had EC data at one age, 33 (44%) had EC data at two or three ages, and 11 (15%) had EC data at all three ages.

To determine whether children participating in one EC assessment differed systematically from those receiving multiple EC assessments, we tested

for group differences in EC scores, demographic characteristics, total problems, and social competence. No significant group differences emerged. Analyses at each age showed no differences between children with no EC data versus any EC data on baseline demographic, problem behavior, or social competence.

Measures

EC battery (Kochanska et al., 1997; Kochanska et al., 1996). The EC Battery was used to assess motor control, inhibition, and delay capacities. The battery consists of tasks and games conducted in the laboratory with an experimenter. Varying combinations of tasks have been used across studies of EC, but all require the child to inhibit and delay behavior. In our study, we generated seven EC scores based on 9 tasks. Of the 12 tasks administered, 3 were excluded: One showed ceiling effects (approximately 90% of children obtained full points for the Tongue task, which requires children to hold a candy on their tongue but not eat it), and 2 tasks (Simon Says and KRISP) had unacceptable psychometric properties (available from the first author). Because tasks were scored on different scales, we rescaled them on a common scale (0–100; Cohen, Cohen, West, & Aiken, 2003). The following formula was used: $N = 100 \times (I - \text{possible minimal score}) / (\text{possible maximal score} - \text{possible minimal score})$, where N is new scale scores and I is old score. According to Cohen et al., this transformation obtains the original shape of the distribution while allowing for meaningful differences in variation to be studied.

A complete description of the laboratory procedures and coding is provided elsewhere (Kochanska et al., 1997; Kochanska et al., 1996). Briefly, as detailed by Kochanska, four tasks were used to measure the ability to suppress a dominant response and initiate a subdominant response: the Tower, Whisper, Wrapped Gift, and Dinky Toys tasks. In the Tower task, children were asked to take turns with the experimenter to build a tower of blocks with 20 wooden blocks. Scores ranged from 10 (*no turns given*) to 20 (*alternated every turn*). For each trial of the Whisper task, the child was instructed to whisper the names of 12 cartoon characters (1 per trial), presented consecutively as color pictures. Instructions were first whispered by the experimenter (1 of 3 of the trials), then spoken in a normal voice (1/3 of trials), and finally yelled (1/3 of trials). Coding for each trial ranged from 1 (*shouts/speaks out loud*) to 3 (*whispers*); the final score was the mean of 12 trials.

In *Wrapped Gift*, the child was instructed not to peek while a gift was being wrapped for 60 sec behind the child's back and not to touch the gift while alone with it for 3 min. Coding was peeking 1 (*peeking*) to 5 (*not peeking*), latency to peek, touching gift 1 (*touching*) to 5 (*not touching*), and latency to touch gift (0–180 sec). All scores were rescaled (0–100) and averaged to create a single composite score for the wrapped gift task. In *Dinky Toys*, the child was instructed to tell the experimenter which toy in a large container of small toys he or she wanted while keeping hands on his or her lap for up to 2 min. Scores were 0 (*grabbed toy*) to 5 (*hands remain on lap during task*).

Five tasks were used to assess the ability to inhibit motor behavior. In the three drawing tasks, *Star*, *Circle*, and *Elmos*, the child was instructed to draw the appropriate figure (star, circle, and a line from one Elmo to another) for three trials (resulting in nine trials). For each task, a baseline trial was completed without instructions for speed, followed by directions to draw slowly for two trials. Coding was done live by the experimenter using a stopwatch. These three drawing tasks were combined into one draw slowly score. The score was the difference between the average of the slow trials and the one baseline trial. In *Walk-a-Line Slowly*, the child was instructed to walk along a 12 ft long strip (2.5-in. wide) taped to the floor, once at regular speed and twice slowly. The task was coded live by the experimenter using a stopwatch. The score was the average of the two slow trials. In the *Cow and Dragon* task, children performed movements commanded by the cow (six trials) but not those commanded by the dragon (six trials). The average score across the six dragon trials was used in our study to reflect motor inhibition. Each trial was rated from 0 (*making a full movement*, i.e., failing to inhibit) to 3 (*not moving*, i.e., successfully inhibiting). Based on these nine tasks, seven EC scores were generated at each assessment points: Tower Mean, Whisper Mean, Wrapped Gift Composite, Dinky Toys, Draw Slowly Difference Composite, Walk-a-Line Slowly Mean, and Dragon Mean.

Interrater reliability. All administrations were coded by two independent raters (the experimenter and a second research assistant who watched the videotaped EC Battery). Raters were blind to intervention status and to parental ratings of child adjustment. Both raters coded each task, except for the drawing and walking tasks, which could not be accurately viewed on videotape and so were timed by the experimenter in the room with the

child (Rater 1). Intraclass correlations for the other five tasks across three assessment time points ranged from .81 (*Wrapped Gift*) to 1.00 (*Dinky Toys*), with an average intraclass correlation of .92. Scores from Rater 1 were used for analyses as they were considered potentially more accurate because they were coded live with unobstructed views of the child and because drawing tasks were only coded by Rater 1.

Child behavior checklist (CBCL; Achenbach, 1999). The CBCL is a standardized assessment of child internalizing and externalizing problems. Parents responded to 118 items describing child behavior, and rated each item as being *not true* to *very true* for their child on a 0 to 2 scale. We examined *T* scores from the broadband Internalizing and Externalizing scales.

Social competence scale (Conduct Problems Prevention Research Group 1995). The Social Competence Scale consists of 12 items that assess children's positive social behaviors, including emotion regulation, pro-social behaviors, and communication skills. Parents were asked to rate how well 12 statements describe their child on a 5-point scale from 0 (*not at all*) to 4 (*very well*). Items include "Your child copes well with failure" and "Your child shares things with others." A total scale score was created for each child (Conduct Problems Prevention Research Group, 1995; Corrigan, 2002, 2003). In this sample, the measure has been shown to be reliable and valid for preschoolers (Gouley, Brotman, Huang, & Shrout, in press). Internal consistency of the measure was high (.87), as was test-retest reliability (*r* ranged from .52 to .69 across 2 years). The scale score was correlated with other measures of social competence, including parent ratings of peer interaction, social skills, emotion regulation, lability and behavior problems, and tests of child cognitive ability.

Analytic Plan

Maximum likelihood confirmatory factor analysis (CFA) using EQS 6.1 (Byrne, 2006) was conducted to examine the factor structure of the EC Battery. We explored whether Suppress/Initiate and Motor Control subcomponents of EC emerged. For the purpose of the CFA, we selected assessments from each age group. To avoid including more than one assessment per child, we randomly selected one data point for the cases with two or three assessments ($n = 44$), with approximately equal numbers of cases from

each age (*n*s for age 4, 5, 6 were 25, 24, and 26, respectively). Using this procedure, we constructed a data set with 75 independent cases with child age ranging from 4.18 to 6.99 ($M = 5.54$, $SD = .80$).

For the remaining analyses, three sets of generalized estimating equation (GEE) analyses (Liang & Zeger, 1986; Zeger, Liang, & Albert, 1988) were employed to investigate (a) the stability of EC; (b) the association between EC and child outcomes over three time points; and (c) the moderation effect of child gender, age, and IQ on the association between EC and child outcomes. GEE was employed instead of standard analysis of variance (ANOVA) techniques because it uses all available data at each time point for all 75 participants rather than excluding participants who are missing one or more time points. Another advantage is that it treats the age/time variable more flexibly than repeated measures ANOVA analyses. This is especially useful for this study because using actual age (instead of assessment wave) allows for more accurate estimation of results. Moreover, GEE is appropriate for both independent and dependent variables that are measured at multiple time points and for including both time-varied and time-invariant (e.g., child gender) variables in a model. Therefore, the GEE approach allowed us to test the association between EC and child outcome conditional on participant characteristics over the three time points (Diggle, Heagerty, Liang, & Zeger, 2002).

Although there were no significant intervention effects on EC, all GEE analyses included

intervention status as a covariate to control for any possible effects associated with intervention condition. Also, analyses were conducted separately for each EC subcomponent (Suppress/Initiate and Motor Control) and child outcome measures. In examining the association between EC and child outcome over time, two sets of analyses were conducted. One included EC (Suppress/Initiate or Motor Control) as a predictor of child outcomes without including the moderators, indicating a significant effect of EC across ages 4 to 6. Another set of analyses examined moderation effects of gender, age, and IQ in the links between EC and outcomes. In this set of analyses, EC and three moderators (gender, age, and IQ) along with three interaction products (i.e., $EC \times Age$, $EC \times Gender$, and $EC \times IQ$) were included. A significant $EC \times Moderator$ effect indicates that the link between EC and outcome differs by moderation factors.

Results

Descriptive Statistics and Factor Structure of the EC Measure

Table 1 presents descriptive statistics by age for each of the seven EC scores and child adjustment variables. All variables were approximately normally distributed as indicated by visual inspection of the distribution and by estimates of skewness and kurtosis. Table 2 shows intercorrelations

Table 1. Descriptive Statistics for Effortful Control (EC) and Child Outcome Variables

	Age 4 ^a				Age 5 ^b				Age 6 ^c			
	<i>n</i>	<i>M</i>	<i>SD</i>	Range	<i>n</i>	<i>M</i>	<i>SD</i>	Range	<i>n</i>	<i>M</i>	<i>SD</i>	Range
EC Task Score												
Walk Slowly Mean	32	8.00	7.34	2–22	52	11.08	7.11	2–23	37	11.42	5.76	3.67–27
Draw Slowly Difference ^d	34	3.61	4.53	–0.80–20	52	6.77	7.37	–0.72–36	36	11.50	8.75	0.20–37
Dragon Mean												
Tower Mean	35	15.21	3.42	10–20	50	17.26	3.04	10–20	36	17.85	3.08	10–20
Whisper Mean	37	1.91	0.70	0.75–3	53	2.14	0.67	0.8–3	37	2.26	0.74	0.3–3
Dinky Toys	37	1.57	1.82	0–5	53	2.91	2.16	0–5	37	2.65	2.11	0–5
Wrapped Gift Composite	36	66.02	24.59	13–100	51	74.92	20.26	18–100	37	75.80	25.71	20–100
EC Subcomponent Scale Score												
EC Suppress/Initiate	37	53.32	20.85	22–100	53	68.33	20.33	27–100	37	68.00	23.52	12–100
EC Motor Control	37	45.07	20.81	1.07–88	54	49.86	18.45	6.75–92	37	53.72	15.54	12.37–85
Child Outcomes												
Internalizing Problems	38	47.08	10.42	33–69	55	46.15	9.14	33–66	37	46.16	9.45	33–63
Externalizing Problems	38	51.03	8.83	30–69	55	51.22	11.57	30–77	37	50.73	11.57	24–73
Social Competence	38	2.26	0.73	0.75–3.58	54	2.47	0.95	0.42–4	36	2.46	0.76	.58–3.83

Note: Individual EC task scores are raw scores, whereas EC scaled scores (Suppress/Initiate and Motor Control) are based on scaled EC task scores (rescaled 0–100). Intervention group, gender, race/ethnicity, and IQ differences on study variables were examined using GEE analyses, and no group differences were found on the study variables across three time points.

^a*n* = 38. ^b*n* = 55. ^c*n* = 37. ^dThis score can be negative because it reflects difference scores.

Table 2. Correlations Among Effortful Control (EC) Variables and Among Study Variables

EC Variables	1	2	3	4	5	6	7
1. Wrapped Gift	—	.27*	.33**	.34**	.26*	.20	.14
2. Tower		—	.14	.27*	.16	.03	.30*
3. Whisper Task			—	.31**	.20	.14	.28*
4. Dinky Toys				—	.16	.06	.31**
5. Walk-a-Line					—	.32**	.28*
6. Draw						—	.27*
7. Dragon							—

Study Variables	1	2	3	4	5
1. Suppress/Initiate	—	.31**	.22	.02	-.04
2. Motor Control		—	.20	-.04	.02
3. Social Competence			—	-.14	-.44***
4. Internalizing				—	.55***
5. Externalizing					—

Note: The analyses were based on a total sample size of 75 (sample use for CFA analyses, with approximately equal sample number from each age group).

* $p < .05$. ** $p < .01$. *** $p < .001$.

among EC measures, which overall are consistent with the hypothesized distinction between Suppress/Initiate and Motor Control. However, the Tower score was only significantly correlated with the Dinky Toys and Dragon, whereas the Dragon score was significantly correlated across most of the EC measures (five of the six scales).

For the CFA, we compared the two- and one-factor models. We first tested the two-factor model using seven EC scores and specifying separate Suppress/Initiate and Motor Control factors. Four indexes were used to evaluate the fit of the two-factor model, including the change in chi-square goodness of fit (χ^2); the goodness-of-fit index (GFI); the comparative fit index (CFI); and the root mean square error of approximation (RMSEA). As a general guideline, GFI and CFI values of .90 or higher and RMSEA values of .05 or lower are considered to reflect good fit of a model (Browne & Cudeck, 1996; Hu & Bentler, 1999). Consistent with our hypotheses and with previous findings (Murray & Kochanska, 2002), the two-factor solution showed good fit with the data, $\chi^2(13) = 7.33$ (GFI = .97, CFI = 1.00, RMSEA = 0). The Tower scale, however, had a standardized factor loading of .18 (the remaining six EC scales had factor loadings ranging from .40 to .76); we eliminated this low factor-loading item and reran the CFA. The two-factor model remained a good fit, with $\chi^2(8) = 4.70$ (GFI = .98, CFI = 1.00, RMSEA = 0). The one-factor model showed relatively poor fit, $\chi^2(9) = 12.04$ (GFI = .94, CFI = .87, RMSEA = .074). The two-factor model showed a better fit than the one-factor model, $\Delta\chi^2 = 7.34$, $p < .01$.

Suppress/Initiate consisted of three tasks that require the suppression of a dominant response and initiation of a subdominant response (i.e., Whisper, Dinky Toys, Wrapped Gift). Motor Control consisted of three tasks that require fine and gross motor control (i.e., Drawing Slowly, Walk-A-Line Slowly, and the Dragon task). The standardized factor loadings for the Suppress/Initiate factor ranged from .54 to .60 and for the Motor Control ranged from .45 to .63. Correlations between subscales showed moderate positive correlations at each age: Age 4: $r(37) = .30$, $p = .07$; Age 5: $r(53) = .30$, $p = .03$; Age 6: $r(37) = .25$, $p = .14$.

Taken together, results of the CFA (poor model fit for one-factor model) and low correlation between factors ($r_s = .25-.30$) support the separation of EC into two separate dimensions. Average intercorrelations among scores making up Suppress/Initiate were .34 (range = .19-.52) at age 4, .30 (range = .29-.34) at age 5, and .33 (range = .24-.48) at age 6; for Motor Control, average correlations were .28 (range = .20-.37) at age 4, .38 (range = .36-.41) at age 5, and .26 (range = .20-.34) at age 6. Intercorrelations did not differ by age or gender.

Temporal Stability of EC

Based on the subsample with two or more time points, Pearson product-moment correlations (ages 4 to 5 and ages 5 to 6) showed that, in contrast to previous findings (Murray & Kochanska, 2002) there was low stability from ages 4 to 5 and moderate stability from ages 5 to 6 for both

Table 3. Developmental Trajectory of Effortful Control (EC) Across Ages 4, 5, and 6 (Linear and Quadratic Models)

Model	Suppress/Initiate			Motor Control		
	Estimate (SE)	95% CI	<i>p</i>	Estimate (SE)	95% CI	<i>p</i>
Linear Model						
Intercept	50.70 (3.78)	43.29, 58.12	<.0001	41.05 (3.51)	34.78, 47.92	<.0001
Age ^a	8.67 (2.38)	4.01, 13.33	<.001	5.56 (1.87)	1.88, 19.23	<.01
Quadratic Model						
Intercept	39.33 (6.23)	27.12, 51.53	<.0001	38.39 (6.11)	26.41, 50.37	<.0001
Age ^a	27.70 (8.50)	11.03, 44.36	<.01	10.02 (8.18)	-6.02, 26.05	.22
Age × Age	-6.18 (2.68)	-11.44, -0.92	.05	-1.45 (2.50)	-6.34, 3.44	.56

Note: Age is actual age (in years) at the time of assessment and is centered at age 4. Results from four generalized estimating equation analyses are presented here. All analyses controlled for intervention status. In the moderation models, after adjusting for intervention status, child gender and IQ were associated neither with baseline EC (suppress/initiate and motor control) nor with change in EC over time. Thus, results for moderation models are not presented. CI = confidence interval.

^aAge 4 = 0.

Suppress/Initiate, $r(23) = .08$, $p = ns$, and $r(24) = .43$, $p < .05$, respectively, and Motor scales, $r(24) = .21$, $p = ns$ and $r(24) = .51$, $p < .01$, respectively.

Because Pearson correlations do not reveal information about developmental changes over time and may not provide the most accurate estimation of stability due to missing data, GEE was conducted to explore the stability of change in EC across ages. Table 3 presents unstandardized coefficients, standard errors, 95% confidence limits, and p values associated with the test of each coefficient from the GEE analysis (both linear and nonlinear models). In the linear models, results show that Suppress/Initiate and Motor Control both significantly increase over time (17.34 and 11.12 point increase for Suppress and Motor EC, respectively, over the three time points). In addition to linear change, results also showed a nonlinear change pattern for Suppress/Initiate. As shown in Figure 1, Suppress/Initiate increased more from age 4 to 5 and leveled off from age 5 to 6. Finally, we also explored whether EC scores or trajectories differed

by gender, ethnicity, or IQ; no moderation effects were found from the GEE analyses.

Main Effects of Effortful Control on Child Outcomes

Next, we examined associations between EC subcomponents and adjustment. Table 2 displays inter-correlations among EC subcomponents and outcome measures. Because correlation analyses did not include all available data and may not provide the most accurate estimation, GEE analyses were carried out. As shown in the top portion of Table 4, GEE analyses indicated that both higher Suppress/Initiate and Motor Control were associated with greater social competence at all ages. EC was not related to internalizing or externalizing problems. Coefficient values shown in Table 4 for internalizing and externalizing problems reflect small effects (ranged from .002 to .03).

Moderators of the Association Between Effortful Control and Child Outcomes

To explore whether associations between EC and child outcomes were moderated by child gender, age, and IQ, GEE analyses (one for each EC subcomponent and outcome) were conducted. As shown in the bottom portion of Table 4, the effects of Suppress/Initiate and Motor Control on child outcomes were not moderated by child gender or IQ. However, associations between both EC subcomponents and child outcomes were moderated by child age. As shown in Figure 2a, high Suppress/Initiate was significantly associated with lower internalizing problems at age 4, but this effect appeared to reverse or become insignificant as children aged. This same pattern emerged for Motor Control (see Figure 2b). To test whether

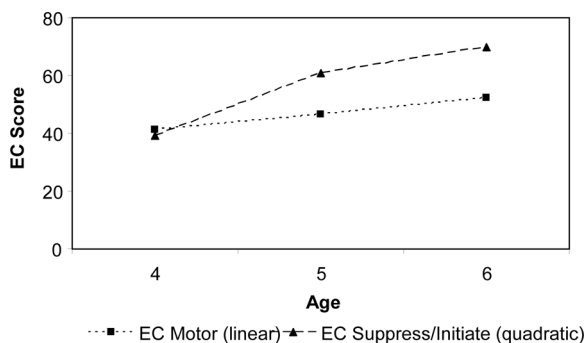


Figure 1. Developmental trajectory of effortful control (EC) scale scores across ages 4, 5, and 6.

Table 4. Effortful Control (EC) and Child Adjustment Across Ages 4, 5, and 6: Main Effects and Moderators

	Internalizing Problems			Externalizing Problems			Social Competence		
	Estimate (SE)	95% Limit	p	Estimate (SE)	95% Limit	p	Estimate (SE)	95% Limit	p
Main Effects									
EC Sup	-0.02 (0.03)	-0.09, 0.05	.53	-0.03 (0.04)	-0.10, 0.04	.46	0.01 (0.003)	0.002, 0.01	.01
EC Mot	-0.002 (0.04)	-0.07, 0.07	.96	0.03 (0.04)	-0.06, 0.11	.52	0.007 (0.003)	0.003, 0.01	.04
EC Sup									
Gender	-0.35 (0.93)	-2.17, 1.47	.71	-2.08 (1.13)	-4.29, 0.12	.06	0.08 (0.09)	-0.10, 0.26	.38
IQ	-0.06 (0.09)	-0.24, 0.12	.52	-0.08 (0.09)	-0.25, 0.09	.36	0.01 (0.006)	-0.002, 0.02	.11
Age ^a	-0.98 (1.23)	-3.39, 1.43	.43	-1.50 (1.16)	-3.78, 0.77	.20	0.04 (0.07)	-0.10, 0.18	.59
Sup	-0.17 (0.07)	-0.32, -0.02	.02	-0.07 (0.08)	-0.22, 0.09	.41	0.01 (0.01)	0.005, 0.02	.22
Sup × Gender	-0.01 (0.03)	-0.07, 0.05	.75	-0.03 (0.03)	-0.10, 0.03	.33	-0.004 (0.003)	-0.008, 0.002	.17
Sup × IQ	-0.005 (0.003)	-0.01, 0.001	.10	-0.001 (0.003)	-0.006, 0.005	.76	0.0002 (0.0002)	-0.0002, 0.001	.33
Sup × Age	0.10 (0.04)	0.01, 0.18	.02	0.02 (0.04)	-0.08, 0.11	.74	-0.0003 (0.003)	-0.006, 0.006	.93
EC Mot									
Gender	-0.33 (0.99)	-2.26, 1.60	.74	-2.25 (1.14)	-4.49, -0.12	.05	0.04 (0.09)	-0.13, 0.22	.62
IQ	0.01 (0.08)	-0.14, 0.15	.94	-0.07 (0.07)	-0.21, 0.07	.31	0.004 (0.005)	-0.005, 0.01	.36
Age ^a	-1.57 (1.25)	-4.03, 0.89	.21	-1.99 (1.06)	-4.08, 0.08	.06	0.08 (0.06)	-0.04, 0.21	.18
Mot	-0.18 (0.09)	-0.35, -0.01	.04	0.06 (0.07)	-0.06, 0.19	.32	-0.01 (0.01)	-0.005, 0.02	.25
Mot × Gender	-0.04 (0.04)	-0.11, 0.04	.30	-0.01 (0.05)	-0.08, 0.10	.88	-0.005 (0.003)	-0.01, 0.002	.14
Mot × IQ	0.0004 (0.003)	-0.01, 0.01	.90	-0.003 (0.004)	-0.01, 0.005	.41	-0.0001 (0.0002)	-0.001, 0.0003	.66
Mot × Age	0.14 (0.06)	0.03, 0.25	.01	-0.02 (0.04)	-0.11, 0.07	.65	-0.001 (0.004)	-0.01, 0.01	.85

Note: Analyses were conducted separately for each EC subcomponent and child adjustment measure. For analyses of main effects, EC Suppress (sup) and Motor (mot) Control were centered at the grand mean. For analyses of moderation effects, the age variable was centered at age 4; gender was effect coded (female = -1, male = 1). Twelve separate generalized estimating equation models are shown in this table, six for tests of main effects and six for tests of moderation. Each model controls for intervention status (effect coded as -1 and 1). The six main effect models also controls for age (centered at the grand mean).

Estimates (*B*, standard error of *B*, and *p*) and 95% confidence limits of the EC fixed effect are shown in this table. These analyses, conducted with Child Behavior Checklist *T* scores, were similar to those conducted with Child Behavior Checklist raw scores. We also tested for quadratic relations between EC and problem behaviors, and we did not find support that high or low EC was associated with more problems behaviors.

^aAge 4 = 0.

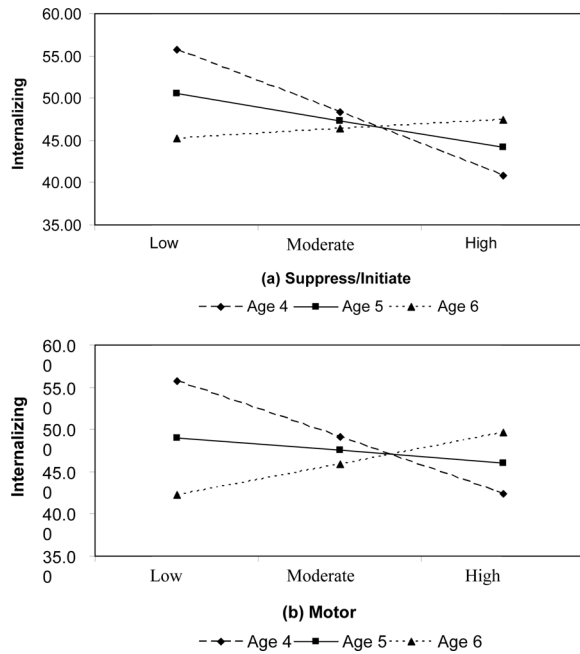


Figure 2. (a) Age moderates the association between suppress/initiate and internalizing problems across ages 4, 5, and 6. (b) age moderates the association between motor control and internalizing problems across ages 4, 5, and 6.

associations at ages 5 and 6 were significantly reversed, we conducted additional GEE analyses that used the same models but centered age at age 5 and 6. Results showed that EC was not significantly associated with internalizing problems at age 5. However, at age 6, high Motor Control was associated (a trend) with high internalizing problems ($B = .10$, $SE = 0.06$, $p = .09$). There was no significant association between Suppress/Initiate and child outcomes at age 6.

Discussion

This is one of the few studies to examine sub-components of EC in preschoolers at risk for psychopathology and among the first to do so using an objective measure of EC. Results suggest that the EC Battery (Kochanska et al., 1997) yields two psychometrically distinct subcomponents (Suppress/Initiate and Motor Control), which have also been found in groups of children at relatively low risk for psychopathology (Murray & Kochanska, 2002). Although moderately correlated and showing similar associations with child adjustment as rated by parents, these subcomponents showed different developmental trajectories over the preschool period. Specifically, both subcomponents showed predicted improvements

with age during the preschool period, with Suppress/Initiate leveling off between ages 5 and 6. These findings suggest that at least some components of EC may be relatively consolidated between 5 and 6 years of age, perhaps due to the rate of neurological maturation; environmental factors such as stressors during the transition to school could also foster consolidation rather than growth in EC (Diamond, 1988; Pennington & Welsh, 1995; Posner & Rothbart, 2000).

It is common across studies using the EC Battery to use different sets of tasks given child age, ability, and study goals (e.g., Kochanska, 1997; Murray & Kochanska, 2002). We found that the KRISP and Simon Says tasks did not provide reliable or valid measures. In addition, the Tower scale, which measures turn taking, had a low loading onto the Suppress/Initiate factor, although in a sample of typically developing children this measure loaded well (Murray & Kochanska, 2002). It may be that for this group of children, the Tower task did not recruit effortful control to the degree that waiting to open a present or picking a toy did (Eisenberg, Sadovsky, et al., 2005; Eisenberg, Zhou, et al., 2005). This illustrates the challenge posed by comparing studies with distinct measures of EC and distinct groups of children. More work is needed on the performance of a standard set of EC tasks, such as the EC Battery, in groups of children at risk and using larger sample sizes.

Although statistically distinct components, both Suppress/Initiate and Motor Control were associated with child social competence. This is consistent with previous research on the EC construct in general (Eisenberg et al., 2004; Eisenberg et al., 2003; Kochanska, 1997). The ability to inhibit one behavior to initiate another is likely associated with the range of skills and capacities that support positive social adjustment and competence, such as delay of gratification, taking turns, and compliance with directives (Derryberry & Rothbart, 1997; Kochanska, 1997). In children at risk for psychopathology, these skills may serve a critical protective function (Gouley et al., in press; Webster-Stratton, Reid, & Hammond, 2001).

Age moderated associations between EC and internalizing problems, suggesting that EC does not have a simple or unidirectional effect on child adjustment in children at risk for psychopathology. High levels of Suppress/Initiate and Motor Control were linked to fewer internalizing problems at age 4, but this effect was nonsignificant by age 5 and 6. For preschoolers at elevated risk for psychopathology, high levels of EC may be particularly adaptive, enabling children to cope with increasingly challenging social demands, such

as the transition to school. It may be that EC plays a less significant role in childhood internalizing symptoms as children age or that risk for internalizing symptoms changes across development (such as an increased role for cognitive factors; Funder & Block, 1989). This finding is in direct contrast to research with typically developing preschoolers showing that 4-year-olds with higher levels of EC also showed greater internalizing problems (Murray & Kochanska, 2002). Future research should assess age-related changes in EC adjustment outcomes, particularly in children at risk for psychopathology. Assessment of other risks and competencies are needed to examine the degree to which subcomponents of EC predict similar or unique aspects of child adjustment.

When interpreting these results, it is important to note several issues. First, several tasks included in the EC assessment were dropped or did not emerge in the factor analyses. This may be because tasks were not valid for at-risk groups of children. Future research should test the validity of the EC assessment using diverse samples. Second, measures of EC might also reflect less voluntary control processes, such as behavioral inhibition (Eisenberg, Cumberland, et al., 2001; Eisenberg, Zhou, et al., 2005). To address this possibility, future research should measure behavioral inhibition along with EC, particularly in relation to internalizing problems (Eisenberg, Cumberland, et al., 2001). Third, like behavioral inhibition, it is unclear from our study what role attentional control might play in predicting adjustment. Previous research suggests that attentional control is a central aspect of EC (Eisenberg, Zhou, et al., 2005; Rothbart et al., 2003). However, attentional control, which is needed to perform well on tasks such as the Drawing, Tower, and Whisper tasks, did not emerge as a distinct subcomponent of EC, perhaps because it is integral to multiple aspects of inhibition and control. In addition, although many of the EC tasks require the child to concentrate and focus attention, the battery does not emphasize measurement of attentional control. That is, no task specifically taxes attention, such as by creating multiple or conflicting demands on attention. Fourth, it is notable that EC was not a significant predictor of parent-rated externalizing problems in this sample with multiple risks. Other family and environmental risk factors may be more influential in predicting externalizing problems relative to EC. Alternately, the effects of EC on externalizing problems may not emerge until later and in interaction with other risk factors such as negative peer influences or temperament. We examined whether IQ was one such risk factor but found no significant effects.

The results also need to be interpreted in the context of several methodological limitations. Missing EC data and the small sample size may have reduced the power of statistical tests in particular with regard to moderation analyses and estimation of the association between EC and child problem behavior. Although the GEE analyses compensated in part for the missing data issue, we still had low statistical power to detect the association between EC and child problem behaviors (3%–13% power to detect small effects). Therefore, analyses need to be replicated in studies using larger samples. Furthermore, all outcome measures were based on parental report. Although parental perspectives are an important indication of child adjustment, future research should include multiple assessments to guard against potential reporting biases and expand to include teacher ratings and observations of children in different contexts (e.g., at home, with peers, in school). Future research should also explore additional factors, such as quality of parenting and peer relationships, which may interact with EC to predict developmental outcomes (Gartstein & Fagot, 2003). Finally, sample characteristics (ethnic diversity, risk status, low IQ) addressed a gap in the literature but limited the generalizability of findings.

Implications for Future Research, Policy, and Practice

Despite limitations, this study makes several contributions. Results suggest that the multifaceted nature of EC should be considered when examining links with child adjustment. Our study also provides useful preliminary evidence and leads for future psychopathology research on the association between subcomponents of EC and problems, and moderators of this association, such as child age. The role of EC in the development and treatment of psychopathology is receiving increasing attention and empirical support. Interventions that target the amelioration of conduct problems and promotion of social skills, for example, focus on teaching effortful and inhibitory control techniques such as attentional focusing and delay of gratification (Brotman et al., 2005; Webster-Stratton et al., 2001). Results of our study suggest that programs designed to promote EC should consider age differences that could have an impact on intervention outcomes. For example, bolstering EC at younger ages may be more effective for reducing internalizing problems, whereas promoting multiple components of EC in older children could have equally positive effects on a range of problems. Future research could directly test these hypotheses by developing interventions

that target multiple components of EC in children at risk for evidencing psychopathology.

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