Shields, A. N., Reardon, K. W., Brandes, C. M., & Tackett, J. L. (2019). The p factor in children: Relationships with executive functions and effortful control. *Journal of Research in Personality*, 82, 103853.

The *p* Factor in Children: Relationships with Executive Functions and Effortful Control

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Author Note

This research was supported in part by grants from the Connaught Fund (Canada), the Ontario Ministry of Research and Innovation (Canada), and the Social Sciences and Humanities Research Council (Canada) to J.L.T.

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Analytic code and supplemental results have been archived on the Open Science Framework at <https://osf.io/dprx4/>.

Abstract

Lower levels of self-regulation have been implicated in multiple psychological disorders. Despite conceptual overlap (broadly reflecting self-regulatory functions), executive functions (EF) and effortful control (EC) are rarely jointly studied in relation to broadband psychopathology. The present study investigated associations of correlated factors (internalizing-externalizing) and bifactor psychopathology models with EF and EC in a large (N=895) childhood community sample ($M_{\text{age}} = 11.54$, $SD_{\text{age}} = 2.25$). Associations between both self-regulation constructs (EF and EC) with psychopathology were largely accounted for via a general psychopathology factor. However, EC evidenced stronger associations, questioning the utility of task-based EF measures to inform self-regulatory psychopathology.

Keywords: developmental psychopathology, self-regulation, executive functions, effortful control

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Self-regulation reflects the ability to manage emotions and behaviors over time and contexts, allowing individuals to inhibit impulsive responses and carry out goal-directed activities (Karoly, 1993). Approaches to measuring individual differences in self-regulation include executive functions (EF), or, alternatively, effortful control (EC). Theoretical overlap between EF and EC has been extensively discussed (Block & Block, 1980; Friedman, Miyake, Robinson, & Hewitt, 2011; Zhou, Chen, & Main, 2012), but correlations between them are small (e.g., between .12 and .21; Blair & Razza, 2007). As a result, there is debate around whether EC and EF both index a broader domain of self-regulation. Despite calls for an integrated framework (e.g., Nigg, 2017), the two continue to be studied separately, with cognitive and clinical researchers focusing on EF, and social and personality researchers focusing on EC.

Impairments in self-regulation are robustly associated with psychopathology (Eisenberg et al., 2009; Snyder, Miyake, & Hankin, 2015), albeit with many potential moderators of this relationship. For example, theoretical conceptualizations of EF versus EC may show differential patterns with psychopathology (Zhou et al., 2012). Furthermore, these differences often reflect divergent measurement approaches (e.g., task-based vs. questionnaire; Toplak et al., 2013). Finally, various approaches to conceptualizing psychopathology (e.g., dimensional vs. categorical) may cloud our understanding of self-regulation–psychopathology associations. The current study aimed to offer some clarity into the pattern of self-regulatory–psychopathology associations across these potential moderators.

Structural Models of Psychopathology

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The categorical/prototypical approach used in traditional psychiatric classification systems (e.g., the DSM; American Psychiatric Association, 2013) has a number of limitations, including extensive comorbidity (Krueger & Markon, 2006); whereas the hierarchical structure of psychopathology specifies latent factors that capture common variance between disorders and symptoms. These often include ‘internalizing’ (e.g., anxiety and depression) and ‘externalizing’ (e.g., substance abuse and conduct disorder) factors (Krueger, 1999; Lahey et al., 2004). However, these factors are substantially intercorrelated ($r \sim .50$; Krueger & Markon, 2006), an association which has recently been captured using a bifactor modeling approach. In bifactor models, all indicators load on a general factor and subsets of indicators additionally load onto specific factors (e.g., internalizing and externalizing), which are uncorrelated with each other and with the general factor (Holzinger & Swineford, 1937). The bifactor model accounts for comorbidity among disorders by parsing general variance shared by all disorders (the “p” factor) from specific variance unique to subordinate spectra of psychopathology (e.g., internalizing and externalizing). Research has demonstrated external validity of the psychopathology bifactor model in children vis-à-vis personality traits, intelligence, and academic performance (Castellanos-Ryan et al., 2016; Lahey et al., 2015; Olino et al., 2018; Tackett et al., 2013), as well as predictive validity for mental health outcomes and criminality (Pettersson, Lahey, Larsson, & Lichtenstein, 2018). Measures of self-regulation have further established the validity of the psychopathology bifactor model (e.g., Hankin et al., 2017; Martel et al., 2017).

Psychopathology and Self-Regulation

EF are defined as top-down mental control mechanisms tied to goal-directed behavior, self-control, and self-regulation abilities (Diamond, 2013). Core EF include inhibition (overriding automatic responses), updating (monitoring and updating working memory contents),

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and shifting (flexibly switching between tasks). EF have also been represented by a bifactor model, including a general EF factor and updating- and shifting-specific factors (Miyake & Friedman, 2012). Alternatively, EC is defined as a temperament trait indexed by planfulness, error detection, dominant response inhibition, and nondominant response activation (Eisenberg, Smith, Sadovsky, & Spinrad, 2004). Facets of EC often include attention (the tendency to focus and shift attention), activation control (the tendency to perform an action even when one does not want to), and inhibitory control (the tendency to plan and suppress in appropriate actions). Despite their apparent conceptual overlap, researchers infrequently examine both simultaneously.

Supporting this overlap, EF and EC often correlate with psychopathology in similar ways (Eisenberg et al., 2009; Snyder, Miyake, et al., 2015). However, this work has not typically focused on structural/dimensional models of psychopathology. Previous research has generally found negative correlations between EF and the *p* factor (*r*s ranging from -.14 to -.30; Bloemen et al., 2018; Caspi et al., 2014; Harden et al., 2018; Huang-Pollock et al., 2017; Martel et al., 2017). Correlations between EF and specific internalizing variance are usually negligible (controlling for *p*), though Bloemen and colleagues (2018) found associations with lower cognitive flexibility (*r* = .30). Findings for EF and externalizing are even less straightforward, with both negative and positive associations in the literature for specific externalizing and working memory (Bloemen et al., 2018; Huang-Pollock et al., 2017).

Despite the wealth of literature examining EC's relationship to child externalizing problems (e.g., N. Eisenberg et al., 2009; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005), to our knowledge only two studies have considered the association between EC and bifactor psychopathology models. EC was negatively associated with both the *p* factor (*r*s = -.13 to -.89)

and the externalizing-specific factor ($r_s = -.18$ to $-.82$) and was not associated or slightly positively associated with the internalizing-specific factor ($r_s = .02$ to $.18$) in youth (Hankin et al., 2017; Olino, Dougherty, Bufferd, Carlson, & Klein, 2014). In research to date, these examinations have looked only at EF or EC. Examining both constructs simultaneously allows us to explore similarities and differences in their patterns of associations with psychopathology.

The Present Study

The goals of the present study were to replicate and extend findings from previous studies of the association between general and specific factors of psychopathology and EF (Caspi et al., 2014; Harden et al., 2018; Huang-Pollock et al., 2017; Martel et al., 2017) and EC (Hankin et al., 2017; Olino et al., 2014), directly comparing EF and EC in overlapping samples for the first time. We examined associations between correlated factor and bifactor models of psychopathology, EF, and EC in a large dataset comprised of three independent community samples. The present study had three primary aims:

1. We examined associations between correlated factor and bifactor psychopathology models and a latent EF factor indexed by lab-based EF tasks. We expected that EF would be negatively related to internalizing and externalizing factors in the correlated factor model, and that these correlations would attenuate in the bifactor model. We also expected that EF would be negatively related to p in the bifactor model with a small-to-medium effect size.
2. We examined associations between the correlated factor and bifactor psychopathology models and a latent EC factor indexed by multiple EC facets. We expected that EC would be negatively related to internalizing and externalizing factors in the correlated factor model, and that these correlations would attenuate in the bifactor model. We also

expected that EC would be negatively related to p in the bifactor model with a medium-to-large effect size.

3. To examine the extent to which each self-regulation construct serves as an indicator of psychopathology, we examined differences between correlations of general and specific psychopathology factors with the EF factor versus the EC factor.

Methods

Participants

The pooled sample consisted of 895 eight to eighteen-year-olds ($M_{\text{age}} = 11.54$, 48% male) and their primary caregivers, derived from three independent community samples. Parent-reported child race/ethnicity for the overall sample was 54% White/non-Latino, 14% Black, 13.5% other/multiple races, 10% Latino/Latina, and 7% Asian (1.5% not reported). Samples 1 ($N=439$, $M_{\text{age}} = 11.73$, 49% male) and 3 ($N=106$, $M_{\text{age}} = 16.48$, 44% male) were recruited from a metropolitan area in southeastern Canada, whereas sample 2 ($N=350$, $M_{\text{age}} = 9.81$, 47% male) was recruited from an urban area in the southwestern United States. Sample-specific demographics and demographic differences between the samples can be found on the OSF page for this project (<https://osf.io/dprx4/>).

Measures

A complete list and description of measures administered in each sample and their reliabilities can be found on the OSF page for this project (<https://osf.io/dprx4/>).

Psychopathology was measured using the Child Behavior Checklist (CBCL-6-18; Achenbach & Rescorla, 2001), a caregiver-report questionnaire, and the Computerized Diagnostic Interview Schedule for Children (C-DISC; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), a structured interview conducted with primary caregivers. Psychopathology assessed included

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CBCL scales Aggressive Behavior, Rule-Breaking Behavior, Anxious-Depressed, Withdrawn-Depressed, and Somatic Complaints, and C-DISC criteria counts for Attention-Deficit/Hyperactivity Disorder (ADHD), Conduct Disorder (CD), Major Depressive Disorder (MDD), Oppositional Defiant Disorder (ODD), Separation Anxiety Disorder (SAD), and Social Phobia (SO). Internal consistency values (standardized alphas) ranged from .36 (C-DISC CD) to .90 (C-DISC ADHD).

EC was measured by the lower-order facets of the Effortful Control domains of two caregiver-report temperament questionnaires, the Early Adolescent Temperament Questionnaire – Revised (EATQ-R; Ellis & Rothbart, 2001) and the Temperament in Middle Childhood Questionnaire (TMCQ; Simonds & Rothbart, 2004). We harmonized across samples by constructing three EC indicators: Activation Control (comprised of the Activation Control facets from both measures), Inhibitory Control (comprised of the Inhibitory Control facets from both measures), and Attention (comprised of EATQ-R Attention and TMCQ Attentional Focus). Internal consistency values (standardized alphas) ranged from .58 (EATQ inhibitory control) to .90 (TMCQ attentional focus).

EF were measured by children's performance on several lab-based tasks and included measures of working memory maintenance (Digit Span Forward) and updating (Digit Span Backward; Lahey et al., 2004), attention (Go/No-Go "go" score), inhibition (Go/No-Go "no-go" score; Fillmore, Rush, & Hays, 2006), and shifting (Trail-Making Test Part B; Reitan, 1992). Children were also administered the Iowa Gambling Task (Bechara, Damasio, Damasio, & Anderson, 1994) or its child analogue, the Hungry Donkey Task (Crone & van der Molen, 2004), which are designed to measure decision-making under conditions of known risk. Our metric of

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interest for the IGT and HDT was the slope of the regression line predicting net advantageous choices from task block number, which was calculated the same way for both tasks.

Procedure

Data for the present study were collected from three studies with no overlapping participants. These studies measured several developmental constructs; measures related to psychopathology, temperament and EF are included here. For additional information about the procedures used, see relevant citations (e.g., Reardon et al., 2016; Tackett et al., 2014, 2017). For all studies, questionnaires were completed by participants either in the lab or at home and returned via mail. Diagnostic interviews and performance-based EF tasks were conducted in the lab. Informed consent was obtained from all participants, and all procedures received ethics approval from the institutional review board at the relevant university.

Results

Maximum likelihood estimation with robust standard errors (MLR) was used for all models, as psychopathology data were skewed (see the OSF page for this project for summary statistics: <https://osf.io/dprx4/>). Amount of data missing was 19.2%, largely due to nonoverlapping measures administered in each sample. Full Information Maximum Likelihood (FIML) was used to handle missing data. Analyses were conducted using base R and the “lavaan” and “psych” packages of R statistical software (R Core Team, 2013; Revelle, 2018; Rossell, 2012). Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values of .95 or greater were interpreted to reflect good fit, while values above .90 were interpreted to reflect adequate fit. Root mean square error of approximation (RMSEA) values below .06 were interpreted to reflect good fit while values of .10 or below were interpreted to reflect adequate fit. Standardized Root Mean Square Residual (SRMR) values below .06 were interpreted to reflect

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adequate fit (Browne & Cudeck, 1992). Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) were used to compare model fit, with lower values indicating better fit and changes in AIC and BIC of greater than 10 indicating model non-equivalency (Burnham & Anderson, 2004). Additional fit indices for the bifactor model can be found on the OSF page for this project. Results for the entire sample are reported below; results for individual samples can be found on the OSF page for this project (<https://osf.io/dprx4/>). Because age was significantly correlated with several of our indicators, we also examined models in which each indicator was residualized on youth age before being entered in the models. Overall patterns remained identical to the models presented below (with the exception that the correlation between p and EF was no longer significant; see <https://osf.io/dprx4/>).

Psychopathology Measurement Models

Confirmatory Factor Analysis was used to compare a correlated factor (internalizing and externalizing) model and two competing bifactor models of psychopathology fit to both questionnaire (CBCL) and interview-based diagnostic (C-DISC) data. Psychopathology measurement model specifications were reproduced from Brandes, Herzhoff, Smack, and Tackett (in press), whose participants partially overlapped with those in the present study, to maintain consistency in model specification across common sources of data from our lab. In the correlated factor model, all indicators loaded onto either internalizing or externalizing factors. In the bifactor model, all indicators loaded onto a general psychopathology (p) factor and onto specific internalizing or externalizing factors.¹ All models were also tested with and without an

¹ We also tested an alternative bifactor model in which depression variables (C-DISC MDD and CBCL Withdrawn-Depressed) were allocated only onto the general p factor, consistent with previous bifactor findings from childhood samples (Tackett et al., 2013). The latent covariance matrix for this model was not positive semidefinite, so this model was not interpreted. These results can be found at <https://osf.io/dprx4/>.

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orthogonal method factor comprised of all CBCL indicators to capture variance associated with methods employed to collect questionnaire data to maintain consistency with previous publications from our lab (Brandes et al., in press).

In all models, the internalizing or internalizing-specific factor was represented by a latent variable composed of C-DISC criteria counts for MDD, SAD, and SO, and CBCL scales Anxious-Depressed, Withdrawn-Depressed, and Somatic Complaints. The externalizing or externalizing-specific factor was represented by a latent variable composed of C-DISC criteria counts for ADHD, CD, and ODD, and CBCL scales Rule Breaking and Aggression. Standardized parameter estimates and fit statistics for each psychopathology model can be found in Table 1.

The best-fitting psychopathology bifactor model did not include a method factor. Because this model had negative residual variance on C-DISC SAD (standardized residual variance = -1.25, *ns*), results are presented from a model with that variable's residual variance constrained to 0. This same model with a methods factor was not interpreted because the latent variable covariance matrix was not positive semidefinite. The best-fitting correlated factor model included a methods factor; this same model without a methods factor provided poor fit to the data.

Psychopathology and EF Structural Models

We next fit a one-factor EF model and examined correlations between the best-fitting psychopathology models and EF. These models are depicted in Figures 1-2, and fit statistics can be found in Table 2. The EF factor was represented by a latent variable composed of Digit Span Forward score, Digit Span Backward score, Trails B time (reversed), Go/No-Go go score, Go/No-Go no-go score, and the slope of the line predicting IGT or Hungry Donkey score by

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block. The single-factor EF model provided good fit to the data (RMSEA = .02, 90% CI [.00, .05], CFI = .99, TLI = .99, SRMR = .03). The correlated factor psychopathology model correlated with the EF factor achieved adequate fit. As predicted, EF was significantly negatively correlated with both externalizing ($r = -.19$, 95% CI [-.28, -.09]) and internalizing ($r = -.23$, 95% CI [-.34, -.11]). The bifactor psychopathology model correlated with the EF factor also achieved adequate fit. As predicted, there was a small negative correlation between p and EF ($r = -.16$, 95% CI [-.26, -.06]). After accounting for the relationship between p and EF, correlations between EF and unique variance in specific psychopathology factors were small and nonsignificant (externalizing: $r = -.10$, 95% CI [-.20, .01]; internalizing: $r = -.12$, 95% CI [-.25, .02]).

Psychopathology and EC Structural Models

We then fit a one-factor EC model and examined correlations between the best-fitting psychopathology models and EC. These models are depicted in Figures 3-4, and fit statistics can be found in Table 2. The EC factor was represented by a latent variable composed of EATQ or TMCQ activation control, attention, and inhibitory control. Fit statistics for this model are not available as it was just-identified. The correlated factor psychopathology model correlated with the EC factor provided poor fit to the data by some indices, but acceptable fit by others. As predicted, EC was significantly negatively correlated with both externalizing ($r = -.71$, 95% CI [-.84, -.57]) and internalizing ($r = -.48$, 95% CI [-.58, -.38]). The bifactor model correlated with the EC factor similarly provided poor fit to the data by some indices, but acceptable fit by others. As predicted, p and EC were significantly correlated ($r = -.38$, 95% CI [-.49, -.28]). After accounting for the relationship between p and EC, the correlation between unique variance in externalizing and EC remained large and significant ($r = -.54$, 95% CI [-.67, -.42]), but the

correlation between unique variance in internalizing and EC was small and nonsignificant ($r = -.09$, 95% CI $[-.19, .01]$).

Discussion

The goal of the present study was to examine the extent to which self-regulation constructs are related to general versus specific factors of youth psychopathology. We examined competing structural models of psychopathology and the relationship of these models to task-based (EF) and questionnaire-based (EC) self-regulation measures. Results suggested that both EF and EC are negatively associated with both internalizing and externalizing in the correlated factor model; however, correlations with internalizing and externalizing dimensions were substantially reduced in the bifactor model when simultaneously accounting for associations with p . This indicates that lower self-regulation characterizes a portion of the general variance shared by all mental disorders, consistent with other findings relating bifactor models of psychopathology to EF or EC (Caspi et al., 2014; Hankin et al., 2017; Martel et al., 2017; Olino et al., 2014). Lower EC additionally characterized a portion of externalizing-specific variance, indicating that EC serves as a specific indicator of externalizing problems, also consistent with previous research (Hankin et al., 2017; Olino et al., 2014).

The bifactor model used in the present study evidenced several very small and nonsignificant factor loadings.² The internalizing-specific factor was heavily concentrated by CDISC Separation Anxiety Disorder, with very small factor loadings for CBCL anxious-depressed and withdrawn-depressed. This indicates that the internalizing-specific factor in children may primarily reflect fear, whereas highly comorbid problems such as anxious

² Because our psychopathology bifactor measurement model and EF factor contained some factors with small and nonsignificant factor loadings, we ran trimmed models in which nonsignificant factor loadings were removed. Overall patterns in these trimmed models were virtually identical to patterns in the untrimmed models (see <https://osf.io/dprx4/>).

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depression and withdrawn depression are more aligned with the general distress or negative affectivity characterizing the general factor. This is consistent with other studies of bifactor psychopathology models in children and adolescents (Brandes et al., in press; Olino et al., 2014). Furthermore, CDISC conduct disorder appeared to be relatively independent of the general factor, consistent with work suggesting that conduct disorder is tied to constricted or shallow experience of emotions (e.g., Frick & Ellis, 1999).

Assessing EF and EC simultaneously further allowed us to examine the extent to which different measures of self-regulation may differentially relate to psychopathology. The magnitudes of the effect sizes indicated that EC serves as a stronger indicator of general psychopathology ($r = -.38$) than does EF ($r = -.16$). Supporting this observation, the confidence interval for the relationship between p and EC was nonoverlapping with the confidence interval for the correlation between p and EF. One interpretation of this finding implicates common method variance – that is, our measures of EC and psychopathology both included parent reports, whereas EF measures were tasks completed by the children. While we used multiple methods to measure psychopathology, both were assessed via parental informants. Furthermore, our bifactor model of psychopathology did not include a method factor, so common method variance may be subsumed under the general p factor, inflating the relationship between EC and p . We are thus unable to rule out common method variance explaining the larger correlation between psychopathology and EC.

It is also possible that task-based and report-based assessments of self-regulation do not measure the same underlying construct. For example, in an examination of performance-based and report measures of EF, Toplak, West, and Stanovich (2013) found only small associations between the two types of measures and suggested that task-based measures index cognitive

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efficiency while rating measures index self-regulatory goal pursuit. Others in this area have demonstrated that self-report measures of self-regulation are better candidates for measuring individual differences, as they are more reliable than behavioral tasks, and reliability is a necessary prerequisite for validity (Enkavi et al., 2019). Furthermore, EF tasks are often found to have low intercorrelations, and to remedy these issues, EF researchers often point to use of latent variable approaches to examine how different EF relate to one another (Miyake et al., 2000). Consistent with these findings, EF in the present study demonstrated poor psychometric properties. While the EF factor model evidenced good model fit, three of the six indicators' loadings were below .20, indicating that the broader set of specific EF tasks may not hang together particularly well. Furthermore, none of the correlations between EF indicators and EC indicators surpassed .20, indicating restricted overlap between the two constructs. These results can be found on the OSF page for this project.

We interpret these findings as indication that broad temperamental factors may be superior to behavioral tasks in characterizing general psychopathology, possibly due to the poor psychometric properties of behavioral tasks. This is directly relevant to NIMH Research Domain Criteria (RDoC)'s goal to investigate psychopathology mechanistically from hierarchical "units of analysis", such as genes, circuits, and physiology. RDoC proponents have emphasized the necessity of beginning with more proximal units of analysis (i.e., physiological, behavioral, and self-report; Patrick & Hajcak, 2016) when examining relationships between the units. With regard to self-regulation, which is termed "cognitive control" in the RDoC matrix, it is perhaps necessary to focus on the *most* proximal units of analysis. It appears that there is considerable work to be done delineating relationships between behavior and self- or other-report units of analysis before attempting to isolate physiological, circuit-level, cellular, and molecular elements

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related to cognitive control. Given that our outcome of interest (psychopathology) was assessed via parent-report in the present study, it will be important for future research to evaluate whether report-based and task-based measures of self-regulation differentially predict behavioral outcomes related to psychopathology, such as suicide attempts or criminality.

Limitations and Future Directions

The authors do not claim that these results can be generalized outside of the population described (e.g., individuals with severe psychopathology). While a strength of this study is the use of both diagnostic (C-DISC) and dimensional (CBCL) assessments of psychopathology, we used only parent-reported psychopathology and EC. Parents may particularly be limited in their ability to report on their children's internalizing symptoms, given more restricted access to their child's internal thoughts and feelings relative to more observable externalizing behaviors (De Los Reyes & Kazdin, 2005). However, there are significant problems relying on child-report data as well, including child reporters' lack of awareness or acknowledgement that their behaviors and emotions are abnormal or problematic (De Los Reyes & Kazdin, 2005). Future research should examine multi-informant models of psychopathology in relation to EF and EC to determine informant-specific associations when establishing the construct validity of the *p* factor.

The EF measures used in the present study covered the major domains of EF (shifting, inhibition, and updating), but EF could be more fully modeled using multiple tasks for each EF domain and using purer measures of EF which do not require EF processes outside the domain of interest (Snyder, Miyake, et al., 2015). Future research in this domain should involve a comprehensive EF battery in order to fully model EF. In the same vein, the present study used only report-based measures of EC. Lab-based measures of temperament also exist, though these are largely validated for use only in early and middle childhood (e.g., Goldsmith & Rothbart,

1996; Murray & Kochanska, 2002). Nonetheless, future research incorporating multiple methods of EC assessment will help evaluate whether lab-based EC measures predict psychopathology with the same magnitude of effect as report-based measures.

Future research should also take a facet-level approach to explore relationships between EC facets and psychopathology. As with EF, it is possible that EC facets are differentially related to general and specific psychopathology factors. For example, Muris, Meesters, and Blijlevens (2007) found that internalizing symptoms were related to low attentional control, whereas externalizing symptoms were related to low activation and inhibitory control. In testing a bifactor model of EC in early adolescents, Snyder and colleagues (2015) found that the best-fitting model included a general EC factor and an activation control-specific factor; this specific factor was related to harm avoidance above and beyond the influence of the general EC factor. Future studies should similarly aim to parse out the extent to which specific factors of EC are related to specific factors of psychopathology above and beyond the influence of the general p – EC relationship.

Finally, while our results indicated that overall patterns of associations between latent factors were similar when controlling for participant age, the use of nonoverlapping measures in the present study prohibited examination of measurement invariance across samples. Further research is needed to examine whether the patterns of stronger associations between psychopathology and report (versus task)-based self-regulation measures is invariant across various demographic factors.

Conclusions

In a large community sample of 8- to 18-year-old children, the present study tested alternative structural models of psychopathology and examined the relationship of these models

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with EF and EC factors. Results indicated that p was associated with both EF and EC in the small to moderate range. Furthermore, the p factor largely accounted for associations between EF and EC with internalizing and externalizing domains, with the exception that externalizing-specific variance also showed substantial associations with EC, even after accounting for common variance in p . These results add to growing evidence supporting the construct validity of the p factor. Finally, these results also pointed to marked differences in the extent to which EF and EC assess individual differences in self-regulation, and underscore the need to be cautious in the use of individual task-based measures of self-regulation when aiming to map out dimensions underlying psychopathology.

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Table 1

Psychopathology Measurement Model Fit and Factor Loadings

Variable	<u>Correlated factor</u> <u>Model with Method</u> <u>factor</u>			<u>Correlated factor</u> <u>Model without</u> <u>Method factor</u>		<u>Bifactor Model*</u>		
	INT	EXT	Method	INT	EXT	<i>p</i>	INT	EXT
CDISC MDD	.41			.32		.26	.28	
CDISC SO	.54			.43		.36	.28	
CDISC SAD	.58			.42		.23	.97	
CBCL Anxious-Depressed	.60		.62	.82		.82	.16	
CBCL Withdrawn-Depressed	.52		.39	.67		.67	.02	
CBCL Somatic Complaints	.47		.31	.58		.54	.22	
CDISC ADHD		.59			.56	.35		.46
CDISC CD		.46			.40	.12		.49
CDISC ODD		.64			.61	.34		.53
CBCL Rule Breaking		.78	.06		.73	.38		.70
CBCL Aggression		.83	.38		.92	.63		.62
Model Fit								
RMSEA		.06			.06		.05	
RMSEA 90% CI		[.05, .07]			[.06, .07]		[.04, .06]	
SRMR		.05			.06		.04	
CFI		.92			.89		.94	
TLI		.88			.86		.90	
AIC		33002.56			33086.67		32970.64	
BIC		33189.55			33249.69		33176.81	
Latent Variable Correlations								
INT	1	.52		1	.63			
EXT	.52	1		.63	1			

*Due to negative residual variance, the variance of CDISC SAD was constrained to 0.

MDD = Major Depressive Disorder; SO = Social Phobia; SAD = Separation Anxiety; ADHD = Attention-Deficit/Hyperactivity Disorder; CD = Conduct Disorder; ODD = Oppositional Defiant Disorder

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Table 2

Psychopathology, EF, and EC Measurement Model Fit

Model Fit	Correlated factor model correlated with EF	Bifactor model correlated with EF	Correlated factor model correlated with EC	Bifactor model correlated with EC
RMSEA	.04	.04	.07	.07
RMSEA 90% CI	[.04, .05]	[.03, .04]	[.07, .08]	[.06, .08]
SRMR	.05	.04	.06	.06
CFI	.92	.93	.86	.88
TLI	.90	.92	.82	.83

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Figure 1

*Associations between the Correlated-Factor Psychopathology Model and the EF Factor**

*CBCL method factor not shown

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Figure 2

Associations between the Bifactor Psychopathology Model and the EF Factor

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Figure 3

*Associations between the Correlated-Factor Psychopathology Model and the EC Factor**

*CBCL method factor not shown

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Figure 4

Associations between the Bifactor Psychopathology Model and the EC Factor