THE CONTRIBUTION OF COGNITIVE SELF-REGULATION TO SOCIAL COMPETENCE: A LATENT CHANGE SCORE ANALYSIS

by

David E. Ferrier
A Dissertation
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ABSTRACT

THE CONTRIBUTION OF COGNITIVE SELF-REGULATION TO SOCIAL COMPETENCE: A LATENT CHANGE SCORE ANALYSIS

David E. Ferrier, Ph.D.
George Mason University, 2016
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Given the importance of social competence in early childhood (Jones & Bouffard, 2012), there are self-regulatory components that can support or undermine positive trajectories for these skills (Rose-Krasnor & Denham, 2008). Moreover, acquiring social competencies and self-regulatory behavior often emerges from the transactions children have with peers and teachers, and optimal development of such skills and abilities can be impeded when children do not experience such positive interaction. Using data from the Early Childhood Longitudinal Study – Kindergarten Class of 2011, the current study looks at latent constructs of cognitive self-regulation and socially competent behavior (i.e., self-control & interpersonal skills) and the dynamic associations between them using a latent change score (LCS) framework. Results indicate that a bivariate LCS model in which both previous levels of cognitive self-regulation and social competence affect the rate of change in the other at the subsequent time point best fit the model. Future applications and recommendations for research are given.
Cognitive Self-Regulation

Cognitive self-regulation has increasingly been in the sights of developmental, school, and cognitive psychologists over the past few decades (e.g., Welsh, Friedman, & Spieker, 2006; Willoughby, Blair, & The Family Life Project Investigators, 2015). Cognitive self-regulation, a construct under the framework of self-regulation and often typified by measures of executive functioning and effortful control (Liew, 2012; Zhou, Chen, & Main, 2012), is often thought of as an umbrella term, capturing a collection of higher-order brain functions that are involved in the volitional, goal-directed control of behavior, thought, and emotion (Garon, Bryson, & Smith, 2008; Miyake, Friedman, Emerson, Witzki, & Howerton, 2000; Zelazo & Carlson, 2012). There is a general consensus on the pool of higher-order cognitive processes that constitute cognitive self-regulation, including working memory, inhibitory control, cognitive flexibility, reasoning, problem-solving, planning, and updating (e.g., Blair & Diamond, 2008; Diamond, 2013). Particular emphasis is typically placed on the working memory, inhibitory control, and attention shifting/cognitive flexibility components, as these are believed to involve a more central role in many emotional and behavioral processes, as
well as in other, later developing cognitive abilities (e.g., Diamond, 2013; Garon et al., 2008; Isquith, Crawford, Espy, & Gioia, 2005; Miyake et al., 2000).

Many aspects of these core cognitive abilities can be seen in as early as the first year of life and continue to develop well into late adolescence and early adulthood (Best & Miller, 2010; Garon et al., 2008; Zelazo & Müller, 2010). Further, whether in part or whole, these cognitive processes are often addressed across numerous developmental disciplines, most noticeably research on temperament, often placing importance on sustained attention and inhibitory control (e.g., Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Liew, 2012). In an increasing fashion, cognitive self-regulatory abilities such as executive functioning have been related to numerous other processes, such as theory of mind (e.g., Carlson & Moses, 2001; Hughes & Ensor, 2005), externalizing and internalizing behaviors (e.g., Hughes & Ensor, 2011), physical health and quality of life (Diamond, 2013), and not surprisingly, both pre-academic and academic skills (e.g., Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Blair & Razza, 2007). Importantly, there is growing support demonstrating the dynamic relations between cognitive self-regulation and other components of self-regulation, including emotion regulation (e.g., Blankson et al., 2013; Carlson & Wang, 2007) and behavioral self-regulatory processes (Morrison, Cameron Ponitz, & McClelland, 2010), suggesting that cognitive self-regulation is both an important contributor to and recipient of a wide range of developmental skills and abilities tied to social, emotional, and academic success.
Moreover, research has consistently shown negative outcomes associated with poor cognitive self-regulation. For instance, individuals demonstrating such difficulties tend to perform poorly on measures of reading, math, and science academic ability (Biederman et al., 2004; Gathercole et al., 2004; St Clair-Thompson & Gathercole, 2006). Even more, research shows that these cognitive self-regulatory shortcomings can carry over into adulthood, resulting in lower educational attainment (Mannuzza, Klein, Bessler, Malloy, & LaPadula, 1993), lower grade point average in the first year of college (Frazier, Youngstrom, Glutting, & Watkins, 2007), and a decreased likelihood of college completion (McClelland, Acock, Piccinin, Rhea & Stallings, 2013).

Aside from the connections between poor cognitive self-regulation and academic outcomes, we believe that self-regulation in early childhood undergirds several facets of optimal social development necessary for future success (Rose-Krasnor & Denham, 2008). First, consider that many facets of self-regulation are theorized to facilitate the development of emotional competence (e.g., Denham, Bassett, Way, Mincic, Zinsser, & Graling, 2012a; Ferrier, Bassett, & Denham, 2014; Ursache, Blair, & Raver, 2012). In turn, children who demonstrate more emotionally competent behavior are more likely to also engage in socially competent behavior, as these abilities are highly related (for a review, see Denham et al., 2003; see also Spinrad et al., 2006). Serving as our springboard, such relations bring into focus the direct role that cognitive processes have in the development of social competence. In fact, within just the past two decades, developmental researchers have provided support that acquiring cognitive self-regulation is associated with increases in prosocial behavior (Denham, Bassett, Zinsser, & Wyatt,
2014a; Hughes & Ensor, 2010) and social cognition (Carlson, Moses, & Claxton, 2004; Denham et al., 2012a; Hughes & Ensor, 2005). Furthermore, both of these social skills outcomes are key to attainment of social competence, a crucial developmental milestone (Raver & Zigler, 1997). In what follows, we will further delve into the important skills and abilities indicative of social competence and how cognitive self-regulation can either supplement or impede socially competent behavior.

**Social Competence**

Congruent with research stressing the significance of promoting self-regulation, parallel research highlights just how important attaining social competence is during early childhood (e.g., Jones & Bouffard, 2012). For instance, children who manifest socially competent behavior are more likely to achieve greater academic success, participate more in school, and are at a lower risk for later psychopathology (Denham, 2006; Mintz, Hamre, & Hatfield, 2011; Raver & Knitzer, 2002; Vaughan Van Hecke et al., 2007). In the present paper, we break down social competence into several components including demonstrating appropriate social skills in both new and routine situations, engaging in positive relationships with parents, teachers, and peers, and developing social cognition skills (e.g., Hubbard & Coie, 1994; Raver & Zigler, 1997; Siekkinen et al., 2013; Vaughn Van Hecke et al., 2007). Moreover, our position is that one’s cognitive self-regulatory abilities can detract from both development of and opportunities to employ these increasingly important social skills, thus warranting a closer examination of the role that self-regulation can have in influencing social
competence (e.g., Halberstadt, Denham, & Dunsmore, 2001; Rose-Krasnor & Denham, 2008).

Social competence is an important indicator of early school success and can relay the ease in which children get along with their peers and teachers, moreover manifesting socially competent behavior requires the employment of cognitive skills (Hughes & Ensor, 2008; Riggs, Jahromi, Razza, Dilworth-Bart, & Mueller, 2006a; Rose-Krasnor & Denham, 2008). Consider the range of social skills that children are expected to increasingly demonstrate as they mature and ascend through school grades. For instance, engaging in prosocial behavior, cooperating with classmates, and appropriately interacting with peers and adults alike, are generally acknowledged as key developmental tasks in a preschool context (Aro, Eklund, Nurmi, & Poikkeus, 2011; Denham et al., 2003). However, at many critical junctures along the way, cognitive self-regulation can deter optimal development of this social skill.

*Prosocial behaviors* often defined to capture an individual’s volitional action that benefits another (Persson, 2005). It clearly involves cognitive self-regulation. Engaging in a prosocial act does not occur through happenstance; rather, such behavior requires the individual to decide and act upon prior consideration. Although the motives behind prosocial behavior can either be altruistic or self-serving in nature (Persson, 2005), both intentions imply a sense of evaluative cognition (i.e., thinking about why they should do such an action), such as those afforded by executive functioning (i.e., *planning*; Best, Miller, & Jones, 2009).
Along this reasoning, two scenarios may demonstrate how poor self-regulation may impede preschoolers’ prosocial behavior. First, the development of prosocial behavior is often a byproduct of social interactions with peers (Fabes, Hanish, Martin, Moss, & Reesing, 2012). Moreover, an individual engaging in prosocial behavior is more apt to socialize with other prosocial peers, however, children who are more impulsive (i.e., cognitively dysregulated) can preclude themselves from such affiliation (Fabes et al., 2012). For example, if a child leaves a popular beanbag chair because they remembered they brought in an action figure, no prosocial behavior has occurred. In contrast, the child who leaves the chair because s/he wanted to share the enjoyable experience of the chair with a peer is behaving prosocially (regardless of whether or not a more desirable toy was remembered). This, we believe is a prime example of the necessity to investigate the role of self-regulatory cognitive processes, (such as those inherent in executive functioning, for example), into the study of prosocial behavior.

A second scenario illustrating the importance of self-regulation to both social competence (i.e., prosocial behavior), and social incompetence could be that for a child having difficulty delaying their gratification, it can be very difficult to take turns or cooperate with peers by sharing pleasurable stimuli (e.g., toys, gadgets). As exemplified in the now ubiquitous “marshmallow test” (see Mischel, 2014, for a review), children can find it very difficult to deny more immediate, tangible rewards in favor of more distal, unrealistic gains. Put in context of socially competent behavior, those individuals desiring more immediate gratification can be actively choosing not to engage in prosocial behavior, if engaging in such behavior detracts from the more pleasurable activity,
suggesting a lack of self-regulatory ability. Similarly, socially incompetent behavior (e.g., aggression, social withdrawal) could be elicited should a teacher make a decision in disagreement with the child’s desires (e.g., “You need to share the computer, Tommy,” or “Class, it’s time to head in from recess”).

A second key developmental component of social competence is the ability to engage in and sustain positive relationships with parents, teachers, and peers (Brophy-Herb, Lee, Nievar, & Stollak, 2007; Denham, 2006). Although parents might have served as the primary, or sole, source of support before preschool, early schooling opportunities open the door for new relationships with peers and teachers to serve as sources of support (Zinsser, Denham, Curby, & Shewark, 2015). However, the preschool classroom can be more structured and routinized than a young child might be used to, and engaging in positive relationships with others within such a context can be significantly impacted by a child’s overtaxed self-regulatory capabilities (e.g., Miller, Kiely Gouley, Seifer, Dickstein, & Shields, 2004; Mintz et al., 2011).

It has been well documented that children tend to thrive when they can engage in higher quality interactions with their teachers and peers (e.g., Blandon, Calkins, Grimm, Keane, & O’Brien, 2010; Curby et al., 2009; Siekkinen et al., 2013), thus further exacerbating the situation when these instances may be more infrequent (Raver, Blackburn, Bancroft, & Torp, 1999). Moreover, prior research has provided support that deficits in cognitive self-regulation are associated with the inability to control one’s behavior (Riggs et al., 2006a), which in turn can sour interactions with peers (Montroy,
Bowles, Skibbe, & Foster, 2014; Nesbitt, Farran, & Fuhs, 2015). To illustrate the importance of not having meaningful, positive relationships, the detriment due to a lack of positive relationships can cascade should children find themselves in the out-group following instances in which they overreact (e.g., retaliate) due to a failure to self-regulate (Eisenberg et al., 1993). In turn, the chances for the child to rebound from these events can be limited without the social support of peers and teachers, highlighting the need for high-quality interaction to maximize learning opportunities (e.g., Bernier, Carlson, & Whipple, 2010; Center on the Developing Child, 2011; Raver et al., 2011). Clearly then, developing socially competent behavior can become compromised at numerous points by suboptimal self-regulatory abilities.

A third component of social competence is the development of social cognitive skills, as this construct encompasses the thoughts, beliefs, and attitudes children develop regarding relationships and the social environment (Lemerise & Arsenio, 2000; Raver & Zigler, 1997). Examples of such social cognitive skills include social problem-solving, emotion knowledge, and self-concept (Raver & Zigler, 1997). Social problem-solving reflects how an individual would tackle a socially-challenging situation (e.g., asking for their ball back after a peer snatches it away) (Denham et al., 2012b; Walker, Henderson, Degnan, Penela, & Fox, 2014). Again, we see how it would be easy to postulate that children manifesting poor cognitive self-regulation would likely be more apt to overreact emotionally or not think through a socially-challenging situation before executing behavior. This relation has been supported in the literature, where children manifesting greater executive functioning abilities were more likely to choose socially competent
(i.e., prosocial) responses and less apt to select passive responses in a hypothetical situation (Denham et al., 2014b). A plausible explanation could be that children with a greater ability to shift their focus (i.e., cognitive flexibility) from an aversive experience can use this ability to their advantage to positively cope (e.g., Blair, Denham, Kochanoff, & Whipple, 2004).

Additionally, associations between emotion knowledge and cognitive self-regulation have been supported in both directions, further emphasizing the role of cognitive self-regulation as a developmental construct both influencing and being influenced by social development (Denham et al., 2014a; Ferrier, Karalus, Denham, & Bassett, forthcoming; von Salisch, Hänel, & Denham, 2015). Moreover, it has also come to be understood that children with a better recognition and understanding of their own and others’ emotional expressions and experiences were more likely to choose more socially adaptive emotional and behavioral choices (Denham et al., 2014b). Children’s self-concept, which is largely influenced by social acceptance (Brown, Mangelsdorf, Agathen, & Ho, 2008), also factors into the social cognition skills that play a role in how a child approaches a situation (Raver & Zigler, 1997). In turn, consider an instance in which a child impulsively calls a classmate a mean name without thinking of the consequences (i.e., the other person’s feelings). Such scenarios surely happen in preschool and it can be easy to imagine that such an event could lead to lower peer acceptance (e.g. Eisenberg et al., 1993; Gomes & Livesey, 2008; Trentacosta & Izard, 2007), which can, in turn, negatively influence the development of social cognition (Rubin, Burgess, Kennedy, & Stewart, 2003).
In sum, for a child to develop and exhibit socially competent behavior, it is becoming increasingly clear that cognitive self-regulation needs not only to be acknowledged but also inculcated, for deficits in cognitive self-regulation appear to limit the growth of positive relationships with others, which in turn, could provide fewer social learning opportunities for children to increase both self-regulatory and socially competent abilities (Hill, Degnan, Calkins, & Keane, 2006; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Rose-Krasnor & Denham, 2008). Due to the nature of secondary data analysis, which precludes us from assessing social cognition skills, in the present paper we focus on two components necessary for socially competent behavior: demonstrating appropriate social skills in both new and routine situations and engaging in positive relationships with parents, teachers, and peers (e.g., Hubbard & Coie, 1994; Raver & Zigler, 1997; Siekkinen et al., 2013; Vaughn Van Hecke et al., 2007).

Aims of the Current Study

Given the importance of social competence in early childhood, there are self-regulatory components that can support or undermine the trajectories of these skills (Blair, 2002; Denham et al., 2012c; Rose-Krasnor & Denham, 2008). Research has supported that a strong self-regulatory foundation can safeguard one from later behavioral problems (i.e., socially incompetent behavior) and an increased risk of psychopathology and later internalizing and externalizing behavior problems (e.g., Barkley, 1997; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Hill et al., 2006; Pennington & Ozonoff, 1996). Moreover, weak or poor self-regulation skills, if left
unaddressed, can impede the efforts of parents and educators to prepare those in their care for future social and academic success (e.g., Blair & Razza, 2007; Graziano, Reavis, Keane, & Calkins, 2007; Rimm-Kaufman et al., 2009). Because of this evidence, efforts to further understand the association between self-regulation and socially competent behaviors should be at the forefront of developmental research. Furthermore, transactions children have with adults and peers can be a valuable source for the socialization of competent social and self-regulatory behavior (e.g., Bernier, Carlson, Deschênes, & Matte-Gagné, 2012; Rimm-Kaufman et al., 2009; Rose-Krasnor & Denham, 2008) and thus, examining how cognitive self-regulation can influence changes in socially competent behavior (and vice versa) over a longitudinal period can provide a more accurate understanding of how these constructs interact over time.

In sum, the two research questions driving the current study are: (1) is the level of cognitive self-regulation related to the amount of change in socially competent behavior? (2) Is the level of socially competent behavior related to the amount of change in cognitive self-regulation? Our focus on these constructs reflects a literature highlighting their importance as developmentally important tasks (Bierman et al., 2008; Blair & Razza, 2007; Denham, 2006; Raver & Zigler, 1997). Through the use of latent change score (LCS) modeling, we seek to answer these questions by examining these associations between cognitive self-regulation and social competence. Accordingly, because we believe that the skills and abilities inherent to cognitive self-regulation facilitate the development of social skills, it is hypothesized that children whom exhibit growth in cognitive self-regulation will demonstrate more socially competent behavior
(e.g., Sawyer, Miller-Lewis, Searle, Sawyer, & Lynch, in press). Consistent with this notion of a dynamic interplay between cognitive self-regulation and social competence, it is also hypothesized that children who exhibit increases (i.e., growth) in socially competent behavior will demonstrate greater cognitive self-regulation, because the learning of self-regulatory behavior often emerges from the transactions children have with peers and teachers (e.g., Bernier et al., 2012; Rimm-Kaufman et al., 2009; Rose-Krasnor & Denham, 2008). Through an incremental model-fitting procedure, we will be able to determine whether or not cognitive self-regulation (or socially competent behavior) serves as a leading indicator of change.
METHOD

Participants


Procedure

The ECLS-K: 2011 features a multi-informant, multi-method procedure including both direct and indirect assessment measures, along with several interviews and questionnaires completed by various adults connected to the participating child (e.g., parent, teacher, school administrator). For the purposes of this study, only information on measures directly used in the proposed analyses are presented, for further information, readers are referred to the User’s Manual for the ECLS-K: 2011 Kindergarten-First Grade Data File and Electronic Codebook (Tourangeau et al., 2014). In the current
sample, participants were directly assessed on four separate occasions with the frequency of twice per academic year (i.e., in the fall and spring of kindergarten and first grade). In addition, the classroom teacher of the child was asked to complete child-level questionnaires in the fall and spring of each academic year (i.e., T1-T4).

**Measures**

The Dimensional Change Card Sort (DCCS; Zelazo, 2006) was used to primarily assess children’s cognitive flexibility, although, the DCCS also builds upon inhibitory control and working memory processes (Buss & Spencer, 2014). In this direct assessment, children are asked to sort 22 picture cards based on different sets of rules (e.g., by the color of the physical sorting card; by what picture is on the sort card). The DCCS provides four scale scores, three of the scores representing the number of correctly sorted cards in each of the three separate sorting conditions (i.e., rules). A fourth scale score, the Combined scale score, is the total of the three aforementioned scale scores and is recommended by the test developer to assess general cognitive performance (Buss & Spencer, 2014; Tourangeau et al., 2014). Test-retest reliabilities over a 2– to 3-week delay have been documented to range between $r = .48$ to $.44$, respectively (Nesbitt et al., 2015). Research has demonstrated that the DCCS correlates with other direct assessment measures of cognitive self-regulation (Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Zelazo, 2006).
To assess the cognitive self-regulation aspect of working memory, the Numbers Reversed subtest of the *Woodcock-Johnson III Tests of Cognitive Abilities* (Woodcock, McGrew, & Mather, 2001) was administered at each data collection period. Following guidelines provided by the test publishers, three separate scores were available for analysis (i.e., standard scores, percentile ranks, & \( W \) scores). Moreover, it is important to note that the \( W \) score is a special transformation of the Rasch ability scale that relates performance to the mean score of 500, which represents the average performance of a child aged 10 years, 0 months. In accordance to the recommendations of the *User’s Manual for the ECLS-K:2011 Kindergarten-First Grade Data File and Electronic Codebook*, the \( W \) score was selected on the basis that it is the most appropriate score to examine growth or stability over time (Tourangeau et al., 2014). According to the test publishers, the median split-half reliability for the Numbers Reversed subtest was .87. Additionally, both construct and content validity for both the Numbers Reversed subtest and the *Woodcock-Johnson III Tests of Cognitive Abilities*, in general, is supported by CHC theory and a congruent factor structure (Schrank, McGrew, & Woodcock, 2001).

The ECLS-K:2011 utilized items developed for the Social Skills Rating System (SSRS; Gresham & Elliott, 1990) to assess aspects of social competence. These items were included in the child-level questionnaires completed by the teachers. Responses were based on a 4-point Likert scale (i.e., 1-4) where higher values correspond to greater exhibited behavior. From the teacher questionnaires, two scales were developed assessing socially competent behavior: Self-Control (4 items), and Interpersonal Skills (5 items). Reported in the *User’s Manual for the ECLS-K:2011 Kindergarten-First Grade Data*
File and Electronic Codebook (Tourangeau et al., 2014), internal consistency values were calculated at each data collection period and ranged from adequate to excellent. Internal consistency values for the teacher scales across the collection periods ranged from (.79 – .82) for Self-Control to (.85 – .87) for Interpersonal Skills. In addition, criterion-related validity has been documented between the SSRS and the Child Behavior Checklist (Achenbach & Edelbrock, 1983; Blandon, Calkins, & Keane, 2010).

To account for some variability in the current analyses, the gender of the child and their overall learning behaviors were entered in as covariates. The Approaches to Learning scale consisted of seven items specifically developed for the ECLS-K and was answered at each time point by the child’s classroom teacher. The scale score is a simple mean rating of the seven items and higher scores indicate that the child exhibited a greater propensity to engage in positive learning behaviors (e.g., “Shows eagerness to learn new things” & “ Easily adapts to changes in routine”). Internal consistency estimates for the seven items were .91 at each of the four rounds of data collection (Tourangeau et al., 2014). Descriptive statistics and correlations for all observed variables and covariates are reported in Tables 1 & 2.

Data Analysis Plan

In the current study, the main goal is to assess whether the level of our latent variable of cognitive self-regulation contributes to changes in socially competent behavior, as well as, whether socially competent behavior contributes to changes in
cognitive self-regulation. To create the latent construct of cognitive self-regulation, both the DCCS Combined Score scale score and the Numbers Reversed $W$ score were combined into a common factor. In order to provide a metric, the DCCS Combined Score indicator was fixed at one $a$ priori, given that it, unlike the Numbers Reversed $W$ score, is theorized to tap multiple aspects of cognitive self-regulation (Buss & Spencer, 2014). Similarly, a common factor was specified for the social competence latent variable, where the loading of the Interpersonal Skills latent variable was fixed at one on the basis that it consisted of more items and demonstrated greater internal consistency than the Self-Control scale (Tourangeau et al., 2014). For both the cognitive self-regulation and social competence common factors, the loadings for the latent variable not fixed to one (i.e., the Numbers Reversed $W$ score and the SSRS Self-Control scale) were constrained to be equal over time.

Through the use of latent change score modeling (LCS), we are able to assess the change between two adjacent observations, represented as a latent variable (Selig & Preacher, 2009). Moreover, a key draw to LCS analyses is that it allows one to model true scores as the product of multiple indicators of change. First, LCS models incorporate aspects of linear growth, akin to linear growth models; in an LCS framework, this parameter is referred to as the additive, or $\alpha$, parameter. In addition to the additive, linear growth component, LCS models account for changes in true scores at time $t$ based on the contribution of the previous time point $[t-1]$ and thus, a non-linear growth component is estimated, which is referred to as the proportional, or $\beta$, parameter. Last, and unique to LCS modeling, is that in a bivariate LCS framework, where the additive and proportional
change parameters are estimated for two different constructs over time, the estimation of coupling ($\gamma$) parameters can also be estimated. The estimation of these coupling parameters allows one to evaluate the effects that one variable, $X$, at time $t-1$ has on the changes of a second variable at the following time $t$ (Ferrer & McArdle, 2010). In the context of the present analysis, this would allow one to evaluate the effect that the mean level of cognitive self-regulation in the fall of kindergarten (i.e., T1) has on the level of growth (i.e., change) in socially competent behaviors in the spring of kindergarten (i.e., T2).

In addition, one is able to assess whether one variable serves as a “leading” or “lagging” indicator or if the association is bidirectional (Ferrer & McArdle, 2004, 2010). Furthermore, LCS examines change and individual differences in the within-person change, however unlike latent growth curve modeling, LCS is better able to model the impact of one construct on changes in another in the context of that specific time interval (Selig & Preacher, 2009). Thus, LCS can be preferable to latent growth curve modeling as it allows for one to determine differences in latent growth trajectories (Selig & Preacher, 2009) reflective of the dynamic nature of these processes (i.e., socialization of self-regulatory and socially competent behavior facilitated through social affordances; Rose-Krasnor & Denham, 2008). It has become standard practice to impose equality constraints on the $\alpha$, $\beta$, and $\gamma$ parameters over time to allow for easier estimation and identification (McArdle, 2009). Together then, the use of a latent change score modeling is appealing given the versatility of this SEM framework.
An LCS framework allows for a series of bivariate dual change score models to be tested, which will be used to address our primary research questions. The first of these models will estimate the additive and proportional change (α and β, respectively) parameters for both cognitive self-regulation and social competence. These estimations are equivalent to fitting slope and intercept parameters in a latent growth curve framework. In this first model, graphically represented in Figure 1a, both coupling parameters were fixed to zero, representing that no dynamic interaction is being explicitly estimated.

The individual estimation of coupling parameters from cognitive self-regulation to changes in social competence (i.e., \( \gamma_{cscr} \)) and from social competence to changes in cognitive self-regulation (i.e., \( \gamma_{sccsr} \)) were estimated in Models 1b and 1c, respectively. In both models, shown in Figures 1b and 1c, the opposite coupling parameter was fixed at zero (i.e., not estimated). In the fourth model, Model 1d, depicted in Figure 1d, both coupling parameters were estimated simultaneously. By evaluating the model fit (i.e., \( \chi^2 \)) across our models, we will be able to assess whether the incremental estimation of coupling parameters produces a significantly worse fitting model (Ferrer & McArdle, 2004; McArdle & Grimm, 2010; Selig & Preacher, 2009).
RESULTS

Findings

Table 1 contains the sample sizes, means, and standard deviations of all of the observed measures from the fall of kindergarten to the spring of first grade. Through the use of an LCS approach estimated using Mplus 6.12 (Muthén & Muthén, 2010), we are able to evaluate the contribution of self-regulatory skills to growth (i.e., change) in socially competent behavior and vice versa (Hamagami & McArdle, 2001).

To reiterate, four bivariate dual change score models were fit to the repeated measurements of cognitive self-regulation and socially competent behavior. Estimates of model fit for the four bivariate models are presented in Table 2. To evaluate relative fit (i.e., directly comparing the nested models), generally the $\chi^2$ test statistic is used, however, when using the maximum likelihood with robust standard errors (MLR) estimator in Mplus (Muthén & Muthén, 2012), the $\chi^2$ statistic is not interpretable in the typical fashion. To correct for this, the Sattora-Bentler Scaled $\chi^2$ (TRd) was calculated between the least restrictive model in which all coupling parameters were freely estimated (i.e., Model 1d) and the more constrained models (i.e., Models 1a-1c, where some combination of the $\gamma_{csrsc}$ and $\gamma_{sccsr}$ coupling parameters were constrained to zero). Although the TRd values comparing Model 1a to Models 1b-1d were each significant, this was not surprising given the enormity of the national dataset (Oishi, 2007) and thus,
evaluating the combination of global fit measures and model complexity allowed us to justify the selection of Model 1d as the best fitting model (CFI= .89, TLI=.88, RMSEA=.07).

All parameter estimates can be found in Table 3 and are interpretable similar to regression weights. Imposing equality constraints and fixing the additive growth parameters equal to 1 resulted in no significance test for this parameter. Moreover, by fixing the additive growth parameter to 1, this does not mean that we expect that the impact of this parameter to simply “add one” to the resulting score at from time \( t \) to \( t+1 \). Instead, the linear growth (along with the intercept) are freely estimated and by fixing the \( \alpha \) parameter to 1, we are assuming that the linear growth accumulates in a systematic fashion (McArdle, 2009).

In terms of social competence, the latent intercept was found to be significantly different than zero \( (p < .001) \) as was the linear growth (i.e., slope) component \( (p < .001) \). The proportional change (i.e., \( \beta \)) parameter was negative and significant \( (p < .001) \) suggesting that the rate of change demonstrated a decrease when there was greater socially competent behavior at the previous time point. Last, the coupling parameter indicated that previous levels of cognitive self-regulation had a significant negative effect on the rate of change in the growth of socially competent behavior \( (p < .001) \).

Similar to our estimates of social competence, in terms of cognitive self-regulation, the latent intercept was also found to be significantly different than zero \( (p < .001) \) as was the linear growth (i.e., slope) component \( (p < .001) \). The proportional
change (i.e., β) parameter was positive and significant ($p < .01$) suggesting that the rate of change demonstrated an increase when there was greater cognitive self-regulatory ability at the previous time point. Last, the significant coupling parameter indicated that higher previous levels of social competence had a negative effect on the rate of change in cognitive self-regulatory ability. Using equations specified by our final bivariate LCS model (McArdle, 2009; Quinn, 2012), Figure 3 represents the predicted latent growth trajectories for both cognitive self-regulation and socially competent behavior.

There were also notable significant relations between the latent variables in our model. Initial levels (i.e., intercept) of cognitive self-regulation were positively associated with the latent slope of social competence and negatively associated with the slope of cognitive self-regulation ($ps < .001$). Initial levels of socially competent behavior were positively related to the latent slopes of social competence ($p = .053$) and cognitive self-regulation ($p < .001$). Last, both latent slopes of cognitive self-regulation and social competence, as well as their latent intercepts were negatively related to each other ($p < .001$).

The results indicate that for the covariates in our model (i.e., gender and teacher-rated approaches to learning), at each time point, manifesting greater positive learning behaviors (i.e., teacher-rated approaches to learning) demonstrated a significant positive association with greater values of cognitive self-regulation and socially competent behaviors. There were some significant gender differences found in our latent constructs of cognitive self-regulation as well. In the fall of the kindergarten year, males scored
higher in cognitive self-regulation, whereas in the following spring, females scored higher in measures of cognitive self-regulation. There were no significant associations between gender and cognitive self-regulation scores at either data collection period in first grade (i.e., T3 & T4). Similar to cognitive self-regulation, greater positive learning behavior scores were associated with more socially competent behavior at all time points. Being male was associated with more socially competent behavior at T2, however, females were associated with more socially competent behaviors in both the fall and spring of first grade. No significant association between gender and social competence was observed at T1. Covariate estimates and their standard errors are listed in Table 4
DISCUSSION

Implications of Findings

Because acquiring social competence and self-regulatory behavior often emerges from the transactions children have with peers and teachers (i.e., through socialization; Bernier et al., 2012; Rimm-Kaufman et al., 2009; Rose-Krasnor & Denham, 2008), it was hypothesized that children who are better able to balance the competing sensory demands, attend to social partners and inhibit impulsive behaviors, for example, (i.e., a greater self-regulatory foundation) would demonstrate more socially competent behavior. Moreover, these children who interacted more positively with their peers (i.e., displayed more socially competent behavior) were expected, in turn, to exhibit increases in cognitive self-regulation, for the increasing complexity of social interaction requires children to process and manage thoughts (e.g., information from differing viewpoints) and behaviors (e.g., delay of gratification) to continue future peer and teacher interaction.

Through the utilization of a latent change score approach, we were able to assess the contributions that both self-regulatory abilities and socially competent behaviors have on the rate of change of one another. A series of four bivariate LCS models were fit to longitudinal data to evaluate this supposed dynamic system. Our results indicate that a model including coupling parameters from latent levels of cognitive self-regulation to changes in social competence and vice versa, fit the data better than models in which
either just one or neither of the coupling parameters were estimated. Moreover, that our results found that the estimation of both coupling parameters resulted in a better fit than either Models 1b or 1c, suggests that instead of one construct exhibiting a leading relation on the other, the development of cognitive self-regulation and socially competent behaviors operate in a dynamic system, a finding is neither surprising nor unsupportive of our theoretical position (e.g., Halberstadt et al., 2001; Raver & Zigler, 1997; Rose-Krasnor & Denham, 2008).

As shown in Table 3 and depicted in Figure 3a, latent constructs of socially competent behavior tended to exhibit increased growth from T1 to T3, powered by positive linear growth component, yet additionally affected by negative proportional growth and a negative coupling parameter with previous cognitive self-regulation skills. Interestingly, the predicted values of social competence decrease from T3 to T4. In other words, those with higher previous values of socially competent behavior exhibited less proportional growth. Moreover, those with higher levels of cognitive self-regulation also exhibited a decrease in the rate of change in social competence. A possible explanation could be that for children who increasingly demonstrate socially competent behavior, perhaps the rate of change does not need to necessarily increase. Instead, one important distinction that must be made between cognitive self-regulation and social competence is that there may be a qualitative threshold set within the conceptualization of social competence. Moreover, teachers responded to the items constituting our social competence latent variable by agreeing to statements using a 4-point frequency scale, ranging from “never” to “very often,” unlike the tasks contributing to cognitive self-
regulation, in which performance was evaluated by direct assessment and not subject to a forced-choice response (Tourangeau et al., 2014). Furthermore, although one can assume that higher values on the social competence latent construct can be viewed in a positive light, it would appear inappropriate to view the decreased value for socially competent behavior at T4 as necessarily indicative of a problem per se, however it was still an unexpected finding that warrants future investigation. In turn, it seems appropriate for future research to investigate whether there are group differences that can attempt to parse out this finding, as the plotted trajectories are based on the average across the sample.

The current study also found that latent constructs of cognitive self-regulation tended to exhibit increased growth throughout kindergarten and the fall of first grade, although it did exhibit a negligible decline in the spring of first grade. This trajectory is graphically represented in Figure 3b. This trajectory was influenced by a positive proportional growth component, yet additionally affected by negative linear growth and coupling parameters with previous social competence skills. In other words, children with higher cognitive self-regulation at the previous time point made greater proportional growth than did children with lower cognitive self-regulation that was minimally affected by the negative linear growth and coupling contributions. In turn, we view this finding as lending credence to the importance of developing adequate self-regulatory behavior early in life for maximal effect (e.g., Blair, 2002). Additionally, the finding that the additive linear slope parameter was negative fits with the developmental literature, which has largely implicated early childhood as more of a period of significant cognitive self-
regulatory growth tapering off around age 5 (i.e., before the time in which this data was collected) and another growth spurt in adolescence (e.g., Carlson, 2005). Moreover, the overall growth trajectory for cognitive self-regulation is in unison with our theoretical rationale that children who increasingly manifest socially competent behaviors are likely afforded more opportunities to interact with peers (and adults alike), further increasing opportunities for the socialization of social, emotional, and self-regulatory learning (e.g., Fabes et al., 2012; Montroy, Bowles, Skibbe, & Foster, 2014; Nesbitt, Farran, & Fuhs, 2015). Furthermore, this appears to be especially true for younger children, further emphasizing the importance of high quality social interaction (Center on the Developing Child, 2011).

Limitations and Future Directions

The present study supported both of our research questions: children’s cognitive self-regulation was a significant predictor of the rate of change in socially competent behaviors and socially competent behavior was a significant contributor to later cognitive self-regulation although it was unexpected that this coupling influence on the growth trajectories would be negative (i.e., a decelerating effect), however, the overall growth trajectories indicate that this negative component did not deleteriously thwart the development of cognitive self-regulation. Generally, this trend applies to socially competent behavior as well, however, one explanation for the decrease at T4 could be due to a regression to the mean effect suggesting that from the beginning of kindergarten through the fall of first grade, socially competent behavior increases substantially yet
what is represented at T4 is just the beginning of an effect that will plateau over time. Accordingly, it is something that should be investigated further to test the accuracy of this hypothesis once future data (i.e., time points) are available for analysis.

A considerable advantage of using a modeling approach such as bivariate LCS modeling is its versatility (McArdle, 2009). Although in the current study equality constraints were imposed on the $\beta$, $\alpha$, & $\Upsilon$ parameters to allow for the model to be easier to identify by the modeling software, perhaps this limits the ecological validity of the model itself. Perhaps future prospective research could profit from evaluating models without imposing equality constraints on the coupling parameters. Such investigations would likely require the respecification of the model, possibly reducing the complexity of the model in order to ensure the model can be properly identified by the software. In the same light, it is also unknown whether the rate of change in cognitive self-regulation should remain constrained across time. Again, imposing equality constraints not only helps with model identification, but assumes that the rate of change is comparable between each time lag (Ferrer & McArdle, 2004); however, the ECLS-K:2011 begins data collection on the tail end of an exponential cognitive self-regulatory growth spurt that does not increase pace until again in adolescence (Best & Miller, 2010; Carlson, 2005). As such, less constrained analyses could allow for better insight regarding the differential effects of less- (i.e., kindergarten) and more-routinized (e.g., first grade) schooling. Furthermore, the removal of equality constraints on the coupling parameters can provide insight into whether there are substantial differences in the effects of cognitive self-regulation and social competence rates of change in the other at different
time points. In fact, considering that our measures of social competence are responded to on a frequency scale, perhaps the definitions, or rather the *expectations* of what is deemed to be an “appropriate frequency” of socially competent behaviors, is a moving target that increases commensurate with age.

There would also be merit in seeing future research on the topic of this dynamic interplay between social competence and cognitive self-regulation integrate more emotional constructs into their modeling approaches given the confluence of social, emotional, and cognitive development (Blair, 2002; Calkins & Marcovitch, 2010; Denham, 2006; Ferrier et al., 2014). Last, although the natural organization of the data could blend some group differences that are accountable to nesting effects (e.g., the effects of different classrooms in different school districts), the current study is not specifying research questions directly related to group differences and instead, is using the current analyses to serve as a preliminary investigation into the dynamic relation between cognitive self-regulation and social competence. Certainly, future analyses could employ multilevel modeling as a means in which to examine any variance attributable to superordinate-level (e.g., teacher or classroom) effects (e.g., Raudenbush & Bryk, 2002).
CONCLUSION

Recent research is revealing that higher levels of improvement in self-regulation in early childhood can serve as a buffer against socially incompetent behavior problems (e.g., internalizing and externalizing problems) later in childhood, strongly underlining the importance of inculcating strong self-regulatory skills in young children (Riggs, Greenberg, Kusché, & Pentz, 2006b; Sawyer, Miller-Lewis, Searle, Sawyer, & Lynch, 2015), however this research has relied predominantly on indirect assessments (e.g., rating scales) of cognitive self-regulation.

To further build a more concrete understanding of the roles that cognitive self-regulation and socially competent behavior have in the promotion of one another, we sought in the current study to further investigate this dynamic relation. Fueled by lines of research highlighting close associations between both cognitive self-regulation and social competence, where weak or poor self-regulation skills, if left unaddressed, can impede the efforts of parents and educators to prepare those in their care for future social and academic success (e.g., Blair & Razza, 2007; Graziano et al., 2007; Hill et al., 2006; Raver et al., 1999; Rimm-Kaufman et al., 2009; Rose-Krasnor & Denham, 2008), the main goal of the current study was to assess the bidirectionality of relations longitudinally. Utilizing a latent change score modeling framework, this study is one of the first to examine the dynamic relation between aspects of socially competent and
cognitive self-regulatory behavior in children, where support for cognitive self-regulation as a leading indicator on the rate of change in social competence was found, whereas the reciprocal relation was not supported in the present analyses. Additionally, we are encouraged that this study will add to current research (e.g., Sulik et al., 2015) that efforts to foster self-regulation can lay the groundwork for future competencies and can protect against later problems (Center on the Developing Child, 2011; Liew, 2012; Riggs et al., 2006a). In turn, it is our hope that this research on understanding how changes in cognitive self-regulation and social competence influence the growth of the other will provide valuable insight to researchers, parents, and teachers alike as to the skills and behaviors to support necessary for enduring success (Denham, 2006).
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Numbers Reversed T1</td>
<td></td>
<td>15598</td>
<td>433.01</td>
</tr>
<tr>
<td>2.</td>
<td>Numbers Reversed T2</td>
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<td>17147</td>
<td>449.68</td>
</tr>
<tr>
<td>3.</td>
<td>Numbers Reversed T3</td>
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<td>5222</td>
<td>456.96</td>
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<tr>
<td>4.</td>
<td>Numbers Reversed T4</td>
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<td>15107</td>
<td>469.33</td>
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<td>5.</td>
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<td></td>
<td>15604</td>
<td>14.20</td>
</tr>
<tr>
<td>6.</td>
<td>DCCS Combined T2</td>
<td></td>
<td>17149</td>
<td>15.14</td>
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<td>7.</td>
<td>DCCS Combined T3</td>
<td></td>
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<td>8.</td>
<td>DCCS Combined T4</td>
<td></td>
<td>15109</td>
<td>16.05</td>
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<td>9.</td>
<td>SSRS Self-Control T1</td>
<td></td>
<td>13550</td>
<td>3.08</td>
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<tr>
<td>10.</td>
<td>SSRS Self-Control T2</td>
<td></td>
<td>15796</td>
<td>3.18</td>
</tr>
<tr>
<td>11.</td>
<td>SSRS Self-Control T3</td>
<td></td>
<td>4658</td>
<td>3.20</td>
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<tr>
<td>12.</td>
<td>SSRS Self-Control T4</td>
<td></td>
<td>13202</td>
<td>3.22</td>
</tr>
<tr>
<td>13.</td>
<td>SSRS Interpersonal Skills T1</td>
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<td>13708</td>
<td>2.99</td>
</tr>
<tr>
<td>14.</td>
<td>SSRS Interpersonal Skills T2</td>
<td></td>
<td>15799</td>
<td>3.13</td>
</tr>
<tr>
<td>15.</td>
<td>SSRS Interpersonal Skills T3</td>
<td></td>
<td>4724</td>
<td>3.11</td>
</tr>
<tr>
<td>16.</td>
<td>SSRS Interpersonal Skills T4</td>
<td></td>
<td>13288</td>
<td>3.14</td>
</tr>
<tr>
<td>17.</td>
<td>Approaches to Learning T1</td>
<td></td>
<td>14770</td>
<td>2.94</td>
</tr>
<tr>
<td>18.</td>
<td>Approaches to Learning T2</td>
<td></td>
<td>15978</td>
<td>3.10</td>
</tr>
<tr>
<td>19.</td>
<td>Approaches to Learning T3</td>
<td></td>
<td>5022</td>
<td>3.04</td>
</tr>
<tr>
<td>20.</td>
<td>Approaches to Learning T4</td>
<td></td>
<td>13449</td>
<td>3.08</td>
</tr>
</tbody>
</table>

*Note:* T1, T2, T3, & T4 refer to measurements collected in the Kindergarten- Fall, Kindergarten-Spring, First Grade-Fall, and First Grade-Spring data collection periods, respectively. Observations at T3 were missing by design and are not indicative of MNAR (Missing Not at Random) data (Tourangeau et al., 2014).
### Table 2: Fit Indices for Bivariate Dual Change Score Models

<table>
<thead>
<tr>
<th>Index</th>
<th>Model 1a: No Coupling</th>
<th>Model 1b: Level CSR --&gt; SC Growth</th>
<th>Model 1c: Level SC --&gt; CSR Growth</th>
<th>Model 1d: Bidirectional Coupling</th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
<td>193</td>
<td>192</td>
<td>192</td>
<td>191</td>
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<tr>
<td>$\chi^2$*</td>
<td>4719.852</td>
<td>3818.278</td>
<td>4709.775</td>
<td>3866.214</td>
</tr>
<tr>
<td>Scaling Correction Factor</td>
<td>1.248</td>
<td>1.126</td>
<td>1.246</td>
<td>1.229</td>
</tr>
<tr>
<td>Sattora-Bentler Scaled $\chi^2$ (TRd)</td>
<td>Comparison</td>
<td>65.555</td>
<td>13.477</td>
<td>371.852</td>
</tr>
<tr>
<td>$\Delta$df</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>p-value</td>
<td>--</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.08</td>
<td>0.07</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>CFI</td>
<td>0.86</td>
<td>0.89</td>
<td>0.86</td>
<td>0.88</td>
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<tr>
<td>TLI</td>
<td>0.86</td>
<td>0.88</td>
<td>0.86</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Note: df= degrees of freedom; *=traditional $\chi^2$ is not comparable due to the usage of the Maximum Likelihood with Robust Standard Errors (MLR) estimator; $\Delta$df = change in degrees of freedom; RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index.
Table 3: Parameter Estimates for Final Bivariate Latent Change Score Model (Model 1d)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>S.E.</th>
<th>Est./S.E.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu_{csr}$ (CSR Intercept)</td>
<td>14.431</td>
<td>0.081</td>
<td>177.979</td>
<td>0</td>
</tr>
<tr>
<td>$\mu_{sce}$ (CSR Slope)</td>
<td>-1.633</td>
<td>0.697</td>
<td>-2.343</td>
<td>0.019</td>
</tr>
<tr>
<td>$\mu_{isc}$ (SC Intercept)</td>
<td>1.029</td>
<td>0.034</td>
<td>30.35</td>
<td>0</td>
</tr>
<tr>
<td>$\mu_{ssc}$ (SC Slope)</td>
<td>11.578</td>
<td>0.707</td>
<td>16.373</td>
<td>0</td>
</tr>
<tr>
<td>$\alpha_{csr}$</td>
<td>1</td>
<td>0</td>
<td>999</td>
<td>999</td>
</tr>
<tr>
<td>$\alpha_{isc}$</td>
<td>1</td>
<td>0</td>
<td>999</td>
<td>999</td>
</tr>
<tr>
<td>$\beta_{csr}$</td>
<td>0.141</td>
<td>0.049</td>
<td>2.893</td>
<td>0.004</td>
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<tr>
<td>$\beta_{isc}$</td>
<td>-0.714</td>
<td>0.021</td>
<td>-34.061</td>
<td>0</td>
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<tr>
<td>$\gamma_{csrsc}$</td>
<td>-0.738</td>
<td>0.047</td>
<td>-15.829</td>
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<tr>
<td>$\gamma_{sccsr}$</td>
<td>-0.23</td>
<td>0.028</td>
<td>-8.123</td>
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<td><strong>Covariances</strong></td>
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<tr>
<td>$\sigma_{CSR,scCSR}$</td>
<td>-0.123</td>
<td>0.025</td>
<td>-4.985</td>
<td>0</td>
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<tr>
<td>$\sigma_{CSR,scSC}$</td>
<td>0.34</td>
<td>0.024</td>
<td>13.916</td>
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<tr>
<td>$\sigma_{CSR,iscSC}$</td>
<td>-0.089</td>
<td>0.006</td>
<td>-13.821</td>
<td>0</td>
</tr>
<tr>
<td>$\sigma_{isc,CSR}$</td>
<td>0.029</td>
<td>0.003</td>
<td>8.951</td>
<td>0</td>
</tr>
<tr>
<td>$\sigma_{scCSR,scSC}$</td>
<td>-0.086</td>
<td>0.017</td>
<td>-5.15</td>
<td>0</td>
</tr>
<tr>
<td>$\sigma_{scSC,scCSR}$</td>
<td>0.009</td>
<td>0.005</td>
<td>1.937</td>
<td>0.053</td>
</tr>
<tr>
<td><strong>Variances</strong></td>
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<tr>
<td>$\sigma^2_{CSR}$</td>
<td>0.53</td>
<td>0.015</td>
<td>35.121</td>
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<tr>
<td>$\sigma^2_{scCSR}$</td>
<td>0.034</td>
<td>0.011</td>
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<tr>
<td>$\sigma^2_{isc}$</td>
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<td>0.004</td>
<td>26.119</td>
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<tr>
<td>$\sigma^2_{ssc}$</td>
<td>0.269</td>
<td>0.032</td>
<td>8.389</td>
<td>0</td>
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</tbody>
</table>

*Note: CSR: Cognitive self-regulation; SC: Social Competence; Constant change (i.e., $\alpha$) parameters were fixed at 1. $\alpha$: constant change parameter; $\beta$: proportional change parameter; $\gamma_{xxyy}$: coupling parameter from xx level to yy growth. I/i= latent intercept; S/s= latent slope. Estimates based on unstandardized values.*
Table 4: Covariates Estimates for Final Bivariate Latent Change Score Model (Model 1d)

<table>
<thead>
<tr>
<th></th>
<th>Cognitive Self-Regulation</th>
<th></th>
<th>Social Competence</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>S.E.</td>
<td>Estimate</td>
<td>S.E.</td>
</tr>
<tr>
<td>T1 (Fall Kindergarten)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approaches to Learning</td>
<td>0.174***</td>
<td>0.020</td>
<td>0.659***</td>
<td>0.01</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.132***</td>
<td>0.033</td>
<td>0.020</td>
<td>0.013</td>
</tr>
<tr>
<td>T2 (Spring Kindergarten)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approaches to Learning</td>
<td>0.185***</td>
<td>0.016</td>
<td>0.568***</td>
<td>0.009</td>
</tr>
<tr>
<td>Gender</td>
<td>0.168***</td>
<td>0.030</td>
<td>-0.113***</td>
<td>0.028</td>
</tr>
<tr>
<td>T3 (Fall First Grade)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Approaches to Learning</td>
<td>0.169***</td>
<td>0.016</td>
<td>0.616***</td>
<td>0.01</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.004</td>
<td>0.026</td>
<td>0.051*</td>
<td>0.025</td>
</tr>
<tr>
<td>T4 (Spring First Grade)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approaches to Learning</td>
<td>0.171***</td>
<td>0.018</td>
<td>0.675***</td>
<td>0.011</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.009</td>
<td>0.029</td>
<td>0.092***</td>
<td>0.025</td>
</tr>
</tbody>
</table>

*Note: *: p < .05; ***: p < .001. Gender was coded dichotomously as 1=Male, 2=Female, thus a significant negative estimate (e.g., -.132) means that being male was associated with higher cognitive self-regulation (i.e., for every 1 point increase in cognitive self-regulation, the gender variable decreased, or became “more male”).
Figures 1a-1d: Bivariate Dual Change Score Models
Note: CSR = Cognitive Self-Regulation latent true score; ΔCSR = Cognitive Self-Regulation latent change score; SC = Social Competence latent true score; ΔSC = Social Competence latent change score; Covariates not shown.
Figure 2: Final Bivariate Dual Change Score Model with Parameter Estimates (Model 1d)

Note: CSR = Cognitive Self-Regulation latent true score; ΔCSR = Cognitive Self-Regulation latent change score; SC = Social Competence latent true score; ΔSC = Social Competence latent change score. Factor loadings, covariates (gender & positive learning behaviors) and variance coefficients not shown. † = loading fixed at 1; *= loading freely estimated; ††: p < .10; *: p < .05; **: p < .01; ***: p < .001; Refer to Table 4 for slope and intercept estimates. Other coefficients not shown: fixed at 1.
Figure 3a: Latent Growth Trajectory for Social Competence
Figure 3b: Latent Growth Trajectory for Cognitive Self-Regulation
REFERENCES


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BIOGRAPHY

David E. Ferrier received his Masters of Arts in School Psychology at George Mason University in 2013 and a Bachelors of Arts in Psychology at Elmira College in 2010. While attending Elmira College, he worked with Dr. Benjamin Lovett. From his experiences working with Dr. Lovett and the hands-on clinical and research training he received under Dr. Ellen Rowe at George Mason University, he became interested in the dynamic development of self-regulation and social-emotional development in young children. David has currently accepted a position as an Assistant Professor of Psychology at the University of Tennessee at Chattanooga beginning in the 2016-2017 academic year, where he will continue his research into how fostering social, emotional, and cognitive development in young children can ensure both early and enduring success throughout life.