The Link Between Self-regulation and Early Childhood Preliteracy in Low-Income Urban Settings

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Abstract

The present study evaluated the correlation that self-regulation and several covariates (age, gender, race-ethnicity, income-to-needs ratio) have with pre-literacy in preschool aged children. The participants were a sub sample of available data from the Chicago School Readiness Project. The participants came from low-income neighborhoods of Chicago, were mostly African-American, and were of preschool age. Regression analysis and statistical inference were the primary tools. Results indicate a definite positive link between self-regulation and pre-literacy. In addition, results suggest self-regulation to be a stronger predictor of pre-literacy than most covariates, with the lone exception of age. Findings contribute to a growing body of research focusing on child self-regulation predicting literacy. Future research may detail possible causal relationships between literacy and self-regulation.

Table of Contents Page

List of Figures and Tables Page

1. Introduction

In recent years, a plethora of research has appeared documenting self-regulation in young children. Though different researchers have referred to self-regulation with varied names, their concepts have remained consistent (McClelland, Cameron, Wanless, & Murray, 2007; Raver, 2004; McClelland, Cameron, Connor et al., 2007; Raver, Blackburn, Bancroft, & Torp, 1999; Blair & Razza, 2007). In this study, we treat phrases such as "learning-related skills", "emotional regulation" and "behavioral regulation" as equivalent to our definition of "self-regulation".

2. Review of Literature

Self-regulation is defined as the ability to control, modify, and adapt one's emotions, impulses or desires (Murtagh & Todd, 2004; Magar, Phillips, & Hosie, 2008). The ability to self-regulate has been associated with various capabilities that enhance behavior and performance. Poor self-regulation among children is linked to their poor risk-taking, where urges of immediate gratification are achieved but negative consequences overlooked (Magar et al., 2008). Deficits in self-regulation may also hinder children's learning in both mathematics and reading comprehension (Blair & Razza, 2007). Children entering school without regulatory skills may face greater risk for peer rejection (Cooper & Farran, 1988; McClelland, Morrison, & Holmes, 2000). Consequently, it is clear that self-regulation plays an important role in developing functional abilities in young children. Lack of self-regulatory capabilities may result not only in short-term but also long-term detrimental effects.

Self-regulation can be considered to be comprised of two related but distinct processes: executive function and effortful control. Several key differences must be noted between the two. While executive function and effortful control both approach self-regulation from a regulatory angle, executive function is neural-based while effortful control is emotionally-based (Blair &

Razza, 2007). In other words, executive function primarily involves the cognitive processes involved in planning and goal-orientation. Effortful control focuses on the act of overriding inherent impulses to stimuli in the environment in favor of less prominent ones, primarily dealing with memory and retention. Executive function performs a similar action in the inhibition of a prevailing response in favor of a less prominent response. The difference between executive function and effortful control lies in the level of awareness. Executive function is based for the most part on cognizant self-regulation. Effortful control, on the other hand, focuses primarily, but not entirely, on subconscious and automatic regulation.

From another perspective, one can view effortful control as the emotional aspect of self-regulation. Emotional regulation controls motivation and purpose. Executive function can be seen as the cognitive aspect of self-regulation. Cognitive regulation involves the control of thoughts and actions toward planning and execution of behaviors (Banfield, Wyland, Macrae, Munte, & Heatherton, 2004).

Many studies in recent years have examined self-regulation in children. The reasoning is that during childhood, the majority of self-regulation abilities develop. The ability to self-regulate is essential to children's early school success and academic achievement (Cole, Dodge, & Kupersmidt, 1990; Ladd, 1990; Schultz, Izard, Ackerman, & Youngstrom, 2001; Cooper & Farran, 1988; McClelland, Morrison, & Holmes, 2000). Studies have revealed that difficulty in children regulating attention results in their lower achievement skills (Howse, Lange et al., 2003). Growth in children behavioral self-regulation predicted growth in early literacy, language, and math skills during prekindergarten (McClelland, Cameron, et al., 2007). Children who enter pre-kindergarten or kindergarten with higher self-regulation have greater success in math and reading over the course of elementary school (McClelland, Acock, & Morrison, 2006). Though

less well-known, self-regulation is also essential for later academic success as the skills associated with self-regulation are just as necessary later on (McClelland, Acock, & Morrison, 2006).

A variety of factors affect the development of self-regulation in children. Of these factors, school appears to be quite influential. There is strong evidence that learning-related skills predict children's early school achievement (Blair, 2002; McClelland, Morrison & Holmes, 2000). Specifically, teachers and classroom environment play a substantial role in developing the social skills in young children that are necessary for interactions. Teachers control their students' developments through classroom atmosphere. Teachers who exhibit confidence, comfort, and certainty in their own skills tend to foster an easy setting for students (Raver, Jones, Li-Grining, Metzger, Champion, & Sardin, 2008). The emotionally positive atmosphere is hypothesized to in turn cultivates self-regulation development. However, mothers of children who have poor self-regulation tend to react more than plan in their treatment of behavioral problems (Gardner, Sonuga-Barke, & Sayal, 1999). In addition, socioeconomic status has also been linked to child conduct problems. Low-income families tend to have parents who spend more time at their jobs. Generally, harsher discipline is used to prevent wrong-doing in a time-constrained environment. Consequently, there is little emotional support. Maltreatment may occur toward the child or between adults, and either or both types of abuse may predict future uncontrolled regulation in the child (Evans & English, 2002; Maughan & Cicchetti, 2002). Other factors such as neighborhood crowding, poor habitation quality, and persistent exposure to violence are associated with lower self-regulation in children (Evans & English, 2002). Finally, low-income families tend to change environments more frequently. Thus, the children have a harder time

adapting to a social setting (Dodge, Pettit, & Bates, 1994). This causes deficits in socialization skills, and consequently lack of ability in adapting to new settings.

Past research documents the relationship between poverty and early childhood literacy. Children from low-income families are at a significant risk for academic underachievement (Ramey, Stedman, Borders-Patterson & Mengel, 1978). Children who live in poverty experience development disadvantages compared to those of more affluent environments (Korenman, Miller & Sjaastad, 1995).

3. The Current Study

Though much research has been done on effortful control and executive function, and even more research has been done on self-regulation, there is a substantial deficit in research on early childhood literacy as linked to self-regulation. To date, our knowledge of literature concerning self-regulation and early childhood literacy extends only so far as that the teacher influences both (Pianta, 1999). Furthermore, low-income urban children are a high-risk group. Successful intervention of self-regulation could potentially improve future academic performance. Conceptually, higher self-regulation should be linked to higher childhood literacy. There is very limited literature documenting this in urban low-income areas however. In response to pressing need for such an analysis, the following study was conducted.

Our primary model links together executive functioning and effortful control as part of self-regulation. Though we do not differentiate the two in the analyses, we do utilize separate tasks to measure effortful control and executive function. Effortful control manages motivation and purpose. Executive function controls thoughts and actions toward planning and execution of behaviors (Banfield, et. al, 2004). As mentioned before, while both involve suppressing a prevailing reaction for a less prominent one, effortful control does so subconsciously while

executive function does so consciously. We will use Pencil Tap and Balance Beam to measure executive function. For effortful control, we will use Snack-Delay, Toy Wrap Wait & Peek.

Though the differences between effortful control and executive function must be noted, we will not attempt to test the differences in this study. We present them to explain the tests for self-regulation and contrast their purposes. In the present study, we will group executive function and effortful control together as self-regulation.

Our principal aim was to examine whether self-regulation predicts child literacy. Our second aim will be to examine the predicting effect of self-regulation on literacy versus that of the predicting power of the covariates on the same. The overall purpose of this study will be to examine whether early childhood literacy is correlated to self-regulation in urban low-income life.

4. Hypotheses

First, we expect that higher self-regulation, executive function and effortful control, would predict higher early childhood literacy in pre-school aged children. Early childhood literacy will be measured by two tests: Elision and Letter Naming/Print Awareness. Since we separate executive function and effortful control as two different entities of self-regulation, we constructed four associations to test. We will examine whether executive function and/or effortful control is/are correlated with Elision. Similarly, we will also examine whether executive function and/or effortful control is/are correlated with Letter Naming/Print Awareness. These tests will be measured against the null hypothesis, which claims that there will be no correlation between any of the three measures.

Second, we expect self-regulation will predict early childhood literacy more accurately than the covariates of gender, race, and income-to-needs. However, we expect age to show higher correlation with literacy than self-regulation will. We theorize that the experience that

comes with age will have a greater positive correlation with literacy than higher self-regulation will.

5. Methods

5.1 Design

The focus of this study was to examine whether effortful control and executive function could show a correlation with literacy in urban low-income areas. The dependent variable examined was the literacy. The independent variables were executive function and effortful control. Covariates included income-to-needs ratio, child age, gender, and race/ethnicity. Income-to-needs ratio was calculated as a comparison with the poverty level. A score below 1.0 is below the poverty threshold. Participants were approached at the beginning of the Head Start year and asked for consent to participate in this study. Most participants in this study were either African-American or Hispanic.

5.2 Participants

5.2.1 Selection Preschool sites were chosen based on three primary characteristics: (a) received Head Start funding, (b) had at least two classrooms that offered full day care, (c) were located in any of the seven high-poverty neighborhoods (Raver et al., 2008). Chicago School Readiness Project (CSRP) staff performed block-by-block surveys of the seven neighborhoods to determine any agencies that met the criteria. Eligible sites were asked to volunteer themselves for participation in the current study. Of these, eighteen sites in total across the seven neighborhoods were included in the present study. Two classrooms within each site were randomly chosen to participate. Between Labor Day and mid-October (the enrollment cutoff date) of the school year, 83% of the available children were recruited. Children were chosen by their teachers. Teachers were instructed to recommend students most likely to benefit

from intervention. During the fall and spring of the school year, teachers reported child behavior problems.

5.2.2 Sample At baseline, 543 children participated in CSRP. By spring of the Head Start year, the participants decreased to 509 children. This change was almost all due to voluntary departure from participation. However, one child was withdrawn by the parent while another was requested to leave the Head Start program.

The present study follows 103 participants that were involved in the CSRP intervention. These children were chosen because they had complete data sets on self-regulation, demographics, and literacy. These 103 children were used in the analysis. The majority of them were African American or Hispanic (African American=1, non-African American=0). There were slightly more females in the study (female=54%). See Figure 1 for descriptive analysis.

Figure 1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std Deviation
Age	103	3.75	5.66	4.7882	0.58788
Gender	103	0	1	.46	0.501
Child Ethnicity (African American)	103	0	1	0.7087	0.45657
Income-to-Needs Ratio	103	0	3.57	0.7278	0.63559

6. Procedure

As explained before, participants for this study were recruited from each of the 35 different classrooms to participate in the present study. In the fall, approximately 17 children from each classroom age 3-5 enrolled in the CSRP intervention study. Parents or caregivers were approached for consent for the children to participate in the study. Parents or caregivers were also interviewed for demographic information (e.g. income-to-needs and race ethnicity). The Pre-CTOPP sample does not include all the participants in the CSRP intervention study.

Approximately 6 children in each classroom were chosen to participate. Children were chosen based on teacher evaluation of below average, average, or high child behavioral disregulation (lack of self-regulation). The selection process equalized the number of children from each of the three behavioral groups with stratified random sampling.

Assessors were trained to administer the Pre-CTOPP as a group. Each question in the subsets was examined. Possible answers were discussed and correct answers were identified. Assessors were also paired and asked to simulate assessor/child interactions through the entire assessment.

Participating children were escorted to a secluded and quiet area outside the classroom to administer the test. Questions were asked in English, but translations were given in Spanish when necessary. If a child wished to change his/her answer to a previous answer, the new answer was accepted. Assessments were completed within approximately ten minutes.

Trained assessors performed a similar process in administering the Preschool Self-regulation Assessment (PSRA). Answers were coded as correct (1) or incorrect (0) for all items.

7. Measures

7.1 Phonological Processing The children were given the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPP). This test was based on the CTOPP (Wagner, Torgesen, & Rashotte, 1999) to provide assessment of phonological sensitivity, phonological memory, and phonological access. Emphasis was placed on the child's ability to recognize, remember, and recall words, phrases, and syllables. The original CTOPP was extended downward to accommodate children from 3 through 5 years of age resulting in the Pre-CTOPP. The present study used two Pre-CTOPP subtests: Elision (an example of this item would be "point to seesaw without see") and Letter Naming/Print Awareness (an example of this item

would be “which picture has letters on it?”). The Elision subtest requires the division of spoken words into smaller segments. The Print Awareness subtest requires the recognition of the alphabet and groups of letters. Due to time constraints, Elision and Print Awareness were chosen because they are the subscales with the highest likelihood of correlation with early reading and long-term validity. The Pre-CTOPP was shown to be reliable and valid. For example, a preliminary analysis conducted by a co-author tested the reliability of the CTOPP, whereby Cronbach’s alpha was calculated for both Elision and Print Awareness. The results showed $\alpha = .93$ for Elision and $\alpha = .94$ for Print Awareness. Thus, Elision and Print Awareness are consistent over repeated testing. To test validity, children’s Pre-CTOPP scores were correlated with their performance on a similar measure of letter-naming, the National Reporting System (NRS). The results show positive correlations between the Pre-CTOPP and the NRS measures ($r(194)=.42$, $p<.01$).

7.2 Self-regulation The Preschool Self-Regulation Assessment (PSRA) was administered to children. Past research has demonstrated the PSRA as a valid measure of both effortful control and executive function (Smith-Donald, Raver, Hayes, & Richardson, 2007). Ten tasks were administered to measure children’s executive function and effortful control. Coding and script were adapted to fit the tasks. Because of availability of data and for convenience, only certain tasks were analyzed in the present study. As a measure of effortful control, the Snack Delay, Toy Wrap, and Wait & Peek were used. To measure executive function, the Balance Beam and Pencil Tap were utilized. As mentioned before, this study will separate executive function and effortful control only to highlight the different aspects of their respective tests. In analysis, executive function and effortful control will be grouped together as one entity.

8. Results

Figure 2 Table of Unstandardized Coefficients and Standard Error

	Model 1: Elision		Model 2: Print Awareness	
	Step 1: EF & EC only	Step 2: EF, EC & covariates	Step 1: EF & EC	Step 2: EF, EC & covariates
Executive Function and Effortful Control	1.70* (0.42)	1.08* (0.49)	0.97* (0.16)	0.47* (0.17)
Income to Needs Ratio		-0.16 (0.52)		0.45* (0.18)
Child Gender		-1.57* (0.62)		-0.46* (0.22)
Child Ethnicity African American		1.32+ (0.69)		0.45+ (0.24)
Child Age		1.53* (0.61)		0.94* (0.21)

** p<0.05 + p<0.10*
Note: Unstandardized coefficients

In order to examine the separate predictive strength of self-regulation and the covariates on both Elision and Print Awareness, two linear regression analyses were performed.

The predicted childhood literacy score can be represented by the following regression equation:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e$$

X_1 represents the child's self-regulation (effortful control and executive function) score, X_2 represents the child's family income-to-needs ratio, X_3 represents the child's gender, X_4 represents the child's race-ethnicity, X_5 represents the child's age, and *e* represents residual error. For Elision (Model 1), Y represents the child's predicted Elision score. For Print Awareness (Model 2), Y represents the child's predicted Print Awareness score.

Model 1 reveals that all but two of the factors are statistically significant at the 0.05 level. Race-ethnicity (β=0.17, p=0.06) shows only a strong trend in predicting strength on Elision

while income-to-needs ratio (β=-0.29, p=0.77) implies a lack of correlation with Elision scores. Results show that being female equates to on average a higher Elision score. Self-regulation showed a significant predicting strength on Elision (β=0.24, p=0.03). Unsurprisingly, child age (in years) and self-regulation scores also showed a significant positive predicting strength on Elision (β=0.26, p=0.01).

When only effortful control and executive function were used as predictors, the self-regulation predicting effect on Elision rose (β=0.37, p=0.00). This difference implies that self-regulation confounds the predictive strength of the covariates when analyzed alone.

Figure 2 shows the unstandardized coefficients which does not allow comparison between predictors. To see any discrepancies, we examine the variables with standardized units. This compares a standard deviation change in the predictors to standard deviation changes in early literacy, thus allowing comparison between the independent variables.

When comparing the standardized coefficients, we see that self-regulation (β=0.24) is a strong predictor of literacy in comparison to the other covariates. Only child age (β=0.26) was a better predictor.

Model 2 shows the same trend as Model 1 in terms of significant predictors with one major exception. For Print Awareness, income-to-needs ratio (β=0.20, p=0.02) is a statistically significant predictor at the 0.05 level whereas for Elision, income-to-needs ratio was not even statistically significant at the 0.15 level. Self-regulation score (β=0.26, p=0.01), gender (β=-0.17, p=0.03), and age (β=0.39, p=0.00) all were significant predictors of Print Awareness. Race-ethnicity (β=0.15, p=0.06) was only a marginally strong predictor indicating, in parallel with Model 1, that there is just a strong trend in predicting strength on Print Awareness.

Analyzing solely the predicting strength of effortful control and executive function on Print Awareness (β=0.52, p=0.00), the outcome was once again similar to Model 1. The standardized coefficient dropped significantly when controlling for the covariates, implying the covariates are confounded in self-regulation. Age (β=0.39) once again is a more powerful predictor than self-regulation (β=0.26). However, the other covariates had lower predicting strength than self-regulation.

9. Discussion

The results indicate support of our first hypothesis. In Model 1 and Model 2, Elision and Print Awareness both showed strong correlations with self-regulation. Self-regulation had approximately one third of a standard deviation change for every unit change in Elision, and one half standard deviation change for every unit change in Print Awareness.

Results also provide compelling support for our second hypothesis. When controlling for the covariates, self-regulation was the dominant predictor of preliteracy in comparison to all the covariates except age. As we hypothesized, age was a stronger predictor of preliteracy than self-regulation. This suggests that there is a strong relationship between early childhood literacy and self-regulation.

Not surprisingly, the covariates too exhibit correlations with early literacy. As children age, their Elision and Print Awareness capabilities increase. Though income-to-needs showed predictive strength on Print Awareness, it was not a significant predictor on Elision. Child Ethnicity showed a negative trend with early literacy (0=African American, 1=other). African Americans accounted for almost 80% of the participants.

Child gender was a significant predictor of early literacy abilities. Males generally performed less well on preliteracy activities than did their female counterparts (0=Female,

1=Male). There was a greater difference between male and female scores in Elision than in Print Awareness. Inspecting the regression coefficient for gender suggests that females, on average, correctly answered one-and-a-half items more than males did on Elision. Similarly, females, on average, correctly answered half an item more than males did on Print Awareness.

Results of this study show surprising connections between self-regulation and early literacy skills.

As stated before, self-regulation and early childhood literacy have a positive direct relationship. A key note must be stressed here. We cannot remark upon which direction the causation occurs, or if any causation occurs at all. The case may be that another factor, for example child age, causes increased self-regulation and early childhood literacy. However, the data does imply that self-regulation and early childhood literacy are not just coincidentally linked.

Curiously, while income-to-needs held very little predicting strength on Elision, it was a significant predictor of Print Awareness. Further research is needed to examine this difference. To explain this phenomenon, we theorize that Print Awareness may be more acutely affected by socio-economic status while Elision is a skill acquired from experience, innate ability, or some other factor unrelated to the family's financial situation.

Results indicate that being African American is correlated with higher literacy scores compared to being non-African American. Since our sample was largely made up of African Americans and Hispanics, we cannot project this correlation onto the general public. However, we speculate that English is the first language in African American families, perhaps resulting in the children having greater mastery of English. Other children, such as Hispanics, may not speak

English at home. This theory would explain why African American children in this study tended to have higher Elision and Print Awareness scores. Further research may verify our suppositions.

The projection of these findings is limited by the urban sample-size. Since we only drew participants from the Chicago school region, these findings may not be consistent with those of non-urban centers.

These findings could also be better supported by a larger sample. Though the number of participants was by no means inadequate, a larger number of participants can always give the study more statistical power, and strengthen the study.

This study is only an investigation of correlations. While we did control for covariates, other factors must also be taken into account before declaring a definitive causation. Future research may follow this line to see whether either self-regulation or early childhood preliteracy causes the other. Identifying the cause will make child behavioral and emotional intervention more successful. In fact, current research has made steps in intervention of young children and reducing child disregulation (Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Metzger, M. W., & Solomon, B., 2009).

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