

# Behavioral Self-Regulation and Relations to Emergent Academic Skills among Children in Germany and Iceland

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The present study investigated a direct assessment of behavioral self-regulation (the Head-Toes-Knees- Shoulders; HTKS) and its contribution to early academic achievement among young children in Germany and Iceland. The authors examined the psychometric properties and construct validity of the HTKS, investigated gender differences in young children's behavioral self-regulation, and explored relations between the HTKS and a teacher report of behavioral self-regulation (the Child Behavior Rating Scale; CBRS) and emerging academic skills. Findings supported the construct validity of the HTKS when used with young German and Icelandic children. Multilevel analyses revealed gender differences, particularly on the CBRS teacher-rated measure. Finally, higher levels of behavioral self-regulation were related to higher academic skills after important background variables were controlled, although some cross-cultural differences in the predictive utility of the HTKS and CBRS were observed. Overall, these results extend prior psychometric work on the HTKS to samples of young European children and support the importance of understanding of the role behavioral self-regulation in young children's development.

## Introduction

In the past decade, education policies in Europe, coordinated by the European Union, have called for an increased understanding of self-regulation in early childhood, with the ultimate goal of increasing equity in education (Leseman, 2009). This goal is substantiated by a growing body of international research showing that self-regulation is a critical

component of school readiness and an important predictor of academic and social competence (e.g., Blair & Razza, 2007; Duckworth & Seligman, 2005; Gestsdottir & Lerner, 2007; McClelland et al., 2007; Suchodoletz, Trommsdorff, Heikamp, Wieber, & Gollwitzer, 2009; Wanless, McClelland, Acock, et al., 2011). However, research on this topic is still in its infancy in Europe and the cultural appropriateness of measures of self-regulation, which have

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been developed and used in other cultural contexts, has not yet been examined. In this paper, we extend prior work by focusing on measuring behavioral self-regulation and examining the relations between behavioral self-regulation and emerging academic skills among children in two European countries, Germany and Iceland.

### **Developmental foundations for behavioral self-regulation in early childhood**

Self-regulation is a comprehensive construct that describes people's capacities to regulate emotions, cognition, and behaviors (Calkins, 2007). Although there is considerable debate about terminology, behavioral self-regulation refers to the behavioral manifestation of the integration of attention, working memory, and inhibitory control (Wanless, McClelland, Tominey, & Acock, 2011c), which stem from executive functions (EF). In practice, children with strong behavioral self-regulation are better able to apply social rules and standards as guidelines for their behavior and, as such, are more functional in all contexts (Vohs & Baumeister, 2004). Children's abilities to regulate mental processes and control behaviors improve dramatically in the first few years of life making this a sensitive period for growth (Best & Miller, 2010; Blair, 2002; Center on the Developing Child at Harvard University, 2011; Diamond, 2002; Garon, Bryson, & Smith, 2008; Vaszonyi & Huang, 2010). The rapid development of behavioral self-regulation in the early childhood years can be seen partly as a result of physiological maturation and changes to structural organization in the prefrontal brain regions (Best & Miller, 2010; Blair, 2002; Center on the Developing Child at Harvard University, 2011). As such, there are age differences over the preschool period in children's ability to regulate behavior (Garon et al.,

2008). In one study, 5-year-olds worked longer on tasks than did 3-year-olds, and reported less difficulty waiting and maintaining their focus, whereas 3-year-olds focused longer on distractions (e.g., toys) (Kalpidou, Power, Cherry, & Gottfried, 2004). Similarly, working memory becomes more accurate during this age period and children show increased inhibitory control (Blair & Razza, 2007; Carlson, 2005; Tominey & McClelland, 2011). Results from a recent longitudinal study indicated a positive rate of change in self-regulation over a 6-year period independent of children's initial level at 4.5 years (Vaszonyi & Huang, 2010). Studies using a recently developed direct behavioral measure (the Head-Toes-Knees-Shoulders task, HTKS), which requires the integration of these cognitive processes, have found similar age differences; older participants achieved higher scores than did younger children (e.g., Cameron Ponitz et al., 2008) and significant gains in HTKS scores across preschool and kindergarten have been observed (e.g., Cameron Ponitz, McClelland, Matthews, & Morrison, 2009; McClelland et al., 2007; Wanless, McClelland, Tominey, et al., 2011). However, there is wide variability in the development of these skills and research suggests substantial individual differences at school entry (e.g., Blair & Razza, 2007; McClelland, Acock, & Morrison, 2006; Sektnan, McClelland, Acock, & Morrison, 2010). Moreover, these individual differences seem to be relatively stable over time (Vaszonyi & Huang, 2010). Thus, the early childhood years are an especially important time period to assess behavioral self-regulation with a measure that is reliable, valid, and culturally appropriate.

### **Cultural variations in development**

Differing cultural traditions, values, and structures support the notion that there

may be cultural variations in behavioral self-regulation and how this construct is measured. Although culture and country are not synonymous (Rogoff, 2003), we use country in the present study to represent participants' shared national identity and refer to this as their culture. Cultural traditions and values can influence teachers' expectations and perceptions of children's self-regulatory behaviors (e.g., Zimmermann, Khoury, Vega, Gil, & Warheit, 1995). Furthermore, child attributes (such as cultural background) relate to teachers' perceptions of children. For example, in one study, teachers rated children's behavior more positively whose cultural background matched with their own (Saft & Pianta, 2001). This suggests that a "fit" based on cultural background may reflect culture-specific definitions of expectations for children's behavior.

Previous research on the cultural context of development has largely focused on comparing the level of a certain variable across different cultures (Cole & Packer, 2011). More recently, however, it has been suggested that the culturally specific relationships between variables may be another important unit of analysis (Raver, 2004; Wanless, McClelland, Acock, et al., 2011). The relations between behavioral self-regulation and academic outcomes, for example, have been substantiated by research with culturally diverse samples (e.g., Raver et al., 2011; Rimm-Kaufman & Wanless, in press; Smith-Donald, Raver, Hayes, & Richardson, 2007; Trommsdorff, 2009; Wanless, McClelland, Acock, et al., 2011). Therefore, the goal of the current paper is to assess whether measures developed with U.S. samples can validly be used with German and Icelandic samples to capture relations between behavioral self-regulation and early academic achievement in each cultural context.

## **The role of behavioral self-regulation in academic achievement**

Behavioral self-regulation skills are particularly relevant in school contexts as they enable children to adapt successfully to classroom demands (e.g., follow classroom rules, pay attention to instructions) and engage in learning opportunities. Several recent studies have related individual cognitive components of behavioral self-regulation (i.e., attention, working memory, and inhibitory control) to academic outcomes. Blair and Razza (2007), for example, found that the ability to focus attention predicted children's academic achievement. Strong working memory has also been shown to relate to better reading and math skills (e.g., Gathercole & Alloway, 2008) and individual differences in inhibitory control account for substantial variability in children's academic outcomes (e.g., Clark, Pritchard, & Woodward, 2010). However, many demands children face in educational settings require these multiple cognitive skills working together (Blair, 2002). There is also strong evidence connecting the integration of these skills (i.e., behavioral self-regulation) with emergent academic achievement (e.g., Connor et al., 2010; McClelland et al., 2007; McClelland, Morrison, & Holmes, 2000; Suchodoletz et al., 2009; Wanless, McClelland, Acock, et al., 2011). Moreover, increasing evidence suggests that behavioral self-regulation skills are malleable. For example, a number of studies have demonstrated that children receiving interventions focusing on behavioral self-regulation show significant gains in behavioral self-regulation skills and increased academic achievement (see e.g., Connor et al., 2010; Diamond, Barnett, Thomas, & Munro, 2007; Raver et al., 2011; Tominey & McClelland, 2011). These results are promising, as they provide preliminary evidence for the plasticity of

behavioral self-regulation across the preschool and early school years and provide an opportunity for the successful implementation of teaching methods and interventions that support behavioral self-regulation.

### **Gender differences in behavioral self-regulation**

Recent research documents a growing gender gap in academic achievement where girls outperform boys in childhood (Morrison & Cooney, 2002) and adolescence in the U.S. and other countries (Duckworth & Seligman, 2006; Halldorsson & Olafsson, 2009). In the search for an explanation, differences in behavioral self-regulation between girls and boys have been discussed as a potential contributor to these achievement disparities. Indeed, mounting evidence points to gender differences in behavioral self-regulation among kindergarten children (e.g., Matthews, Cameron Ponitz, & Morrison, 2009), elementary school children (e.g., Cameron Ponitz, Rimm-Kaufman, Brock, & Nathanson, 2009; Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006), and adolescents (e.g., Duckworth & Seligman, 2006) with girls outperforming boys. In a German sample, however, gender differences were only found according to mother reports but not on a direct measure of behavioral self-regulation (Suchodoletz, Trommsdorff, & Heikamp, 2011). To date, there have been no studies of possible gender differences in behavioral self-regulation skills among Icelandic children. These findings point to the importance of investigating whether gender differences in behavioral self-regulation emerge across cultural settings and how they are reflected in children's early academic skills.

### **Measuring behavioral self-regulation**

A number of different methods have been used to measure behavioral self-regulation in young children, including self-reports, direct assessments, and others' reports of children's regulation (for a review of measurement see McClelland et al., 2010). In research with young children, caregiver and/or teacher reports and direct observations are the most common assessment methods (McClelland et al., 2010; Smith-Donald et al., 2007). Teachers are an important source of information and have valuable perspectives on children's behavior in classroom settings. Compared to a direct measure, teachers typically base their ratings on many observations of behaviors over an extended period of time and in many different contexts. Several studies have documented positive associations between teacher-ratings and directly measured behavioral self-regulation (e.g., McClelland et al., 2007; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). However, although teacher-ratings provide useful information, possible biases may be introduced (Mashburn, Hamre, Downer, & Pianta, 2006; Rothbart, Ahadi, Hersey, & Fisher, 2001). For example, teachers' personal attributes may color their subjective evaluations (Rimm-Kaufman, Pianta, & Cox, 2000) and their expectations about children's behavior may affect their judgments about whether a certain behavior has occurred more often than is appropriate for children of a particular age. In addition, cultural values and perceptions of children may impact teacher-ratings (e.g., Heine, Lehman, Peng, & Greenholtz, 2002; Weisz, Chaiyasit, Weiss, Eastman, & Jackson, 1995). Thus, teachers in one culture may have different expectations than teachers in another culture, which has been referred to as "the reference group effect" (e.g., Heine et al., 2002).

Recently, direct measures have become common in the assessment of behavioral self-regulation with young children (e.g., Garon et al., 2008; Kochanska, Coy, & Murray, 2001; McIntyre, Blacher, & Baker, 2006). Many direct measures, however, are not easy to apply in school settings as they were designed for the laboratory. Recently, lab-based self-regulation tasks have been adapted for field research, including the Preschool Self-regulation Assessment (PSRA; Smith-Donald et al., 2007), and validated with culturally diverse samples in the U.S. (e.g., Raver et al., 2011; Smith-Donald et al., 2007). In general, however, ceiling effects for 5-year-olds have been identified on the majority of regulatory tasks developed for younger children (Rothbart, Posner, & Kieras, 2006).

The Head-Toes-Knees-Shoulders task (HTKS) was developed as a direct measure of behavioral self-regulation for preschoolers and early elementary school-aged children (Cameron Ponitz et al., 2008; Cameron Ponitz, McClelland, et al., 2009). The task produced valid scores on behavioral self-regulation in different cultural contexts. In U.S. samples, positive correlations have been shown between HTKS scores and parent ratings of attention and inhibitory control (e.g., Cameron Ponitz, McClelland, et al., 2009). In China, positive correlations were found with directly measured attention and working memory skills (Lan, Legare, Cameron Ponitz, Li, & Morrison, 2011). Furthermore, research using the HTKS demonstrated predictive validity such that higher behavioral self-regulation predicted higher mathematics, vocabulary, and early literacy scores in U.S. (e.g., Cameron Ponitz, McClelland, et al., 2009; McClelland et al., 2007) and Asian samples (e.g., Taiwan, China, and South Korea; Wanless, McClelland, Acock, et al., 2011). Finally, reliability assessments of the

measure have shown excellent inter-rater reliability (Cameron Ponitz et al., 2008; Connor et al., 2010). The HTKS might be especially useful because it is quick to administer, requires few materials, can be easily used in classroom settings, and approximates behavior that children exhibit in classroom settings (e.g., having to inhibit shouting out an answer and raising a hand instead) (Cameron Ponitz et al., 2008; Cameron Ponitz, McClelland, et al., 2009). However, no studies have systematically examined the use of the HTKS in multiple European samples.

Given the different strengths of teacher reports and direct assessments, using both types of measures may be most informative when assessing young children's behavioral self-regulation, especially in cultures where there is limited research on children's behavioral self-regulation skills. However, commonly used measures have often been developed and validated in samples outside of Europe. Raver (2004) argued that meaningful conclusions from data collected with a certain assessment can only be drawn if measurement equivalence has been established, i.e., if an assessment tool measures a given developmental construct in the same way across samples from diverse (cultural) backgrounds. Furthermore, worldwide changes in the cultural make-up of societies substantiate the need to investigate the appropriateness of measures that have been developed with a group in which one cultural background predominates for potential use among individuals from different cultural backgrounds (Allen & Walsh, 2000). In order to meet the growing need of European policy makers, educators, and researchers for tools that produce valid and reliable ratings of children's behavioral self-regulation, the present study explored the appropriateness of the HTKS as an

assessment of behavioral self-regulation in young children from Germany and Iceland.

### **The present study**

The present study examined the cultural appropriateness of the HTKS as a quick and easy-to-administer direct measure of behavior self-regulation by addressing three aims: (1) to examine the psychometric properties and construct validity of the HTKS in Germany and Iceland, (2) to investigate gender differences in young children's behavioral self-regulation in these two European countries, and (3) to explore the links between behavioral self-regulation and academic achievement in Germany and Iceland. With respect to the construct validity of the HTKS, we hypothesized that HTKS scores would (a) reflect variability in behavioral self-regulation among German and Icelandic children, (b) vary by child age with older children scoring higher than younger children, and (c) relate positively to teacher-ratings of classroom behavioral self-regulation, as has been found with previous research in U.S. (e.g., Cameron Ponitz et al., 2008; Cameron Ponitz, McClelland, et al., 2009) and Asian samples (e.g., Wanless, McClelland, Acock, et al., 2011). It was unclear whether gender differences could be expected in behavioral self-regulation among German and Icelandic children because of mixed findings of previous research. However, based on some research favoring girls on behavioral self-regulation and academic skills (e.g., Duckworth & Seligman, 2006; Halldorsson & Olafsson, 2009; Matthews et al., 2009), it was plausible that girls would outperform boys on both measures of behavioral self-regulation (i.e., HTKS and teacher-rating). Finally, based on previous studies (e.g., Blair & Razza, 2007; Connor et al., 2010; McClelland et al., 2007; Wanless, McClelland, Acock, et al., 2011), we hypothesized that there would be positive

relations between behavioral self-regulation scores (i.e., HTKS and teacher-rating) and emergent academic skills, which would also speak to the predictive validity of the HTKS. In these analyses, we controlled for several variables associated with academic skill formation: child age, gender, and maternal education.

### **Method**

#### ***Participants***

The data for the present research were collected from children, parents, and teachers in Germany and Iceland. As a whole, 412 children (201 girls), 318 parents and one teacher from each of the 36 classrooms participated (see Table 1 for descriptive statistics). The average age of the children was 65 months. Although the age range was similar among participants from Germany and Iceland (ranging from 46 to 81 months in the German sample and from 49 to 86 months in the overall Icelandic sample), the early childhood education system differed in terms of the level of schooling for children of this age. In Germany, all the children were either in their second or third year of preschool. Note that children in Germany remain in preschool (which is called "kindergarten" in Germany) for three years until they enter the first grade of compulsory school around the age of six. In Iceland, children in the targeted age group attended either preschool or the first year of compulsory school. Thus, in Iceland two samples of children participated: sample 1 (age range between 49 and 62 months) which will be referred to as preschool (which is called "playschool" in Iceland) and sample 2 (age range between 73 and 86 months) which will be referred to as 1st grade (the first year of compulsory school). Academic outcomes differed

Two-thirds of the mothers (67%) had completed a university-level degree. There was an average of 28 children that participated in each of the four elementary schools.

### ***Procedure***

Data on behavioral self-regulation, academic skills, and family background were collected from children, teachers, and parents in each country. All measures (including instructions) in Germany were in German and all measures (including instructions) in Iceland were in Icelandic. Identical measures of behavioral self-regulation were used for the samples in both countries and included the Head-Toes-Knees-Shoulders task (HTKS) and a questionnaire in which the children's teachers rated their behavioral self-regulation in the classroom setting (Child Behavior Rating Scale; CBRS). To assess children's academic achievement, different measures were chosen to reflect the respective focus in early childhood education and children's early learning environment in Germany and Iceland. In the German sample, measures of academic achievement included measures of vocabulary and letter knowledge. A math assessment was additionally included in Germany as children have some informal math preparation in preschool, whereas in Iceland, preschool-education does not typically include math instruction. Thus, the Icelandic preschool sample, which had not started formal reading instruction, received three measures of pre-reading skills (vocabulary, letter knowledge, and phonological awareness). For the first graders, three measures of pre-reading skills (vocabulary, letter knowledge, and phonological awareness) and two measures of early literacy (single word reading and reading comprehension) were administered.

Although there were differences in achievement measures, the procedures of data collection were identical in all samples: assessments were given in two sessions, each lasting between 20 and 30 min. All participants were tested individually in a quiet area in their (pre)school. Due to practical constraints (such as recruitment procedure of (pre)schools and families, (pre)school schedules, etc.), there were however different data collection timelines. In Germany, all measures were administered in the middle of the preschool year. Two examiners collected the data in Germany. In Iceland, all measures were administered near the end of the academic year by two examiners for each sample. All data collectors attended training prior to data collection that included watching trained research assistants giving the measures to children, practicing with pilot children who were not included in the sample, and training of scoring procedures.

### **Measures**

#### ***Background questions***

In both countries, parents completed questionnaires asking about various background variables. Maternal education was coded into six levels in each country, ranging from "Has not completed compulsory education" (1) to "A graduate university-level degree" (6). Descriptive statistics for mothers' education are provided in Table 1.

#### ***Direct measure of behavioral self-regulation***

The Head-Toes-Knees-Shoulders task (HTKS) was used as a direct measure of each child's behavioral self-regulation (Cameron Ponitz et al., 2008; Cameron Ponitz, McClelland, et al., 2009). Children were given the task in either German or Icelandic; instructions were translated and

back-translated by professors who were native speakers in German or Icelandic and also native or fluent in English. In recent research, scores showed reliability and validity with preschoolers and early elementary students (e.g., Cameron Ponitz et al., 2008; Cameron Ponitz, McClelland, et al., 2009; Connor et al., 2010; McClelland et al., 2007; Wanless, McClelland, Acock, et al., 2011). In the task, children need to focus on the task and the instructions (attention), remember multiple rules (working memory), and stop a dominant response and replace it with the opposite response (inhibitory control). The first 10 items (the Head-to-Toes Task, HTT, which was used for the Icelandic preschool sample) included two types of paired commands (e.g., “touch your head” and “touch your toes”). In the second part, two new paired commands were added (e.g., “touch your shoulders” and “touch your knees”). The HTKS includes both parts with 10 commands each. All items were given in a consistent order. Each part of the task was introduced with practice items. In the task, the child was asked to do the opposite of what the examiner says. The items were scored with 0 for an incorrect response, 1 for a self-correct (initially responding incorrectly, but then correcting him/herself), or a 2 for a correct response. Total scores on the HTT (only the first 10 items) range from 0 to 20 points and for HTKS (total of 20 items) from 0 to 40 points. Higher scores indicated higher levels of behavioral self-regulation. In the present study, for all samples, examiners scored different children, so traditional methods of inter-rater reliability could not be calculated. However, there were no significant differences between examiners in children’s HTKS scores in the German sample, after controlling for child age ( $F(3,185) = 2.60, p > .05$ ), or in the Icelandic preschool and first grade samples after controlling for child age and data collection site ( $F(1,107) = 1.78, p$

$> .05$  and  $F(3,185) = 2.60, p > .05$ , respectively).

### ***Teachers’ assessment of classroom behavioral self-regulation***

In Germany and Iceland, teachers used the Child Behavior Rating Scale (CBRS) to assess each child’s behavioral self-regulation in the classroom that requires the demonstration of working memory, attention, and inhibitory control (Bronson, Tivnan, & Seppanen, 1995). In a recent study (Matthews et al., 2009), factor analyses identified 10 items within this measure that assess the child’s self-regulatory behaviors in the classroom. These 10 items have been found in previous research to have strong inter-item reliability, and relations to other measures of behavioral self-regulation and academic outcomes (see e.g., Cameron Ponitz, Rimm-Kaufman, et al., 2009; Matthews et al., 2009; Wanless, McClelland, Acock, et al., 2011). To determine whether the behavioral self-regulation factor was present in all three samples, factor analyses with a promax rotation were conducted. In each of the samples, the same 10-item behavioral self-regulation factor emerged. Results were consistent with previous research (see e.g., Cameron Ponitz, McClelland, et al., 2009; Matthews et al., 2009; Wanless, McClelland, Acock, et al., 2011; Wanless, McClelland, Tominey, et al., 2011). Confirmatory factor analyses were then run with these 10 items and the patterns of results were consistent. All 10 items loaded highly on the classroom behavioral self-regulation factor, with most loadings being greater than .70. Sample items include, “Sees own errors on tasks and corrects them” and “Observes rules and follows directions without requiring repeated reminders”. Items were rated on a 5-point Likert scale from 1 (never) to 5 (always), where higher scores demonstrate higher



levels of behavioral self-regulation. The measure was translated and back-translated by professors who were native speakers in German or Icelandic and also native or fluent in English. Internal consistency of the 10-item behavioral self-regulation scale was good among German (Cronbach's alpha = .92) and Icelandic (Cronbach's alpha = .95) participants.

### *Academic skills in Germany*

Vocabulary, reading, and mathematics subtests from the achievement subscale of the Kaufman Assessment Battery for Children – German Version (K-ABC – II; Kaufman, Kaufman, Melchers, & Preuss, 2006) were used to assess the emerging academic skills of the German participants. The K-ABC – II is a widely used, individually administered test for assessing cognitive processing skills in children including an achievement scale which measures children's acquired knowledge and applied skills. It has demonstrated strong reliability and validity (Kaufman et al., 2006).

Letter knowledge was assessed using the first items of the reading subtest where children were shown printed letters and asked to identify them. First, all children were asked to identify five upper case letters (A, T, D, N, E). Children who were able to identify at least one of those letters were subsequently shown five lower case letters (m, p, f, r, d). In the vocabulary subtest, children were asked to supply the name or word for a picture (e.g., window, door knob). The mathematics subtest assessed children's emerging ability to count, to compare quantities, and to solve first arithmetic problems. Tasks were presented by showing children colored pictures of a family visiting the zoo (e.g., "There are six elephants in the zoo. If four of them left how many elephants would remain there?"). In

all three achievement subtests, the total scores represented the total number of correct answers.

### *Academic skills in Iceland*

Three assessments of pre-reading skills (phonological awareness, vocabulary, and letter knowledge) were used to assess the academic skills of the Icelandic participants. Additionally, Icelandic children in the 1st grade sample received a measure of single-word reading and reading comprehension. The preschool sample of children in Iceland was given a standardized test of phonological awareness intended for preschool children (Símonardóttir et al., 2002). The test is a part of a screening battery for reading difficulties and includes seven subtests each measuring different aspects of young children's phonological skills. The test is widely used in preschools in Iceland and has demonstrated good reliability and predictive validity (Björnsdóttir, Símonardóttir, & Einarisdóttir, 2003). The 1st grade sample in Iceland was given a modified version of an initial sound production task to assess phonological awareness. In this task the children were asked to say the first sound of monosyllabic words that start either with a consonant cluster or a single consonant (e.g. the/c/sound in "cat" or the/s/ sound in "spy"). The task was originally used by Caravolas and Bruck (1993) (see also Caravolas & Landerl, 2010). The internal consistency of this test was high (Cronbach's alpha = .87) and correlated strongly with other literacy measures used in this study. In both tasks, higher scores represented a higher level of phonological skills.

Vocabulary was assessed using a test modeled after the widely used Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007) and is composed of 14 blocks

of 12 words each, plus three training items. The total score for each child was a raw score and represented the total number of correct answers. The internal consistency of the test was high (split-half .98 and Cronbach's alpha = .93–.97) and no children scored at floor or ceiling.

Letter knowledge was assessed by showing the children one printed letter at a time in a random order and asking them to identify it. Both age groups were asked to identify 28 of the 32 letters of the Icelandic alphabet. One point was given for each correct response.

First-grade children were also given a measure of single-word reading that contained 48 words of varying length, frequency, and orthographic complexity. The total score represented the total number of words read correctly. In the present study, the internal consistency of this test was high (Cronbach's alpha = .98) and there were no indications of either floor or ceiling effects in the children's responses. There was a high correlation between scores on single-word reading and other literacy measures used in this study.

In addition, in first grade, reading comprehension was assessed with a test consisting of five passages of varying length and difficulty. The internal consistency of this test was high (Cronbach's alpha = .92) and it showed significant correlations with other theoretically related measures used in this study, such as single-word reading and vocabulary.

### **Analytic strategy**

Our analytic approach examined the data within each sample so that the culturally driven variations between cultures could be identified. Specifically, we analyzed the samples separately because they were collected in qualitatively different

contexts both defined by country and by level of schooling. By keeping the samples separate, we were able to detect all differences in relations between covariates and outcomes, which may have been washed out in an analysis that combined all of the data and included "country" as a covariate, for example (Wanless, Larsen, & Son, 2011).

For the two behavioral self-regulation measures, there was some missing data on one measure in the German sample (17% on the CBRs) but very little in the Icelandic samples (see Table 1). In both countries, there was no missing data on child age, gender, but some missing data on mothers' education (30% in Germany and 22–26% in Iceland). The majority of academic outcomes had less than 5% missing data, with the exception of 12% missing on phonological awareness in the Icelandic preschool sample. Analyses of the patterns of missingness, including correlations and logistic regressions, suggested that missingness was not significantly related to other variables in our dataset. In other words, there was no evidence that the patterns of missingness were systematic. Although there is no definitive way to test for the assumption of missing completely at random (MCAR), the lack of significant predictors of missingness suggests this is the case. In our analyses, missing data was handled with Bayesian estimation as it is robust to small samples.

We began our analyses by examining descriptive statistics using SPSS for Windows, Version 17 (SPSS for Windows, Rel. 17.0.0., 2009). Multi-level analyses were conducted using Mplus Version 6.1 (Muthén & Muthén, 2009). Multi-level models were used to account for the nested structure of the data (children nested in classrooms) because intraclass correlations (ICC) for each sample ranged from .00 to

.18 based on unconditional models of both measures of behavioral self-regulation, and from .00 to .16 for unconditional models of academic outcomes. Specifically, HTKS ICCs were .08 in Germany, .00 in the Icelandic preschool sample, and .18 in the Icelandic 1st grade sample. For the CBRS, ICCs were

.09 in Germany, .07 in the Icelandic preschool sample, and .03 in the Icelandic 1st grade sample. These ICCs indicated that treating the children in our study as independent would bias our standard errors. Therefore, multi-level modeling was used to adjust for this non-independence. After examining unconditional models, independent variables were added as fixed effects to look at average effects across all classrooms. The CBRS was group-mean centered to adjust for differences in teachers' own metrics for rating their students relative to the other children in the class. In these cases, the CBRS was group-mean centered at level 1 and a level-2 version of the CBRS was added to account for mean class differences. In all of our multi-level models, we used Bayesian estimation because of its ability to address non-normal outcomes and to deal with relatively few clusters (Muthén, 2010; Raudenbush & Bryk, 2002).

## Results

The present study had three goals: (1) to investigate the construct validity of a direct measure of behavioral self-regulation (HTKS) in Germany and Iceland; (2) to examine possible gender differences in behavioral self-regulation in each country, and; (3) to examine the relations between behavioral self-regulation and emergent academic skills in the two countries.

### *The variability of behavioral self-regulation as measured by the HTKS and relations to teachers' assessment of behavioral self-regulation and child age*

In each sample, the range and distribution of scores was investigated, as well as relations to the teachers' assessment of the children's behavioral self-regulation and their age. Table 2 summarizes the distribution of the children's HTKS scores for each sample. Children in the German sample scored on average above the halfway mark (20 points out of 40) on the HTKS (see Table 2). Score distribution indicated that most children ( $n = 176$ , 92.7%) scored within the task range; only a small proportion of the children did not receive a single point and scored at floor ( $n = 13$ , 6.8%) and only one child (0.5%) responded correctly to all the items and scored at ceiling level. Among the Icelandic preschool children who were administered the first 10 items of the HTKS (the HTT), the mean score was 13.4 points out of 20. In this group, a small proportion of the children ( $n = 12$ , 10.8%) scored at floor and eight children (7.2%) scored at ceiling. The mean score of the first graders in the Icelandic sample was 33.3 (out of 40). All the children in this group were able to respond correctly to one or more items and two (1.8%) scored at ceiling. The distribution of scores was negatively skewed in all samples, although skewness and kurtosis values did not exceed accepted levels for normal distributions (e.g., Kline, 2005). However, skewness (-1.82) and kurtosis (4.44) in the Icelandic 1st grade sample suggested a limited variability with many high-scoring children.

The HTKS captured more variability in children's behavioral self-regulation than the CBRS in the German sample and the Icelandic preschool sample but not in the Icelandic 1st grade sample (see Table 3). The relationship between the children's

scores on the HTKS and their scores on the teacher-ratings of behavioral self-regulation (CBRS) was examined to explore construct validity of the HTKS within each sample. Multi-level analyses with the HTKS as the outcome and the CBRS group-mean centered as a predictor along with child age were conducted. A significant positive relation was found between the two measures in the German sample (standardized  $\beta = .22$  ( $p < .01$ ), and in both age groups in the Icelandic sample (preschool: standardized  $\beta = .29$  ( $p < .01$ ); 1st grade: standardized  $\beta = .33$  ( $p < .01$ )). As expected, there was a positive correlation between HTKS scores and age among the German children ( $r$  (190) = .36 ( $p < .01$ ), as well as among the Icelandic preschoolers ( $r$  (111) = .21 ( $p < .05$ ) and first graders ( $r$  (111) = .19 ( $p < .05$ )). Overall, the HTKS had a broad distribution of scores, and was significantly and positively related to teacher-ratings of behavioral self-regulation in the classroom as well as to child age in the German and Icelandic samples.

### ***Gender differences in behavioral self-regulation***

The second research question examined gender differences on the two behavioral self-regulation measures (direct measure and teacher-rating). As reported in the previous section, age was significantly correlated with children's behavioral self-regulation. Due to the fact that in the German sample boys were significantly older than girls ( $M_{\text{boys}} = 63.36$  months,  $M_{\text{girls}} = 59.33$  months;  $t(188) = 3.95$ ,  $p < .01$ ), analyses addressing gender also controlled for child age to ensure that gender differences were not a function of age.

For scores on the HTKS, significant gender differences were found in the Icelandic 1st grade sample only ( $M_{\text{girls}} = 34.58$ ,  $M_{\text{boys}} = 32.37$ ;  $B = -2.21$ ,  $p < .01$ ) but

not in the German or in the Icelandic preschool samples ( $B_{\text{Germany}} = 1.35$ , ns;  $B_{\text{Iceland}} = -.42$ , ns) (see Table 3). For the teacher-ratings on the CBRS, when controlling for age, girls were rated higher than boys on behavioral self-regulation in all three samples (see Table 3; Germany:  $M_{\text{girls}} = 3.86$ ,  $M_{\text{boys}} = 3.68$ ,  $B = -.26$ ,  $p < .05$ ; Iceland – Preschool:  $M_{\text{girls}} = 4.19$ ,  $M_{\text{boys}} = 3.67$ ,  $B = -.61$ ,  $p < .01$ ; Iceland – 1st Grade:  $M_{\text{girls}} = 4.08$ ,  $M_{\text{boys}} = 3.56$ ,  $B = -.50$ ,  $p < .01$ ). Thus, gender differences in behavioral self-regulation were present when using the teachers' assessment but not for the younger children when using the HTKS direct measure.

### ***Relations between behavioral self-regulation and vocabulary, early mathematics, and emerging literacy***

Our last research question examined the relation between the two measures of behavioral self-regulation and early academic achievement. In the German sample, children with higher directly assessed behavioral self-regulation (HTKS) earned higher scores on all three academic outcome variables ( $ps < .01$ ,  $B_{\text{letter knowledge}} = .07$ ,  $B_{\text{vocabulary}} = .12$ ,  $B_{\text{math}} = .13$ ; see Table 4), controlling for child age, gender, and mother's level of education. In contrast, teacher-rated (CBRS) classroom behavioral self-regulation was significantly related only to mathematics ( $B = .89$ ,  $p < .05$ ). A slightly different pattern of results emerged for the Icelandic samples. In the preschool sample, both directly assessed (HTKS) and teacher-rated (CBRS) behavioral self-regulation, were significantly related with vocabulary scores (HTKS:  $B = .98$ ,  $p < .05$ , CBRS:  $B = 14.88$ ,  $p < .01$ ; see Table 5). For letter knowledge, neither behavioral self-regulation measure reached significance. For phonological awareness, significant relations were found only with the teacher-rated (CBRS) behavioral self-regulation ( $B =$

9.07,  $p < .05$ ). Among the Icelandic 1st grade children, the directly assessed behavioral self-regulation (HTKS) was significantly related to phonological awareness ( $B = .14$ ,  $p < .05$ ) and single word reading ( $B = .54$ ,  $p < .05$ ), whereas teacher-rated (CBRS) behavioral self-regulation was significantly related to all outcomes ( $ps < .05$ ,  $B_{\text{letter knowledge}} = 4.40$ ,  $B_{\text{vocabulary}} = 6.22$ ,  $B_{\text{phonological awareness}} = 2.50$ ,  $B_{\text{single word reading}} = 11.14$ ,  $B_{\text{reading comprehension}} = 4.71$ ; see Table 6). Specifically, children with higher teacher-rated behavioral self-regulation relative to their peers in their classroom earned higher achievement scores on all of the outcome measures. Effect sizes of the relations between behavioral self-regulation and academic outcomes were in the German sample  $.31_{\text{HTKS}} (.04_{\text{CBRS}})$  for letter knowledge,  $.42_{\text{HTKS}} (.09_{\text{CBRS}})$  for vocabulary, and  $.39_{\text{HTKS}} (.17_{\text{CBRS}})$  for math. In the Icelandic preschool sample, the effect sizes were  $.05_{\text{HTKS}} (.14_{\text{CBRS}})$  for letter knowledge,  $.32_{\text{HTKS}} (.56_{\text{CBRS}})$  for vocabulary, and  $.16_{\text{HTKS}} (.54_{\text{CBRS}})$  for phonological awareness. Finally, the effect sizes in the Icelandic 1st grade sample were  $.12_{\text{HTKS}} (.58_{\text{CBRS}})$  for letter knowledge,  $.14_{\text{HTKS}} (.29_{\text{CBRS}})$  for vocabulary,  $.20_{\text{HTKS}} (.50_{\text{CBRS}})$  for phonological awareness,  $.20_{\text{HTKS}} (.60_{\text{CBRS}})$  for single word reading, and  $.19_{\text{HTKS}} (.57_{\text{CBRS}})$  for reading comprehension.

## Discussion

Findings of the present study support the construct validity of a direct measure of behavioral self-regulation (the Head-Toes-Knees-Shoulders task; HTKS) when used with young German and Icelandic children. Specifically, children's scores in both countries showed variability that was consistent with developmental theory and previous research on behavioral self-regulation. Older children scored higher on the HTKS as compared to younger children,

and scores were positively related to teacher-ratings of class- room behavioral self-regulation. Gender differences in behavioral self-regulation were evident for all children on the teacher-rated measure, but only for the Icelandic first-grade children when using the direct measure, with girls showing higher scores than boys. Finally, higher HTKS scores were related to higher academic skills in Germany and in Iceland but there were also culturally specific relations between HTKS scores and academic outcomes.

### *An evaluation of a direct measure of behavioral self-regulation in Germany and Iceland*

The present study provides evidence for acceptable psychometric qualities of the HTKS when used with young children in Germany and Iceland. Overall, the scores demonstrated variability among participants in both countries. The results are consistent with other studies using the HTKS to assess children's behavioral self-regulation across different samples and countries. For example, McClelland et al. (2007) reported similar mean scores in a U.S. sample of preschool children who were comparable in age to the Icelandic preschool children. Similarly, Wanless, McClelland, Acock, et al. (2011) found mean HTKS scores in U.S. kindergarten children that were comparable in age to those in the German sample. The variability of behavioral self-regulation among German and Icelandic preschoolers measured by the HTKS was comparable to that found in U.S. preschool and kindergarten samples (e.g., Cameron Ponitz, McClelland, et al., 2009; Wanless, McClelland, Acock, et al., 2011). In addition, consistent with results from studies in the U.S. (e.g., Connor et al., 2010), the majority of children in the Icelandic first-grade sample scored near ceiling level. These results suggest that children in first

grade may be approaching a point at which the HTKS measure is becoming too easy, thereby limiting the ability of the measure to sufficiently capture individual variability in behavioral self-regulation. A more complex version of this measure may be appropriate to use in future research with children over the age of six years.

Previous studies have suggested that there may be culturally specific relations between HTKS scores and teacher-ratings of behavioral self-regulation in the classroom. For example, a study by Wanless, McClelland, Acock, et al. (2011) in four cultures found significant relations between the two types of assessments (HTKS and CBRS) among children from the U.S. and South Korea but not in Taiwan and China. In the present study, the correlations between HTKS scores and teacher-ratings in all three samples were similar to results found in U.S. samples (Matthews et al., 2009; McClelland et al., 2007; Wanless, McClelland, Tominey, et al., 2011). Cultural variations in teachers' perception of and expectations for children's behavior as compared to children's actual behavior may explain culturally specific relations between teacher ratings and direct measures of behavioral self-regulation (e.g., Wanless, McClelland, Acock, et al., 2011). Rogoff (2003) has argued that cultural beliefs and expectations about children and their development emerge on the basis of individuals' participation in cultural structures and practices when sharing common experience with people of one's cultural group. In line with this argument, research has demonstrated that teachers' attributes (e.g., cultural background) correlate with their reports of children's behavior in the classroom (see e.g., Howes, 2011; Saft & Pianta, 2001). However, the same may be true for the data collectors, whose cultural perspective may influence their perception of the child's behavior

during a direct assessment and which should be considered in future research. The varying degree to which the two measures of behavioral self-regulation are related when used in diverse cultures and the potential effects of teachers' and observers' cultural backgrounds on their ratings support the use of both types of measures in studies of behavioral self-regulation among young children.

Together, the findings of our study suggest that the HTKS may be appropriate for use with young children in Germany and Iceland. The results thus provide further evidence for the HTKS as a useful tool to assess behavioral self-regulation among children of different cultural backgrounds. The versions of the HTKS used in the current study, however, may be most appropriate for children under the age of six.

### ***The relation between behavioral self-regulation and gender***

Gender differences in behavioral self-regulation emerged in both countries, especially according to the teachers' assessment, where teachers rated the girls higher than the boys. The results extend previous research finding boys at a behavioral disadvantage at the beginning of formal schooling (e.g., Cameron Ponitz, Rimm-Kaufman, et al., 2009; Rimm-Kaufman et al., 2009). However, the present results could also suggest that boys have worse classroom behavior than their performance on the HTKS indicates because teachers rated boys' classroom behavioral self-regulation lower than their HTKS scores. Another explanation for the lower teacher evaluation of boys' behavioral self-regulation is teachers' different behavioral expectations for boys and girls (Cooper & Farran, 1988; for further discussion see Beaman, Wheldall, & Kemp, 2006). It is important to note, however, that

socialization processes teach girls and boys what is expected for each gender. The transmission of cultural gender schemes promotes children's gender identities and their gender role conceptions (Bronstein, 2006). Such schemes encourage behaviors that are seen as gender appropriate within one's cultural background (Brody & Hall, 2010; Bronstein, 2006). Thus, expectations for boys' and girls' behavior may vary according to the cultural background in which the child is embedded and influence both perceived and actual differences in the behavior self-regulation skills of boys and girls.

### ***The relation between behavioral self-regulation and emerging academic skills***

As hypothesized, there were significant positive relations between behavioral self-regulation and academic outcomes in both countries beyond the influence of important background variables, such as child age, gender, and maternal education. Within the German sample, only the HTKS, and not the CBRS, was related to all three outcome measures (vocabulary, letter knowledge, and math), whereas the teacher-rated classroom behavioral self-regulation (CBRS) related only to math. This result may reflect German kindergarten teachers' emphasis on promoting children's number knowledge more than letter knowledge. In the Icelandic preschool sample, both measures of behavioral self-regulation related to vocabulary and the CBRS additionally related to children's phonological awareness, but neither related to children's letter knowledge. One possible explanation is that in Iceland, like in Germany, instruction in letter knowledge does not typically start until the beginning of formal schooling. Thus, individual differences in letter knowledge at this early age may reflect other influences in the home or early child care settings rather than

children's ability to utilize the school learning environment. This explanation is supported by the moderately strong correlation between letter knowledge and mothers' education in the preschool sample ( $r = 0.40$ ), and the finding that teacher-rated behavioral self-regulation significantly related to letter knowledge in Grade 1, by which time formal instruction in letter knowledge has begun. Although the CBRS related to all the outcomes in the Icelandic first-grade sample (vocabulary, phonological awareness, letter knowledge, single-word reading, and reading comprehension), the HTKS was only related to phonological awareness. The lack of association between HTKS and many of the academic outcomes in this sample may be explained by the limited variability in HTKS scores. Therefore, future studies should consider using a more complex version of the HTKS with children over the age of six.

The lack of relations between the CBRS and vocabulary (and letter knowledge, respectively) among the German children raises a number of questions. It is possible that differences in the teacher/student ratios may have influenced the different patterns that were observed in the two countries; in Germany, preschool teachers have often more than 20 children, so they may have limited time with each child. This is true for the Icelandic teachers in first grade, but not for the preschool teachers, where the ratio is much lower. The differences between teacher's ratings in Germany and Iceland might also be explained by differences in teacher's training. In Germany, preschool teachers are required to have three years of vocational training. In Iceland, until recently, preschool and elementary school level teachers have been required to have three years of undergraduate training to acquire a teaching certificate, which has been increased to five years of university-level training (at the

undergraduate and graduate level). Such advanced training programs may focus more intensively on teacher's assessment skills. Thus, future research should control for teacher education level.

### **Practical implications**

Together with previous research using the HTKS (e.g., Cameron Ponitz, McClelland, et al., 2009; Connor et al., 2010; McClelland et al., 2007; Wanless, McClelland, Acock, et al., 2011; Wanless, McClelland, Tominey, et al., 2011), analyses from this paper make several contributions to research on children from diverse cultural backgrounds. First, across cultures, the task can easily be administered in field settings following a brief training process. Second, the findings suggest consistent predictive utility of the HTKS across multiple groups of children from various cultural backgrounds. And finally, although the relations between behavioral self-regulation and academic outcomes are likely to be bi-directional, associations between HTKS scores and student success were replicated across various studies with children of different ages, gender, and cultural backgrounds. Although preliminary, these findings suggest a possible universal pattern of relations between behavioral self-regulation and academic achievement across samples in the U.S., Asia, and Europe. In sum, the HTKS has the potential to be applied in pre-primary educational settings by regular staff and provide information about children's behavioral self-regulation skills that can be used for prevention and intervention.

The present study also adds to a growing body of research suggesting that promoting the development of behavioral self-regulation in preschool, kindergarten, and the first grades of formal schooling may help children be more successful in school

(see e.g., Blair & Razza, 2007; McClelland et al., 2007; Wanless, McClelland, Acock, et al., 2011). As recent research suggests, behavioral self-regulation is malleable, and can be supported in children who may be at risk for poor self-regulation (Raver et al., 2011; Tominey & McClelland, 2011). Trying to ensure that all children attend first grade with sufficient skills to pay attention, remember instructions, and inhibit behaviors, is particularly important when considering that the academic achievement gap that is present at school entry is likely to increase across childhood and into early adulthood (e.g., Heckman, 2006). In recent years, curricula, such as the "Tools of the Mind" preschool curricula program, have been used to help children learn to control attention, responses, or behaviors (Bodrova & Leong, 2006; Diamond et al., 2007).

### ***Limitations of the current study and next steps***

Although the current study provides important information regarding the measurement of behavioral self-regulation and its role in different cultures, some limitations should be noted. In this study, we did not control for the effects of intelligence, which is a strong predictor of academic achievement. It should be emphasized, however, that previous research has suggested that behavioral self-regulation predicts academic achievement beyond the effects of intelligence (Blair & Razza, 2007; McClelland et al., 2000, 2006; Suchodoletz et al., 2009; Welsh, Nix, Blair, Bierman, & Nelson, 2010).

Although mothers' level of education is a widely used indicator of socio-economic status, it does not provide a full picture of the children's family background. Future studies would benefit from using more comprehensive measures of family characteristics that are expected to relate to



self-regulation skills. In addition, in the present study, samples in each country were regionally representative of the relatively homogeneous population but, at the same time, Germany and Iceland, like most societies, are becoming increasingly diverse with recent demographic changes. Although we were not able to address this issue in the present study, previous research has revealed a complex relation between various family risk factors, such as ethnic minority status and low socioeconomic status (SES), and children's behavioral self-regulation (e.g., Howse, Lange, Farran, & Boyles, 2003; Rhoades, Greenberg, Lanza, & Blair, 2011; Sektnan et al., 2010; Wanless, McClelland, Tominey, et al., 2011). Thus, it is important that the current study will be replicated in Germany and Iceland with more diverse samples that will provide information about possible variations in the relations between behavioral self-regulation and school readiness within each culture.

Finally, the results of this study are based on a cross-sectional assessment and because of practical constraints, some differences in time points when data were collected. Differences in outcomes measured, however, were intentionally designed to reflect the culturally specific emphases of early childhood programs in each country. Longitudinal studies are needed to provide sufficient evidence about the development and implications of self-regulatory skills prior and during the first years of schooling. Future research should also work toward increased alignment of measures and time frames to increase the opportunity for cross-cultural comparison.

## Conclusions

This study demonstrated the complex relations between behavioral self-regulation and different types of academic outcomes. Overall, the findings demonstrate the

importance of behavioral self-regulation skills before and during the first year of formal schooling for academic achievement among German and Icelandic children. These findings add to a growing literature that has demonstrated the importance of self-regulatory skills for school success in the U.S. and Asia, and to the literature focusing on the role of behavior self-regulation in early childhood in Europe.

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Table 1

*Descriptive Statistics (Mean, Standard Deviation, Percent Missing) for all measures*

	Germany – Kindergarten ( <i>N</i> = 190)	Iceland – Preschool ( <i>N</i> = 111)	Iceland – First grade ( <i>N</i> = 111)
<b>Background variables</b>			
Child age	61.24	55.70	79.32
(in months)	(7.28)	(3.46)	(3.36)
	0.0%	0.0%	0.0%
Child gender	0.47	0.51	0.59
(1 = boys, 0 = girls)	(0.50)	(0.50)	(0.49)
	0.0%	0.0%	0.0%
Mothers' education	4.63	4.28	4.61
	(1.29)	(1.30)	(1.09)
	30.0%	21.6%	26.1%
<b>Behavioral Self-Regulation</b>			
HTKS Direct Assessment	25.29	13.41	33.27
	(11.29)	(6.30)	(5.52)
	0.0%	0.0%	0.01%
CBRS Teacher Rating	3.78	3.92	3.78
	(0.70)	(0.73)	(0.79)
	17.4%	3.6%	0.02%
<b>Academic variables</b>			
Pre-reading skills			
Phonological Awareness	--	49.85	5.61
	--	(12.22)	(3.92%)
	--	12.6%	0.0%

Table 1 continued

*Descriptive Statistics (Mean, Standard Deviation, Percent Missing) for all measures*

Vocabulary	18.20	87.41	119.93
	(3.21)	(19.57)	(17.17)
	0.5%	3.0%	0.9%
Letter Knowledge	2.34	12.41	23.16
	(2.57)	8.60	(6.02)
	0.5%	0.0%	0.0%
Early Literacy			
Single Word Reading	--	--	17.94
	--	--	(14.72)
	--	--	0.0%
Reading Comprehension	--	--	6.41
	--	--	(6.51)
	--	--	0.01%
Mathematics	12.46	--	--
	(3.72)	--	--
	0.0%	--	--

*Note.* HTKS is the Head Toes Knees Shoulders Task (Range = 0-40). The Head to Toes Task (HTT)

(Range = 0-20) was used for the Iceland – Preschool sample only.

Table 2

*Distribution of HTKS-scores*

	<i>ICCs</i>	Mean ( <i>SD</i> )	Range	Skewness	Kurtosis	% scoring at floor	% scoring at ceiling
Germany – Preschool (HTKS)	.08		0 – 40	-1.01	0.02	6.84	0.53
Boys ( <i>N</i> = 90)	.20	27.13 (10.86)	0 – 40	-1.38	1.23	7.78	1.11
Girls ( <i>N</i> = 100)	.00	23.64 (11.47)	0 – 39	-0.75	-0.56	6.00	0.00
Iceland – Preschool (HTT)	.00		0 – 20	-1.14	0.00	10.81	7.21
Boys ( <i>N</i> = 56)	.08	13.32 (6.18)	0 – 20	-1.22	0.36	12.50	5.36
Girls ( <i>N</i> = 55)	.01	13.50 (6.48)	0 – 20	-1.09	-0.20	9.09	9.09
Iceland – First Grade (HTKS)	.18		8 – 40	-1.82	4.44	0.00	1.81
Boys ( <i>N</i> = 65)	.29	32.27 (6.17)	8 – 40	-1.61	3.33	0.00	1.54
Girls ( <i>N</i> = 46)	.16	34.57 (4.13)	18 – 40	-1.90	5.56	0.00	2.17

*Note.* HTKS is the Head Toes Knees Shoulders Task (Range = 0-40). The Head to Toes Task (HTT) (Range = 0-20) was used for the Iceland – Preschool sample only. *SD* = Standard Deviation. *ICC* is the intraclass correlation coefficient.

Table 3

*Multi-level models of gender and behavioral self-regulation controlling for child age*

Dependent Variable: Behavioral Self-Regulation					
		Direct measure: HTKS		Teacher rating: CBRS	
		CoV	S. Coeff. (p. <i>SD</i> )	CoV	S. Coeff. (p. <i>SD</i> )
Germany – Kindergarten		44.64		18.52	
Parameter:	Age		.34** (.06)	.11	(.08)
	Gender		.06 (.07)	-.19*	(.08)
Iceland – Preschool		46.98		18.62	
Parameter:	Age		.20* (.09)	.29	(.08)
	Gender		-.03 (.10)	-.41**	(.08)
Iceland – First Grade		16.59		20.90	
Parameter:	Age		.18 (.09)	.21	(.08)
	Gender		-.19** (.07)	-.32**	(.08)

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . HTKS is the Head Toes Knees Shoulders Task (Range = 0-40). The Head to Toes Task (HTT) (Range = 0-20) was used for the Iceland – Preschool sample only. CBRS is the Child Behavior Rating scale (group-mean centered). CoV = Coefficient of Variation. S. Coeff. = Standardized Coefficient. p. *SD* = Posterior Standard Deviation. Gender is dummy coded (1 = boys and 0 = girls).

Table 4

*Multi-level models of behavioral self-regulation on pre-reading skills and early mathematics among German children*

	Letter Knowledge		Vocabulary		Early Math	
	S. Coeff. (p. <i>SD</i> )		S. Coeff. (p. <i>SD</i> )		S. Coeff. (p. <i>SD</i> )	
<b>Model 1</b>						
Age	.21**	(.07)	- .00	(.07)	.36**	(.06)
Gender	-.11	(.07)	-.05	(.07)	.03	(.06)
Mothers' Education	.15	(.09)	.07	(.10)	.17	(.08)
HTKS	.31**	(.07)	.40**	(.07)	.41**	(.06)
<b>Model 2</b>						
Age	.30**	(.07)	.13	(.07)	.45**	(.06)
Gender	-.08	(.07)	-.01	(.07)	.08	(.06)
Mothers' Education	.20*	(.09)	.15	(.11)	.18*	(.08)
CBRS	.00	(.07)	.09	(.08)	.16*	(.07)

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . HTKS is the Head Toes Knees Shoulders Task as direct assessment of behavioral self-regulation (Range = 0-40). CBRS is the Child Behavior Rating Scale as teacher rating of behavioral self-regulation (group-mean centered). S. Coeff. = Standardized Coefficient. p. *SD* = Posterior Standard Deviation. Gender is dummy coded (1 = boys and 0 = girls).

Table 5

*Multi-level models of behavioral self-regulation on pre-reading skills among Icelandic preschool children*

	Letter Knowledge		Vocabulary		Phonological Awareness	
	S. Coeff. (p. <i>SD</i> )		S. Coeff. (p. <i>SD</i> )		S. Coeff. (p. <i>SD</i> )	
Model 1						
Age	.03	(.09)	-.08	(.09)	.11	(.10)
Gender	-.13	(.09)	-.08	(.09)	.12	(.09)
Mothers' Education	.25*	(.10)	.08	(.11)	.13	(.11)
HTT	.07	(.09)	.28*	(.09)	.11	(.09)
Model 2						
Age	-.02	(.10)	.00	(.09)	.01	(.09)
Gender	-.05	(.10)	.11	(.09)	.12	(.09)
Mothers' Education	.25*	(.10)	.05	(.10)	.11	(.10)
CBRS	.20	(.11)	.49**	(.08)	.35*	(.10)

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . HTT is the Head to Toes Task as direct assessment of behavioral self-regulation (Range = 0-20). CBRS is the Child Behavior Rating Scale as teacher rating of behavioral self-regulation (group-mean centered). S. Coeff. = Standardized Coefficient. p. *SD* = Posterior Standard Deviation. Gender is dummy coded (1 = boys and 0 = girls).

Table 6

*Multi-level models of behavioral self-regulation on pre-reading skills (letter knowledge, vocabulary, and phonological awareness) and early literacy (single word reading and reading comprehension) among Icelandic first grade children*

	Letter Knowledge		Vocabulary		Phonological Awareness		Single Word Reading		Reading Comprehension	
	S. Coeff. (p. SD)		S. Coeff. (p. SD)		S. Coeff. (p. SD)		S. Coeff. (p. SD)		S. Coeff. (p. SD)	
Model 1										
Age	.06	(.09)	.07	(.09)	.11	(.09)	.06	(.09)	.09	(.09)
Gender	.00	(.09)	.12	(.09)	-.13	(.09)	-.05	(.09)	-.05	(.09)
Mothers' Education	.19	(.12)	.29**	(.10)	.22	(.10)	.19	(.10)	.19	(.10)
HTKS	.12	(.09)	.14	(.10)	.20*	(.09)	.20*	(.09)	.18	(.10)
Model 2										
Age	-.04	(.08)	.04	(.09)	.04	(.09)	-.03	(.08)	.01	(.08)
Gender	.17	(.08)	.17	(.09)	-.01	(.09)	.10	(.08)	.09	(.08)
Mothers' Education	.13	(.10)	.27**	(.10)	.17	(.10)	.15	(.09)	.17	(.09)
CBRS	.53**	(.08)	.27*	(.10)	.48**	(.08)	.55**	(.07)	.53**	(.08)

*Note.* \*  $p < .05$ . \*\*  $p < .01$ . HTKS is the Head Toes Knees Shoulders Task as direct assessment of behavioral self-regulation (Range = 0-40).

CBRS is the Child Behavior Rating Scale as teacher rating of behavioral self-regulation (group-mean centered). S. Coeff. = Standardized

Coefficient. p. SD = Posterior Standard Deviation. Gender is dummy coded (1 = boys and 0 = girls).

