Learning and Individual Differences 57 (2017) 9–21

Contents lists available at ScienceDirect

Learning and Individual Differences

journal homepage: www.elsevier.com/locate/lindif

Home environmental and behavioral risk indices for reading achievement

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ARTICLE INFO

Keywords:
Environment
Temperament
Behavior
Reading

ABSTRACT

The goal of this study was to identify home environmental and temperament/behavior variables that best predict standardized reading comprehension scores among school-aged children. Data from 269 children aged 9–16 (M = 12.08; SD = 1.62) were used in discriminant function analyses to create the *Home* and *Behavior* indices. Family income was controlled in each index. The final *Home* and *Behavior* models each classified around 75% of cases correctly (reading comprehension at grade level vs. not). Each index was then used to predict other outcomes related to reading. Results showed that *Home* and/or *Behavior* accounted for 4–7% of the variance in reading fluency and spelling and 20–35% of the variance in parent-rated problems in math, social anxiety, and other dimensions. These metrics show promise as environmental and temperament/behavior risk scores that could be used to predict and potentially screen for further assessment of reading related problems.

1. Introduction

Many people view the task of developing children's reading skills as the purview of formalized education. Yet abundant research shows that the home environment is related to reading outcomes and plays a role in fostering the development of early literacy skills (Burgess, Hecht, & Lonigan, 2002; Griffin & Morrison, 1997). The development of reading skills is also potentially impacted by the child's own temperament and behavior (e.g., attention problems, impulsivity; Spira & Fischel, 2005). Given the numerous child-level variables that are associated with reading skills, it would be valuable to combine them and capture their collective predictive power. Moreover, it would be particularly useful to employ a strategy that does not just combine variables but that identifies those that capture unique variance in reading performance thereby providing a set of potential targets for intervention. In this way, "risk scores" could be developed that capture salient risk factors into single scores, which may help translate research findings on risk into practice in schools and clinical settings by consolidating the array of risk variables into a single indicator that could be used in conjunction with other information to identify children who may need additional assessment or intervention. The present study was aimed at characterizing risk in terms of child-level home factors and in terms of child-level temperament and behavior dimensions into single scores that could predict an important reading outcome.

The idea of creating a single index or "risk score" to capture a complex set of variables is not new. For instance, Sameroff, Seifer, Baldwin, and Baldwin (1993) created a composite from 10 family- and child-level environmental variables in predicting IQ stability while covarying socioeconomic status (SES) and race. In 2005, the field of molecular genetics adopted a risk score model as a way to increase the power of association studies that had largely failed to identify genetic variants for phenotypes that had significant heritability (Horne et al., 2005). "Genetic risk scores" (Horne et al., 2005, p. 177) have proven useful because they combine the most salient genetic risk variants into a composite that conveys a magnitude of risk that can be detected in relation to an outcome even though each individual genetic variant comprising the risk score accounts for very little variance on its own. These prior examples of combining multiple variables into single risk scores provided some of the inspiration for the present study.

1.1. Home environment index

The home literacy environment is "complex and multifaceted" with many different conceptualizations (Burgess et al., 2002, p. 411) and yet it is possible to derive simple metrics of it. Two decades ago, Griffin and Morrison (1997) demonstrated the utility of a "succinct" measure of home literacy that significantly predicted reading outcomes in children. Their composite was formed from the sum of nine items on a parent questionnaire including the amount of TV watched by the child, time spent reading with the child, parents' reading habits in the home, and

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http://dx.doi.org/10.1016/j.lindif.2017.05.010
Received 18 August 2016; Received in revised form 19 May 2017; Accepted 28 May 2017

reading resources in the home (books, magazines). The home literacy environment score significantly predicted reading outcomes in both kindergarten and second grade while controlling for maternal education and child IQ. Griffin and Morrison's work showed that the home environment as it relates to reading outcomes could be meaningfully characterized through a single variable.

Other researchers have since characterized the home environment and their work highlights important considerations when creating a single metric. For instance, Van Steensel (2006) examined the structure of the home literacy environment and identified three profiles among children (ages 5 to 7), and Burgess et al. (2002) tested six different conceptualizations of it based on "active" (e.g., reading with a parent) versus "passive" (e.g., seeing a parent read) behaviors in 4- and 5-year-old children. In both of these studies, home literacy environment profiles marked by active/engaged behaviors in the home such as parents reading with or to their child were best in predicting reading outcomes. Similarly, Sénéchal and LeFevre (2002) conceptualized a Home Literacy Model consisting of both informal and formal literacy experiences. Informal literacy experiences occur when a book or text is present but is not the primary focus (e.g., shared reading between a child and parent), whereas formal literacy experiences occur when attention is primarily given to the book or text (e.g., parents teaching the alphabet or reading words). Recent longitudinal research on the informal and formal literary indices suggests that they may differentially affect reading-related outcomes. For example, Sénéchal and LeFevre (2014) found that informal literacy experiences predict growth in oral language (i.e., receptive vocabulary), whereas formal literacy experiences predict growth in reading (i.e., early literacy and growth in word reading).

Thus, prior research has shown that "active" or "formal" elements in the home environment are more related to reading outcomes than "passive" or "informal" elements. As children grow and their reading skills become established, the role of the home environment is no longer one of supporting literacy development but rather supporting academic success. The active components that are salient in the environment of 4- to 7-year-olds (e.g., reading with parents) will likely get replaced with other components such as those that promote good study habits and convey expectations about academic success. The present study extends prior work by measuring aspects of the home environment as it relates to reading in a wider age range of children. Moreover, while prior studies were aimed at characterizing the structure of the home literacy environment, the present study was designed to create an index from only those variables that account for significant unique variance in an effort to increase its predictive power of reading achievement.

Other aspects of the home environment not directly related to literacy, and thus not captured by existing measures of the home literacy environment, may also account for unique variance in reading achievement (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). For example, household chaos, defined as an environment with high levels of crowding, background noise, and number of people coming in and out (Wachs, 1989), has been shown to have a significant but small correlation with the home literacy environment, suggesting it taps different aspects of the home environment (Johnson et al., 2008). Further, research has shown that the degree of chaos in the home is significantly inversely related to several early reading skills over and above the home literacy environment (Johnson et al., 2008). A negative relationship between chaos and reading comprehension in middle childhood has also been shown (Taylor & Hart, 2014). Additionally, parenting styles may be relevant given previous work suggesting that parental warmth, acceptance, and responsiveness are predictive of reading achievement in early and middle childhood (Bradley & Caldwell, 1984; Bradley, Corwyn, Burchinal, Pipes McAdoo, & Garcia Coll, 2001; Merlo, Bowman, & Barnett, 2007), whereas parental strictness may be negatively related to reading skills (Lee & Kim, 2012).

1.2. Behavior index

The home environment provides an important context for supporting academic success, but aspects of a child's behavioral or psychological functioning that are related to reading comprehension may be used to create a separate index to capture additional aspects of risk that may complement or even interact with the home environment risk. For instance, one of the most widely studied behaviors in relation to reading comprehension is attention-deficit/hyperactivity disorder (ADHD; American Psychological Association, 2013), which is inversely associated with reading outcomes (Brock & Knapp, 1996; Little, Hart, Schatschneider, & Taylor, 2016; Stern & Shalev, 2013) and shares genetic underpinnings with reading (Greven, Rijsdijk, Asherson, & Plomin, 2012; Greven, Harlaar, Dale, & Plomin, 2011; Martin, Levy, Pieka, & Hay, 2006; Willcutt, Pennington, & DeFries, 2000). ADHD shows high rates of comorbidity with other behavioral problems such as conduct disorder (Biederman, Newcorn, & Sprich, 1991), which itself shows comorbidity with reading disability (Martin et al., 2006). The associations between ADHD and other common childhood behavior disorders to reading disability argue for their consideration when creating a behavior index to complement the home environment index.

The reason that ADHD is related to reading problems has to do, in part, with deficits in attention (Fergusson & Horwood, 1992; Rowe & Rowe, 1992), an executive functioning skill. Executive functioning refers to a set of processes which guide goal-directed behavior (Banich, 2009), and it includes a broad array of skills from attention to planning to shifting focus in the face of feedback. Research has demonstrated that better executive functioning longitudinally predicts higher academic performance (Bull, Espy, & Wiebe, 2008). Moreover, decreased executive functioning skills have been found among children with ADHD and conduct disorder (Moffitt, 1990; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005), suggesting the possibility that these disorders arise, in part, due to deficits in executive functioning. Thus, executive functioning dimensions such as attention would be important to consider when creating a behavior index of risk for reading problems.

Finally, achievement in school is related to individual differences in temperament, which influences thoughts, emotions, and behavior. For example, persistence (the tendency to continue a task despite obstacles), approach/withdrawal (the tendency to approach rather than withdrawal), and adaptability (the ease at which a child adjusts to new situations) all predict increased academic achievement (Bramlett, Scott, & Rowell, 2000; Martin, Nagle, & Paget, 1983). Differences in children's temperament in regard to respect for rules have recently been shown to have significant associations with reading comprehension that is explained, in part, by aspects of the home environment (Taylor & Hart, 2014). Behavioral problems and temperament traits could impact the child's environment not just at school but also at home by eliciting reactions from parents that may actually decrease the child's motivation to do well on schoolwork. As such, temperament traits are important to consider when creating a behavior index for predicting reading comprehension.

1.3. Controlling for SES

When one imagines an academically impoverished home environment, it is easy to focus on SES as a major contributing factor because it predicts academic achievement and literacy such that children from poorer families tend to have lower achievement (Molfese, Modglin, & Molfese, 2003; Sirin, 2005; Weigel, Martin, & Bennett, 2006). Meta-analyses have demonstrated that there is an average correlation of 0.30 between SES and achievement (Sirin, 2005; White, 1982), indicating that SES should be accounted for when predicting achievement while also cautioning that SES is inadequate as a sole measure of the home environment. In this study, SES was treated as a control variable when creating both the home environment and the