Learning and Individual Differences 49 (2016) 209–215

Contents lists available at ScienceDirect

Learning and Individual Differences

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

Predicting responsiveness to intervention in dyslexia using dynamic assessment

Sebastián Aravena [a,b,c,*], Jurgen Tijms [a,b,c], Patrick Snellings [a,c], Maurits W. van der Molen [a,c]

[a] Department of Developmental Psychology, University of Amsterdam, Nieuwe Achtergracht 129B, 1018 WT Amsterdam, The Netherlands
[b] IWAL Institute, Amsterdam, Tweede Hugo de Grootstraat 45a, 1052 LB, The Netherlands
[c] Rudolf Berlin Center, Amsterdam, Valckenierstraat 65-67, 1018 XE, The Netherlands

ARTICLE INFO

Article history:
Received 13 June 2015
Received in revised form 30 March 2016
Accepted 24 June 2016
Available online xxxx

Keywords:
Dyslexia
Dynamic assessment
Letter–speech sound learning
Treatment success
Response to intervention (RTI)

ABSTRACT

In the current study we examined the value of a dynamic test for predicting responsiveness to reading intervention for children diagnosed with dyslexia. The test consisted of a 20-minute training aimed at learning eight basic letter–speech sound correspondences within an artificial orthography, followed by a short assessment of both mastery of these correspondences and word reading ability in this unfamiliar script. Fifty-five (7- to 11-year-old) children diagnosed with dyslexia engaged in specialized intervention during approximately 10 months and their reading and spelling abilities were assessed before and after. Our results indicated that the dynamic test predicted variance in reading skills at posttest, over and above traditional static measures, such as phonological awareness and rapid naming. These findings indicate that responsiveness to learning new letter–speech sound correspondences has a prognostic value for the success of specialized reading intervention.

1. Introduction

Developmental dyslexia, henceforth referred to as dyslexia, is characterized by a specific and significant impairment in the automatic recognition of written words (Fletcher & Lyon, 2008; Peterson & Pennington, 2012; Snowling, 2012). There is ample evidence that specialized intervention is effective in ameliorating reading and spelling proficiency of children with dyslexia (see Galuschka, Ise, Krick, & Schulte-Körne, 2014 for an overview). Unfortunately, not all dyslexic readers benefit to the same extent and there is a substantial amount of non-responders as well (Galuschka et al., 2014; Singleton, 2009; Torgesen, 2005). Gaining more insight into factors that can predict responsiveness to intervention in dyslexia would be very welcome as it could help us to identify nonresponders at an early stage and, by doing so, to prevent wasting time, effort, and resources on interventions that are not effective.

A framework that is particularly important in this context is response to intervention (RTI), which is a common practice in educational settings across the United States and several European countries nowadays. RTI is an approach in which a tutor provides a pupil with progressively intense and individualized tiers of instruction with the aim of finding the best possible way to educate children and of identifying children with learning disabilities (Fuchs & Fuchs, 2006; Grigorenko, 2009; Gustafson, Svensson, & Fälth, 2014). Pupils who do not respond to Tier 1 receive more intensive and individualized instruction within Tier 2, and those who are unresponsive to Tier 2 proceed with even more rigorous instruction within Tier 3. Depending on the educational system, the framework is sometimes complemented by a fourth tier, which consists of placement in special education or referral to assessment and therapy within the health care system.

Although many pupils benefit from RTI as they receive high-quality instruction as soon as learning difficulties arise, the notion that intervention should initially be of modest intensity has been questioned (Denton et al., 2011; Vaughn, Denton, & Fletcher, 2010). Especially the value of Tier 2 intervention for the most learning disabled continues to be a subject to debate (Compton et al., 2012; Fuchs, Fuchs, & Compton, 2010). Indeed, there is evidence that engaging in less intensive tiers of intervention may not be effective for addressing the reading difficulties of children with dyslexia (Vaughn et al., 2010). Early identification of nonresponders could thus potentially improve their chance to benefit from intervention by intensifying initial intervention.

A convenient starting point for identifying factors predicting intervention success would be to focus on the standard assessment of dyslexia, which typically consists of a combination of reading and writing tasks along with a set of phonology-related tasks, such as phonological awareness, rapid naming, and verbal short-term memory, as well as some general cognitive measures. Indeed, several studies indicate that some of these factors, among which poor phonological awareness in

* Corresponding author at: IWAL Institute, Amsterdam, Tweede Hugo de Grootstraat 45a, 1052 LB, The Netherlands.
E-mail address: s.aravena@uva.nl (S. Aravena).

http://dx.doi.org/10.1016/j.lindif.2016.06.024
1041-6080/

particular, can predict unresponsiveness to early literacy intervention within children at risk for dyslexia (see Al Otaiba & Fuchs, 2002 and Nelson, Benner, & Gonzalez, 2003 for an overview), but it is far less clear whether these findings hold for children diagnosed with dyslexia (Frijters et al., 2011; Hatcher & Hulme, 1999; Morris et al., 2012; Tijms, 2011). For this group there is a paucity in our knowledge of factors moderating responsiveness to intervention (Démonet, Taylor, & Chaix, 2004; Frijters et al., 2011; Hoeft et al., 2011; Shaywitz, Morris, & Shaywitz, 2008; Tijms, 2011). A recent meta-analysis including twenty-two randomized controlled trial studies of reading disabled children failed to identify subject-related moderators of responsiveness to intervention (Galuschka et al., 2014).

Dynamic assessment (DA) might be a viable approach for examining potential moderators of responsiveness to intervention. The focus of DA is on learning potential rather than learning outcome (Grigorenko, 2009; Gustafson et al., 2014). A typical DA procedure requires the pupil to engage in a training in which feedback is provided. The effect of training is then used to estimate the pupils' learning potential. There is ample evidence that this kind of process-oriented testing better predicts future learning than conventional testing within various academic domains, including reading skill (Caffrey, Fuchs, & Fuchs, 2008; Fuchs, Compton, Fuchs, Bouton, & Caffrey, 2011; Grigorenko & Sternberg, 1998; Gustafson et al., 2014; Jeltova et al., 2007; Spector, 1992). However, other studies have shown little advantage of dynamic testing over static testing (Caffrey et al., 2008). In a recent study Petersen, Allen, and Spencer (2014) compared the utility to predict reading difficulty at first grade of two DA reading measures and two commonly used one-point-in-time pre-reading measures administered to 600 kindergarten children and found both DA measures to be superior to the common static measures. DA has also been used to examine moderators of responsiveness to intervention recently. Cho, Compton, Fuchs, Fuchs, and Bouton (2014) showed that DA predicted the responsiveness to a validated reading intervention program. In this study, first-grade students received Tier 2 reading intervention within small groups during 14 weeks. DA of decoding was found to be a significant predictor of the growth in word identification fluency and the final level attained.

In the current study, we applied DA to children diagnosed with dyslexia in order to predict the success of subsequent specialized Tier 4 intervention. The DA we developed consists of a 20-minute training aimed at learning eight new basic letter–speech sound correspondences, followed by a short assessment of both mastery of the correspondences and word reading ability in this unfamiliar script. Letter–speech sound learning is the central focus of the training, because recent research suggests that a fundamental letter–speech sound learning deficit is a key factor in dyslexia (Blomert, 2011; Kronschnabel, Brem, Maurer, & Brandeis, 2014; McNorgan, Randazzo-Wagner, & Booth, 2013; Mittag, Thesleff, Laasonen, & Kujala, 2013; Peterson & Pennington, 2015; van Atteveldt & Ansari, 2014; Žarić et al., 2014). The advantage of adopting an artificial script is that differences in previous exposure to experimental stimuli can be ruled out, allaying concerns about noncontrolled factors influencing performance. In a previous study we demonstrated that our DA procedure differentiates between dyslexic readers and normal readers and predicts individual differences in reading and spelling ability (Aravena, Tijms, Snellings, & van der Molen, 2015). In the current study we examined whether, in addition to its diagnostic value, the DA procedure has prognostic value as well. The participating children engaged in specialized Tier 4 intervention during approximately 10 months. We tested their reading and spelling abilities before and after intervention and related these to the scores on our DA, as well as to the scores on two conventional static measures frequently used for the assessment of dyslexia, namely a phonological awareness task and an alphanumeric rapid naming task. Unlike most approaches to DA (Grigorenko, 2009; Grigorenko & Sternberg, 1998), our assessment did not involve instruction but just associative learning from exposure and implicit feedback. The 20-minute training consisted of a computer game in which children had to match speech sounds to unfamiliar letters. As correct responses led to success in the game and incorrect responses were penalized, children learned the letter–speech sound correspondences just by playing the game, without being aware of learning. Instructions were only related to the specifics of the game and did not reveal the underlying learning objective. This approach was chosen to approximate letter–speech sound learning as it naturally occurs and to measure the capacity to master new letter–speech sound correspondences, without interference from more general factors related to instruction, such as intelligence, verbal comprehension, or attention.

In brief, in the current study we examined whether a new DA procedure predicted the success of a subsequent specialized intervention within a group of children diagnosed with dyslexia. We expected this procedure to be an adequate candidate for this purpose for two reasons. First, because it focuses on the formation of letter–speech sound correspondences, a process that appears to be disrupted in children with dyslexia. Second, because it focuses on learning rate rather than on learning outcome.

2. Method

2.1. Participants

Participants were 55 primary education pupils (30 boys and 25 girls) diagnosed with dyslexia recruited from a nation-wide center for dyslexia in the Netherlands. The children had a mean age of 9 years and 3 months ($SD = 12.39$ months, age range = 7.33–11.08 years). An estimate of general intelligence was obtained by averaging the standardized C-scores ($M = 5$, $SD = 2$) of the subtest Analogies from the SON-R (Laros & Tellegen, 1991), a non-verbal reasoning-by-analogy task in which the child had to extract a principle and to apply it to a new situation ($r = 0.79$, test–retest), and the subtest Vocabulary from the WISC-III (Kort et al., 2005), a measure of expressive vocabulary requiring the child to describe the meaning of words of increasing complexity ($r = 0.90$, test–retest). The IQ estimates ranged from 3 to 8.5 ($M = 5.57$, $SD = 1.37$). Informed consent was obtained from the parents of each child.

Consistent with standard norms for severe dyslexia in the Dutch health care system (Blomert, 2006), children were diagnosed with dyslexia when they met all of the following three inclusion criteria: (1) either word reading speed was 1.5 standard deviation (SD) or more below average or, word reading speed was at least 1 SD below average together with a spelling skill of 1.5 SD or more below average; (2) performance on at least two out of six administered phonology-related tasks was at least 1.5 SD below average; and (3) the child had shown a poor response to intervention provided at school. Exclusionary criteria were uncorrected sensory disabilities, broad neurological deficits, low IQ (<80), poor school attendance, and ADHD. Because we incorporated Hebrew graphemes in our assessment, previous experience with Hebrew script was also an exclusionary criterion. All participants were native speakers of Dutch. The study was approved by the University's Ethics Committee.

2.2. Dynamic assessment

The dynamic assessment (DA), which had a total duration of approximately 30 min, consisted of a 20-minute training dedicated to learning non-existent letter–speech sound correspondences followed by a short assessment of both mastery of the newly learned correspondences and word reading ability in the artificial script. A summary of the different components of the DA is provided below.

2.2.1. The letter–speech sound training

The training consisted of a computer game in which the child had to match speech sounds to their corresponding orthographic representations (Aravena et al., 2015). Correct associations were rewarded while