Research in Developmental Disabilities 32 (2011) 540–548

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Handwriting development in grade 2 and grade 3 primary school children with normal, at risk, or dysgraphic characteristics

Anneloes Overvelde *, Wouter Hulstijn

Donders Centre for Cognition, Radboud University, Nijmegen, The Netherlands

ARTICLE INFO

Article history:
Received 8 December 2010
Accepted 20 December 2010
Available online 26 January 2011

Keywords:
Handwriting
Dysgraphia
Dysgraphic children
Visuomotor integration

ABSTRACT

The wide variation in prevalence of dysgraphic handwriting (5–33%) is of clinical importance, because poor handwriting has been identified as one of the most common reasons for referring school-age children to occupational therapy or physiotherapy, and is included as an criterion for the diagnosis of Developmental Coordination Disorder. This study aimed to map the development and improvement in handwriting during the early grades to differentiate between temporary and consistent dysgraphic handwriting. In this longitudinal and cross-sectional study, children in grade 2 (age 7–8 years, $n = 169$) and grade 3 (8–9 years, $n = 70$) took handwriting (Concise Assessment Method for Children's Handwriting; acronym BHK) and visuomotor integration (BeeryVMI) screening tests twice within one school year. Dysgraphia decreased strongly from 37% to 17% in grade 2 and diminished further to a low and stable rate of 6% in grade 3. Stability in handwriting quality only occurred in the children whose scores were within the normal range. The *at risk* and *dysgraphic* children continued to show significant and substantial improvement during grades 2 and 3. BeeryVMI was inappropriate as a screening instrument for handwriting problems. It was concluded that handwriting must be consistently dysgraphic before making any decisions about a diagnosis of dysgraphia or referral for therapy.

1. Introduction

Handwriting is an important skill, related to school performance and the child's self-esteem (Feder & Majnemer, 2007). In previous studies, the prevalence of handwriting problems among school-age children has been estimated to vary between 5 and 33% (Hamstra-Bletz & Blote, 1993; Karlsdottir & Stefansson, 2002; Rubin & Henderson, 1982; Smits-Engelsman, Niemeijer, & Van Galen, 2001). This wide variation in prevalence of clinical importance, because problems with handwriting have been identified as one of the most common reasons for referring school-age children to occupational or physiotherapy services (Bosga-Stork et al., 2009; Hammerschmidt & Sudsawad, 2004). Moreover, poor handwriting has been mentioned as one of the diagnostic criteria for Developmental Coordination Disorder (DCD; DSM-IV-TR, APA, 2000; ICD-10, WHO, 1992). Clinical practice has shown that some children were able to overcome their handwriting problems easily, whereas others had more persistent problems. Precisely in these age groups, in which handwriting is undergoing development and rapid improvements are being made (Karlsdottir & Stefansson, 2002), the timing of testing could have great impact on the identification of handwriting problems and might form a simple explanation for the wide variation in the prevalence of handwriting problems. To establish whether there is a genuine indication for therapy, it is necessary to differentiate between temporary and persistent dysgraphic handwriting and to gain insight into the development of handwriting quality and

* Corresponding author.
E-mail address: AnneloesOvervelde@gmail.com (A. Overvelde).

0891-4222/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ridd.2010.12.027

speed. In a combined longitudinal and cross-sectional study on children in grades 2 and 3, our aim was to provide a more detailed description of the development of *normal*, *at risk* and *dysgraphic* handwriting.

Handwriting is a complex activity in which lower-level perceptual-motor (motor planning and execution) processes and higher-level cognitive (psycholinguistic and executive) processes continuously interact (Abbott & Berninger, 1993; Graham & Weintraub, 1996; Van Galen, 1991). As soon as the low-level motor processes have become relatively automatic, the high-level processes (e.g. planning, language generation, reading and editing) can be activated concurrently as in adult writing. Children in grade3 still seem to alternate between these high-level and low-level processes while composing text, because the low-level processes had not yet become automatic (Olive & Kellogg, 2002). In our study on handwriting disability or dysgraphia, we focused on the low-level processes.

In children who were showing *typical* development, handwriting was found to be characterized by rapid quality improvement during grade 1 (age 6–7 years) that reached a plateau by grade 2 (age 7–8 years). Further improvements were seen by grade 3 (age 8–9 years), when handwriting had become automatic, organized and available as a tool to facilitate the expression of ideas (for an overview of studies see Karlsdottir & Stefansson, 2002; review Feder & Majnemer, 2007). These authors described continuous and somewhat linear increases in writing speed over the grades. Thus, although the typical development of the total group has been described, clinical practice needs more specific details about the characteristics of children *at risk* for handwriting difficulties and children with dysgraphia.

To our knowledge, only two longitudinal studies described the development of handwriting in terms of profiles. Recently, Karlsdottir and Stefansson (2002) have given an overview of the number of children with handwriting problems and the distributions during grades 1–5.They presented average developmental profiles of children with 'functional' and 'dysfunctional' handwriting in grade 1 to grade 5, obtained by annual testing at the end of each school year. Children with *functional* handwriting reached their final quality level at the end of grade 1, whereas the children with *dysfunctional* handwriting improved significantly from grade 1 to grade 5. The definition of *functional* handwriting was based on the legibility of the written content and just five characteristics to judge the individualized letter forms (letter formation, slant, size, spacing and alignment). In an earlier study, Hamstra-Bletz and Blote (1993) described the longitudinal development of children with dysgraphia from grade 2 to grade 7. Normal handwriting and the product of dysgraphic children were described in more detail (13 characteristics). However, their dysgraphic group was determined by using a cut-off score of 10% of the total study population and consisted of only 12 children.

In clinical as well as in experimental research, good instruments must be used to rate handwriting and define groups. The Concise Assessment Method for Children's Handwriting (acronym BHK; Hamstra-Bletz, De Bie, & Den Brinker, 1987), developed from the dysgraphia scale of De Ajuriaguerra et al. (1964,1979) (as cited in Hamstra-Bletz, 1993), has frequently been used for this purpose (e.g. Flapper, Houwen, & Schoemaker, 2006; Kaiser, Albaret, & Doudin, 2009; Smits-Engelsman et al., 2001). We consider that the 13-characteristic BHK is suitable to assess the rapid developments in handwriting during the early grades and to provide more detailed profiles of handwriting that is *at risk* or *dysgraphic*. The BHK covers more global characteristics ('organization of written work') and contains several items to score 'letter formation'. Checks should also be made of the quality of the letter trace ('fine motor ability') (Hamstra-Bletz et al., 1987; see Table 2). BHK-norm-references on the quality of handwriting have only been published for grades 2 and 3, but speed norm-references are available for all ages.

Until now, very little research has addressed global longitudinal profiles of *dysfunctional* or *dysgraphic* handwriting. Such characteristic developmental profiles are of great therapeutic importance in view of the high prevalence of handwriting problems and, correlatively, given that handwriting is the main focus of therapy in paediatric physiotherapy and occupational therapy. By using a simple and frequently-used test, such as the BHK, it should be possible to transfer the results to therapeutic practice. This study focused on the development of handwriting in subgroups of children (with *normal*, *at risk*, or *dysgraphic* handwriting) in the second grade (age 7–8 years) and third grade (age 8–9 years) of primary school. Testing a large group of children within a short period of half a year enabled us to map handwriting characteristics in specific subgroups. We analysed improvements in handwriting quality, the (clusters of) items of the BHK, correlations with the visual-motor-integration score and increases in handwriting speed.

2. Method

2.1. Participants

Data were obtained in two sessions (T1 and T2) from 239 children in grade 2 (age 7–8 years, $n = 169$) and grade 3 (age 8–9 years, $n = 70$) at four mainstream primary schools, located in the eastern part of the Netherlands. Mean age differed significantly between the children in grade 2 (7.7 years $\pm$ 0.6 months at T1) and grade 3 (8.7 years $\pm$ 0.5 months at T1) ($p < .001$). Duration of handwriting lessons also differed significantly (grade 2: 14.63 $\pm$ 4.3 months; grade 3: 22.86 $\pm$ 2.8 months; $p < .001$). Within the two grades, no significant differences were found between gender distribution or mean age. The percentages of left handed children were within the normal variation of handedness (13% and 11% in grade 2 and grade 3, respectively).

In the Netherlands, children with minor learning disabilities, motor dysfunction, or behavioural problems attend mainstream primary schools, where they have the opportunity to receive adaptive education. The following information was obtained from the teacher: in grade 2, nine children were receiving therapeutic assistance in handwriting (5.3%) and seven children had been diagnosed with spelling difficulties (4.1%). In grade 3, two children were registered as having minor behavioural problems. None of these problems (spelling, motor, or behavioural) were having severe effects on the children's