

## What should we assess in primary handwriting?

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### Introduction

This paper reports some of the findings of research into the relationship between handwriting and composition in primary aged children. It suggests that the importance of handwriting for composition has been underestimated and that teachers may not be assessing the most important aspects of handwriting.

In complex models of writing processes, handwriting has been seen as part of the translation of ideas, or transcription. However, in pedagogic practice this has often meant that handwriting is seen not as a part of the composing process, but as a presentation skill. Both the National Curriculum for England (DfEE/QCA, 2000) and the new Framework for Literacy (DES/PNS, 2006) concentrate on the formation and orientation of letters in handwriting and speed is mentioned only for typing. Despite this, research suggests that fast, automatic handwriting may have a significant effect on children's composing (e.g. Berninger et al, 2006; Berninger & Graham, 1998, Medwell et al, 2007). This research suggests that for writers who do not produce letters swiftly and automatically, the actual production of written letters may interfere with their ability to compose text. Far from being a purely motor act, Berninger and Graham (1998) stress that handwriting is "language by hand" and their research suggests that orthographic and memory

processes (the ability to recall letter shapes) contribute more to handwriting than do motor skills (Berninger & Amtmann, 2004). Handwriting is about training the memory and hand to work together to generate the correct mental images and patterns of letters and translate these into motor patterns of letters – automatically and without effort! If this is the case, then the goals of teaching handwriting in primary school are not purely about letter formation and orientation, as national frameworks seem to suggest – we are aiming for children to develop an efficient and automatic hand. In fact, we are aiming for handwriting not to be an issue which demands the attention of young writers!

A significant number of children experience handwriting difficulties throughout their schooling, although estimates of how many are experiencing handwriting difficulties range from as high as 44% (Alston, 1985; Rubin & Henderson, 1982) to as low as 5% (Barnett et al, 2006). Lack of handwriting automaticity may affect a significant number of primary and secondary aged children and a number of studies suggest that their handwriting difficulties are likely to impact upon their ability to compose written language (Jones and Christensen, 1999; Berninger, Mizokawa and Bragg, 1991). One small study of a mixed age sample (Connelly and Hurst, 2001) has tentatively suggested that this link between handwriting automaticity and composition is likely to be true for children in England. Small intervention studies (Jones & Christensen 1999; Christensen, 2005) suggest that some types of handwriting instruction can improve children's automaticity and by doing so, their composition ability. However, we do not know which children this would benefit and we do not know early enough in their writing careers. There are sophisticated multiple measure tests available for children of 9 years and above (Barnett et al, 2007), but difficulties at primary level have to be extreme before such an individual test would be used. More essential, perhaps, is for teachers of younger children to know what it is important to assess and to be able to do so early.

### The study

This study aims to examine in more detail whether the findings about orthographic-motor intervention (Jones and Christensen, 1999; Graham et al, 1997;

Berninger, Mizokawa and Bragg, 1991) can be generalised to the British context. One small study of a mixed age sample (Connelly and Hurst, 2001) has suggested that this link between handwriting automaticity and composition is likely to be true for England. The present study uses a larger sample focussed on two younger age groups and some results for Year 2 children (age 6-7) and Year 6 children (aged 10-11) are reported here.

One of the aims of this study is to look at achievement in a range of measures of handwriting (neatness, handwriting speed and letter generation) in school pupils at the end of Year 2 and Year 6, and the relationship of these aspects of handwriting to the primary goal of instruction: written composition. This is the first step towards identifying what we should be assessing (and teaching) in primary aged handwriting.

### The Sample of Writers

The Y2 sample included 186 Year 2 pupils with a mean age of 7:6. The Y6 sample included 198 Year 6 pupils with a mean age 11:4 months (SD 3.5). All testing was conducted towards the end of the academic year.

The pupils were drawn from four primary schools in Solihull, Coventry and Warwickshire and had a range of economic backgrounds. In terms of attainment these schools were typical of the national average. In national end of Key Stage 2 tests at age 11 in 2006, 81% of their pupils achieved level 4 (the expected level) or above in English (national average 79%), and 75% achieved level 4 or above in mathematics (national average 75%).

### Measurements of composition

The writing of all the children in the sample was assessed as part of the statutory end of Key Stage 1 (KS1) assessment at the end of Y2 (age 6-7) and Key Stage 2 assessment at the end of Y6. The composition task involved children in writing two pieces – a longer and a shorter piece, of two contrasting text types. The writing of the Y2 children was assessed using the national test paper and marked by teachers using task specific criteria which offer 30 marks for composition. The writing of Y6 children was marked by external markers using similar criteria.

### Measurement of handwriting

Three measures of handwriting were used for the study. These address different aspects of handwriting ability.

#### *Handwriting style and neatness (SAT Measure)*

Handwriting style and neatness in the course of composing is statutorily assessed as part of the Standard Assessment Tasks (SAT) at KS1 and up to three marks can be awarded for handwriting using the nationally agreed criteria which refer at KS1 to letter formation and orientation and at KS2 to letter formation, orientation, regularity and word placement. The assessment for these three marks is made on a sample of handwriting done during a composition assessment and is a product analysis. Fluency is taken to mean evidence of the effective joining of letters. This is a measure of neat product but not of speed or movement. In the Handwriting SAT for Year 2 children 57 children (30.6%) scored 1 point, 80 (43.0%) two points and 40 (21.5%) three points. The mean was 1.9 (SD 0.8). In the Handwriting SAT for Year 6 children, 76 children (38.4%) scored 1 point, 95 (48.0%) two points and 25 (12.6%) three points. The mean was 1.7 (SD 0.67). This shows a surprisingly large number of children struggling with orientation and regularity of letter formation at Year 2 and letter formation, orientation, regularity at Year 6.

#### *Handwriting copying speed*

A copying test, The Handwriting Speed Test (Wallen et al., 1996) was used to assess handwriting speed, giving a score in letters per minute (LPM). This test was designed and standardised for children in Australia, although not for the English context or for children below Year 4 (8-9 year olds). The test involves copying the sentence “The quick brown fox jumps over the lazy dog” as many times as possible in three minutes on a test sheet. All letters, including crossings-out, were counted and the test rubric applied consistently. The tests were marked by two separate markers and a high level of inter-marker reliability was established. Inter-rater reliability using Pearson’s product moment correlation was  $r=.99$ . This test assesses children’s ability to see, remember and reproduce a sentence containing all the letters of the alphabet, and does not assess neatness (although letters have to be correctly formed) or ability to generate letters.

The range of scores for the Handwriting Speed Test of the Year 2 children was from 9 to 75 letters per minute with a mean of 33.7 (SD=11.9). The range of scores for the Handwriting Speed Test of the Year 6 children was from 1 to 113 letters per minute with a mean of 64.2 (SD=19.1).

#### *Automatic letter writing test*

Orthographic-motor integration of handwriting involves mentally coding and rehearsing visual representations of letter patterns and integrating them with motor patterns (Berninger, 1994). This was measured using a form of the alphabet writing task described by Berninger, Mizokawa and Bragg (1991) and adapted by Jones and Christensen (1999) for whole classes, rather than individuals. The task involves writing in lower-case as many letters of the alphabet as possible in one minute. Pupils who complete all 26 letters in lower case continue the task in upper-case. Although children have plenty of opportunity to write all the letters in the course of their school work, they rarely write the whole alphabet from memory in sequence, so this task is not well rehearsed and demands organization and retrieval of letter forms in visual memory as well as the generation of the relevant motor patterns.

The children were asked to write as quickly and as neatly as possible on a test sheet. Scores were calculated by counting letters which were recognisable out of the context of the rest of the writing. Omissions, reversals, transpositions (of case) and substitutions did not count towards children's scores. Scores are given in alphabet letters per minute (ALPM). The tests were marked by two separate markers and again a high level of inter-marker reliability was established ( $r = 0.98$ .)

The range of scores for Year 2 children on the Alphabet Task was from 3 to 44 alphabet letters per minute (ALPM) with a mean of 16.7 (SD=8.4) and for year 6 from 1 to 78 alphabet letters per minute with a mean of 31.8 (SD 11.5). There is no evidence of any ceiling effect with this older age group compared to our Y2 sample. The mean ALPM score at Y6 is twice as high as the mean score at Y2 (mean=16.7, SD 8.4). Over 95% of the Y2 sample score below the Y6 mean, so performance is clearly very strongly age related.

## Is there evidence for a relationship between handwriting and composition?

For the Y2 sample there is a very high correlation between performance on the Alphabet Task and Composition ( $r = .58$ ). Alphabet Task performance accounts for 34% of the variance in composition for these Y2 children. This is higher than the correlation for speed alone (Handwriting Speed Test) at  $r = .44$  or the correlation with neatness and letter formation (indicated by the handwriting SAT score) of  $r = .54$ . The Handwriting Speed Test involves copying and is a pure measure of speed, which may well contribute to composition by allowing the child to write more in a given time. However, The Alphabet Task measures the mental generation and motor production of the letter symbols and it is automatic performance at this orthographic-motor integration which may account for its stronger prediction of composition quality because it frees up the working memory to focus on composing. Speed alone is not enough.

For the Y6 children there was a high correlation between performance on the Alphabet Task and Composition ( $r = .46$ ), which accounted for 21.5% of the variance in composition. This is a lot lower than for Y2 (34%) children and may represent changes in the demands of the composition process. However, it is still a surprisingly high amount of variance for an element of handwriting which is not assessed in our schools.

## Elements of handwriting as predictors of composition

It is important to identify which aspects of handwriting (of those we have measured) actually predict success in composition, as this may influence teaching and assessment. A multiple regression analysis of the three handwriting predictors of composition at Y2 is presented in Table 1. The Alphabet Task is entered first because it is the best single predictor of composition. The scores on the Alphabet Task and the Handwriting Speed Test are highly correlated ( $r = 0.60$ ) but not synonymous. Thus adding Handwriting Speed to the regression increases the multiple  $r$  to  $.67$ , explaining an additional 10% of the variance in composition. Handwriting Speed may well contribute to composition by allowing the

Y2 child to write more in a given time. Finally the Handwriting SAT makes only a minimal addition to

the prediction of composition, explaining just an additional 1.2% of the variance.

**TABLE 1: Stepwise multiple regression of Y2 handwriting measures against composition score**

Variable	Multiple R	Adjusted R square	B	Standard error	Beta	Significance of t
ALPM	.58	33.8	.24	.05	.34	p<.001
Handwriting SAT	.67	44.4	2.73	.48	.36	p<.001
Handwriting Speed	.68	45.6	6.97	.04	.14	p<.05

When all three handwriting measures (ALPM, LPM and KS2 handwriting mark) are included in a regression equation for the Year 6 data, only the Alphabet Task scores and neatness as indicated by KS2 handwriting score are significant. Together the multiple r with composition is raised to 0.56,

so neatness explains a further 10% of the variance in composition over and above ALPM. Pure handwriting speed plays no part in predicting composition in the Y6 children after ALPM and neatness are accounted for.

**TABLE 2: Multiple regression of handwriting measures against writing composition score**

	Unstandardised Coefficients (B)	Standard Error	Standardised coefficients (Beta)	t	Significance
(Constant)	11.307	1.700		6.651	.000
ALPM	.251	.050	.384	5.060	.000
Handwriting Speed	.03	.028	.096	1.287	.200
SAT handwriting score 1 (vs.2)	-3.343	.922	-.234	-3.626	.000
SAT handwriting score 3 (vs.2)	3.119	1.325	.150	2.355	.020

*a Dependent Variable: KS2 Composition score.*

### Is there a causal relationship between ALPM and composition?

What has been demonstrated above is only a correlation between performance on the Alphabet Task and composition scores. This is not sufficient to establish a causal role for automatic letter production in relation to composition. The correlation might arise from the influence of a third factor that determines both ALPM and composition scores. For example, Graham and Weintraub (1996) have demonstrated a relationship between handwriting and reading attainment, and it may be that reading, as a measure of general literacy competence, under

lies both high ALPM and high composition scores (Jones & Christensen, 1999). A partial correlation was computed to establish the relationship of ALPM with composition, independent of the influence of reading proficiency. The measure of reading proficiency used was the SAT reading levels for each child, as assessed using the SAT reading test and tasks administered at the end of KS1. At KS2, for the Y6 sample both the maths and reading scores were used for this purpose.

At Y2 (age 7), the Reading score is a good predictor of both composition ( $r=.84$ ) and performance on the Alphabet Task ( $r=.55$ ) so is a relevant control

variable. The zero-order correlation of ALPM and composition is 0.58 (see Table 2). After controlling for reading score, the partial  $r$  drops slightly to 0.43, but remains highly statistically significant ( $p < .001$ ). For the Y6 data, combined reading and mathematics scores was an appropriate control variable since it was positively correlated both with composition (0.63) and with ALPM (0.50). The zero-order correlation of ALPM and composition is 0.46. After controlling for reading score, the partial  $r$  drops slightly to 0.22, but remains statistically significant ( $p < .005$ ).

Thus there is a strong relationship between ALPM and composition in Y2 even when variation in reading attainment is accounted for and a strong relationship in Y6 when reading and mathematics are accounted for. This is important since it establishes that the correlation between performance on the Alphabet Task and composition is not simply mediated by both being related to good reading. This evidence does not definitively establish that low handwriting automaticity causes poor composition, but it makes it more likely that there is some direct association in the correlation and that low automaticity is an important area for assessment.

## Conclusions

The results of this study identify a very wide range of performance in handwriting measures and one of the most basic issues raised by the results is the lack of existing normative data in this area. We do not have information about teacher's expectations or targets for handwriting, nor do we have norms for young children in the UK population. This is the case not only for orthographic-motor integration, the primary focus of this paper, but also for handwriting and speed. Further information in both these areas would be of assistance to teachers and researchers in deciding which children might benefit from handwriting intervention.

The results discussed above suggest that a high proportion of the variance in composition for the children in this sample is related to their handwriting and, in particular, to their ability to generate letters automatically, as measured by the Alphabet Task. This supports the idea that letter generation makes cognitive demands on children of this age and may take up working memory capacity which

is, therefore, not available for higher level composing tasks. This is a very important finding, given the widespread assumption, discussed above, that handwriting is a matter of presentation. These findings support the suggestion that handwriting is indeed a language act and that orthographic-motor integration, that is automatic letter production, is not only a different measure from speed but is more significantly related to composition than speed or neatness in the present sample of English children.

The results are of interest in relation to children with Special Educational Needs and test accommodation that allow pupils 25% extra time in the national tests. These generally require evidence of slow handwriting speed as the rationale for allowing the extra time. This data would suggest that the rationale is inappropriate, as it is not so much slow handwriting but orthographic integration and neatness that are the pertinent factors in the KS2 composition score. Of the three tests recommended for handwriting speed assessment, only the DASH (Barnett et al, 2007) includes a specific letter generation element.

Finally, these results suggest that policy and practice in the assessment and teaching of early handwriting should be reconsidered to support improvement in composition. In addition to emphasis on letter formation, we should consider early letter generation and automaticity as priorities, before orientation and speed.

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