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Can one written word mean many things?

Pre-readers' assumptions about the stability of written words' meanings

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Abstract

Results of 3 Experiments confirm previous findings that in a moving word task pre-readers aged 3-5 years judge as if the meaning of a written word changes when it moves from a matching to a non-matching toy, for example when the word 'dog' moves from a dog to a boat. We explore under what circumstances children make such errors, and identify new conditions under which children were more likely correctly to treat written words' meanings as stable: When the word was placed alongside a non-matching toy without having previously been alongside a matching toy; when two words were moved each from a matching to a non-matching toy; and when children were asked to change what print said. Under these conditions children more frequently assumed physical forms had stable meaning, as they do with other forms of external representation.

Keywords: Representation; Meta-language; Written words; Symbols

Assumptions about the stability of word meanings

Can one written word mean many things?

Pre-readers' assumptions about the stability of written words' meanings

Over their preschool and early school years, normally developing children show increasing mastery at handling relationships between external representations of various kinds and their referents. A relatively early achievement at around two and a half years is the ability to use photographs, drawings or video recordings to locate hidden objects (DeLoache, 2004; DeLoache & Burns, 1994; Troseth & DeLoache, 1998; Liben, 1999). Later, at around three years of age, children become able to use scale models and simple maps in the same manner (DeLoache, 1991; Liben, 1999; Marzolf & DeLoache, 1994; see also MacConnell & Daehler, 2004). Subsequently, children reveal understanding that photographs or drawings can represent their referents as they looked in the past rather than as they are currently (Robinson, Nye & Thomas, 1994; Thomas, Jolley, Robinson & Champion, 1999; Zaitchik, 1990). In a typical task, children see a drawing or a photograph of an object, and features of the object are then changed. Many 3-year-olds judge as if they believe that the representation (out of sight) has physically changed to stay in match with its real referent. By 4 to 5 years of age few children make this error. Later still, by the age of around 6 to 7 years, children can evaluate as inadequate utterances which under-specify their intended referents (Flavell, Speer, Green & August, 1981; Robinson & Robinson, 1982; Apperly & Robinson, 1998). Younger children consider an utterance (a linguistic representation) to be effective in conveying the intended meaning so long as it does not actually mis-describe the intended referent. Older children in contrast reveal understanding that utterances represent their intended referent

in a particular way (Apperly & Robinson, 2003; Robinson & Apperly, 2001). These many accomplishments require the child to focus in increasingly complex ways on the dual nature of representations, both as entities in their own right and as representations of their intended referents (DeLoache, 2000; 2004; Liben, 1999).

Within this vast literature lies a surprisingly small amount of research on children's understanding of written words as representations. Much of the literature on early understanding of written words focuses on other aspects of metalinguistic awareness, for example identifying names and sounds of letters (Adams, 1990; Whitehurst & Lonigan, 1998). Yet insofar as understanding words as representations connects with being able to read, it could be one of the most important aspects of representational understanding. Literacy gives access to new worlds of knowledge and communication and enables children to advance through the education system in western societies.

Furthermore, because written words have conventional generic meaning, we might find theoretically interesting differences in the developmental course of children's mastery of this form of representation in comparison with the others summarized above. In the hiding tasks mentioned children use a picture of a particular room; in standard false picture tasks the picture represents a particular aspect of the world; in tasks involving ambiguous utterances the speaker refers to a specific referent from a set. In contrast, although the written word 'pig' can be used to refer to a particular pig, it also refers generically to all pigs whether or not an appropriate referent is in the vicinity. DeLoache and Burns (1993) suggest that 2-year-old children treat symbols as having generic rather than specific meaning, in that they can correctly label objects in pictures yet fail to use

those pictures to infer the location of a specific real referent. They suggest that early experience with pictures might predispose children to prefer generic over specific interpretations.

One further reason why children's conceptions of written words as representations is of interest is that unlike pictures and models, written words' meanings are not transparent to pre-readers (Bialystok, 2000; Bialystok & Martin, 2003). Because they are dependent on being told what the written word says, pre-readers may treat written words differently from these other form of representation.

According to Bialystok (1991; 1997; 2000; Bialystok & Martin, 2003; Bialystok & Senman, 2004) children who already know a fair amount about words and letters but who cannot yet read, suffer from a 'serious misconception' about how print signifies meanings, and surmounting this misconception is a prerequisite for learning to read. In particular, these authors argue that pre-readers are inclined to assume that the meaning of a written word can change according to its physical placement. In Bialystok's moving word task children see two pictures or toys, for example a dog and a boat. The written word for one of them, dog, is introduced and children are told what the word says. The word is placed adjacent to the dog and is then moved 'accidentally' adjacent to the boat and then back to the dog. Children are asked what the word says in each of these three positions. Pre-readers aged 3- to 5-years typically judge correctly that the word says dog when adjacent to the dog, but wrongly that the word says boat when adjacent to the boat (a moving word error). Bialystok (2000) concluded children who made these moving word errors "Did not accept that the meaning of the printed word is determined

exclusively by the printed letters. Instead they believed that the correspondence with the picture had at least some role in determining its meaning." (p178).

In contrast, children performed relatively well when recognisable line drawings were used instead of words, or analogical or numeric representations of small numbers, and made relatively few errors when written proper names were used (Bialystok, 2000). Similarly, Apperly, Williams and Williams (in press) replicated Bialystok's moving word errors but found that children very rarely made errors when an unrecognisable drawing (a scribble) moved from a matching toy to a non-matching toy, rather than a written word. Children treated as stable the meaning of a scribble labelled as a drawing made by a younger child, while apparently treating written words as flexible in meaning.

These results strongly suggest that children treat written words differently from the way they treat other forms of external representation. In the moving word task, pre-readers are prepared to treat a single physical form as potentially having many different meanings. With other forms of representation, children behave in line with the assumption that one representational form has one meaning. For pictures and models, for example, prior to managing the duality of representations, children seem inclined to focus either just on representations as objects in their own right, or just on the representational relationship (DeLoache, 2000; Liben, 1999). A child who treated the written word 'pig' as an object in its own right, ignoring its role as a representation, would presumably assume that it maintained its identity (as a substitute pig?) across contexts. A child who over-emphasized the representational aspect of the written word might be expected to assume that the physical form of the representation changed with the real referent (Beilin & Pearlman, 1991; Thomas et al. 1999).

There is some evidence that children do err in that latter way with written words. Thomas et al. (1999) gave 3- and 4-year-olds a task in which a doll wore a sticker showing a sheep. The experimenter wrote the doll's name followed by 'sheep' and turned the paper face down. The doll's sticker was then changed to a lion and the doll was turned face down. Children were asked both which sticker was written on the paper and whether the writing had been changed, along with a check question to ensure children remembered what sticker the face down doll was currently wearing. Some children judged that the writing had changed and that it now said 'lion'. In contrast when changes were made to a doll other than the one represented in writing children answered correctly that the writing had not changed and reported correctly what was written. The implication of the results of Thomas et al. (1999) is that children tend to assume that changes in physical form accompany changes in meaning. This is apparently contrary to the assumption revealed by errors in Bialystok's moving word task, that one physical form can have two meanings. However this one study by Thomas et al. (1999) should perhaps not be given too much weight. The question about physical change may have been difficult for children to understand. One third of the original sample did not complete the study because they failed a pretest to assess their understanding of the change question.

In contrast the findings using Bialystok's moving word task have been replicated many times. Because the written word in this procedure is face up it seems unlikely that children who make moving word errors could assume the word's physical form has changed. Bialystok's interpretation appears to be more plausible: That children assume that one physical form is flexible in meaning.

It remains unclear however just under what circumstances children make such errors with written words. Our aim in the experiments presented here was to find out. One possible result was that responses indicating flexibility of written words' meanings appeared reliably and frequently across a wide range of tasks. This would have suggested that young children treat the relationship between written words and their referents very differently from the way they treat the relationship between other representations and their referents. As we shall report below, however, the results suggest that particular task characteristics make it more or less likely that children will treat written words' meanings as stable. Although the moving word task reveals difficulties which children do not show with other forms of representation, those difficulties are context specific. Our conclusion in this paper will be that the question for future research is 'Why do children fail in the standard moving word task but not in other tasks?'

It has already been argued that particular features of the standard moving word task may maximize errors. Bialystok (1999) points out that to succeed, children need to attend to the print and avoid being distracted by the picture or real object. Yet because the word is initially adjacent to a matching picture or object, 'the child's attention is almost irresistibly drawn to the picture' (p640). In line with this analysis, Bialystok (1999) found performance on the moving word task was related to performance on Frye, Zelazo and Palfai's (1995) dimensional change card sorting task, interpreted as a measure of executive control. In this task children begin by sorting pictures according to a rule, and after successfully sorting on this basis they are asked to begin sorting them on the basis of another rule. Children aged 3- to 4-years find this switch difficult under certain conditions (Perner & Lang, 2002). Bialystok (1999) argues that in both the moving word

and the card sorting tasks, the initial criterion for responding becomes obsolete later in the task. In the card sorting task children have to begin using the new rule; in the moving word task children have to realise that the movement is irrelevant and that the meaning of the written word remains unchanged.

In addition, Bialystok and Martin (2003) found performance on the moving word task was weakly related to accuracy on Gerstadt, Hong and Diamond's (1994) day-night stroop task. In this task children have to avoid naming the picture they see (e.g. 'night'), and say the opposing word instead ('day') and vice-versa. Children aged 3- to 4-years find this difficult over repeated trials. Again, there is a similarity to the demands of the moving word task: Children also have to inhibit a prepotent response, namely saying the name of the adjacent toy when asked what the word says.

The evidence so far, then, suggests both that there is something about the way children treat written words which maximizes the chances of their making errors (compared with other forms of representation), but also that there might be particular features of the moving word task which maximize the chances of children making errors (compared with modified tasks which are less demanding of attentional and inhibitory control). This latter suggestion has as yet no *direct* supporting evidence; it arises from task analysis and from correlations between moving word errors and performance on tasks of attentional and inhibitory control.

In the experiments which follow we examine children's performance in variants of the moving word task, not designed just to reduce its attentional and inhibitory demands but more generally to assess children's readiness to treat print as having fixed meaning in various different conditions. The variations we used in Experiments 1 and 2 arise from

suggestions made in previous work (Bialystok & Martin, 2003). In Experiment 1 we modified the standard task in a way that may discourage children from assuming a word says the name of whatever toy it is alongside. In Experiment 2 we used a task which, unlike the variation used in Experiment 1, did not appear to reduce the inhibitory or attentional demands of the standard task, but which we expected children to construe in a more appropriate way. In Experiment 3 we asked children to change what a card said, rather than asking them what it said after a change in its physical placement. By comparing performance on each of these tasks with that on the standard moving word task, we expected to gain a clearer idea of the range of conditions under which children treat the meaning of written words as flexible or fixed, and so to begin to clarify how children eventually develop a robust understanding of the stability of meaning of written words.

Experiment 1

Bialystok (1999; Bialystok & Martin, 2003) identifies a feature of the standard moving word task which may lead children astray, and so this is a sensible starting point for further research. She argues that the initial placement of the word alongside a matching object may encourage use of a position-based strategy to determine word meaning. When the word is then moved to a non-matching object, this strategy produces a moving word error. Bialystok and Martin (2003) attempted to avoid encouraging use of a position-based strategy by having no initial matching condition. Instead a written word ('dog') was initially placed alongside a non-matching picture (a boat), and then moved to a second non-matching picture (a tree). Rather than making things easier, children found the new task more difficult overall than the standard task. Bialystok and Martin (2003)

suggest that to answer correctly in the new task, children had to accept and remember the experimenter's assertion of what the word says even though this corresponds to neither of the pictures on the table.

In our first Experiment we tried to avoid the confusion that might arise when there is no relationship between the word and pictures simply by reversing the order of events in the standard moving word task. In our reverse task the written word was initially placed alongside a non-matching toy and then moved to a matching toy. We examined whether or not children are less likely to give the name of the non-matching toy when asked what the word says in the reverse task than in the standard task. If they are this would suggest that the particular demands of the standard task induce errors.

A potentially important difference between the standard moving word task and the reverse task is in the manner in which the word is moved adjacent to the non-matching toy: 'Accidental' in the moving word task and intentional in the reverse task (since in the reverse task the experimenter places the word adjacent to the non-matching toy immediately after telling the child what it says). Previous research has always employed an 'accidental' movement of the word to the non-matching toy to minimize the sort of pragmatically based errors identified on Piagetian conservation tasks (McGarrigle & Donaldson, 1974). We checked whether 'accidental' movement is effective in minimizing pragmatically based errors. Children undertook two moving word tasks differing only in how the word was moved adjacent to the non-matching toy: 'Accidentally' by a puppet as in the standard task or intentionally by the experimenter.

Method

Participants. Fifty-eight children (27 girls) took part. They were aged from 3;09 to 4;08 (mean = 4;03) and attended nursery classes in 2 schools in Staffordshire U.K. with lower middle class intakes. All children in this and subsequent Experiments were monolingual speakers of English.

Design. All children initially undertook a reading task then 2 trials each of the Accidental moving word task, Intentional moving word task and the Reverse task. The order of these 3 tasks, the toys and matching words used on the tasks and the location of the matching and non-matching toys (left and right to the child; vice-versa) were all counterbalanced between children.

Procedure. In the *Reading task* the child was shown cards on which were written the child's own first name and six words used in the subsequent moving word and reverse tasks. Cards to be read were presented in the order: Child's own first name, pig, car, frog, duck, mouse and elephant all printed on 9 X 4 cm card in Size 72 Times New Roman script. The task was discontinued after three consecutive errors to avoid exposing children to prolonged failure.

Before the remaining tasks were undertaken the child was introduced to Max the dog, a hand puppet operated by the experimenter. It was explained that Max had a cold. Max subsequently sneezed to emphasize this point.

For the standard *Accidental moving word task*, the child was shown 2 toys such as a frog and a lion which were named. A card with the word frog written on it was then presented and the child was told "This card has the word frog written on it". The word was then moved adjacent to the toy frog and the child was asked the introductory

question "What does this card say?" After the child responded Max sneezed and in doing so moved the card so it was adjacent to the toy lion. The child was asked again what the word said (inconsistent question).

The *Intentional moving word task* was identical in procedure to the 'accidental' task except that children were asked to "Watch what I do now" and the experimenter moved the word from the matching toy to the non-matching toy.

The *Reverse task* was identical in procedure to the accidental moving word task except the word (e.g. 'frog') was initially placed by the experimenter to adjacent to the non-matching toy (e.g. the lion) and then moved 'accidentally' to the matching toy (e.g. the frog). Children were asked what the word said after its intentional movement adjacent to the non-matching toy (inconsistent question) and again after its 'accidental' movement adjacent to the matching toy (consistent question).

Results

For the reading task each child received a score out of 7 based on the number of words read correctly.

As expected most answers to the introductory and consistent questions on the 3 moving word tasks were correct. Four children made errors. Their data are included in the analyses below.

Each child received scores of 0,1, or 2 according to number of correct answers to the inconsistent question (when the word was alongside the non-matching toy) in the accidental moving word task, the intentional moving word task, and the reverse task.

Preliminary analyses revealed no effect of gender, task order, the different words used on the tasks between children or the location of the matching and non-matching

toys. These variables are therefore not considered further. On the reading task 2 children read their own first name and one other word used on subsequent moving word or reverse trials. Both were successful on all moving word and reverse trials, and they have been excluded from the analyses below. Twenty-six children read their own name only (name readers) and thirty read none of the words (non-readers). Table 1 summarizes these children's performance on the 3 tasks.

Insert Table 1 near here.

A 2-way ANOVA with task type (accidental; intentional; reverse) as a within-subject factor and reading group (name reader; non-reader) as a between-subject factor revealed a main effect of task: $F(2, 55) = 8.6$, $p = .001$. Planned comparisons showed performance on the reverse task was more accurate than performance in the accidental moving word task: $t(55) = 2.93$, $p = .005$, and in the intentional moving word task: $t(55) = 3.63$, $p = .001$. Performance in the intentional and the standard accidental moving word tasks did not differ: $t(55) = 1.07$, $p = .289$. Since use of parametric tests for scores of 0, 1 and 2 is not uncontroversial, in this and in subsequent experiments we confirmed these results using Wilcoxon tests. The main effect of reading group was not significant: $F(1, 54) = 1.26$, $p = .267$, nor was the interaction: $F(2, 54) = .04$, $p = .957$.

Discussion and Conclusions

The better performance in the reverse task than in the standard accidental moving word task is as predicted on the basis of Bialystok and Martin's (2003) interpretation of the inhibitory and attentional demands of the standard task, although their results using a

task with 2 non-matching toys did not support their prediction. Our results suggest that when children do not encounter an initial match between a written word and a toy, they are unlikely to assume that the meaning of the written word is determined by whichever toy it is placed adjacent to. According to Bialystok and Martin's (2003) interpretation of the demands of the standard task, a position-based hypothesis for determining word meaning is made salient because the word is initially placed adjacent to the object it does name. In the reverse task, the position-based hypothesis is not made salient, and as predicted children are less likely to judge that the word names the non-matching object.

Apperly et al. (in press) used a task similar to our reverse task, although theirs did not differ in difficulty from a task in which there was initial matching between word and toy. However in their procedure the non-matching toy was moved to the word rather than the word being placed alongside the toy and this could have made the non-matching toy more salient than it was in our task.

There was no difference in difficulty between the accidental and intentional moving word tasks on the inconsistent trials. 'Accidental' movement in previous published work (e.g. Bialystok 1991; 1997; 1999; 2000; Bialystok & Martin, 2003) was used in order to minimize the risk of children changing their response simply because the social context suggests to them that something has changed (Donaldson, 1978). Our results suggest this precaution may be unnecessary in the moving word task. In addition, children might have interpreted the experimenter's deliberate movement of the word as revealing an intention that the word should now refer to the non-matching toy even though its physical form remains unchanged. This appears not to be the case.

Most children could not at the outset read any of the words used in the subsequent tasks. The 2 children who did read one of the words used made no moving word errors, even for the words they could not read, as expected on the basis of Bialystok's argument that understanding words' meanings are fixed, as assessed by the moving word task, is a prerequisite to reading. There was no evidence first name readers performed differently on the tasks than non-readers.

Experiment 2

The reverse task in Experiment 1 was easier, according to Bialystok and Martin's (2003) interpretation, because the attentional and inhibitory demands were reduced: When asked the inconsistent question children did not have to ignore a previously successful position-based strategy. Our second variation on the standard task also arises from Bialystok and Martin's (2003) study, although this time the aim was not to reduce attentional or inhibitory demands but rather to assess children's responses in a task that might make more sense to them. Bialystok and Martin (2003) found that when neither toy matched the written word children performed particularly poorly overall, and these authors suggest children perhaps found the task confusing. This raises the possibility that children might also be confused by the presence of the single non-matching toy in the standard task. The non-matching toy has no word to go with it and is simply a distracter. Children may assume wrongly that it has a genuine role in the game and in trying to make sense of its presence, may make moving word errors. In Experiment 2 we modified the task to give both toys a genuine role. In this new task, the word exchange task, each of 2 words started alongside their matching toys and then both words were swapped over so that each lay beside a non-matching toy. Children were asked what each word said.

The word exchange task could be particularly difficult. The child has to remember what 2 words say instead of one, and has to bear in mind both their movements instead of just a single word's move. Unlike the reverse task, there are no obvious reductions in inhibitory or attentional demands. As in the standard task the child may be encouraged by the initial word-toy matching to use a position-based strategy to determine word meaning, and has to inhibit saying the name of the adjacent non-matching toy.

On the other hand the word exchange task may make better sense to the child than the standard moving word task. Each toy has its own word and the experimenter's deliberate swapping could be construed as similar to a classroom activity in which the teacher tests the child's recognition of words. Here, like Bialystok (1991; 1997; 1999; Bialystok & Martin, 2003) we draw on Donaldson's (1978) broad argument about the importance of tasks making 'human sense' to the child and the risks associated with the child and experimenter interpreting the task in different ways (see also Siegal, 1997).

In Experiment 2 we used an easier reading task than the one used in Experiment 1. There, written words were shown without the children having any knowledge of the possible referents and the great majority of children within the age groups and samples used in our studies perform at floor in such a reading task (and are considered pre-readers by their teachers). This time children were shown the set of words in conjunction with the set of referents and they were asked to place each word alongside its correct referent. In addition we gave the reading task at the end of the testing session, after children had been told what each word said in the other tasks. Children might succeed at this just by identifying the initial sounds, and children who were borderline readers might have been able to learn at least some of the words from their prior experience within the testing

session. Our aim was to identify children who were on the verge of reading independently and to see how they performed in the moving word task and the word exchange task.

Method

Participants. Participants were 92 children (40 girls) from nurseries and schools in Staffordshire, U.K. with lower middle class intake. The sample was divided into a young group aged from 3;10 to 4;06 (mean = 4;04; N = 46), and an old group aged from 4;06 to 5;06 (mean = 5;01; N = 46).

Design. All children undertook 3 tasks. The first 2 were the moving word task and the word exchange task (2 trials of each), with the order of these 2 tasks counterbalanced between children. The word sorting task always came last. The toys and matching words used were counterbalanced across the moving word and word exchange tasks between children. The 2 matching toys and words from the moving word task and 2 of the matching toys and words from the word exchange task were used for the word sorting task.

Procedure. The *Moving word task* was the same as the standard accidental task used in Experiment 1. For the *Word exchange task* the child was shown 2 toys such as a pig and a cow which were named. The child was then shown a card with the word pig written on it and told, "This card has the word pig written on it. Now, I'm going to put the card here (adjacent to the toy pig)". The child was then shown another card with the word cow written on it and similarly told that the card says cow and it was placed adjacent to the cow. The child was then asked what each card said (introductory questions). The experimenter then said, "Watch what I do now", and slowly moved the

word pig adjacent to the toy cow and the word cow adjacent to the toy pig. The child was then asked an inconsistent question for each card. The child was asked about each card "What does this card say?"

In the *Word sorting task* a toy dog, horse, mouse, pig and bird were arranged in a horizontal line. Cards with the toys' names written on them were arranged in random order below the display along with two distracter words. All words were arranged upside-down (but face-up) from the child's perspective. The child was told, "These words are upside-down. Some of these words name these toys. Let's see if we can find the right word for the right toy. The experimenter demonstrated by placing the word bird the right way up and adjacent to the toy bird, and the child was encouraged to continue.

Results

In answer to the introductory questions of the moving word and word exchange tasks only 2 children made an error on any trial. Their data are included in the analyses. Answers to these questions are not considered further. Each child was given scores based on the number of correct answers to the inconsistent questions in the moving word task (scores out of 2) and the word exchange task (scores out of 4 since the child was asked about 2 words on each trial). To compare performance on the moving word and word exchange task, scores on the latter task were divided by 2. Only 2 children passed one test question and failed the other on one of their 2 word exchange task trials, the remainder passed or failed both test questions of a given trial. These 2 children were scored as failing the trial. For the word sorting task, children passed if they placed all 4 words the right way up adjacent to toys, and at least 3 of the 4 were alongside the correct toy. All other response patterns were classified as failures.

Preliminary analyses showed no effect of gender or of the different words used in the tasks between children, so these variables were not considered further. Table 2 summarizes younger and older children's performance on the 2 tasks.

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Insert Table 2 near here

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First we compared performance on the moving word and word exchange tasks. As shown in Table 2, children in both age groups performed well in the word exchange task, and the older children also performed well in the moving word task. A mixed 3-way ANOVA was applied to the data with task type (moving word task; word exchange task) as a within-subject factor, and age (young; old) and task order (moving word task then word exchange task; vice versa) as between-subject factors. There was a main effect of age: $F(1, 88) = 39.52$, $p < .001$. The 5-year-old children were better on both tasks than the 4-year-old children. There was a main effect of task: $F(1, 88) = 16.4$, $p < .001$. Children found the word exchange task easier than the moving word task. There was also a main effect of task order: $F(1, 88) = 3.94$, $p = .05$. The tendency was for better performance on both tasks when the word exchange task preceded the moving word task (Word exchange task mean = 1.78 *vs.* 1.57, Moving word task mean = 1.49 *vs.* 1.19). Finally, there was an interaction of age group and task: $F(1, 88) = 10.64$, $p = .002$. Planned comparisons revealed that the young group found the moving word task more difficult than the word exchange task: $t(45) = 4.04$, $p < .001$, whereas the old age group performed no differently across tasks: $t(45) = 1$, $p = .323$. We confirmed these two results using Wilcoxon tests. There were no other significant or near significant effects.

Next we examined the relationship between performance on the moving word and word exchange tasks on the one hand, and the word sorting task on the other. Despite the fact that the word sorting task provided an undemanding test of reading, the 38 children who passed it (5 from the young age group and 33 from the old age group) performed almost perfectly. There were no errors by word sort passers on the moving word task, and only a single error on the word exchange task. In contrast 28 of the 54 word sort failers (52%) scored 0 in the moving word task and only 21 (39%) scored the maximum of 2. Word sort failers performed better on the word exchange task: 10 (19%) scored 0, and 35 (65%) scored the maximum of 2.

Discussion and Conclusions

Once again children who made errors on the standard moving word task treated written words' meanings as fixed a one-to-one relationship between written word and meaning in a modified task. The word exchange task appears superficially to be more demanding than the standard task because the child has to remember what 2 words say instead of just one and monitor both of their movements rather than just a single word's move. The metalinguistic and inhibitory and attentional demands of the word exchange task seem not to be any less than those in the standard moving word task, since words still move from matching to non-matching toys. Our suggestion is that the word exchange task makes more sense to the child because each toy has a role to play. Unlike in the standard task children were not inclined to make moving word errors in the word exchange task through trying to make sense of the role of the wholly irrelevant non-matching toy. As an unknown reviewer points out, because each toy has an associated word, the task implies a one-to-one mapping between words and their referents. In

contrast, the standard moving word task does not: There is one toy with no word. Children may construe the word exchange task as similar to a classroom activity in which the teacher tests their word recognition. Just as Bialystok and Martin's (2003) task with 2 non-matching pictures may have been more confusing than the standard task, our word exchange task where each word has a matching toy appears to have been less confusing.

Note that the word exchange task was easier than the moving word task despite the fact that word movement was deliberate in the word exchange task but accidental in the moving word task. If deliberate movement tends to encourage children to change their answer (although Experiment 1 provided no evidence that it does) then this would if anything have increased the difficulty of the word exchange task relative to the moving word task.

The tendency was for children who had the word exchange task first to perform better on both the word exchange and the moving word tasks. One possibility is that because children interpreted the word exchange task as a straightforward test of recognition of the two words, they applied that same interpretation to the moving word task and so performed relatively well. Children who had the moving word task first in contrast may have been encouraged to use the position-based strategy to determine word meaning and continued to use that in the subsequent word exchange task. If this interpretation is correct it implies that errors on the moving word task are not just an inevitable consequence of its inhibitory and attentional demands but can be avoided if children construe the task in a different way.

Children who performed well on the word sorting task made virtually no errors in the word exchange or moving word tasks, despite the likelihood (given teachers'

judgements that the vast majority were pre-readers) many of these children probably would not have been able to read the words spontaneously without contextual cues and may only have been using initial letter sounds to sort correctly. The children who made errors on the word exchange and moving word tasks performed more poorly in the word sorting task. Importantly, many children who performed poorly in the word sorting task nevertheless performed well in the word exchange task. It could have been that only children on the verge of reading (word sort passers) succeeded on the relatively easy word exchange task but that was not the case. This suggests at the very least that a misconception about the way written words convey meanings is not the immediate impediment to learning to read.

Experiment 3

In the final Experiment our aim was to explore how children set about making print say something different. Did they assume its physical form must change (e.g. the word must be replaced by a word with a different form), or did they assume a mere change in the word's physical placement would be effective? The child was shown that a card had a different word written on each side, one for each of two toys on display. Initially, the word which was face up was placed adjacent to its matching toy. The child was then asked to make the card say the name of the non-matching toy. All the children experienced standard moving word trials immediately beforehand, so they had seen that words could be moved. They had also all moved words to toys themselves in a word sorting task. We also checked that they did move cards in a control task in which this was the correct response.

If children spontaneously moved the card adjacent to the non-matching toy to make it say that toy's name, this would be indicative of a misconception about how written words convey meaning. On the other hand, if they rarely or never did that, and instead indicated that the physical form of the written word must change if its meaning is to change, this would suggest that children's first assumption in this context is *not* to treat words' meanings as determined by their proximity to toys or pictures.

Method

Participants. Fifty-six nursery children (22 girls) took part. They were aged from 3;09 to 4;09 (mean = 4;02) and attended a nursery in Staffordshire, U.K. with a middle class intake.

Design. All children undertook 4 tasks in the following order: Word sorting task, moving word task, card turn task and card move task. There were 2 trials for each of the moving word, card turn and card move tasks. The toys and matching words were counterbalanced across task type between children.

Procedure. For the *word sorting task*, the child was introduced to a toy dog, frog and a teddy bear, and shown 5 cards with written words. The child was told that 3 of the words matched the toys. The experimenter placed the word teddy (standard term in U.K. for a teddy bear) adjacent to the teddy bear, telling the child what the word said, and asked the child to try and place the other words adjacent to the toys they named. Unlike the word sorting task in Experiment 2 the words were not placed upside-down, in order to avoid priming a correct move response on the card move task. This task ensured that all children had moved cards prior to the card turn task but it also served as a brief check on children's reading skills.

The procedure for the *Moving word task* was the same as the standard accidental task used in Experiment 1. For the *Card turn task* the child was shown 2 toys such as a duck and a tree which were named. The experimenter showed a card saying "This card has the word tree written on it, what does this card say?" Once the child correctly responded the experimenter turned the card over and continued, "But on this side the card has the word duck written on it." The card was then placed adjacent to the duck and the child was asked what the card said (introductory question). The child was then asked "We want the card to say tree, can you put the card right?" (demonstration question).

The *Card move control task* checked that children did move a card when this was correct, and did not turn it over when this was incorrect. The child was shown 2 toys such as a teddy bear and a horse which were named. The experimenter showed a card with the word teddy written on one side, and horse on the other. This was explained exactly as in the card turn task, but this time with the word teddy face up the experimenter said "Watch what I do now" and turned it through 90 degrees so it was incorrectly aligned for reading. The child was then asked, "We want the card to say teddy, can you put the card right?" (demonstration question). This task always followed the card turn task, when turning was the correct response, to maximize the chances of children wrongly turning the card over in the card move task.

Results

One child made errors on one introductory question of the moving word and one introductory question of the card turn task. His data are included in the analyses. For the moving word task, each child received a score out of 2 for the inconsistent questions, according to the number of times they correctly reported what the word said when it was

adjacent to the non-matching toy. For the card turn and card move tasks each child received scores out of 2 for the demonstration questions. To pass the card turn task, children had to turn the card over or indicate that it should be turned, whether or not they also moved it adjacent to the matching toy. To pass the card move task, children had to rotate the card into a correct horizontal position or indicate that it should be moved, but must not turn it over. For the word sorting task, children received a score out of 2 for the number of words correctly placed adjacent to the toys they named.

Preliminary analyses showed no effect of gender or of the different words used in the tasks between children, so these variables were not considered further. On the card turn task only 4 children out of 56 wrongly moved the card adjacent to the non-matching toy without turning it over on both trials, and 1 child did so on 1 trial. The remaining errors were non-responses. On the card move task 8 children wrongly turned the card over on both trials, and 1 did so on 1 trial. Clearly children were inclined to turn the card over only when it was correct to do so: 46 out of 56 did so on both trials in the card turn task, compared with 8 in the card move task. Table 3 gives the scores for the moving word, card turn and card move task.

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Insert Table 3 near here

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A one-way ANOVA with task type (moving word; card turn; card move) as a within-subject factor revealed a main effect of task: $F(2, 55) = 11.24$, $p < .001$. Planned comparisons showed performance on the card turn task was more accurate than on the moving word task: $t(55) = 4.43$, $p < .001$, and performance on the card move task was

also more accurate than on the moving word task: $t(55) = 3.59$, $p = .001$. Scores on the card turn and move tasks did not differ: $t(55) = .88$, $p = .383$. Wilcoxon tests showed the same effect.

As a stricter test of correct decisions about when to move and when to turn the cards, we devised a composite card turn and move task score. Children received a score of 2 if they passed both trials of both the card turn and card move task. They received a score of 1 if they passed at least 1 trial of the card turn and 1 trial of the card move task. All other children received a score of zero. Using this strict composite score, performance on the card turn and move task (mean = 1.32) and on the moving word task (mean = 1.05) met a 1-tailed criterion for significant difference: $t(55) = 1.84$, 1-tailed $p = .035$. A 1-tailed Wilcoxon test showed the same effect.

The primary purpose of the word sorting task was to ensure children had physically moved cards prior to the card turn task, so we could be confident that moving cards was in their response repertoire. Because there were only 2 words to sort, and the words were the right way up, children could perform well by chance and the relationship with moving word errors was expected to be less clear-cut than in the previous studies. In the word sorting task 8 children were correct on both trials. Amongst these 8 children, 6 passed both trials of the moving word task and the remaining 2 passed one trial. All 8 children passed both trials of the card turn task. Five of the 8 children passed both trials of the card move task, one child passed one trial and the remaining 2 children failed both trials.

Discussion and Conclusions

Assumptions about the stability of word meanings

We again confirmed that in the standard moving word task children judge as if the meaning of a written word can be changed according to its physical placement. Yet in the card turn task there was little sign that children respond on this basis. Instead, when they were asked to change what a word said, they responded as if they assumed that the physical form of the word needed to be changed even though the move response had been primed. As in the word exchange task, each toy in the card turn task had an associated word, although in the card turn task both were written on a single card. As suggested in Experiment 2 in connection with the word exchange task, the card turn task may have implied a one-to-one mapping between words and their referents. Nevertheless, children had every opportunity to move the card alongside a non-matching toy had they assumed that that placement would change what the word said, and they chose not to do so. Whereas the particular conditions of the moving word task induce children to treat written words' meanings as flexible, the conditions of the card turn task do not.

The word sorting task used in this Experiment was probably intermediate in difficulty between the reading task used in Experiment 1 in which children had no clues as to the words' meanings, and the word sorting task given at the end of the session in Experiment 2 with the set of referents available. However the small number of words to sort increased the incidence of correct sorting by chance. Children who performed well in the word sorting task were virtually error-free on the moving word task, and many children who performed more poorly nevertheless succeeded on the card turn and move tasks. Again, children who seemed not even to be on the verge of reading independently treated written words' meanings as fixed.

Final Discussion and Conclusions

Assumptions about the stability of word meanings

The results of all 3 Experiments confirm previous findings that in Bialystok's moving word task pre-readers are likely to judge as if they assume the meaning of a written word can change according to its proximity to potential referents. Bialystok and Martin (2003) consider these errors to be symptomatic of a fundamental misconception about how print signifies meaning, and overcoming this is a prerequisite for learning to read: "...once they grasp this essential nature of print… they will have achieved the insight that opens the door to literacy." (Bialystok & Martin, 2003, p242).

Our results are consistent with the suggestion that success on the moving word task is a pre-requisite for learning to read: The children in our experiments who could read one of the words (Experiment 1) or who passed the word sorting tasks (Experiments 2 and 3) made hardly any errors on the standard moving word task or on our modified tasks.

Importantly, it could have been otherwise. Obviously learning to read involves treating written words as having fixed meanings in normal everyday circumstances when words appear without pictorial support, or with appropriate pictorial support. However in the early stages of reading the child might still be thrown by difficult conditions such as those in the moving word task. As the child's reading skills become more solid, she is protected from such distraction. If so, a child at the very early stages of reading (as diagnosed by our word sorting task for example) might make errors in a standard moving word task, yet perform well in a variation which makes weaker executive demands such as the reverse task, or which makes better intuitive sense, like the word exchange task, or which elicits the child's spontaneous strategy for changing word meaning, like the card turn task. Our results are not in line with this possibility.

In addition, it could have been that our modifications to the standard moving word task had no effect on the incidence of errors. Pre-readers might have been inclined to treat written words' meanings as flexible across a range of different circumstances. If so, as we pointed out in the introduction, this would have suggested that young children treat the relationship between written words and their referents very differently from the way they treat the relationship between other representations and their referents. The published literature might lead us to expect that result. Variations tested by Bialystok and Martin (2003) and by Apperly et al. (in press) led to no reduction in errors when generic written words (as opposed to personal names or uninterpretable drawings) were used.

Our results show however that even with generic written words, under certain conditions many (but not all) pre-readers can treat meanings as stable; their fragile hold on how print represents is not necessarily overwhelmed when a written word lies alongside a non-matching referent. These more supportive conditions included ones which appeared to be less demanding of executive and inhibitory control than the standard moving word task: In Experiment 1 we simply reversed the order of events so that the word was not placed adjacent to the matching toy before being moved to the non-matching toy. Children were therefore not tempted into using an incorrect position-based strategy to determine word meaning. However a reduction in executive demands was not necessary for improved performance. In Experiment 2 the order of events was the same as in the standard task but both toys had words associated with them, implying a one-to-one relationship between word and referent. Children were not misled into giving the non-matching toy a role in the game, and assumed each word maintained its original meaning after it was moved to a non-matching toy. In Experiment 3 children were given

the opportunity to demonstrate their understanding of how written words convey meaning, and they chose the option which implied that words have fixed rather than flexible meanings: Changing the physical form rather than the physical placement. In all these relatively easy tasks, the stability of written words' meanings may have been implied more strongly by the context than it is in the standard task.

Clearly young children do have specific difficulty understanding how written words represent their referents: They make errors in the standard task which they do not make with uninterpretable drawings for example (Apperly et al., in press). However with written words they also have difficulty specifically in the standard task that they do not necessarily have in our modified tasks. The question for future research is 'Why do children make errors in the standard moving word task but not in other tasks?' and not 'Why do children treat written words as representations differently from other forms of external representation?'

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Table 1. Experiment 1: Mean Scores (sd) and Distributions of Scores on the Accidental and Intentional Moving Word Tasks and the Reverse Task.

		Task		
		'Accidental'	Intentional	Reverse
Name readers	Mean (sd)	1.19 (.94)	1.12 (.95)	1.46 (.9)
	Distribution 0,1,2	9; 3; 14	10; 3; 13	7; 0; 19
Non-readers	Mean (sd)	.93 (1.02)	.87 (.97)	1.17 (.95)
	Distribution 0,1,2	16; 0; 14	16; 2; 12	11; 3; 16

Table 2. Experiment 2: Mean Scores (sd) and Distributions of Scores on the Moving Word and Word Exchange Tasks by Age Group.

Age group		Moving Word Task (Max = 2)	Word Exchange Task (Max = 2)
Young	Mean (sd)	.83 (.95)	1.44 (.81)
[4yrs]	Distribution 0,1,2	25; 4; 17	9; 8; 29
Old	Mean (sd)	1.85 (.52)	1.91 (.35)
[5yrs]	Distribution 0,1,2	3; 1; 42	1; 2; 43

Table 3. Experiment 3: Mean Scores (sd) and Distributions of Scores on the Moving

	Task		
	Moving Word	Card Turn	Card Move
Mean (sd)	1.05 (.96)	1.7 (.69)	1.57 (.78)
Distribution 0,1,2	24; 5; 27	7; 3; 46	10; 4; 42