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The Role of Attention in Word Learning from Shared

Storybook Readings

Zoe Martine Flack

Thesis (by papers) submitted for the degree of

Doctor of Philosophy

University of Sussex

September, 2017

I hereby declare that this thesis has not been and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature:………………………………………

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Summary

Shared storybook readings with an adult provide children with opportunities to imagine different worlds, experiment with new ideas and be inspired. Existing research shows that shared storybook reading also supports word learning. To date the role of attention in word learning from shared storybooks has been largely overlooked. The aims of this research programme were to investigate how changes to storybook reading interactions, or storybook formats might influence children's word learning by making target words and objects more or less salient using various attentional manipulations which could be used in the real world.

Chapter 1 provides an introduction and literature review. Chapter 2 presents a multi-level meta-analysis of studies of word comprehension from shared storybook reading. Empirical chapters (Chapters 3-6) use bespoke storybooks controlling for story length and number of exposures to novel vocabulary to examine children's word learning from storybooks. Participants are 3- and 4-year-old typically developing children. In Chapter 3 children's eye movements are recorded while they are presented with repeated or different stories. We find no evidence of differences in eye movements or word learning between conditions. Chapter 4 demonstrates that presenting storybooks one page at a time (as in Chapter 3) improves word learning compared with when two pages are displayed at a time. Chapter 5 investigates whether illustration complexity (Experiment 1) or salient illustration features (Experiment 2a and b) affect children's learning of the depicted novel words. We found no evidence to support this with the stimuli we used. Chapter 6 investigated the role of storybook repetition in learning new words and the development of narrative skills.

Overall, the research programme supports the idea that children's word learning can best be supported by storybooks and reading styles which provide a suitable level of informational content and adult scaffolding from which they can learn.

Dedication

For Vee, who made me believe I could do whatever I set my mind to. The world was a richer place with you in it.

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Contents

Introduction

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Introduction

Word learning is a particularly important part of a child's development. Even before birth, children are gathering information about language; becoming familiar with the sounds and detecting the patterns that will help them communicate with those around them (e.g., DeCasper & Spence, 1986; Werker & Tees, 1984). With each passing day they accumulate more experience of the world around them, learning how to pick out individual words (e.g., Saffran, Aslin, & Newport, 1996), and with successive encounters, working out what these words may mean (Smith & Yu, 2008). Children begin to try to produce some of the words they have learned around the time of their first birthday (Fenson et al., 1994). After the rather gradual process of acquiring these first few words, children begin to add to their vocabularies rather more quickly, with estimates suggesting children learn about 500 words per year during the first few years of school (Biemiller & Boote, 2006; Milton & Treffers-Daller, 2013).

As children learn more words, they become more skilled at word learning. This means that children with larger vocabularies continue to learn words at a faster rate than those who started with smaller vocabularies (Marchman & Fernald, 2008), thus widening the performance gap over time (e.g., Hart & Risley, 1995; Penno, Wilkinson, & Moore, 2002; Stanovich, 1986). Children with larger vocabularies at school entry are more likely to be successful academically (e.g., Lonigan & Whitehurst, 1998; Milton & Treffers-Daller, 2013), particularly with general language skills (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003), and literacy skills (Cunningham & Stanovich, 1997; Whitehurst et al., 1994). Academic success provides greater opportunities for children later in life (e.g., Carnevale & Rose, 2011; Kautz, Heckman, Diris, Weel, & Borghans, 2015), and provides protective benefits against negative outcomes such as criminality (e.g., Farrington & West, 1990; Losel & Farrington,

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2012). This makes giving children the best possible start with word learning an important goal—particularly in the pre-school years, as these benefits can increase exponentially.

Children learn much of their vocabulary from everyday life experiences (Hoff & Nagles, 2002; Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007; Montag, Jones, & Smith, 2015). Parents and others typically encourage children to learn new vocabulary such as nouns during conversations (Fernald & Hurtado, 2006; Schwab & Lew-Williams, 2016), for example, by modelling "Ball. Look at the ball" or by providing helpful emphasis around important vocabulary (Fernald & Mazzie, 1991; Rice, Buhr, & Oetting, 1992). But children also learn from explicit tuition (e.g., Kame'enui & Baumann, 2012; McKeown, Beck, Omanson, & Pople, 1985) and speech that is not directed toward them (e.g., Akhtar, Jipson, & Callanan, 2001). Another important source of new vocabulary is that encountered in books (e.g., Biemiller & Boote, 2006; Bus, 2001; Montag et al., 2015).

Storybooks provide a window into a whole new world, one not limited by the banalities of everyday life. Children's literature introduces new themes, characters and perspectives, giving young children the opportunity to engage with real and imaginary scenarios which broaden their horizons (Abad & Pruden, 2013; Heath, Houston-Price, & Kennedy, 2014; Richert & Smith, 2011). Storybooks are a source of pleasure for many reasons, not least that they provide exciting new learning opportunities.

In this thesis I consider just one of the many benefits of sharing a book with a child, namely that of word learning. My aims for this thesis are to investigate various aspects of the storybooks used in shared storybook reading and how they contribute to successful word learning. More specifically, I address the following overarching questions:

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      a.) Which aspects of storybooks and storybook reading are most important in helping children learn words from shared storybook reading?

      b.) To what extent does storybook repetition help word learning?

      c.) What is the role of simplicity and complexity in word learning from shared storybook reading?

      This thesis begins with a full synthesis of existing research on word learning from shared storybook reading in the form of a meta-analysis (Paper 1). This analysis indicates that who reads, the child's age and the interval between story and test were not factors influencing word learning from storybooks. It also indicates that the role of storybook repetition in word learning would benefit from further study. This topic is subsequently investigated in Papers 2, 4 and 5. Thus, this thesis offers empirical insight into children's word learning from shared storybook reading (Papers 2, 3, 4 & 5), using a cognitive load framework to investigate how changes to storybook reading formats can help direct children's attention to (or away from) the aspects of storybooks that are critical to word learning.

Background

      A child's development includes many milestones, of which language is but one. Learning language, rather like eating solid foods or learning to walk, is only achieved by successfully combining the right equipment with the right opportunities and emerging abilities. For example, in order to learn to walk, children need to build up enough muscle mass to support their weight, be able to control their bodily movements with reasonable accuracy, and understand the movements required to locomote forwards (or, indeed, backwards; Thelen, 1996). To learn words, children need to be able to identify a word from a string of speech, abstract from their environment some meaning

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for it, be able to store and recall it, and then learn how to articulate it themselves. This process draws on memory, and audio, visual, perceptual and attentional skills. All words are new to begin with, and even when we consider we 'know' them, our understanding or construction of their meaning requires continual modification, as our experiences relating to these change.

How children achieve the amazing feat of learning to understand, and even produce new vocabulary at such a tender age has been the source of a great deal of scholarly debate over the years (Chomsky, 2006; MacWhinney, 2000; Pinker, 1994; Skinner, 1957). Early claims that children can learn more than 10 new words per day (Bloom & Markson, 1998) have been replaced by more moderate claims in the region of 4 words per day (Biemiller & Boote, 2006; Bion, Borovsky, & Fernald, 2013). This is still rather miraculous, particularly when one considers the other developmental challenges children are facing during this time. But, it is important to temper our excitement at this incredible achievement, lest we forget to ensure that we provide the rich experiences children need to have the best chances of developing their vocabularies.

Word Learning from Shared Storybook Reading

The links between successful word learning and shared storybook reading are well established (e.g., Elley, 1989; Robbins & Ehri, 1994; Sénéchal & Cornell, 1993). Although there is little contention about the efficacy of shared storybook reading for word learning, our understanding of the impact of how these readings are conducted could be improved. For example, Whitehurst et al. (1988) proposed improving the level of word learning from shared reading with a more interactive reading style, enhancing word learning significantly (see also Mol, Bus, de Jong, & Smeets, 2008). So called "dialogic techniques" exist in the literature in a number of forms. For example, they

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may include pointing to key vocabulary (e.g., Sénéchal, Thomas, & Monker, 1995),

repetition of vocabulary or stories (e.g., Coyne, McCoach, & Kapp, 2007; Penno et al.,

2002; Sénéchal, 1997), providing definitions (e.g., Coyne, Simmons, Kame'enui, &

Stoolmiller, 2004; Justice, Meier, & Walpole, 2005) asking questions (Justice, 2002;

Sénéchal et al., 1995) and their combinations, in addition to the basic storybook reading.

Dynamic Systems Theory

Word learning can be seen as the product of many interactions in the course of

development; combining maturational processes with the individual's experiences at a

particular moment in time (Fogel & Thelen, 1987). The production of a child's first

word may appear to signal a unitary skill, but in reality, many components combine to

emerge as this behaviour at this particular moment in time. For example, the child needs

to know enough about the social world to want to communicate, some experience with

the word or sounds they try to produce, and the motor co-ordination and physical

maturity to articulate the word.

Dynamic systems theory (DST) has its roots in physics and mathematics (Thelen

& Smith, 1994; Thelen & Smith, 1998) but provides the explanatory power to explain

the complexities of human development, cognition and behaviour like no other theory

can (Fogel & Thelen, 1987). Spencer et al. (2006) summarise DST as having four

central tenets. They are that of time, multicausality, embodiment, and finally, the

importance of individuality in development. The relevance of these to the topic of word

learning from shared storybook reading is considered here. The issue of time relates not

just to the emergence of word learning in the moment, but of many nested timescales

(Smith & Thelen, 2003). For example, a child's experience of being read storybooks,

and their existing vocabulary size reflect their longer term developmental history.

Shorter timescales could reflect that of the day of their visit to the lab, and the child's

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experience during the storybook reading and test session reflect the "in the moment" timescale. All of these timescales contribute to a child's behaviour in the task on the day.

The theme of multicausality refers to the multiple origins for behaviour. In the context of the current research this could be a child's social interaction experience, or the preparedness of speech motor apparatus from chewing and crying (Fogel & Thelen, 1987). The theme of embodiment in this context could refer to how a child is feeling, what other distractions are competing for their attention, how comfortable they are, and whether they have a good view of the storybooks. Finally, the theme of individuality is particularly prescient in this context because each child has a different trajectory, so the behaviours or performance we see during testing, in the lab, on the day are just a snapshot of a much larger, more complex picture.

DST offers a single unitary framework for considering the complexities of developmental change at many levels and from many perspectives (Spencer et al., 2006; Thelen & Smith, 1998). For the current thesis to have real-life value, consideration of the myriad of other interactions contributing to the performance we measure is critical. For the current thesis, therefore, I investigate the role of cognition, as just one of the many contributing factors to word learning during storybook reading. The aim of the carefully controlled experiments is to reveal information about this singular feature before considering how this may interact with the real world to produce the behaviour in question—word learning.

Cognitive Load Theory

Cognitive load theory (Paas, Renkl, & Sweller, 2003; Sweller, 1988, 1989) sets out to explain how limited cognitive resources are distributed to complete a learning task (Plass, Moreno, & Brünken, 2010). Originally conceived as purely an instructional

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theory, it has since developed to have much broader applicability (Sweller, 2010). Our ability to learn from any given situation relies on limited cognitive resources. Cognitive load theory predicts how these resources are prioritised, based on the complexity of the task, the way it is presented and the existing task-relevant skills of the learner (Plass et al., 2010). The complexity of the task is seen as intrinsic; in the context of this thesis, the task is that of learning the target words. At its most basic, this task requires some level of cognitive resources which cannot be reduced beyond a particular point. However, the presentation of the task, (in this context, the storybooks, the manner of the reading and the immediate environment during the reading) can be altered to more effectively support learning, by removing materials which are extraneous to the learning task at hand. With experience, a learner can develop schema—shortcuts which use fewer resources, to help reduce the overall load of a task. Also, when a learner is completing a task with a low cognitive load (i.e., easy task, presented without extraneous material), they can contribute 'spare' cognitive resources toward schema development. With time, and experience, learners can handle increasing levels of complexity (Kalyuga, 2010; Paas et al., 2003). In the context of learning words from shared storybooks, a child's individual developmental history with storybooks, and their 'in the moment' learning can contribute to their schema. In the current thesis, for example, storybook repetition could support schema development and reduce extraneous load because children have less new material to process.

A related idea is that of desirable difficulties (R. A. Bjork, 1999; R. A. Bjork & Kroll, 2015). This theory suggests gradual introduction of certain challenges which can improve learning, but within certain confines. I explore this idea in Paper 4 when I consider the idea of balance between complexity and simplicity.

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General Methods for Experimental Papers

This thesis uses converging methods to examine how storybook reading repetition and storybook features influence children's attention to, and thus, word learning from storybooks. In addition to the analytical methods employed for the meta-analysis (Paper 1), the experimental papers investigate word learning using eye-tracking (Paper 2), shared reading (Papers 3-5) and transcription methods (Paper 5).

There are several methodological challenges associated with using storybooks for experimental research. Here, I consider these, and outline the general methods adopted for this thesis.

Commercially available storybooks are suitable for addressing many research questions, but do have some disadvantages for studying word learning (Horst, 2013). For example, children may have seen them before, they may vary in length, style or difficulty, and target words may not be frequent enough or suitably placed (Horst, 2015b; Robbins & Ehri, 1994). Many commercially available storybooks for young children are illustrated with cartoon characters, and in particular, non-human animal characters. Evidence suggests that children learn better from realistic depictions (Ganea, Pickard, & DeLoache, 2008; Ganea, Preissler, Butler, Carey, & DeLoache, 2009) with real-life characters and plots (Richert, Shawber, Hoffman, & Taylor, 2009; Richert & Smith, 2011; although, see also Weisberg et al., 2015). Designing storybooks that provide the experimental control required is a solution, but carries the risk that new storybooks may introduce some, as yet unknown variable. Using storybooks which have been designed specifically for research, and have produced replicated effects (Horst, Parsons, & Bryan, 2011; Williams & Horst, 2014) gave me the experimental control and reliability required for the basis of most of my experiments. In Paper 4, I made

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minor manipulations to the original illustrations from Horst et al. (2011) and in Paper 2,

Experiment 2, I produced new storybooks of my own.

Another important methodological issue for word learning research is that of

choosing which words to test, and how many to include. Using entirely novel words

(i.e., *blicket*, *cheem*, *manu*) ensures complete experimental control over children's pre-

experimental exposure to vocabulary, which cannot be achieved with other words.

Some researchers opt to use synonyms for recognizable objects, for example, Sénéchal

(1997) included the word *fedora* paired with a picture of a hat. Learning new labels for

objects children have a label for may require a different level of processing, or reflect

different learning than learning a label for a new object (Ard & Beverly, 2004; Cain,

Oakhill, & Elbro, 2003), so in the current studies, I opted to use entirely novel

vocabulary. The level of word learning challenge needs to be well balanced to be able to

explore different effects. Primary aged children can learn no more than about 3-4 words

per day (Biemiller & Boote, 2006), and learn new words better when they are exposed

to them several times (e.g., Samuelson, 2002; Woodward, Markman, & Fitzsimmons,

1994). All storybooks used in the current thesis included two target words encountered

four times.

Word learning can be measured in a number of ways. For example, on word

comprehension tests children may be shown a page with four pictures and asked to

point to the correct referent of a new word (cf. PPVT, Dunn & Dunn, 2015). On

production tests children may be asked to provide definitions (e.g., Biemiller & Boote,

2006), choose between two possible definitions (e.g., Coyne, McCoach, Loftus, Zipoli,

& Kapp, 2009) or produce the target word in response to pictorial cues (e.g., Hoover,

Storkel, & Hogan, 2010). Thus, different test types reflect qualitatively different levels

of word knowledge, which can make comparisons across methods difficult. Producing a

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word on demand is more difficult than simply identifying the referent for a word from a selection of possibilities (see e.g., McMurray, Horst, & Samuelson, 2012). Comprehension tests which use a 4-alternative forced choice design such as the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2015) provide a standardised measure suitable for comparison across studies, so this is the test-type I adopted.

The final storybook related methodological issue to discuss is that of reading style. Evidence suggests that using an interactive reading style which includes explanations, questions, or repetitions of target words can improve children's word learning from a storybook (Coyne et al., 2007; Justice, 2002; Whitehurst et al., 1988), but there is a lack of clarity as to how these interact (Ard & Beverly, 2004). For this reason, and to ensure the best possible experimental control, I chose to read all stories verbatim from storybooks. In the current thesis, children's learning reflects incidental word learning (Rice, 1990) as they were provided with no additional prompts to support them beyond the experimental manipulations declared in each experiment.

In addition to the issues particularly pertinent to storybook research, there are some broader methodological issues to consider. There is considerable debate about a wide range of issues which underpin good quality science (Benjamin et al., 2017), of which one such topic is that of the importance of appropriate sample sizes (Quinlan, 2013; Vankov, Bowers, & Munafò, 2014). Adequate sample sizes, and statistical power are important because they impact directly on the accuracy and meaningfulness of the findings of a study. If a given effect is large, then this can be detected with a small sample size, but with large sample sizes we are more likely to find statistically significant findings (Oakes, 2017; Quinlan, 2013).

The issue of sample sizes within topics which investigate more difficult to access populations such as that of developmental research is particularly complex.

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Identifying, recruiting, and scheduling child participants is difficult, costly and time consuming (Horst, 2015a). This is particularly the case when participants are required to attend labs at university campuses, rather than participate in research whilst attending nurseries or schools or in their home settings. This means that collecting large samples is particularly challenging for work such as that presented here; lab-based studies with 3- and 4-year-old children. In order to balance the conflicting needs to ensure new discoveries are made, and to ensure scientific rigour (Oakes, 2017), in the current thesis sample sizes were estimated based on power calculations using effect sizes from previous studies which employed the same stimuli (Horst et al., 2011). In some cases, sample sizes of 12 per condition were considered adequate (e.g., in Paper 3), as effect sizes were expected to be large, and in other cases, I increased sample sizes in subsequent replications (such as increasing the sample size from 12 in Paper 2, Experiment 1 to 18 in Paper 2, Experiment 2). In Paper 5, I anticipated that for the multiple effects I was measuring, and the uncertainty about the size of such effects, a considerably larger sample size would be required. Therefore, for Paper 5, I planned a larger sample of 21 participants per condition. In Paper 4, the same power calculations as used for Paper 3 were conducted, although in retrospect, the effect in question may be considerably smaller and necessitate a larger sample to reveal the effects in question.

These considerations, and the subsequent decisions about sample size are consistent with those elsewhere in the shared storybook literature. For example, in M. A. Evans and Saint-Aubin (2013), an eye tracking study investigating looking behaviours during storybook readings, a sample size of 18 per condition was used to find meaningful effects, and Oakes (2017) reports sample sizes as small as 8 per condition in her review of infant eye tracking studies. For behavioural studies with comparable sample sizes, see Ard and Beverly (2004); Fisher, Godwin, and Seltman

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(2014); Read (2014). Despite evidence to suggest sample sizes within the thesis are consistent with similar studies, and based on legitimate power calculations, the current concerns about the reproducibility of such research are well founded. The sample sizes for some of the experiments here may reflect a limitation in that respect. The impact of small sample sizes and reproducibility is discussed in more detail in the General Discussion.

Overview of Current Research

Paper 1

Although few would question shared storybook reading as a source of word learning for preschool age children, the evidence for how factors such as reading style, repetition and age moderate these effects is less clear. This paper presents a multi-level meta-analysis of the effect of shared storybook reading on 2,455 children's word learning. The 38 studies included allowed us to investigate the moderating effects of reader, reading style, age, tokens, story repetitions, story to test interval, proportion of nouns and word novelty on word learning. Analyses indicated large, robust effects of shared reading on word learning, even after outlier removal and correction for publication bias. Reading with a dialogic style, such as pointing or providing word definitions was a highly significant moderator of word learning. The number of words tested and number of exposures (tokens) also moderated word learning effects. Who reads, the child's age, and story to test interval were not moderators of word learning. These results suggest that factors that contribute to the complexity of the word learning task, such as the role of story repetition, word novelty and word types, are important topics for future research. I believe this meta-analysis is the first of its kind, providing useful guidance for early years educational practitioners and researchers alike.

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Paper 2

Repeating stories is beneficial for word learning (Horst et al., 2011; McLeod & McDade, 2011; Penno et al., 2002; Sénéchal, 1997), although the exact mechanism for this is unknown. This paper presents two experiments, which investigated this effect in 3.5-year-old children with eye-tracking. In both experiments children heard either repeated or different stories while their eye movements were recorded, then completed a 4-AFC word learning task. Across both experiments there were no differences in word learning or eye movements between conditions. One explanation is that the presentation of storybooks differed from that of earlier experiments because when displayed on a computer screen, they were displayed only one page at a time, but in earlier experiments children were presented with storybook pages displayed two at a time. This provided the motivation for Paper 3, which investigates the effects of the number of illustrations displayed simultaneously on word learning.

Paper 3

To investigate whether children's improved word learning could be attributed to the number of illustrations presented at a time, the storybook pages from Experiment 1, Paper 2 were arranged into three different layouts. In Experiment 1 children were each read three different stories with illustrations, which were either presented as two regular-sized A4 illustrations, one regular-sized A4 illustration, or one large A3-sized illustration per spread. Importantly, children in all three conditions saw the same number of illustrations overall. Children learned words significantly better when only presented with one illustration at a time, which accounts for the findings in Paper 2. I conclude that pre-literate children are unable to tell which illustration the text relates to so face greater processing demands when presented with two illustrations at a time.

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In Experiment 2, I tested whether directing children's attention to the correct illustration could overcome this word learning deficit from two page illustrations. Indeed, children whose attention was directed to the correct illustration performed as well at the word learning task as children in the single-page illustrations conditions in Experiment 1. This supports the view that helping direct children's attention to the relevant information can improve word learning. I investigate this further in Paper 4.

Paper 4

If children's word learning from shared storybook reading is improved when children have fewer illustrations to look at, then illustrations containing less extraneous information should also improve word learning, compared with illustrations containing more extraneous visual information. If such word learning gains can be attributed to attentional processes, then manipulating the salience of target objects should also influence word learning performance. These predictions were tested in Paper 4. In Experiment 1, 3.5-year-old children heard stories with either complex or simple illustrations. There was no evidence that illustration complexity affected word learning. In Experiment 2a and 2b either the salience of target objects (Experiment 2a) or competitor objects (Experiment 2b) was increased. Again, there was no difference between conditions in either experiment. I attribute our lack of findings to the subtlety of the contrast in illustrations between conditions.

Paper 5

The final paper investigates the effects of storybook repetition on speech production. Using storybooks from Horst et al. (2011), 4-year-old children were read three; either the same, or different stories. After each reading children retold the story they had just heard using each page as a prompt. I measured children's use of novel vocabulary, overall speech volumes and accuracy with retelling the story content. There

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were no differences between conditions in either retelling or performance on the word

learning trials. I ascribe this failure to replicate earlier findings to the increased number

of story repetitions overall.

Summary of Current Research

To investigate the role of children's attention in learning words for shared

storybook reading I posed three over-arching questions to be investigated within the

current thesis. These are answered as follows:

a.)   *Which factors are important in helping children learn words from shared*

        storybook reading?

Paper 1 identifies dialogic reading styles, the number of words tested and tokens as

important for word learning from shared storybook reading. It also identifies the role of

repetition, word novelty and word type as topics worthy of further research. Papers 2, 3

and 4 provide evidence that what children are looking at i.e., illustrations, play an

extremely important role in supporting word learning. In particular, findings suggest

that providing just the right level of visual information can really benefit word learning.

These findings support both cognitive load theory (Plass et al., 2010; Sweller, 1988,

1989) and desirable difficulties theory (R. A. Bjork, 1999; R. A. Bjork & Kroll, 2015)

as both suggest that providing a balance of novel and challenging material is key to

optimising learning. In the current thesis I demonstrate how various storybook formats

can result in improved learning, and suggest why some may not.

b.)   *To what extent does storybook repetition help word learning?*

Paper 1 found mixed evidence for the role of story repetition in word learning. One

possible explanation is that repetition offers benefits in some circumstances but not

others. For example, perhaps children of certain ages benefit more than others from

hearing the content repeated, or perhaps books with fewer novel words benefit less from

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repetitions because their content is simpler. In Papers 2 & 5 we identified one such

example when we were unable to replicate earlier findings of improved word learning

from repeated readings relative to different stories because children's performance was

improved by the presentation of only one illustration at a time. Paper 5 found no

beneficial effect of story repetition on 4-year-old children's retelling ability, or novel

word production or comprehension. This may be because even children hearing

different stories effectively benefitted from some repetition, even though it was their

own version, and children in the same stories effectively encountered the stories six

times. This may have also negatively affected their motivation (see e.g., Paas, Tuovinin,

Merriënboer, & Darabi, 2005).

As cognitive load theory (Plass et al., 2010; Sweller, 1988, 2010) predicts,

reducing extraneous visual information improved word learning (Paper 3) which likely

impacted our findings about repetition (Papers 2 and 5). Note, the data for Papers 3 and

5 were collected concurrently, hence the design decisions for Paper 5. Repetition should

support word learning, because children receive less extraneous visual information. But

although benefits to word learning from repeated reading are well established, here I

have identified some important interactions, which fit with the findings from the

broader literature (in Paper 1 we found that repetition was a highly variable moderator).

Namely, the benefits of repetition may be more helpful when materials are particularly

challenging.

c.)   What is the role of complexity in word learning from shared storybook reading?

The roles of simplicity and complexity emerged as a key theme of the thesis. In Papers

2, 3 & 5 the reduction in visual content improved children's word learning performance.

In Paper 4, although I did not find evidence for the effects predicted with the

manipulation of the salience of the illustrations, this may be due to our stimuli. If the

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level of visual complexity is important, it is possible that these effects may only be detectable when the contrast between simplicity and complexity is high enough. This is an important area for future research.

As cognitive load and desirable difficulties theory both predict, the role of complexity in word learning is… complex. We found that reducing complexity by reducing the number of illustrations simultaneously improved word learning, (Paper 3) and that helping children identify the key information (Paper 3, Experiment 2) improved word learning. However, within-illustration complexity and salience manipulations did not improve word learning. Similarly, using repetition as a method to simplify content for children did not improve word learning.

Taken together, the current thesis suggests achieving the right level of complexity *is* important to word learning. Dynamic systems theory stresses the importance of considering findings such as these in light of the many other interacting factors. It seems likely that the level of complexity is relative to the task, and the individual child. Children's learning will benefit from incremental increases in complexity, but the challenge will be working out exactly what the optimal complexities are.

Paper 1:

The Effects of Shared Storybook Reading on Word Learning: A Meta-Analysis

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Abstract

Although a rich literature documents pre-literate children's word learning success from shared storybook reading, a full synthesis of the factors which moderate these word learning effects has been largely neglected. This meta-analysis included 38 studies with 2,455 children, reflecting 110 effect sizes, investigating how reading styles, story repetitions, tokens and related factors moderate children's word comprehension, while adjusting for the number of target words. Dialogic reading styles, tokens, and the number of words tested all moderated word learning effects. Children's age, who read, and time between story and test were not moderators. We identify story repetition and word types as topics which merit further research. These results provide information to guide researchers and educators alike to the factors with the greatest impact on improving word learning from shared storybook reading.

The Effects of Shared Storybook Reading on Word Learning: A

Meta-Analysis

Shared storybook reading provides several benefits to young children including parent-child bonding (Barratt-Pugh & Rohl, 2015; Schwartz, 2004), fostering a love of reading later in life (Bus, 2001; Pillinger & Wood, 2014) and learning to sustain attention (Lawson, 2012). Much of children's developing lexicon is encountered through everyday conversation (Weizman & Snow, 2001), but shared storybook reading provides a complementary source of vocabulary (Montag et al., 2015). Because vocabulary size at school entry predicts later academic achievement (Coyne et al., 2004; Sénéchal, LeFevre, Thomas, & Daley, 1998), understanding how to help children maximize word learning from shared storybook reading can provide feasible interventions for education. For the purposes of this paper, we focused on word comprehension (the understanding of what a word refers to) rather than word production (the ability to use a word verbally at any moment), although word learning may refer to either comprehension or production in the shared storybook reading literature. Numerous investigators have demonstrated that shared storybook reading promotes word comprehension (e.g., Justice, Meier, et al., 2005; Sénéchal & Cornell, 1993), however, a clearer understanding of the strength of these effects is wanting.

Several factors are reported to influence word learning from storybooks, including who reads (Hindman, Connor, Jewkes, & Morrison, 2008), how they read (Bus, van Ijzendoorn, & Pellegrini, 1995; Reese & Cox, 1999), the child's age (Hargrave & Sénéchal, 2000), the types of words being taught (e.g., McLeod & McDade, 2011; Storkel & Maekawa, 2005), the number of words in the story (e.g., Robbins & Ehri, 1994), and how many times the story is heard (e.g., Horst et al., 2011; Sénéchal, 1997). For example, Whitehurst & colleagues (1988) found more interactive

reading styles positively influence word learning from storybooks. Specifically, they taught parents to use dialogic styles such as open-ended questions, pointing, repetition and generally encouraging text-related talk during reading. The benefits of such dialogic styles have been widely reported (e.g., Biemiller & Boote, 2006; Justice, Meier, et al., 2005; Sénéchal, 1997). Dialogic styles represent relatively simple interventions, which can be easily taught to parents or teachers to enhance word learning.

Although mothers' reading styles have garnered particular attention (e.g., Ninio, 1980; Reese & Cox, 1999), research examining the reading styles of both parents suggests any differences between mothers and fathers reading styles are rather subtle (Blake, Macdonald, Bayrami, Agosta, & Milian, 2006; Schwartz, 2004). This informs our understanding of how parents read with their children, but not how this influences subsequent word learning. Further, many of the experiments concerned with word learning from shared storybook readings are designed with experimenters or teachers as the reader, rather than parents. If the reader affects word learning, this would have important, practical implications for the generalizability of word learning research to naturalistic settings. In addition, a deeper understanding of the impact of different readers may inform future experimental designs (see also Aram & Besser, 2009).

Young children can learn up to four words each day (Bion et al., 2013; Fenson et al., 1994). More specifically, Biemiller and Boote (2006) compared 11 studies on shared storybook reading and reported word learning gains of approximately two words per day for 3- to 12-year-old children. Historically, children's word learning was thought to be as high as up to nine new words per day (Carey, 1978), based on the observation of children fast mapping (quickly guessing the meaning of a new word based on lexical, syntactic and contextual cues). Although children may recognize a word after a single exposure under certain conditions (see Horst & Samuelson, 2008 for

a review), robust lexical representations require multiple, repeated exposures

(McMurray et al., 2012). Increasing target word occurrences (tokens) within storybooks

can provide these additional exposures (Elley, 1989). Reading the same story repeatedly

can also provide multiple exposures. Several studies have examined the effect of

different numbers of storybook repetitions on word learning (e.g., Biemiller & Boote,

2006; Horst et al., 2011; McLeod & McDade, 2011; Sénéchal, 1997; Wilkinson &

Houston-Price, 2013), but as yet, the true strength of this effect has not been examined.

Our literature review uncovered a wide range of approaches to investigating

word learning from shared storybook reading. The number of target words within a

story, the number of tokens, the kinds of words (e.g., nouns, verbs), the number of times

a story is read, as well as who is reading, all vary greatly across studies. Similarly, how

word learning is assessed also varies. The National Reading Panel (2000) suggests that

researcher-developed assessments are more sensitive to word learning gains than

existing standardized educational assessments that measure increases in general

vocabulary. In practice, some experimental assessments measure growth in the total

number of words children comprehend (i.e., general vocabulary), while others measure

recall or production of specific target words from the text. Studies that include

assessments of general vocabulary routinely involve interventions and longer

timescales, (typically several weeks or more, see e.g., Aram & Besser, 2009; Reese &

Cox, 1999; Valdez-Menchaca & Whitehurst, 1992). The dearth of meta-analyses

addressing word learning from shared reading to date may well be explained by the high

level of variability between measurement approaches. Although Marulis and Neuman

(2010) investigated the effects of vocabulary interventions beyond shared storybook

reading and Mol et al. (2008) investigated the effect of dialogic reading by parents,

there are no meta-analyses exploring the effects of shared storybook reading on word

learning in such breadth, despite a very rich contribution of research (but see Swanborn & de Glopper, 2002, meta analysis indicating word learning gains of 15% of target words when school children read to themselves).

The goal of the current meta-analysis was to estimate the population effect of shared storybook reading on word comprehension. We focus on word comprehension because it precedes word production (Huttenlocher, 1974) and we could systemically examine more potential moderators because studies of word comprehension were overall more similar in methods—despite the high level of variability noted above. Each study included in this meta-analysis assessed word learning for a specified number of individual target words using a comprehension task similar to the Peabody Picture Vocabulary Task (Dunn & Dunn, 2015). We considered how changes in reader, reading style, child's age, tokens, story repetitions and word type moderate word comprehension. Our aim was to provide helpful guidance for best practices, both for experimental design and for shared storybook reading in naturalistic settings.

Method

Literature Search and Inclusion Criteria

We conducted a systematic search of the online databases British Education Index, Education Resources Information Center, PsycInfo, Scopus and Web of Knowledge. Figure 1 shows a schematic of the search strategy. We used the following search terms, alone and in combination: *Child*, Language Acquisition, Picture Book, Picturebook, Story, Story Book, Storybook, Vocabulary,* and *Word Learning*. In addition, we used relevant mailing lists and personalized emails to contact key researchers in the field, asking for details of relevant studies to include (published and unpublished). Finally, reference lists from relevant reviews were searched to identify additional studies. To be included in the analysis, studies were required to meet several

criteria (see Figure 1 for our selection strategy), consistent with PICOS guidelines

(Liberati et al., 2009).

Databases searched
British Education Index $n = 63$
Education Resource Information Center $n = 783$
PsycInfo $n = 782$
Scopus $n = 444$
Web of Knowledge $n = 551$
$n = \mathbf{2623}$

Other sources
Direct author contacts $n = 9$
Listserv responses $n = 19$
$n = \mathbf{28}$

(After duplicates removed) $n = \mathbf{1635}$

Exclusions
Publication prior to 1990 $n = 213$
Did not meet design criteria $n = 1208$
Non typical sample $n = 143$
Paper not available $n = 28$
Could not compute effect size $n = 11$

Number included $n = \mathbf{32}$

Secondary Search
Number added $n = \mathbf{6}$

Final Sample
$n = \mathbf{38}$
Effect sizes $= \mathbf{110}$

Figure 1. The schematic to show the identification process for included studies

We included studies published after Elley (1989): a seminal shared storybook

reading study. Thus, we included studies dated from 1990 until the original search date

of January 2015 and a follow-up search date of May 2017. The search procedures were

identical. Included study designs provided a measure of children's word learning

following an adult reading one or more storybooks. As such, most of the studies tested children who were not yet in formal schooling though some studies did involve teachers reading to school-aged children. Participants were typically-developing children and not specifically multi-lingual (although studies where fewer than half of the children were second language learners were retained if investigating second language acquisition was not the focus of the research). Storybook readings could have been single or multiple events, and adult readings included live or pre-recorded stories from real books or displayed on computer screens, provided the images were static.

Comprehension tests using 4-alternative forced-choice trials like those used on the Peabody Picture Vocabulary Test (e.g., PPVT-4, Dunn & Dunn, 2007) are widely employed to test children's comprehension of target words and provide a comparable standard across studies. This measure involves asking children to select the picture that best reflects a given word from an array of four pictures. Where children do not know the correct answer, the likelihood of being correct by chance is 25%. To ensure effect size comparisons were meaningful, we excluded studies that used arrays of more than four pictures (e.g., Ewers & Brownson, 1999), or required children to provide definitions (e.g., Biemiller & Boote, 2006; Leung, 2008) because chance levels would differ.

Experimental designs varied across the studies we included, but followed similar patterns, generally related to the kinds of target words that they included. There were three kinds of target words: words that were confirmed unknown using a pre-test or pilot to confirm their novelty (e.g., *forlorn*, Beck & McKeown, 2007), sophisticated words selected to ensure their relative novelty for the target age range (e.g., departed for 4- or 6-year-olds, C. Houston-Price, Howe, & Lintern, 2014), or completely novel pseudo-words (e.g., *manu*, Horst et al., 2011). Studies that used confirmed unknown

words (e.g., *forlorn*) included pre-tests or pilots to determine baseline word knowledge before storybook reading (e.g., Abel & Schuele, 2013; Wilkinson & Houston-Price, 2013) and therefore did not include no storybook reading control groups. Similarly, studies that used completely novel pseudo-words (e.g., *manu*, McLeod & McDade, 2011; Williams & Horst, 2014) used novel words so that any word learning could be directly attributed to the storybook intervention. Using completely novel words that children would have no knowledge of before the study effectively means a pre-test score of 0 and turns the test scores into post-test scores because only storybook reading can account for any knowledge gained. Thus, studies that used completely novel target words also did not include no storybook reading control groups. Other studies included control groups but the task for the control groups varied. For example, children in the control groups were exposed to different books or different reading techniques (e.g., Horst et al., 2011; Mandel, Osana & Venkatesh, 2013). In these cases we opted to treat so-called control groups as separate effects sizes because the children still received storybook exposures and the comprehension tests met our design criteria for inclusion. This keeps the calculation method for the individual effect sizes consistent across research designs.

Finally, sufficient information to compute the relevant effect sizes was required. To this end, we retained studies for which a copy of the paper (or in the case of unpublished studies, the original dataset) was obtained. We made an exception for pre/post-test correlations as these were provided in so few papers. We emailed 12 authors (15 journal articles) where information was missing. Three authors replied, but only one was able to provide the correlations we required. There were an additional three authors for whom no contact details could be found. Note, as a meta-analytic review our institution did not require additional ethical approval for this research.

Analysis Strategy

For each study we calculated the raw change between the pre- and post-test

scores in words learned. Where no pre-test was conducted a pre-test score of 0 was

assumed, note this includes studies that used completely novel words (e.g., *manu*) as

described above. Effect sizes[1] were calculated and the meta-analysis conducted using

the metafor software package (Viechtbauer, 2010) for R (R Core Team, 2015).

Coding. Each study was assigned a unique study code, and effect sizes within

studies were also numbered. A coding frame was agreed and primary coding was

completed by the first author. We coded general study descriptors such as publication

type and dates and participant age and test type (e.g., 4-alternative forced-choice).

For potential moderators we coded year of publication, reader (e.g.,

experimenter, teacher, parent or combination), book genre (non-fiction or fiction), book

type (computer or paper) and illustration type (photos or cartoons). For moderators

related to testing, we coded the delay between storybook reading and testing as a

continuous variable. We also included the number of story repetitions, tokens and the

proportion of nouns used as target vocabulary. We chose to calculate this as a

proportion of overall target words because this enabled us to retain the maximum

number of studies for this moderator, given that some studies combined nouns and

verbs (e.g., Gallingane, 2010; Zipoli, Coyne, & McCoach, 2010).

Finally, we also calculated the total number of "words tested," which is not

necessarily the number of intended target words. For studies using completely novel

words (e.g., *manu*), all target words counted as words tested because children could not

have any knowledge of these words at the start of the study. However, for studies using

confirmed unknown words (e.g., *forlorn*) pre-test scores sometimes suggested *a priori*

knowledge of some of the target words. In these cases, we subtracted the pre-test scores

from the total number of target words to provide a more conservative number of words tested. For example, Abel and Schuele (2014) intended their study to include 15 target words. At pre-test, children correctly identified on average 6.51 words ($SD = 2.8$), suggesting they already knew some of the target words. In this case, we calculated the "words tested" as 8.49 (the difference between the intended number of target words and those children had correctly identified on the pre-test before the storybook intervention) and "target words" as 15.

To assess reliability of moderator and effect size calculations and coding studies to be excluded, a second coder randomly selected 15% of both excluded and included studies. Agreement of 100% was reached on which studies were to be excluded. For exclusion reasons and for moderator and effect size data, Cohen's Kappas ranged from .95 to 1. Final codes used for analysis were reached by agreement.

Analysis. The final data set consisted of 38 unique studies, contributing 110 effect sizes. Some studies included multiple effect sizes. For example, because they tested multiple age-groups (e.g. Wilkinson & Houston-Price, 2013) or different reading conditions (e.g., McLeod & McDade, 2011). Studies which contribute multiple effect sizes not only violate the assumption of independence of effect sizes but can distort population effect sizes, because a single study can contribute several times to the overall effect size calculation (Field, 2015). For this reason, we used the *rma.mv()* function with restricted maximum-likelihood estimation in metafor to perform a multi-level meta-analysis, in which effect sizes (level 1) are nested within studies (level 2). We allowed effect sizes to vary across studies (random effects) and entered moderators as fixed effects. We calculated robust 95% BCa confidence intervals around the parameter for each moderator using 1000 bootstrap samples because the number of effect sizes, *k*, was generally small. We also repeat the analysis with 3 outliers removed (see Table 1).

Moderators.

Reader, reading style and child age. "Reader" (experimenter, teacher) varied across studies. In one case, the experimenter was also the teacher, and in one case parents read, so these two cases were excluded from the reader moderator analysis. We measured the moderator "dialogic reading" categorically. Specifically, we classified reading styles as dialogic if the reader added something to a verbatim text reading. For example, reading styles with pointing, repetitions via extra-textual speech, or the addition of dictionary definitions as they read for target vocabulary were classified as dialogic. Dialogic and non-dialogic styles accounted for 49 and 61 of the effect sizes, respectively. "Age" was measured in months, based on best estimates from data provided and varied from 35 to 122 months ($M = 62.71$, median $= 55.94$, $SD = 23.13$).

Experimental design. The number of "story repetitions" were provided in 104 cases and ranged from a single reading of a story through to seven readings ($M = 2.19$, $SD = 1.04$). "Words tested" measured the number of words children did not know and could therefore learn. The number of words tested ranged from 2 to 34.84 words ($M = 7.48$, $SD = 5.11$). "Tokens" refers to the number of word exposures. Not all studies control for tokens. For example, in some dialogic studies dictionary definitions (e.g., Penno et al., 2002), or repetitions (Leung, 2008; Reese & Cox, 1999) are used freely and therefore tokens are not reported by the original authors. Tokens were provided for 83 effect sizes and ranged from 1 to 12 tokens ($M = 6.01$, $SD = 4.37$). The "story to test interval" was measured in hours, based on the best estimate using the data provided. For example, where authors reported a delay of 3 days, we calculated this as 72 hours. Story to test interval varied from immediate to 10 weeks ($M = 363.75$ hours, or 2 weeks, 1 day, $SD = 448.78$ hours, or 2 weeks, 4 days).

Word type. Several studies report different rates of word learning for nouns and verbs (e.g., McLeod & McDade, 2011), thus we aimed to include this as a moderator. Many studies included both nouns and verbs, and some do not report separate scores for nouns and verbs, therefore, we analyzed this as a continuous variable, "proportion of nouns." For each effect size we calculated the proportion of target words that were nouns ($M = .91$, $SD = 0.20$). For 44 effect sizes we could not calculate proportion of nouns because the authors did not specify how many of the target words were nouns. The categorical moderator "word novelty" reflects the use of novel words (e.g., *manu*, $k = 38$) or real words, which are either sophisticated known words (e.g., *departed, k = 16*), or confirmed unknown (e.g., *forlorn, k = 56*).

Results

Word Comprehension from Storybooks

A total of 110 effect sizes from 38 studies with 2,455 children contributed to these analyses. Figure 2 presents the forest plot (Lewis & Clarke, 2001) of effect sizes for each study. Note, that the models fitted included multiple effect sizes within studies whereas for the forest plot the average effect size within a study is displayed. Comprehension test studies report a positive effect of shared storybook reading on word learning, $k = 110$, raw change = 3.025 words [2.622, 3.366], $p < .001$. Overall, children learned 45% ($SD = 24\%$) of the words to which they were exposed. Studies in this sample were also significantly heterogeneous, $Q(109) = 10019.576$, $p < .001$, suggesting variability in the studies which may be accounted for by moderator variables (summarized in Table 1).

Abel & Schuele 2014		3.89 [2.58, 5.20]
Ard & Beverly 2004		6.62 [5.51, 7.72]
Beck & McKeown 2007		4.68 [3.08, 6.28]
Blewitt & Langan 2016		3.45 [2.95, 3.96]
Blewitt et al., 2009		5.18 [4.21, 6.14]
Brett et al., 1996		3.18 [1.87, 4.50]
Chen & Liu 2014		8.28 [7.27, 9.29]
Damhuis et al 2015		3.24 [1.71, 4.76]
Evans & Saint-Aubin 2013		1.00 [0.26, 1.74]
Flack & Horst (unpublished)		1.59 [1.35, 1.83]
Flack & Horst, 2017		1.53 [1.33, 1.72]
Flack et al (unpublished)		1.15 [0.77, 1.53]
Horohov & Oetting 2004		9.15 [7.82, 10.48]
Horst (unpub A)		1.67 [1.45, 1.89]
Horst (unpub B)		1.25 [1.04, 1.46]
Horst et al., 2011		3.55 [2.81, 4.29]
Houston-Price et al., 2014		5.04 [4.60, 5.47]
Justice 2002		3.33 [2.78, 3.88]
Kaefer et al., 2014		1.30 [1.03, 1.57]
Mandel et al., 2013		0.19 [0.13, 0.25]
McLeod & McDade 2011		3.09 [2.45, 3.74]
Pinkham et al., 2014		1.04 [0.81, 1.27]
Pullen et al., 2010		6.98 [6.75, 7.21]
Ralli & Dockrell 2005		1.77 [1.64, 1.91]
Ramachandra et al., 2011		3.45 [3.01, 3.89]
Robbins & Ehri 1994		4.39 [3.71, 5.07]
Senechal & Cornell 1993		1.87 [1.04, 2.70]
Senechal 1997		1.53 [0.61, 2.46]
Senechal et al., 1995		1.46 [0.34, 2.58]
Strasser et al., 2013		2.13 [1.52, 2.74]
Suggate et al., 2013		3.72 [3.10, 4.34]
Teepe et al., 2017		0.79 [-1.16, 2.74]
Walsh & Blewitt 2006		3.42 [2.67, 4.17]
Walsh & Rose 2013		3.27 [2.35, 4.18]
Wilkinson & Houston-Price 2013		2.73 [1.82, 3.64]
Williams & Horst (unpub A)		1.46 [1.17, 1.75]
Williams & Horst (unpub B)		2.46 [2.03, 2.89]
Williams & Horst 2014		1.22 [0.95, 1.50]
RE Model		3.02 [2.44, 3.60]

Figure 2. Effect sizes for the 38 studies. Note, where studies include multiple effect sizes, these are aggregated.

Table 1. Moderators for word learning from shared storybook reading ($k = 111$) and with outliers removed ($k = 106$)

	Full Sample			Without Outliers		
Moderator Analysis	*k*	Estimate	[95% BCa CIs]	*k*	Estimate	[95% BCa CIs]
No. Target Words	110 (38)	0.062*	[0.009, 0.106]	105 (35)	0.054*	[-0.009, 0.088]
No. Words Tested	110 (38)	0.176***	[0.081, 0.537]	105 (35)	0.160***	[0.072, 0.588]
Reader						
No. target words	108 (36)	0.085**	[0.035, 0.167]	103 (33)	0.074**	[0.037, 0.124]
Reader		0.473	[-1.613, 0.604]		0.109	[-0.920, 1.070]
Dialogic Reading						
No. target words	110 (38)	0.050	[-0.001, 0.086]	105 (35)	0.036	[-0.028, 0.067]
Dialogic reading		1.224***	[0.769, 1.847]		1.207***	[0.760, 1.847]
Age						
No. target words	110 (38)	0.059*	[-0.015, 0.105]	105 (35)	0.052*	[-0.012, 0.088]
Age		0.006***	[-0.001, 0.024]		0.006***	[-0.004, 0.021]
Tokens						
No. target words	83 (29)	0.329***	[-0.075, 0.559]	80 (27)	0.234**	[-0.032, 0.432]
Tokens		0.259***	[-0.037, 0.402]		0.254***	[0.026, 0.400]
Story Repetitions						
No. target words	104 (36)	0.073	[-0.042, 0.184]	101 (34)	0.036	[-0.046, 0.131]
Story repetitions		0.156***	[-0.129, 0.390]		0.162***	[-0.107, 0.363]
Story to Test Interval						
No. target words	106 (36)	0.068*	[0.009, 0.152]	101 (33)	0.046	[-0.023, 0.118]
Story to test interval		0.001	[-0.002, 0.002]		.001**	[-0.002, 0.003]
Proportion of Nouns						
No. target words	66 (30)	0.210*	[0.097, 0.330]	63 (28)	0.131*	[0.021, 0.194]
Proportion of nouns		-2.345	[-4.548, 0.518]		-2.421*	[-4.595, -0.500]
Word Novelty						
No. target words	110 (38)	0.101***	[0.050, 0.210]	105 (35)	0.092***	[0.043, 0.166]
Novel v confirmed unknown		-1.638**	[-2.728, -0.696]		-1.120*	[-2.116, -0.463]
Novel v sophisticated		1.263*	[-0.117, 2.162]		1.654**	[0.962, 2.751]

Note: *p* values * $< .05$, ** $< .01$, *** $< .001$

Moderator Analyses

Studies ranged in the number of target words and the number of words tested. Critically, this could mean that a raw score of 4 words correct could be as high as 75% accuracy in a study that included 6 target words, but could be as low as 25% for a study that included 12 target words. To adjust moderators for this we included the total number of target words indicated by each study's author(s) in each of the models. We chose the total number of target words rather than number of *words tested* because all studies provided the number of intended target words whereas words tested could only be calculated for studies that included pre-test measures or completely novel words.

Words tested was a significant predictor of word comprehension, although the effect size was very small. Despite another relatively small effect size for tokens as a moderator, 95% BCa confidence intervals suggested the real effect size could be zero. For comparison we provide details of both the moderators "target words" and "words tested," modelled in isolation at the top of Table 1. All subsequent moderation analyses include the "target words" variable in addition to the moderator of interest.

Reader and Reading Style. Whether a teacher or experimenter read the book was not a significant moderator of word comprehension (see Table 1). The use of dialogic reading styles, however, was a significant moderator. Specifically, using dialogic reading styles ($k = 49$) results in children learning 1.22 more words than non-dialogic reading ($k = 61$) after adjusting for number of target words tested. Thus, when it comes to learning words from storybooks, it is less about *who* reads the story and more about *how* the story is read.

Despite a *p*-value of less than .05, the 95% BCa bootstrap confidence interval for age when adjusted for number of target words included zero. Assuming that this CI is one of the 95% that contains the population value, this means that the population

effect of age on word leaning could be zero. In any case, the estimate of the effect revealed a very small effect (Table 1): 0.06 of a word, thus, regardless of the significance, the effect of age on the ability to learn words from shared storybook reading appears trivial.

Experimental Design. Despite finding a moderate effect size for tokens, BCa confidence intervals included 0 suggesting the true population effect could be 0. The very small estimate for the number of story repetitions adjusted for the number of target words suggests story repetitions are a predictor of word learning, although widely spaced BCa confidence intervals which included 0 suggest the true population effect could be 0. Because precise numbers of tokens were not always reported (particularly in studies using dialogic techniques), we also repeated this analysis with only those studies that provided a precise number of tokens. For the 61 cases with story repetitions ranging from 1 to 7 ($M = 2.28$, $SD = 1.11$) we found a similar estimate of words learned (0.151, [-0.138, 0.402], $p < .001$) when adjusting for the number of target words. Once again though, BCa confidence intervals included 0. In addition, the estimate for story to test interval was very small and confidence intervals suggest the population effect is likely to be 0. Overall this suggests a minimal effect of story to test interval on word comprehension.

Word Type. For studies providing a separate breakdown of performance for nouns and verbs the mean number of nouns learned was 2.77 ($SD = 1.73$, range = 0.76 – 8.28, k = 40) out of a mean of 6.29 nouns presented and the mean number of verbs learned was 3.10 ($SD = 0.64$, range = 2.64 - 3.55, $k = 2$) out of a mean of 5.00 verbs presented. Remaining effect sizes included combinations of nouns, verbs or adjectives. Despite a large effect size, the proportion of nouns among the target words did not significantly predict word learning. Confidence intervals were wide and contained 0,

suggesting potentially little difference in word learning from stories that included only nouns or a mix of word types.

Word novelty, i.e., the kind of target word used (e.g., *forlorn*, *departed*, *manu*), predicted word comprehension when adjusted for the total number of target words. Specifically, using confirmed unknown words (e.g., *forlorn*, $k = 56$) results in significantly fewer words learned than tests, which use novel words (e.g., *manu*, $k = 38$). Although estimates using sophisticated words (e.g., *departed*, $k = 16$) suggested significantly greater word learning than using novel words, wide confidence intervals including 0 suggest this effect could be 0.
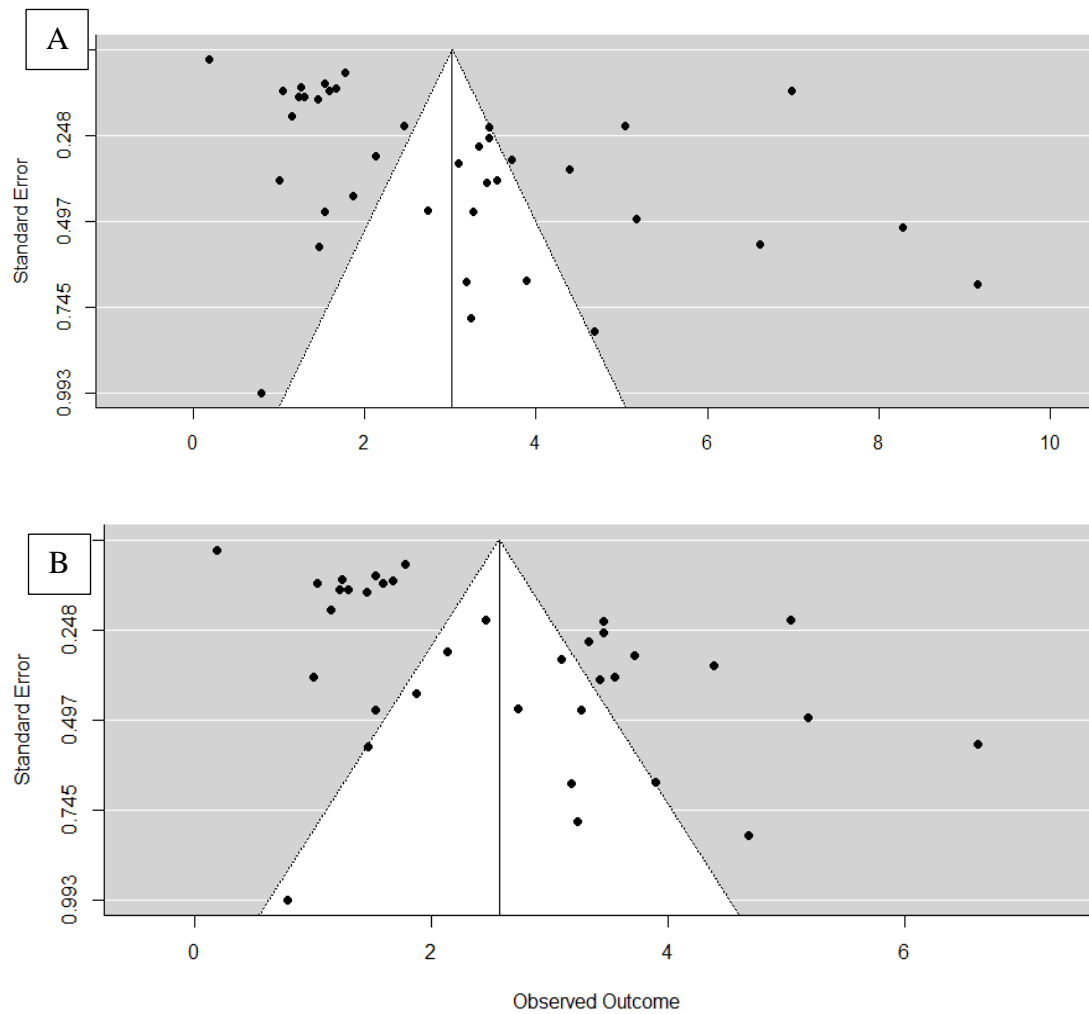
Outliers

We assessed the sample for outliers, using residual Q-Q plots and investigated the influence these studies had over the wider sample, using leverage plots (e.g., Cook's distance, hat values etc.). From these we identified three possible outliers in our sample (plots are available for inspection at https://osf.io/rxbdz/). These studies had standardized residuals over or close to 3, and had noticeably higher values than other studies on their standardized residuals, Cook's distances and dffit statistics. These three studies (five effect sizes) included design features that our analyses demonstrate should lead to high rates of word learning from storybooks. Specifically, each of these studies included completely novel words and two studies (four effect sizes) used dialogic reading techniques. A closer inspection of the procedure for one study in particular revealed that children received instructions that they would hear some "silly words… and they should help the examiner figure out what the words meant" (Horohov & Oetting, 2004, pp. 52). This may have focused children's attention on the words, by making word learning the explicit objective of the task, which is not typical in the procedures of other studies.

We repeated our analysis with these three studies removed and our results are depicted in the right-hand columns of Table 1 for comparison. The removal of these studies did not substantively change the findings for the main analysis, although it reduced the estimate to a more moderate 2.571 words learned, [2.237, 2.856], $p < .001$. Individual moderator analyses were largely unaffected by removal of these cases, except in the case of tokens, the proportion of nouns, and word novelty. The BCa confidence intervals for tokens, after adjusting for the number of target words used, changed to become more precise and no longer included 0 after removal of outliers. This suggests more tokens, i.e., more exposures to target words, leads to better word learning. The proportion of nouns, after adjusting for the number of target words, still produced a large effect size estimate, but confidence intervals no longer included 0, suggesting that although the estimate still lacked precision, the true population effect is not likely to be 0. After adjusting for the number of target words, word novelty, in particular, the use of sophisticated, but not pre-tested words, were associated with higher word learning performance than when compared with novel words. Confidence intervals suggest this could be a population wide effect.

Publication Bias

Figure 3 shows the funnel plots for the studies in this meta-analysis. There is a clear sparsity in the lower right and no effects in the lower left (i.e. truncation below zero) indicative of one-tailed, selection bias. Qnorm plots of residuals (available at https://osf.io/rxbdz/) suggest publication bias, but for a population with a non-zero effect size (Wang & Bushman, 1998). To quantify the likely effect of publication bias, a sensitivity analysis based on Vevea and Woods (2005) was conducted. We modelled a scenario in which nonsignificant studies ($0.05 < p < 1$) were about half as likely to be published as significant studies (i.e. a fairly severe situation).

Figure 3. Funnell plots of effect sizes for the meta-analysis. Panel A shows original analysis, and Panel B shows with outliers removed.

The overall population effect size estimate changed from 3.027 to 2.79[2.] Even correcting for severe selection bias the overall population effect size estimate was reduced only modestly. This sensitivity analysis suggests that our estimates would not be radically reduced by the inclusion of unpublished studies based on our assumptions about the likely pattern of selection bias.

We also conducted additional analyses to investigate the relationship between study variance and effect size. Mediation analyses suggested that story to test interval, ($p = .022$), target words ($p = .078$), and the proportion of nouns ($p = .059$) provide some mediation. Further information about these analyses is provided at https://osf.io/rxbdz/

Discussion

In addition to being a highly enjoyable activity for both children and adults, shared storybook reading supports reading skills (Bus et al., 1995; Niklas, Cohrssen, & Tayler, 2016; Sénéchal & LeFevre, 2002) and later vocabulary development (Elley, 1989; Robbins & Ehri, 1994; Sénéchal & Cornell, 1993) by providing a richer source of linguistic input than conversation alone (Mol et al., 2008; Montag et al., 2015). This is important for child development because a child's vocabulary size predicts later academic performance (Snow, Griffin, & Burns, 2005), behavioural regulation (Morgan, Farkas, Hillemeier, Hammer, & Maczuga, 2015) and even criminal convictions (Murray, Irving, Farrington, Colman, & Bloxsom, 2010). We used multi-level meta-analysis to estimate the population effects of shared storybook reading on word learning and to investigate the factors moderating this relationship from studies, which together included 2,455 participants. Overall, we found children were able to comprehend just under half of the new words to which they were exposed which is consistent with other reports in the literature (see, e.g., Biemiller & Boote, 2006).

Overall, learning is the product of an embodied child interacting with other people and its environment (Thelen & Smith, 1994). In highly naturalistic situations, such as shared storybook reading, there will be multiple factors simultaneously influencing children's learning, including what the child is currently experiencing (e.g., the attributes of a given storybook) and the child's previous knowledge (i.e., the child's own developmental history interacting with books). Although we were keen to understand these important interactions, we limited ourselves to simple moderator analyses in the current meta-analysis because there were too many explicit variables across studies to perform multiple moderator analyses for every possible combination of factors that could interact with each other while maintaining statistical power. The original papers discuss their own interactions. In addition, we noticed orthogonal patterns in the literature. For example, studies using completely novel words (e.g., *manu*) tended to also include very few target words. Likewise, studies using dialogic reading styles tended to not control for tokens. Below we review our findings and discuss the orthogonal patterns we encountered as well as highlight areas that need more research.

Word Learning From Storybooks: What Really Matters

How you read. Our results indicate reading style and use of dialogic techniques (such as pointing, providing definitions or asking children questions as you read) dramatically influences the number of new words children learn from shared storybook reading. In fact, our results suggest that, after adjusting for the number of target words, the use of dialogic styles increases word learning by more than one word per child. Many different dialogic techniques were employed across the studies we reviewed. Techniques included describing pictures (Reese & Cox, 1999), providing dictionary definitions before readings (Coyne et al., 2004), asking questions during readings

(Blewitt, Rump, Shealy, & Cook, 2009; Walsh & Blewitt, 2006) or incorporating music (Joyce, 2012). Although we suspect there may be different effects across techniques (e.g., Ard & Beverly, 2004; Reese & Cox, 1999) we did not investigate the effects of these different styles separately as we had already planned to investigate so many individual moderators.

Tokens. The moderating effects of tokens on word comprehension when adjusted for the number of target words, were small but precise, indicating the importance of multiple exposures for word learning. Increasing the number of tokens provides children with greater opportunity to learn and consolidate new words (Samuelson, 2002; Woodward et al., 1994). This will surprise few—after all, word learning experiments have consistently manipulated tokens to affect word learning gains, both directly (e.g., Blewitt et al., 2009) and indirectly, for example through storybook repetitions (e.g., Sénéchal, 1997; Sénéchal et al., 1995). Similarly many dialogic reading techniques are specifically aimed at increasing tokens, for example, by asking children to repeat words. Our analysis (after removal of outliers) provides evidence of a true population effect. This is good news because increasing tokens is a remarkably simple intervention, which can be used by parents and teachers alike with minimal specific training.

The number of words tested. Overall, we found some evidence of moderating effects from the number of new words tested. The number of words tested was calculated by subtracting the pre-test scores (i.e., words children already knew) from the number of intended target words. These effects remained remarkably stable, even after removal of outliers. In some studies only a subset of the words deemed difficult enough to be selected as target words on the test trials were actually used as target words (e.g., Vuattoux, Japel, Dion, & Dupéré, 2014; Weisberg et al., 2015). However, in these cases

children still encountered all of the potentially new words during storybook reading (e.g., a storybook may contain the not-fully known word *departed,* but that word may not be on the researcher's list of target words). Thus, children may be working to learn additional new words beyond those that the researchers intended to test. That is, the number of target words is not necessarily an indication of the level of difficulty of a story. If the entire story contains a high number of unknown words—even if some are not explicitly tested—then children's overall word learning could be underestimated. Therefore, researchers should take care to ensure non-target words are still well-matched to children's abilities.

Word Learning From Storybooks: What Matters Less

Who reads. Whether a familiar teacher or researcher the child has just met reads a storybook does not affect children's word comprehension. For experimental design, the lack of an effect for word comprehension is good news as it suggests results obtained in the lab will generalize to naturalistic settings.

Age. Hundreds of studies within educational and developmental psychology, and within the language acquisition literature more generally, demonstrate that older children have more proficient word learning skills than younger children (e.g., Bion et al., 2013). Therefore it should follow that word learning increases with age, however, this was not what we found in the shared storybook reading literature. In our analysis any moderating effects of age were trivial. One explanation for why age does not moderate word learning from storybooks is because experiments are designed with a specific participant age-range in mind and already take into account an appropriate level of challenge. That is, researchers understand that older children learn new information more quickly, and so provide older children with more words to learn within a single experiment and also with fewer exposures to each word. Indeed, a closer examination of

our database indicates that storybooks read to older children include more target words ($r = .24$, $p = .01$) and fewer tokens ($r = -.38$, $p < .001$) than those read to younger children. This indicates that researchers *are* taking overall book difficulty into account when they select storybooks for use in research. In addition, other factors that correlate with age but not available to us, such as pre-experimental vocabulary size, or amount of experience with storybooks, may also contribute to word learning success.

Story to test interval. For word comprehension, we found no significant moderating effects of story to test interval. This finding is unexpected in light of other studies demonstrating that differences in stimuli presentation affects both short- and long-term word learning success (e.g., Vlach, Ankowski, & Sandhofer, 2012). In our sample, the delay between the reading and testing varied from immediate testing to testing after 10 weeks, but with some noticeable gaps (for example, there were no studies testing delays of between 1 and 2 weeks). Thus, our finding may be affected by missing data. In addition, some studies in our sample assessed word learning only once, some twice and some three times, but no studies assessed word learning more frequently than three times. Adolph, Robinson, Young, and Gill-Alvarez (2008) argue that more frequent sampling is beneficial for discovering the shape of developmental change. At first glance, testing more frequently sounds like an ideal recommendation for research in word learning from shared storybooks. However, every time children are tested they are re-exposed to the target words and/or definitions. That is, they are given another opportunity to encode (Munro, Baker, McGregor, Docking, & Arciuli, 2012) and learn (Horst & Simmering, 2015), which then makes it difficult to determine how much of their word learning is due to their initial storybook exposure.

Word Learning From Storybooks: Topics for Future Research

Story repetitions. Repeated readings of the same storybooks benefit word learning, even after controlling for tokens (Biemiller & Boote, 2006; Horst et al., 2011; McLeod & McDade, 2011). We found a small effect of repetition on word comprehension, but confidence intervals suggest a lot of variability in these studies, and the true effect could be 0. Story repetition may reflect another orthogonal pattern in word learning from shared storybook reading, with studies that include repeated readings testing fewer words. Alternatively, repetition effects could be stronger at some ages than others. For example, Horst et al. (2011); McLeod and McDade (2011); and Sénéchal (1997); Damhuis, Segers, and Verhoeven (2015) all found robust effects of story repetition with 3- to 5-year-old children. These explanations are not mutually exclusive, but they do suggest further investigation into the effects of storybook repetition on word learning is needed.

Word novelty. Target words were divided into three categories: real words that were either confirmed unknown (e.g., *forlorn*), deemed too sophisticated for the age-range of children being tested (e.g., *departed*) or completely novel, plausible pseudo-words (e.g., *manu*). Word novelty was a strong moderator of word comprehension. Most interestingly, word learning effects differed greatly for each word type. For example, even after adjusting for the number of target words, children correctly identified more than one whole extra word in tests using novel words (e.g., *manu*) than confirmed unknown (e.g., *forlorn*). However, children correctly identified more than one whole word more than that in tests using sophisticated words (e.g., *departed*) than novel words.

These results are surprising, but we believe this highlights the impact of methodological differences across studies. One possible explanation for why studies

using novel words resulted in fewer words learned than those using sophisticated words

is that of pre-experimental control. All words are novel at some point, but repeated

encounters to new words results in a gradual transition from unknown to known. Word

learning requires multiple exposures to a word (e.g., McMurray et al., 2012). Children

tested with real words may have some pre-experimental exposure to these words, which

is not measured, therefore providing an advantage when tested over entirely novel

vocabulary. Novel words control for children's pre-experimental exposure to target

words because children definitely have not encountered these elsewhere. However, this

explanation would also predict that studies using novel words would result in fewer

words learned than those using confirmed unknown words, but this was not the case.

Though, as noted above, studies using novel words typically included fewer target

words overall. This leads us to believe this is an important consideration in research

design, particularly where comparisons are made between studies using words of

varying degrees of novelty.

Word type. Overall, we found 2- to 10-year-old children could learn

approximately 2-5 new words from shared storybook reading (approximately 2.77

nouns, 3.10 verbs). The proportion of nouns tested suggested this was a strong

moderator of word learning, however, widely spaced confidence intervals included 0,

suggesting the true effect could be zero. Interestingly, with outliers removed, nouns

were still not learned better than verbs. There is abundant evidence that nouns are easier

to learn than verbs (for a review see Golinkoff & Hirsh-Pasek, 2008), but our analyses

showed conflicting evidence of this in the shared storybook reading literature.

Differences in word learning effects for nouns and other word types is an interesting and

important topic which merits further investigation.

Conclusions

Our review integrates studies from education, developmental psychology and the control groups in communication disorders research to quantify the effect of shared storybook reading on children's word comprehension. Although large positive word learning effects were expected, the real value here was in gaining an understanding of the many factors moderating these effects.

This meta-analysis highlights several important variables, which *really* affect the quality and quantity of word learning from shared storybook reading. Reading style is of paramount importance: dialogic reading styles that encourage additional interaction with the text significantly improve word learning. The amount of new vocabulary introduced is clearly important and how often these new words are heard. We suggest story repetitions, word novelty and word type as important areas for future research as there was greater variability in the findings for these. Together, these insights provide valuable guidance to both researchers investigating word learning from shared storybook reading, and to parents, teachers or speech therapists wishing to provide the best possible learning environment for their children.

Footnotes

[1] Alternative effect sizes, all data and additional plots are available at

https://osf.io/rxbdz/

[2] To do this analysis it was necessary to aggregate effect sizes within studies so that each study produced only 1 effect size. This differs from the multi-level approach used in the main analysis which explains the difference in the unadjusted value here and that reported earlier.

Paper 2:

The Effects of Storybook Repetition on 3-year-old Children's Word Learning and Eye Movements.

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Abstract

Children learn words better from hearing stories repeated than hearing different stories.

We conducted two experiments investigating whether differences in word learning

could be accounted for by differences in eye movements. In both experiments 3.5-year-

old children were presented with either one story repeated or three different stories

while their eye movements were recorded. Stories included two novel objects, which

were named and depicted four times in each story, so all children encountered each new

word twelve times. In both Experiment 1 ($n = 24$) and Experiment 2 ($n = 36$) there were

no significant differences in word learning between conditions. In addition we found no

differences between conditions in number of target fixations, target looking time or the

latency from word onset to target fixation. Possible reasons for the lack of effects are

discussed, including the impact of the computerised presentation of storybooks.

The Effects of Storybook Repetition on 3-year-old Children's Word

Learning and Eye Movements

Reading a story to a child forms part of a good bedtime routine (Christodulu & Durand, 2004; Durand, 1998), helps the child learn new vocabulary (Biemiller & Boote, 2006; Hargrave & Sénéchal, 2000) and even improves academic outcomes in later life (Lonigan & Whitehurst, 1998). Shared reading of storybooks provides an opportunity for children to hear new words, typically accompanied by pictures, which illustrate the new words' meanings. Shared reading provides a natural intervention by providing valuable learning opportunities in an enjoyable way. Gaining a full understanding of how to maximise any learning allows us to offer children the best possible chances for the future.

A variety of factors influence the ease with which children acquire new vocabulary from sharing a storybook with an adult. Children learn fewer facts when books contain manipulative features such as pull tabs and pop-ups (Tare, Chion, Ganea, & DeLoache, 2010). Children also learn new words better when the book features realistic photos than simple drawings (Ganea et al., 2009). Dialogic techniques such as asking children vocabulary-related questions during reading also improves children's word learning (e.g., Sénéchal et al., 1995; Walsh & Blewitt, 2006; Whitehurst et al., 1988). In addition, the type of new words presented (i.e. noun or verb) also influences later recall (Horst, 2013; McLeod & McDade, 2011).

Robbins and Ehri (1994) showed that encountering a target word more frequently increases learning as it provides more opportunities to hear and therefore encode the word. Repetitions of words can occur within a story, but the stories themselves can also be repeated. Repeatedly reading the same storybook provides repetition of the new words and the context in which these words are presented. Sénéchal (1997) found that

fewer words were learnt from a single reading than from multiple readings and Robbins and Ehri (1994) found fewer words were learnt from two readings than from four readings. However, in these studies children who were exposed to more repetitions of the target words also received more reading time overall. McLeod and McDade (2011) explored the effects of story repetition and controlled the number of word exposures. In addition, they used novel, made-up words to rule out the possibility of any pre-experimental knowledge, which is a common methodological flaw in this research area (Horst, 2013). Children heard either one story presenting target words three times but read on a single occasion, or a shorter story containing each target word only once but repeated over three occasions. McLeod and McDade found that children who heard the story repeated learned significantly more words than those who heard them in the single story, despite all children hearing the target words the same number of times overall.

Horst et al. (2011) investigated the impact of repetition on word learning. They too used novel words, but unlike McLeod and McDade (2011), they also ensured all children were read to an equal number of times, so that the number of readings was no longer a confounding factor between conditions. In this study children heard either three different stories or the same story three times. Importantly, all children heard the two target words the same number of times, and all children heard stories an equal number of times. Children hearing the same stories correctly identified significantly more words than children who heard the different stories, and significantly more than expected by chance. This was the case on both tests of immediate recall and delayed retention. Horst et al. (2011) suggested that repetition of story contexts reduces attentional demands, allowing children to attend to different details on each re-reading, such as the new vocabulary, which in turn aids word learning.

Horst and colleagues' (2011) explanation is also consistent with cognitive load theory (Paas et al., 2003; Sweller, 1988, 1989). Cognitive load theory describes learners as having limited cognitive resources available to allocate to learning from new materials, such as books. Where information is complex, working memory can be stretched, resulting in less than optimal learning. With experience learners can make short-cuts to save chunks of information called schemas to long term memory, thereby freeing up working memory to work on new aspects of the original materials. When learners encounter more simple materials, or have more experience, they can allocate cognitive resources to new learning. Cognitive load has prompted new ideas about how to ensure complex materials are delivered without extraneous information not pertinent to the task, to ensure learners are able to learn what they need to learn faster (Paas et al., 2003; van Merrienboer, Kirschner, & Kester, 2003).

In the case of word learning from storybooks, the repetition of stories allows children to attend to different aspects of the story with each reading (Horst, 2013; Horst et al., 2011; Williams & Horst, 2014), allowing for better processing of the new objects featured in the pictures and referred to in the text. When children encounter three different stories, some of their attention is allocated to understanding the changing plot or characters as well as gaining a broad visual appreciation of each of the accompanying illustrations. In contrast, when children encounter the same story three times, they can allocate less of their attentional resources to the characters and the plot, and move onto other aspects, such as the novel objects much faster, thereby allocating more attention to the novel objects and their names.

Eye movements are closely linked to, if not entirely co-located with, attention and therefore provide a good measure of attention (Hutton, 2008). Recently, M. A. Evans and Saint-Aubin (2013) explored how repeated readings influence eye movements over

time and the impact this has on 4-year-old children's word learning. Children were read three stories on seven occasions during a 2-week period, and their eye-movements were recorded on the first and final readings. Storybooks introduced 15 target nouns, mentioned just once per visit. Children showed evidence of word learning and the amount of time spent looking at the illustrations reduced from the first to last visit, but there was no evidence of any difference in time spent looking at the target objects. Because M. A. Evans and Saint-Aubin (2013) did not record eye movements for all the readings, there is no clear picture of how repeated readings may change eye movements incrementally. It is therefore possible that across subsequent readings, children may have familiarised themselves fully with the targets and any differences in eye movements may have been missed in the sessions that were not eye-tracked (sessions 2-6). The question of exactly how repetition facilitates word learning therefore remains unanswered.

In the current study we created three storybooks, which each included two novel name-object pairs depicted four times each. Children were presented with either three different stories or the same story repeated three times on a computer monitor while their eye-movements were recorded. Children's eye movements were recorded during every storybook reading. Children then completed a simple 4-alternative forced-choice word learning test. If hearing stories repeated facilitates word learning by freeing up attentional resources we should see differences in looking patterns between children hearing the same or different stories. We would also expect novel object fixation times to differ between conditions, with each reading. Novel object fixations could increase with repeated readings because children need to pay less attention to other aspects of the pictures so can attend to the novel objects. Alternatively, novel object fixations could reduce with repeated readings as children stop attending to novel objects when they

have finished visually processing them (see, for example Kidd, Piantadosi, & Aslin, 2012). If hearing stories does not facilitate word learning by reducing attentional load, then we would expect to see no differences in eye movements between conditions.

Experiment 1

Method

Participants

Twenty-four 3-year-old children participated ($M = 39.8$ months, $SD = 2.15$ months, range 35.19 months to 43.28 months). Children were monolingual, British English speakers from predominantly middle-class families. All children were typically developing with no reported speech or language difficulties. Twelve children were randomly assigned to either the different stories ($M = 38.27$ months, $SD = 2.12$ months, range 35.19 months to 42.12 months) or same stories condition ($M = 39.20$ months, $SD = 2.20$ months, range 36.50 months to 43.13 months). There was no significant difference in ages, $t(22) = 1.46$, $p = .16$. There was no difference in maternal education between conditions, Fisher's exact test $= 4.54$, $p = 0.19$. Five mothers in the different stories and one mother in the same stories condition had completed high school (GCSEs) and/or further education (A-levels or equivalent). Two mothers in the different stories condition and five in the same stories condition had completed an undergraduate degree. Three mothers in each condition had completed a Post-graduate qualification, and one mother in the different stories condition had a doctoral degree. One mother in the different condition and three mothers in the same condition declined to answer this question. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Storybook reading experiences. Parents were asked to provide information regarding their children's pre-experimental history with storybooks, this is depicted in Table 1.

Table 1. Pre-experimental history with storybooks (21 parents responded in Experiment 1 and 26 parents responded in Experiment 2). Standard deviation in parentheses.

	Age of onset of daily reading	Stories read per day	Minutes spent reading per day
Experiment 1	2.52 months	3.14 stories	22.71 mins
	(3.91 months)	(1.82 stories)	(12.85 mins)
	Range: 0-12 months	Range: 1-10 stories	Range: 10-60 mins
Experiment 2	2.73 months[1]	2.89 stories[2]	19.88 mins
	(3.47 months)	(0.98 stories)	(7.21 mins)
	Range: 0-12 months	Range: 1.5 – 5 stories	Range: 8 – 40 mins

Notes. 1.) 24 parents in Experiment 2 responded. 2.) 22 parents in Experiment 2 responded.

Stimuli and Apparatus

Storybooks. Three 10-page (including title page) storybooks were minimally modified for computer display from those created by Horst et al. (2011): *The Mystery Auntie, 'I Don't Want to Share', and Mischief at the Toyshop.* Children's attention to text has been considered elsewhere (e.g., Evans & Saint-Aubin, 2005; Justice, Skibbe, Canning & Langford, 2005), and was not part of our research aims, so text was removed from pages. Stories were centred around the lives of a young girl and boy and portrayed simple themes (e.g., family visiting, sharing, and not wandering off) set in everyday locations (e.g., the home, out with friends, or in a shop). Each story depicted and named

two novel objects four times. Throughout each story, objects were named incidentally and were not the focus of the story. The objects appeared twice on their own pages and twice together. Novel objects were a striped cup-and-ball game (*zorch*) and a giant, blue pen with orange, rubber strings on the end (*manu*).

Pages were displayed for just long enough to allow the longest page to be read aloud: 6 seconds for the title page and 16 seconds for the remaining nine pages. The story was recorded by a female native British English speaker to provide the audio to accompany the storybook. Across the three books there were no differences between number of words per page, $F(2,18) = 0.30$, $p = .75$, or length of audio recordings, $F(2,18) = 1.80$, $p = .20$.

Test stimuli. A test booklet was created to test word learning. Each page pictured four objects. A warm-up trials page included images of four known objects: a red fish, a blue cup, a yellow duck and an orange spoon. Test trial pages included images of each novel object (*manu* and *zorch*) as well as additional novel objects, which were not featured in the storybooks. Target novel objects were featured once with the other target novel object and two novel distractors, and once each with three distractor novel objects and counterbalanced across each of the possible four quadrants. All object images were decontextualized, that is, they were presented on a plain white background without any other contextual information.

Apparatus. Eye movements were measured with a desktop SR Research Eyelink 1000 Plus and Dell Precision laptop. This system provides a high sampling rate (500 Hz) and accuracy (<0.5° average). Only the pupil for which the most accurate calibration was achieved was tracked. Storybooks were presented on a Mitsubishi Diamond Plus 230SB monitor and the storybook audio was played through two speakers placed either side of the monitor. Refresh rate was set to 85Hz.

SHARED READING & WORD LEARNING

Procedure

A target sticker was placed on each child's forehead for the purposes of focusing the eye tracker. During piloting some children initially objected to having the sticker placed on their faces, therefore during testing the experimenter and parent wore the stickers before inviting the child to wear one too. The experimenter asked parents to secure children in a car seat to reduce excessive movement during the experiment. While the parent seated the child, a cartoon was displayed on the screen and the experimenter adjusted the camera position, and prepared the equipment for use. Children sat with their eyes approximately level with the top of the screen, with a viewing angle of 45 degrees. When each child was comfortably positioned a five point calibration was completed.

Children heard either one story three times, or three different stories each read once. Recalibration was prompted between stories, but was only used if necessary. Story and story order was counterbalanced across participants. Importantly, children in both conditions were exposed to the novel objects and words an equal number of times.

After the final reading all children were removed from the seat and invited to play a pointing game. We found children were better able to point to items within the test booklet when not restrained in the seat. The experimenter presented the test booklet to children and positioned it so children could reach to point. There were four warm-up trials and four test trials. For warm-up trials children were asked to point to each of the four known objects, thereby pointing to an object in each of the four quadrants. The experimenter provided praise for correct answers in warm-up trials, but no feedback was provided after each test trial. Across the four test trials the novel targets (*manu* and *zorch*) appeared both individually and together. Other novel objects were novel distractors that the children had not previously seen. Picture locations (e.g., top left

quadrant) were counterbalanced across pages. On completion the experimenter thanked children for their participation with a small gift (e.g., a colouring book).

Analysis. Looking times provide a measure of the time a child spends looking at the screen. With children, even more so than with adults, maintaining attention to the screen can be difficult. Conventional practice is to analyse target looking measurements as proportions of overall looks, which naturally discounts blinks, or time spent looking away from the screen (e.g., M. A. Evans & Saint-Aubin, 2013). In addition, occasionally children obscured the sticker, which prevents the eye tracker from recording the looking behaviour until the sticker is uncovered. On the whole, children's attention was excellent, with looking successfully recorded 75% of the time, demonstrating that stories were suitably timed and interesting enough to maintain attention.

For each page of the 30 storybook pages, eye movement data reports were downloaded from Eyelink Data Viewer program. Although some effort was made to size match the target objects, this was not always possible. Because these books were designed for an earlier paper-based study, there was a limit to how closely these could be matched without disturbing other aspects of the illustrations, particularly when two objects appeared together on a page.

The smallest possible interest area was defined for each of the target objects, then an additional border of 10 pixels depth was added around the object (for example, see Figure 1). Therefore, although target objects differed across books in overall pixel size (*The Mystery Auntie*: $M = 16,533$, $SD = 6394$; *I Don't Want to Share*: $M = 24,300$, $SD = 8,100$; *Mystery at the Toyshop*: $M = 24,429$, $SD = 8,735$) this was not significant, $F(2,12) = 2.36$, $p = .14$. There was also no significant difference between the pixel coverage for the two target objects (*zorch, manu*), $t(21) = 1.09$, $p = .29$.

Figure 1. Example page featuring novel object and interest area
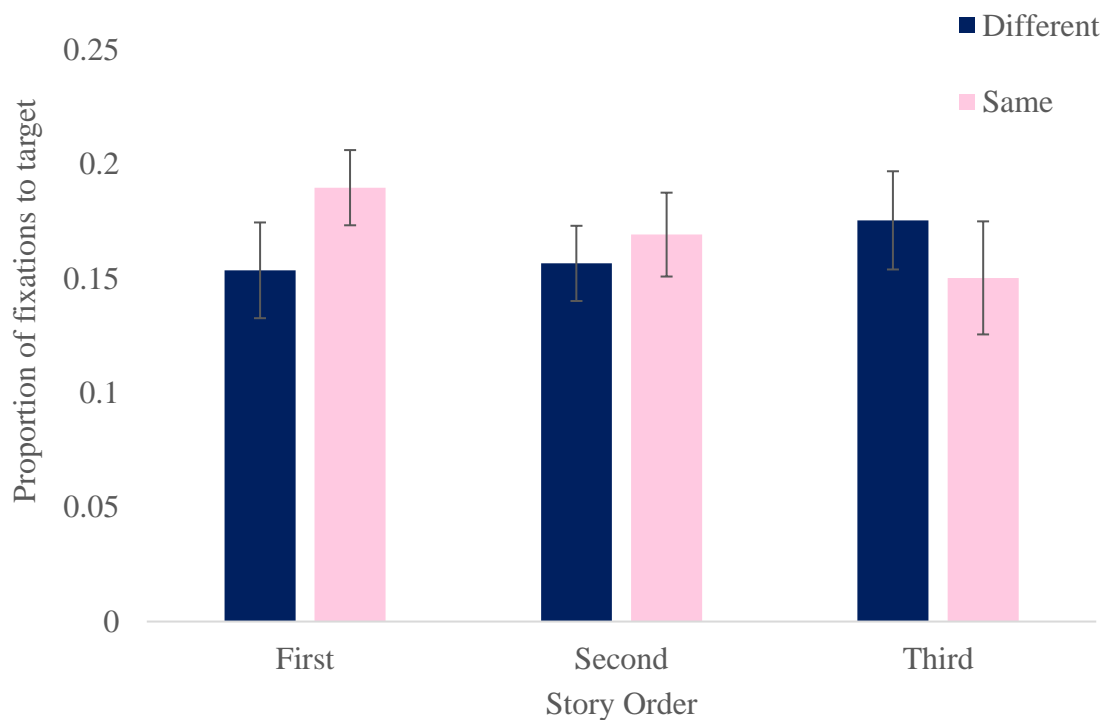
Results

Word Learning

Children correctly identified the correct target objects significantly better than by chance in both the same stories ($M = 0.77$, $SD = 0.27$, $t(11) = 6.66$, $p < .001$, $d = 1.92$) and different stories conditions ($M = 0.52$, $SD = 0.42$, $t(11) = 2.24$, $p = 0.047$, $d = 0.65$). There was no significant difference in word learning between children in the same stories condition and those in the different stories condition, $t(18.83) = 1.74$, $p = 0.10$.

Eye Movements

Overall children fixated on the stories for 75.34% ($SD = 0.03\%$) of the time they were displayed. The time children spent looking at the stories reduced with each successive story read, $F(2,42) = 13.40$, $p < .001$, $\eta_p^2 = 0.39$, but did not differ significantly between conditions, $F(1,21) = 2.07$, $p = 0.17$. Children's target fixations accounted for 16.61% ($SD = .07\%$) of overall fixations to pages including targets. To

test for differences between conditions with each successive reading we entered the proportion of fixations to target objects into a mixed-design ANOVA with condition (same, different) as an independent measures factor and story order (first, second, third) as a repeated-measure and (see Figure 2). The proportion of fixations to target objects did not differ significantly with either condition, $F(1,21) = .04$, $p = .84$ or story order $F(2,42) = 0.16$, $p = .86$. There was a non-significant interaction, $F(2,42) = 2.70$, $p = .08$.

![Bar chart showing the proportion of fixations to target. The y-axis "Proportion of fixations to target" ranges from 0 to 0.25. The x-axis "Story Order" shows First, Second, Third. Two conditions are shown: Different (dark blue) and Same (pink). First: Different ~0.155, Same ~0.19. Second: Different ~0.157, Same ~0.17. Third: Different ~0.175, Same ~0.15. Error bars represent +/- 1 SE.]

Figure 2. The proportion of fixations to target objects per page for same and different stories, by successive storybook readings +/- 1 SE.
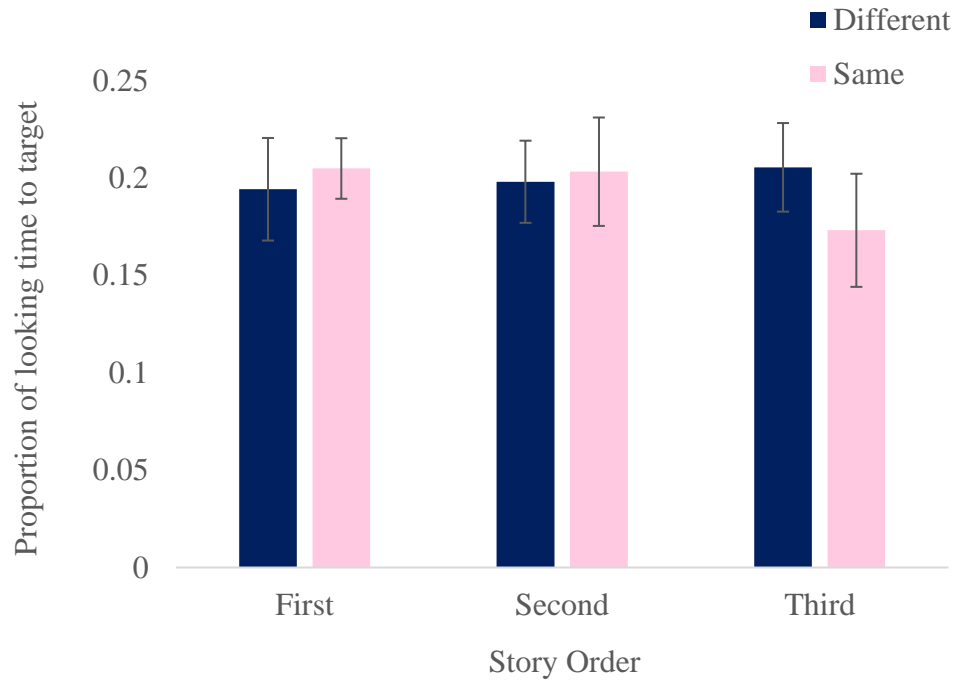
Figure 3. Proportion of looking time to target objects per page for same and different stories with successive readings +/- 1 SE

We also tested for differences in the proportion of overall time spent looking at target objects between conditions for each reading. A mixed-design ANOVA with condition (same, different) as an independent measure and story order (first, second, third) as repeated-measure was conducted (see Figure 3). Here we found no significant effect of condition, $F(1,21) = 0.13$, $p = 0.72$, or story order, $F(2,42) = 0.05$, $p = .95$. There was a non-significant interaction, $F(2,42) = 1.03$, $p = .37$ between story order and condition.

SHARED READING & WORD LEARNING
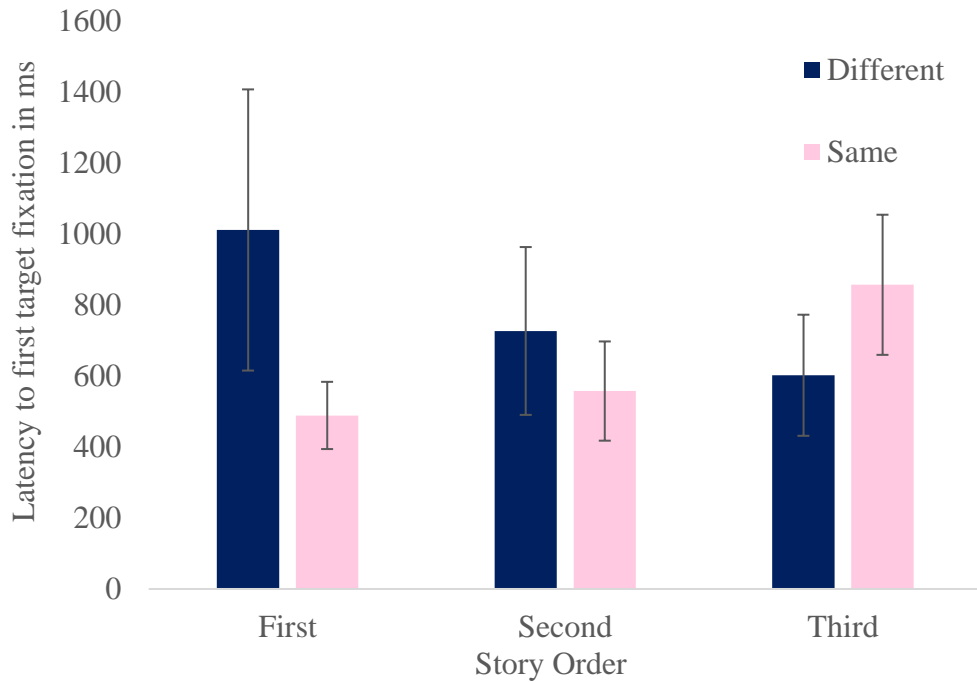
Figure 4. Latency to first target object fixation in milliseconds per page of same and different stories with successive readings +/- SE.

We measured latency (see Figure 4) from target word onset to the first look to a target object on each page ($M = 685.80$ ms, $SD = 748.59$ ms). To test for differences in latency to first target fixation between conditions and successive readings we entered the latencies into a mixed-design ANOVA with condition (same, different) as an independent measures factor and story order (first, second, third) as a repeated-measure. We found no significant effect of condition, $F(1,20) = 0.40$, $p < .53$ or story order, $F(1.53, 30.67) = 0.176$, $p = .78$ (Huynh-Feldt corrected for sphericity). There was a non-significant interaction between story order and condition, $F(1.53, 30.67) = 1.22$, $p = 0.30$ (also Huynh-Feldt corrected for sphericity).

Discussion

Children in both conditions showed evidence of word learning and there was no significant difference between conditions. Further, we found no evidence of differences

in the proportion of fixations, proportion of overall looking time or the latency to the first target fixation on pages featuring targets. One possible explanation is that the storybook pages were not well suited to eye-tracking. The stimuli were not originally created for eye-tracking and as such were visually complex, with multiple characters featured on each page, and target objects were not well matched for size. Children's overall target fixation time was rather low (~15%) and we considered that the inclusion of multiple characters on many pages might be rendering any effects more difficult to find. In addition, novel objects were sometimes partially obscured because they were held in characters' hands, or were poorly size matched across pages. Thus, for Experiment 2 we designed a new set of storybooks where target objects were more similarly sized across images and never featured on the same page as storybook characters.

Experiment 2

Method

Participants

Thirty-six 3-year-old children participated ($M = 41.77$, $SD = 1.76$ range = 39 to 45.05 months). Children were monolingual, British English speakers from predominantly middle-class families. All children were typically developing with no reported speech or language difficulties. Eighteen children were each randomly assigned to either the same stories ($M = 41.49$, $SD = 1.72$ range = 39.01 to 45.05) or different stories condition ($M = 42.06$, $SD = 1.81$, range = 39 to 44.63 months) with no significant difference in ages, $t(34) = 0.97$, $p = .34$. There was no difference in maternal education between conditions, Fisher's exact test = 4.66, $p = 0.32$. Three mothers in each condition had completed high school (GCSEs) and/or further education (A-levels or equivalent). Five mothers in the different stories condition and eight in the same

stories condition had completed an undergraduate degree. Four mothers in the different

stories condition and one in the same stories condition had completed a Master's

degree, and one mother in the same stories condition had a doctoral degree. Eleven

parents declined to answer this question. None of the children in Experiment 2 had

previously participated in Experiment 1. Parents were reimbursed for travel costs and

children chose a small gift as a thank you for participating (e.g., a colouring book).

Storybook reading experiences. Parents were asked to provide information

regarding their children's pre-experimental history with storybooks (Table 1).

Stimuli and Apparatus

Storybooks. Three storybooks were created using real photographs. Each

storybook was 11 pages long (including title page) and contained two novel objects, a

yellow sponge on a wand (*yine*), and a wooden coloured toy (*poge*), each named and

pictured four times per story. Throughout each story, objects were named incidentally

and were not the focus of the story. Novel objects always appeared on pages that did

not include characters competing for attention. The characters were girls and boys aged

8-10 years. Scenes were arranged to ensure novel objects were approximately the same

sizes across pages. Stories were written for 3-year-old children, with plots children

would be familiar with (e.g., searching for a lost toy, a day trip to the beach, or helping

around the home) as previous research suggests familiar plots help children's

understanding of stories (Kim & Hall, 2002).

Twelve additional 3- and 4-year old children were recruited in a local nursery.

Children were read the new storybooks and asked to complete a ratings task to ensure

stories were similarly enjoyable. A one-way ANOVA revealed no difference in

enjoyment between stories, $F(2,22) = 0.38$, $p = .69$, $\eta_p^2 = 0.03$ and children reported enjoying the stories 81% of the time.

As in Experiment 1, pages were displayed for just long enough to allow the longest page to be read aloud: 4 seconds for the title page and 14 seconds for remaining pages. The story (audio) was recorded by a female native British English speaker. Across the three books there were no differences between number of words per page, $F(2,20) = 0.81$, $p = .46$ or length of audio recordings, $F(2,20) = 0.09$, $p = .91$.

Test stimuli. A test trial booklet was created as in Experiment 1 with the novel target objects from Experiment 2 with the same novel distractor objects. A warm-up trial page included images of four known objects (e.g., a brown chair, a blue fork, a red block and a purple cup).

Apparatus. Eye movements were measured as in Experiment 1.

Procedure

The procedure was the same as in Experiment 1.

Results

Word Learning

Children correctly identified the correct target objects significantly better than by chance in both the same stories ($M = 0.54$, $SD = 0.30$, $t(17) = 4.12$, $p < .001$, $d = 0.97$) and different stories conditions ($M = 0.47$, $SD = 0.32$, $t(17) = 2.95$, $p = .009$, $d = 0.70$). There was no significant difference in word learning between children in the same stories condition and those in the different stories condition, $t(33.87) = 0.67$, $p = 0.51$.

SHARED READING & WORD LEARNING

Eye Movements

Overall children fixated on the stories for 81.01% ($SD = 4.62\%$) of the time they were displayed. The time children spent looking at the stories reduced with each successive story read, $F(2,68) = 6.64$, $p = .002$, $\eta_p^2 = 0.16$, but did not differ significantly between conditions, $F(1,34) = 2.40$, $p = 0.13$. There was a non-significant interaction between story order and condition, $F(2,68) = 2.30$, $p = .11$.
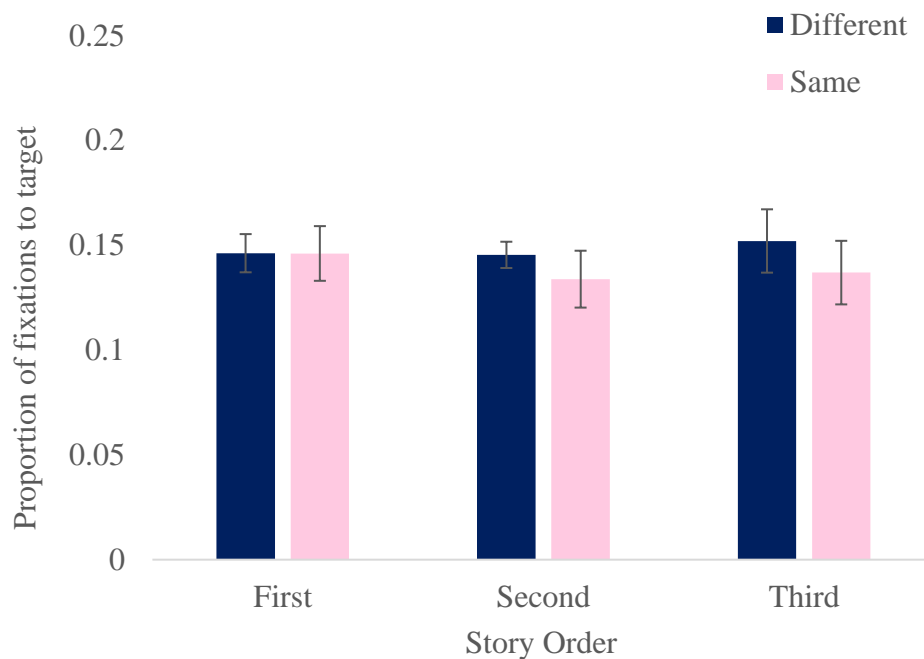

Figure 5. Proportion of fixations to target objects per page for same and different stories with successive readings +/- 1 SE.

Children's target fixations accounted for 14.34% ($SD = .05\%$) of overall fixations to pages including targets. To test for differences between conditions with each successive reading we entered the proportion of fixations to target objects into a mixed-design ANOVA with condition (same, different) as an independent measures factor and story order (first, second, third) as a repeated-measure (see Figure 5). The proportion of fixations to target objects did not differ significantly with either condition, $F(1,34) =$

.41, $p = .53$ or story order $F(2,68) = 0. 26, p = .78$. There was a non-significant

interaction, $F(2,68) = .35, p = .71$.
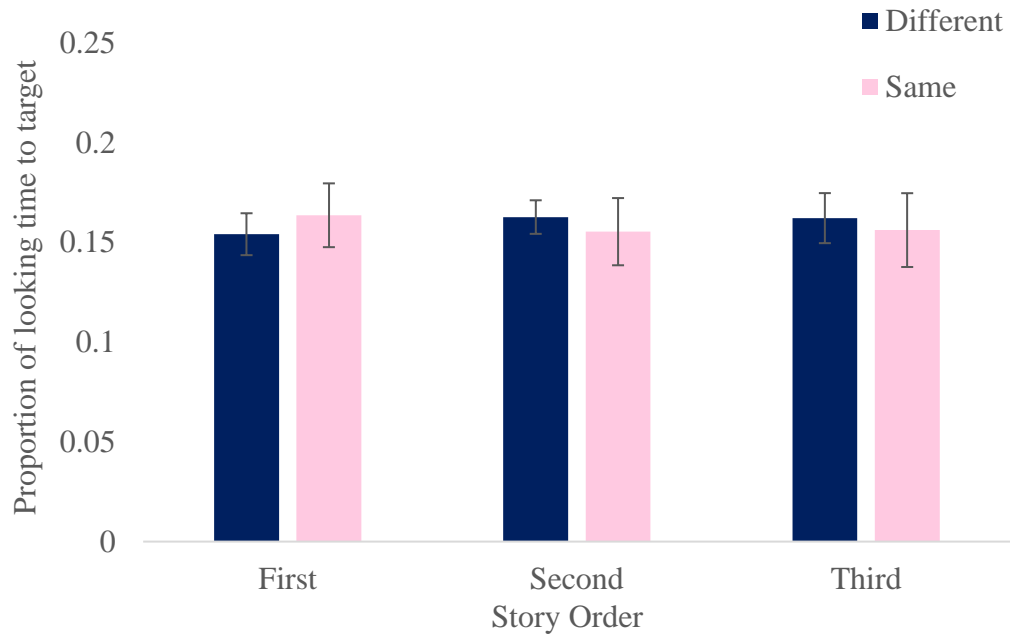
Figure 6. Proportion of looking time to target objects per page for same and different stories with successive readings +/- 1 SE.

We also tested for differences in the proportion of overall time spent looking at

target objects between conditions for each reading. A mixed-design ANOVA with

condition (same, different) as an independent measure and story order (first, second,

third) as repeated-measure was conducted (see Figure 6). Here we found no significant

effect of condition, $F(1,34) = 1.89, p = .18$, or story order, $F(2,68) = 0.51, p = .61$.

There was a non-significant interaction between story order and condition, $F(2,68) = .65, p = .53$.

SHARED READING & WORD LEARNING

We measured latency (see Figure 7) from target word onset to the first look to a

target object on each page ($M = 358.69$ ms, $SD = 504.58$ ms). To test for differences in
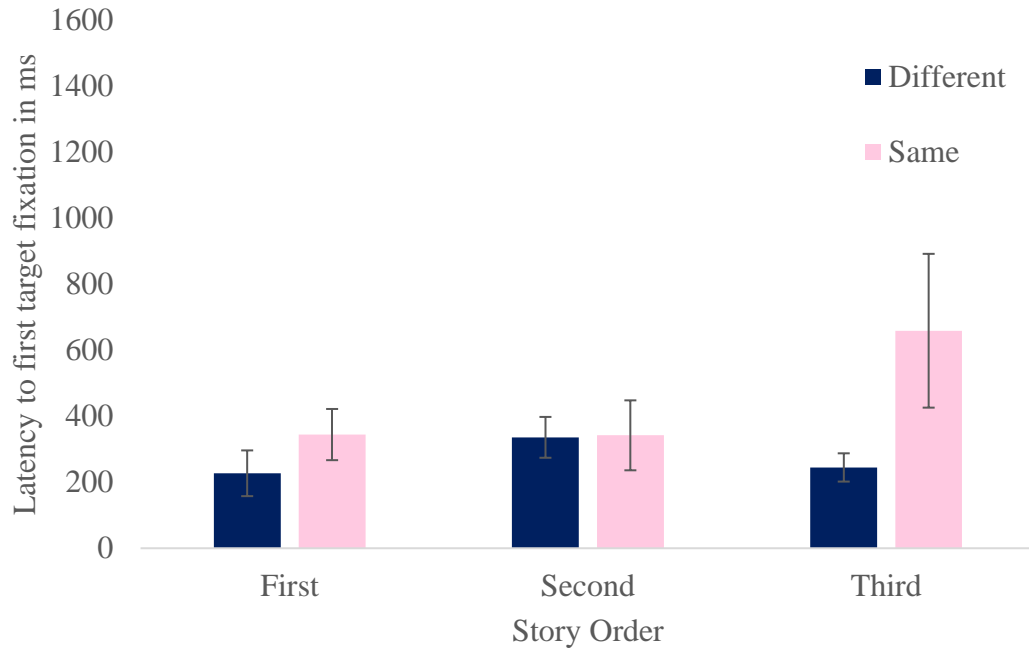
Figure 7. Latency in milliseconds to first target object fixation after word onset
per page for same and different stories with successive readings +/- 1 SE.

latency to first target fixation between conditions and successive readings we entered

the latencies into a mixed-design ANOVA with condition (same, different) as an

independent measures factor and story order (first, second, third) as a repeated-measure.

We found no significant effect of condition, $F(1,34) = 2.71$, $p = .11$ or story order,

$F(1.71, 58.15) = 1.24$, $p = .29$ (Huynh-Feldt corrected for sphericity). There was a non-

significant interaction between story order and condition, $F(1.71, 58.15) = 1.92$, $p = .16$

(also Huynh-Feldt corrected for sphericity).

Discussion

As in Experiment 1, children in both conditions showed evidence of word learning and there was no significant difference between conditions. Although children who heard stories repeated learned more words than children who heard different stories, this difference was not significant. We also found no evidence of any effects of condition on eye movements, despite removing competition from characters on the pages featuring target objects. In fact, the proportions of fixations and proportion of time spent looking at target objects remained relatively similar across the two experiments, despite the different storybooks used.

General Discussion

We conducted two experiments, which measured eye-movements of preschool-aged children while they were presented with either one storybook repeated or three different storybooks on a computer screen. We expected to replicate earlier experiments, which showed that children learn words better when they hear stories repeated (e.g., Horst et al., 2011; McLeod & McDade, 2011; Sénéchal, 1997), but, although children in all conditions learned words, children did not learn significantly more words from repeated stories than from different stories. We also found no evidence of differences in the number of fixations or overall looking duration to targets, or the latency from target word onset to target object fixation between conditions in either experiment. If differences in word learning are the result of differences in eye-movements, the fact that we did not find significant differences in word learning between conditions may be why we did not find differences in eye-movement patterns.

We failed to replicate earlier word learning findings, and any corresponding looking differences. We suspected the lack of differences in eye movements between conditions was due to the naturalistic nature of the stimuli; with looks focusing on characters, rather than novel objects, and with novel objects sometimes partially obscured or not well size-matched. Visual attention is biased towards social aspects of visual scenes, such as human figures (e.g., Buswell, 1935; Yarbus, 1967). This means that people are more likely to fixate on characters in a scene than other aspects of the illustrated environment (Birmingham, Bischof, & Kingstone, 2008). We corrected for these issues in Experiment 2 and also increased the sample size to give the best chance of finding an effect (Oakes, 2017). Despite these efforts we found the same pattern of results.

Despite being 3-4 months younger, children in Experiment 1 performed the word learning task at very similar levels to the children in other studies that used the same storybook stimuli (Horst et al. (2011) and Williams and Horst (2014). An earlier pilot study found that 42-month-old children performed at ceiling on the word learning task. This was surprising as these stimuli have been used in other studies, so we had well-informed expectations for children's word learning performance. The key difference between this study and earlier studies using these storybooks was that storybook pages were presented one-at-a-time on a computer screen, rather than as printed storybooks with two pages displayed simultaneously; one on the left page, one on the right page. We speculated that the presentation of single illustrations may benefit children's word learning and explored this in another study (Flack & Horst, 2017). Indeed, 3.5-year-old children learned words better when the stories were presented one page at a time, rather than two pages per spread. As children's word learning is facilitated by the presentation of single pages, rather than two pages at a time, it is feasible that eye movement

strategies in the current study may be less varied with less visual content, making effect sizes smaller and more difficult to find. Thus, to adequately explore the mechanisms behind preschool word learning from shared storybook reading we should measure eye-movements with storybooks presented with two illustrations at a time. This presents an exciting avenue for future research.

Here we present two experiments investigating the mechanisms that support children's improved word learning from hearing stories repeated, rather than different stories. We were unable to replicate earlier findings. Specifically, we replicated the word learning effect in the same stories conditions but found children in the different stories conditions learned significantly more words than in previous studies. A follow-up study has revealed that the task in the current study was made easier by reducing visual complexity because children only saw one page at a time, rather than two as in earlier studies (see Flack & Horst, 2017). We also found no evidence of differences in eye movements for children who heard repeated, rather than different stories. Understanding the mechanisms supporting improved word learning from shared storybook reading, remains an important goal, and one which will need to encompass storybook layout in future research.

Paper 3:

Two Sides to Every Story: Children Learn Words Better from One Storybook

Page at a Time

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Author Note

Abstract

Two experiments tested how the number of illustrations in storybooks influences 3.5-year-old children's word learning from shared reading. In Experiment 1, children encountered stories with either two regular-sized A4 illustrations, one regular-sized A4 illustration, or one large A3-sized illustration (in the control group) per spread. Children learned significantly fewer words when they had to find the referent within two illustrations presented at the same time. In Experiment 2 a gesture was added to guide children's attention to the correct page in the two illustrations condition. Children who saw two illustrations with a guiding gesture learned words as well as children who had seen only one illustration per spread. Results are discussed in terms of the cognitive load of word learning from storybooks.

Two Sides to Every Story: Children Learn Words Better from One

Storybook Page at a Time

Sharing illustrated storybooks is a common activity for parents and young children (e.g., Rideout, Vanderwater, & Wartella, 2003) and provides a richer source of vocabulary than everyday conversation (Montag et al., 2015). Several studies demonstrate that the styles of illustrations influence how well children learn from books (Ganea, Canfield, Simons-Ghafari, & Chou, 2014; Ganea et al., 2008; Tare et al., 2010; Waxman, Hermann, & Woodring, 2014). However, little is known about how the *number* of illustrations influences learning. The current experiments investigate how well children learn new words from storybooks when they view one or two illustrated scenes at a time.

Pre-literate children rely on illustrations to help them make sense of the story content (for a review see, Wagner, 2013). Specifically, in an eye-tracking study, Justice, Skibbe, Canning, and Lankford (2005) found 4-year-old kindergarten children looked longer at the illustrations than the print that accompanied complicated texts, indicating that even with some emerging print awareness, children look primarily at illustrations. In another eye-tracking study, M. A. Evans and Saint-Aubin (2005) found that even with a range of illustration styles, preschool children spent the majority of their time looking at illustrations and only 6% of their time looking at the printed text (for similar findings, see e.g., Roy-Charland, Perron, Boulard, Chamberland, & Hoffman, 2015; Roy-Charland, Saint-Aubin, & Evans, 2007).

Pre-literate children have a growing awareness of reading conventions, such as, print conveys meaning and is read from left-to-right and top-to-bottom (for a review see International Reading Association & The National Association for the Education of Young Children, 1998; Snow, Burns, & Griffin, 1998). However, because they cannot

yet read, young children are unlikely to know when the reader has moved from the left-hand page to the right-hand page. That is, children may be unable to determine which illustrated scene represents which part of the story. Thus, multiple illustrated scenes displayed simultaneously may make it more challenging to associate new words with their illustrated representations.

When learning from picture books, i.e., books that include isolated images of one or very few objects or people presented as line drawings or photographs (e.g., Ganea et al., 2008; Ganea et al., 2009) , children may be able to use mutual exclusivity (Markman, Wasow, & Hansen, 2003, see also Halberda, 2006) to determine which object to attend to. In such cases presenting multiple illustrations per spread may not be as challenging because children may understand that if the left image is a toy telephone, then the word *blicket* must refer to the right image, i.e., the chrome wire egg holder (Ganea et al., 2008). In fact, 3-year-old children learn words best when another object *is* present and struggle with only one image at a time (Zosh, Brinster, & Halberda, 2013). A likely explanation for this effect is that word learning involves remembering both what something is and what it is not (e.g., McMurray, Horst & Samuelson, 2012; Axelsson, Churchley & Horst, 2012). However, commercially-available storybooks like *The Gruffalo* by Julia Donaldson or *Goodnight Moon* by Margaret Wise Brown often include rich illustrated scenes containing multiple items. How such illustrated scenes influence word learning has been neglected in the word learning from shared storybook reading literature.

Evidence suggests that word learning is even more challenging for children when increasing amounts of perceptual information are presented simultaneously. For example, children struggle to learn object names when target objects are presented in less predictable locations (Benitez & Smith, 2012), with many extraneous objects

(Horst, Scott, & Pollard, 2010) and with multiple combinations of extraneous objects, rather than the same combinations repeatedly (Axelsson & Horst, 2014). Such findings are consistent with cognitive load theory (Sweller, 1998, 1989 or see, Paas et al., 2003 for a review), which explains how working memory capacity is inherently limited and is especially problematic in situations with extraneous information. Thus, reducing extraneous perceptual information helps children focus on the target information, which then improves learning. For example, Son, Smith, and Goldstone (2008), reduced cognitive load by providing simplified depictions of novel objects and found that this promoted better generalization of novel objects than more complex examples. Whether decreasing the number of illustrated scenes presented simultaneously in a storybook also decreases the cognitive load of word learning from shared storybook reading remains unknown.

In the current experiments we investigate whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words incidentally from shared storybook reading. All children were presented with three storybooks that included illustrated scenes of a family's activities. The same two novel objects were included across the scenes and were named on the pages on which they were depicted (four pages for each object). Critically, all children heard the same three stories and saw the same 10 illustrations per story, however, the number of illustrations presented simultaneously and guidance varied across conditions. In Experiment 1, children saw either two illustrations (one scene on each page of the open book) or one illustration (only on the right-hand page with the other side blank). Children in a control condition saw a large storybook (cf. Big Book Reading, Tse & Nicholson, 2014) with one illustrated scene on the same size as the two illustrations combined. If decreasing the number of illustrations also decreases the cognitive load of

word learning from storybooks then children should learn more words when they see

only one illustration at a time. In contrast, if the number of illustrations does not affect

cognitive load, then children should learn words equally from one- or two-illustration

books. In Experiment 2, we investigate whether guiding children's attention to the

correct page with a simple gesture helps children focus on the correct page and

improves word learning—even with two illustrations.

Experiment 1

Method

Participants

Thirty-six 3.5-year-old children ($M = 41.99$ months, $SD = 1.76$ months, range =

38.87 - 45.14 months) participated. Children were monolingual, British-English

speakers from predominantly middle-class families. All children were typically

developing with no reported speech or language difficulties. Twelve children each were

randomly assigned to one of the three conditions: one illustration ($M = 41.87$, $SD =$

0.65, 6 girls), two illustrations ($M = 42.85$, $SD = 0.43$, 6 girls), or control condition (one

large illustration, $M = 41.92$, $SD = 0.45$, 6 girls). There was no difference in maternal

education levels between conditions, Fisher's Exact Test = 3.71, $p = .98$. Two mothers

each in the one and two illustrations conditions and three mothers in the control

condition had completed high school (GCSEs and/or A-levels) and/or completed a

vocational diploma or access course. Eight mothers each in the one and two illustrations

conditions, and six in the control condition had an undergraduate degree and/or an

undergraduate degree with a postgraduate certificate (e.g., Postgraduate Certificate in

Education (PGCE), an additional teaching qualification). One mother each in the one

illustration and control conditions had a Master's degree and one mother in each

condition had a doctoral degree. One mother in the two illustrations condition and one

mother in the control condition declined to answer this question. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli

     Storybooks. Stimuli included three 10-page storybooks slightly modified from Horst et al. (2011) *The Very Naughty Puppy*, *Nosy Rosie at the Restaurant*, and *Rosie's Bad Baking Day*. Each storybook depicted and named the same two novel objects four times. We only included two targets because Biemiller and Boote (2006) showed that children can learn about 2 new words from shared storybook reading. Each object had a function: the orange inverted slingshot functioned like a hand mixer (*tannin*) and the metal kinetic wheel was used like a rolling pin (*sprock*). Throughout each story, objects were named incidentally and were not the focus of the story. The objects appeared twice on their own pages and twice together. We used real photographs edited with the poster edges feature in Photoshop to make them look like drawings typical of a commercially available children's book. Across storybooks there was no difference in the number of words per page, $M = 45$, $SD = 9.34$, $F(2,24) = 0.98$, $p = .39$.

     All children heard the same stories and saw all of the illustrations for each story. The only difference between conditions was the way the storybooks were printed (see Figure 1): children either heard stories with two A4 illustrated scenes per open spread, one A4 illustrated scene per spread (i.e., the left-hand page was always blank), or one A3 illustrated scene per spread. In the ISO A-series paper system (i.e., European standard), A3 pages (29.70 x 42.00 cm) are twice the size of A4 pages (21.00 x 29.70 cm), thus the A3 condition served as a control condition where the storybooks included only one illustration per spread (as in the one A4 illustration condition) but included the same overall illustrated area as the two A4 illustrations condition). Because the one

illustrations condition differed from the two illustrations condition in both surface area

and amount of items/details, we wanted to include a control condition to disentangle

which of these was driving any effects we might obtain. Equating the number of

items/details would have precluded presenting all children with the same illustrations;

therefore, we chose to test surface area as the control condition. Data from all three

conditions were collected at the same time.

When two illustrated scenes were displayed simultaneously (i.e., in the two

illustrations condition), these scenes reflected different aspects of the plot so were

sometimes set in different rooms or with different characters (see Figure 1). For

example, in *Rosie's Bad Baking Day*, page 4 displays the kitchen tools and ingredients

Rosie puts on the counter, including the *sprock* and *tannin* among several items and

page 5 depicts Rosie holding the salt instead of the sugar as she is about to stir her

dough with the *tannin*.
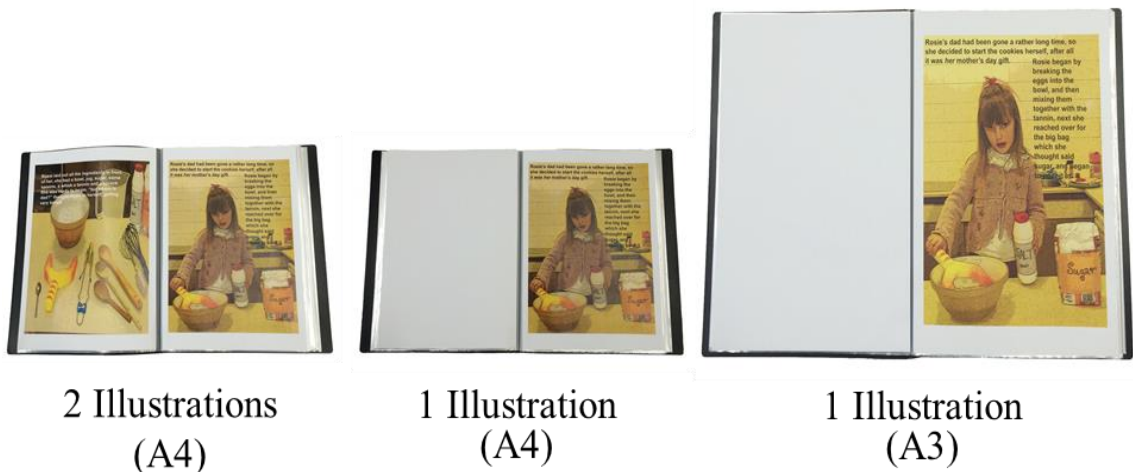
Figure 1. Page 5 in *Rosie's Bad Baking Day* as seen by the children in the 2 illustrations, 1 illusion and 1 large illustration conditions, respectively. Note, in the 2 illustrations condition page 4 is viewed at the same time as page 5.

Enjoyment ratings. Three emoticons were printed in a row on a single laminated card and each paired with the responses "liked a lot", "liked a little", and "didn't like" (see also, Williams & Horst, 2014).

Test stimuli. An A4 test booklet with images of four novel objects per right-hand page was used on the test trials (the left-hand pages were blank). On each page, four objects were presented on a plain white background without any other contextual information. Across test trials the targets (*tannin* and *sprock*) were presented with four additional novel objects that the children had not previously seen, so that each trial would present children with a different combination and it would not appear that a question was being repeated. Finally, a practice trial page included images of four known objects: a dog, a plane, a duck and a chair.

Procedure

Each child was tested individually in a children's lab at the university. During the reading phase, the experimenter sat opposite the child and held the storybook upright, to her side, with the pages facing the child, like a teacher would when reading to a group of children. The parent sat on a seat in a different corner of the room. All children were read each of the three stories. For each child all three stories were presented in the same format (e.g., two illustrations per spread). No dialogic techniques, such as giving definitions for novel words or pointing, were used during the readings. Story-order was counterbalanced across children.

After each story the experimenter showed children the enjoyment ratings cards and asked children whether they "liked the story a lot," "liked the story a little," or "didn't like the story at all," while simultaneously pointing to the corresponding emoticon. We included this measure to ensure differences in word learning could not be attributed to differences in enjoyment across conditions. Children indicated their

choices by pointing to the emoticon, often with verbal confirmation. For half of the children the order enjoyment ratings were presented from "liked the story a lot" to "didn't like the story at all" and for half the children the order was reversed.

After reading the final story, the experimenter tested word learning using the test booklet, which did not include illustrated scenes, rather isolated images of objects. The test phase began with four warm-up trials to get the child used to pointing to pictures in the test booklet and to ensure the child understood the task. Warm-up pages included images of only highly familiar objects. The experimenter opened the test booklet to one of the warm-up trial pages and asked the child to point to one of the familiar objects (e.g., "can you point to the plane?"). Across the four counterbalanced warm-up trials, children were asked to point to an object in each quadrant of the page. Test pages included images of only novel objects, thus children could not solve these trials by using process of elimination. On each trial the experimenter turned to a different test page and asked the child to point to one of the novel objects. In total children were asked to point to each target novel object twice (see also Werchan & Gómez, 2014). On half of the trials only one target was present (e.g., the *sprock* with three other novel objects) and on half of the trials both targets were present (e.g., the *sprock* and *tannin* with two other novel objects). Trial order, page and quadrant were counterbalanced across participants.

Results

Individual story reading durations ranged from 105 to 230 seconds ($M = 146.48$s, $SD = 2.11$s). Preliminary analyses indicated no effect of illustration format on children's average reading durations between conditions, $F(2,33) = 0.23$, $p = .79$, partial $\eta^2 = 0.01$.

ONE PAGE AT A TIME

Enjoyment Ratings. Overall, children generally reported that they liked the stories (37%) and liked them a lot (45%). There was no difference between conditions in the total numbers of "a lot," "liked" and "not at all" in children's enjoyment ratings, $X^2(4) = 4.46$, $p = .38$. There was also no difference between stories, $X^2(4) = 4.41$, $p = .35$.

Word Learning. Children in the one illustrations condition ($M = 0.75$, $SD = 0.34$, $t(11) = 5.14$, $p < .001$, $d = 1.48$) and in the control (one large) condition ($M = 0.75$, $SD = 0.30$, $t(11) = 5.75$, $p < .001$, $d = 1.66$), chose the target object more than expected by chance (.25) see Figure 2, Left Panel. However, with Bonferroni's correction to correct for Type-I error ($p = .017$), children in the two illustrations condition did not chose the target object more than expected by chance ($M = 0.44$, $SD = 0.28$, $t(11) = 2.28$, $p = .04$, $d = .66$).
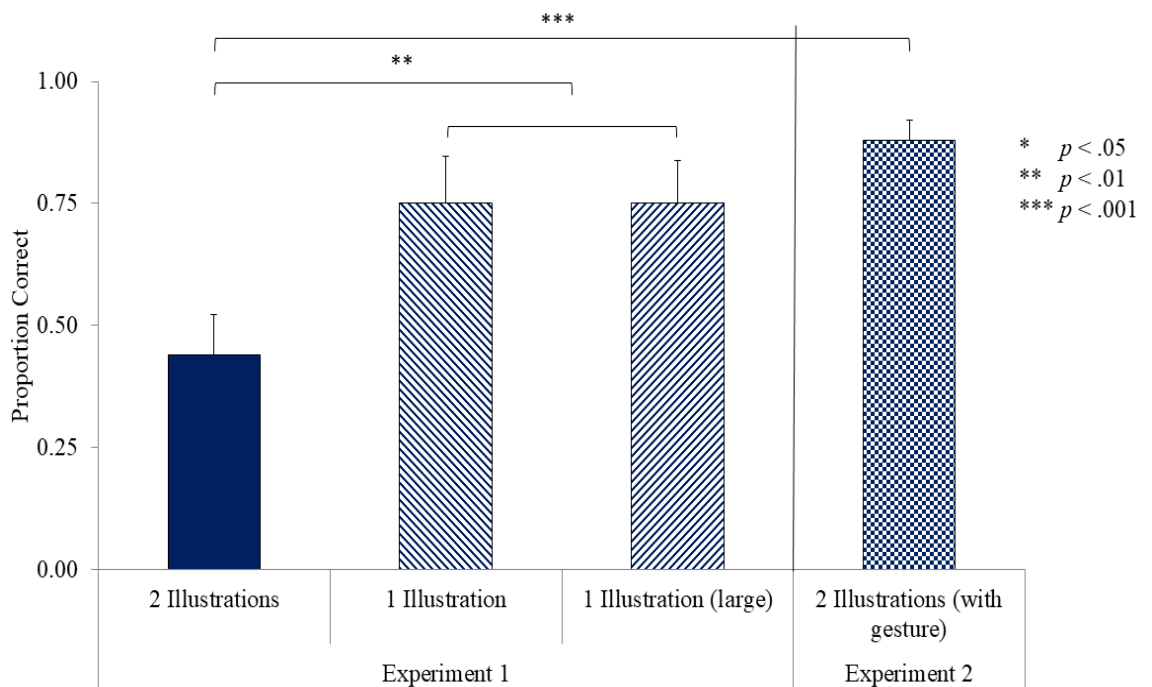
Figure 2. Proportion of correct word learning trials for Experiment 1 (left) and Experiment 2 (right). Error bars represent +1 SEM.

To test for differences between illustration formats, children's proportions of correct choices were entered into an ANOVA with illustration format (two, one, one

large) as between-subjects factor. The ANOVA yielded a main effect of illustration

format, $F(2, 33) = 4.10$, $p = .03$, partial $\eta^2 = 0.20$. Planned contrasts showed that

children who saw two illustrations learned words less well than children who saw one

illustration per spread, $t(33) = 2.87$, $p = .007$, partial $\eta^2 = 0.20$. There was no difference

in word learning between one illustration in A4 or one illustration in A3 $t(33) = 0.00$,

ns. Thus, illustration size did not affect word learning, but the number of illustrations

did.

Discussion

Many illustrated storybooks are printed with two illustrations per spread (e.g*., In

the Night Kitchen* by Maurice Sendak or *Dinosaur Roar!* By Paul and Henrietta

Stickland)—if not more (e.g., *The Incredible Book Eating Boy* by Oliver Jeffers

contains 6 illustrations on pages 7-8). Further, some books include a combination of one

or more illustrations per spread (e.g., *The Smartest Giant in Town* by Julia Donaldson).

Our goal is not to suggest that all of these books be reprinted. However, because young

children do not necessarily know when the text is referring to the left- or right-hand

page, they may benefit from a non-verbal gesture to look to the correct page.

Specifically, a non-verbal signal may help children to focus on the correct illustration at

the correct time, thus improving their chances of learning new words from the

storybook (cf. Booth, McGregor, & Rohlfing, 2008). Gestures support word learning

from stories above and beyond reading without gestures (e.g., Rohlfing, Grimminger, &

Nachtigaller, 2015; Sénéchal, 1997).

Thus, in Experiment 2 we again read children storybooks with two illustrations

per spread, but included a quick sweeping hand gesture to indicate which page we were

reading from. We chose a sweeping gesture over the other possible techniques to keep

the manipulation visual without additional auditory information. We did not use a

pointing gesture because we wanted to perform the same gesture on every page and some pages did not include a novel object, while others included both novel objects. Thus, this sweeping gesture allowed us to maintain an incidental word learning task, as opposed to providing ostensive reference (Rice, 1990). If storybooks with one illustrated scene per spread are more helpful than storybooks with two illustrated scenes because children do not know which page to look at, then guiding them towards the correct page should improve word learning to similar levels as those from single illustration displays.

Experiment 2

Method

Participants

An additional twelve 3.5-year-old children ($M = 40.45$ months, $SD = 1.30$ months, range = 38.45 to 45.03 months, 6 girls) participated. Children were monolingual, British-English speakers with no reported speech or language difficulties. Two mothers had completed high school (GCSE's and/or A-levels), seven had an undergraduate degree or an undergraduate degree with a postgraduate certificate. One mother had completed a Master's degree, one a doctoral degree and one declined to provide this information. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli

The same stimuli were used as in the two illustrations condition in Experiment 1.

Procedure

All children were read the two illustrations storybooks. The procedure was the same as in Experiment 1 except that before reading each page, the experimenter

smoothly swept her open hand from the top of the page to the bottom, thereby drawing

children's attention to the correct page.

Results

Individual story reading durations ranged from 131 to 298 seconds ($M =$

158.86s, $SD = 30.45$s). There was no significant difference in average reading durations

between children in this experiment and children in the two illustrations condition of

Experiment 1 ($M = 148.81$s, $SD = 20.34$s)$, t(22) = 1.26, p = .22, d = 0.43$. Thus, adding

a simple sweeping gesture only added on average 1 second per page to the time needed

to read a story.

Enjoyment ratings. Overall, children generally reported that they liked the

stories (61%) and like them a lot (19%). Again, there was no difference between stories,

Fisher's Exact Test, $p = .50$.

Word Learning. Children learned the words from the story (see Figure 2, Right

Panel). Specifically, children chose the target object more than expected by chance ($M =$

0.88, $SD = 0.17$, $t(11) = 12.84$, $p < .001$, $d = 3.71$). Our goal was to determine whether

adding a simple gesture would be sufficient to improve children's word learning from

storybooks with two illustrations per spread. Thus, we compared the word learning

performance of children in the current study to children in the two illustrations

condition of Experiment 1. Children who had the additional support to guide their

attention to the correct page learned words significantly better than children who did not

have that support, $t(22) = 4.58$, $p < .001$, $d = 8.78$.

Discussion

In Experiment 2 we investigated whether orienting children's attention to the

correct storybook page with a simple gesture while reading could diminish the effects of

cognitive load from multiple illustrated scenes found in Experiment 1. Adding the

gesture did not significantly increase the amount of time needed to read the story, but did significantly improve children's word learning compared to reading without a guiding gesture.

The rates of word learning observed in Experiment 2 are similar to other studies using dialogic reading techniques, such as pointing or asking questions (e.g., Elley, 1989; Sénéchal et al., 1995; Walsh & Blewitt, 2006). For example, Ard and Beverly (2004) read storybooks to 3- and 4-year-old children either verbatim or with one of three dialogic techniques; added questions, added comments, or both questions and comments. Children learned approximately 75% of the new vocabulary with the dialogic reading techniques included but only 53% with verbatim readings. Although the efficacy of the use of dialogic techniques to improve children's word learning from storybooks is not in doubt, multiple dialogic techniques are often employed in combination, making it harder to compare effects across the literature for individual techniques (see Wasik, Hindman, & Snell, 2016 for a recent review). It is therefore particularly exciting to see that such a simple gesture could have such powerful effects on children's learning.

General Discussion

Across two experiments we investigated whether decreasing the number of storybook illustrations presented simultaneously increases preschool children's ability to learn words from shared storybook reading. In Experiment 1 we read children 10-page stories with either one, two, or one large illustration per spread. Children learned the new words better when presented with only one illustration per spread, regardless of the image size, even though all children saw the same number of illustrations overall. In Experiment 2 we read children the same stories with two illustrations per spread, but added a small sweeping gesture to indicate which page we were reading. Although

children in this condition were presented with multiple illustrations at once, they were able to focus their attention to learn more words than expected by chance and more words than children who were presented with the same number of illustrations but no guidance on which page to attend to. Taken together these findings suggest that children's word learning is improved by helping children focus on the relevant information by either reducing the number of illustrations presented (Experiment 1) or directing their attention to the correct illustration (Experiment 2). These findings provide additional insight into studies demonstrating that reading the same short story (fewer illustrations) repeatedly leads to better word learning than reading one longer story (more illustrations, (McLeod & McDade, 2011)) or reading different stories (also more illustrations, Horst et al., 2011; Williams & Horst, 2014).

These findings are consistent with cognitive load theory (Paas et al., 2003; Sweller, 1988, 1989), which suggests that extraneous information can prevent optimal learning. The more information children need to think about, the more challenging the task. Consequently, removing extraneous perceptual information may improve learning (see, e.g., Son et al., 2008). For example, kindergarten children are better able to learn information from science lessons when the extraneous information of a highly-decorated classroom is removed (Fisher et al., 2014). Similarly, reducing the amount of extraneous information in graphs improves children's mathematics skills (Kaminski & Sloutsky, 2013) and removing extraneous information in ABC books improves alphabet learning (Chiong & DeLoache, 2012). However, children do struggle when the learning situation is overly simplified, for example when no extraneous information is present (e.g., Zosh et al., 2013). In the current study, in the two illustrations format, children are faced with processing additional materials—which in some cases may even provide conflicting information—slowing down the process of word learning. Children do not

know when the story moves from one illustration to the other. In contrast, in the one illustration format, the child is provided with only the relevant scene, which corresponds with the text they are currently hearing, thereby reducing the cognitive load associated with understanding the story and the new words. Similarly in Experiment 2, children are directed towards the relevant scene, thereby reducing cognitive load.

In the real world children's literature includes both picture books of decontextualized pictures and stories with rich illustrated scenes. Thus, a single page can have any number of items on it, which adds to the challenge of identifying and determining the referent for a new word. We know the number of items visually presented to children influences learning about both words and objects (e.g., Horst et al., 2010; Oakes & Ribar, 2005; Thom & Sandhofer, 2009; Zosh et al., 2013). In the current study we read children storybooks with illustrated scenes containing multiple items to examine how the amount of extraneous visual information affects incidental word learning. Because the illustrations were rich and complex, there was always at least some distractor item present (cf. Zosh et al., 2013) and children could use the cross-situational regularities across pages to learn the name-object associations via gradual associative learning (see Smith & Yu, 2008; McMurray et al., 2012). Several studies have presented books consisting of simplified drawings (e.g., Ganea et al., 2008) which might have a different effect on word learning (see for example related findings with simplified objects, Smith, 2003). However, studies using picture books with simplified drawings often focus on children's learning of object categories and not word learning (but see for example, Read, 2014). Future research is needed to further explore the roles of attention and perception in children's word learning from both storybooks with illustrated scenes and picture books with simplified drawings.

Although children in the current studies learned target words better when presented with single illustrations, there may be benefits for other types of learning from multiple illustrations. For example, story comprehension may be better supported by having more to look at, particularly as visual attention to illustrations during storybook reading predicts story comprehension (Kaefer, Pinkham, & Neuman, 2016). Therefore, future research is needed to understand how the number of illustrated scenes influences other types of learning from storybooks, beyond that of learning names for objects.

The current findings add to a growing literature on the usefulness of dialogic techniques for teaching words from storybooks. Dialogic techniques include providing definitions (e.g., Coyne et al., 2004), asking children questions (e.g., Walsh & Blewitt, 2006) and asking children to point to items on the page (e.g., Sénéchal et al., 1995). During shared storybook reading adult pointing helps children attend to specific items (Roy-Charland et al., 2015) and facilitates vocabulary growth (Sénéchal, 1997). Here we demonstrate another non-pointing gesture also facilitates word learning from storybooks. Importantly, our sweeping gesture dramatically improved word learning from storybooks without significantly increasing the amount of time it took the adult to read the story. However, we only tested children's ability to learn concrete nouns, but there may be differences in the effect of gesturing on learning other word classes, which might benefit from more specific pointing.

The current findings may also be informative for research comparing e-books (i.e., storybooks presented on screens) with traditional two-illustration paper storybooks. Some studies report a deficit in learning from e-books (e.g., Segers, Takke, & Verhoeven, 2004) while others do not (e.g., Korat & Shamir, 2007; Segal-Drori, Korat, Shamir, & Klein, 2010). One explanation for this discrepancy is that e-books

often contain added manipulative features, which may hinder learning. For example, e-books often contain additional games (e.g., de Jong & Bus, 2002) or interactive dictionary features (e.g., Korat, 2009). Previous research indicates that added manipulative features such as pull-tabs hinder learning from paper books (Tare et al., 2010), however some features of e-books may be helpful in the same way as dialogic techniques by highlighting key information at the right time. Another explanation is that e-books are often presented only one illustration at a time (e.g., Verhallen & Bus, 2011), which could be an additional confounding factor when comparing between storybook media types. The current findings suggest that such single illustrations help children focus their attention on relevant information and may aid learning especially when children are exploring books without an adult.

The current experiments demonstrate that reducing the number of simultaneous illustrations to just one at a time improves children's word learning from shared storybook reading. When altering the number of illustrations is not possible, providing a simple gesture to direct children's attention to the correct page provides sufficient support to enable word learning in this otherwise complicated learning situation. Both of these findings have important implications for educational research and suggests that even seemingly minor differences in illustration format and providing scaffolding cues can result in significant differences in how well children learn. These findings should help shape future storybook research design, and provide useful practical solutions, which could be used by teachers and parents alike and may inform our understanding of how to create eBooks and other media that children may encounter without an adult. Furthermore, in an age of seemingly endless possibilities, they provide a stark reminder that less is sometimes more

Paper 4:

The Effects of Illustration Complexity and Salience on Pre-Schoolers Word

Learning from Shared Storybook Reading

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Abstract

Shared storybook reading is an effective way to teach new vocabulary, but little research has explored the role storybook illustrations play in supporting word learning. We conducted three experiments investigating how differences in illustration complexity and the salience of objects within the illustrations affected 3.5-year-old children's word learning. In all three experiments children were read three stories in which two novel objects were named and depicted four times after which they completed a word learning test. In Experiment 1 ($N = 24$) children heard either complex or simply illustrated stories. We found no effect of illustration complexity on word learning. In Experiment 2a ($N = 24$), children heard stories with salient target objects or the original control storybooks. Again, word learning did not differ between conditions. In Experiment 2b ($N = 24$) children heard one story three times; either a control storybook or a version with salient competitor objects. Although we found no differences between conditions, children who heard the salient competitor version no longer showed evidence of word learning. This pattern of results suggests an effect, which might be detectable with a greater contrast in stimuli between conditions.

The Effects of Illustration Complexity and Salience on Pre-Schoolers Word

Learning from Shared Storybook Reading

Even before children can read, early storybook experiences are particularly important (e.g., Niklas et al., 2016). These experiences help foster a love of reading (National Research Council, 2000) and develop skills that support later academic success (e.g., Robbins & Ehri, 1994; Sénéchal, LeFevre, Hudson, & Lawson, 1996; Whitehurst et al., 1988). For example, listening to stories promotes vocabulary growth (e.g., Elley, 1989; Robbins & Ehri, 1994; Sénéchal et al., 1995) which is an important foundation for later reading and writing skills (Cunningham & Stanovich, 1997; Stanovich & Cunningham, 1993). Subsequent academic achievement is related to later life outcomes such as earnings (Deming, Cohodes, Jennings, & Jencks, 2016; Kautz et al., 2015) and mental health (Sideridis, 2005), so providing excellent quality early storybook experiences can set children up with a good start in life.

For these reasons, research on early childhood reading experiences has provided a great deal of practical information to support parents and other adults to maximise these opportunities. For example, Whitehurst et al. (1988) demonstrated that teaching parents to use a dialogic reading style (such as asking open-ended questions to increase the level of story related engagement) resulted in children producing better quality speech than straight reading, even after a nine month delay. More recently, the advent of e-books and the effects on children's learning when compared with traditional print books have been investigated (Korat, Levin, Atishkin, & Turgeman, 2013; Mol, Bus, & De Jong, 2009). E-books provide the opportunity to build in aspects of the dialogic reading style advocated by Whitehurst and colleagues, although evidence has been mixed for the role of e-books, particularly in word learning (Korat & Shamir, 2007; Segal-Drori et al., 2010; Segers et al., 2004). This confusion may be due to confounding

different formats, in particular that of illustrations, when traditional print books are compared with e-books (see Flack & Horst, 2017).

Illustrations are an important part of children's books, particularly for pre-literate children, not least because children rely on looking at illustrations to understand the stories (M. A. Evans, 2010; M. A. Evans & Saint-Aubin, 2005; Justice, Skibbe, et al., 2005; Wagner, 2013). The style of illustrations featured in children's books can influence children's learning from shared reading. For example, very young children learn less from books with manipulative features such as lift the flap books (Shinskey, 2016; Tare et al., 2010) and learn fewer words from drawings than from realistic depictions such as photographs (Ganea et al., 2008; Ganea et al., 2009). Note, the books used in these studies are typically picture books rather than storybooks, so illustrations feature isolated objects, rather than rich illustrations to support the narrative of a story. Thus, research investigating the role of storybook illustrations in supporting word learning is still rather limited.

Flack and Horst (2017) used rich illustrations and found that the number of illustrations displayed simultaneously affected 3.5-year-old children's ability to learn new words from the stories. All children heard the same 10-page stories, either presented one illustration at a time, or two illustrations at a time, but children who heard the one-illustration versions learned more words than those who were read the two-illustration version. Flack and Horst (2017) concluded that preschool children were slower to learn words when both illustrations were visible because they do not know which page is relevant, so may scan both illustrations, thus making finding the referent for new vocabulary more challenging. This suggests visual complexity in storybook illustrations may affect children's learning from storybooks, because they have more to process.

In the current experiments we investigate the role of visual complexity and the salience of target objects and competitors in 3.5-year-old children's word learning from storybooks. Experiment 1 investigates word learning as a function of the complexity of storybook illustrations, whereas Experiments 2a and 2b explore word learning as a function of the salience of objects within the storybook illustrations. In Experiment 1 children were read three 10-page, richly-illustrated storybooks. The same two novel objects were named and depicted four times in each storybook. Importantly, all children heard the same three stories and encountered novel objects the same number of times, however, the complexity of the illustrations presented varied. Half the children saw the original, complex versions of the illustrations, and half saw simplified versions. If visual complexity affects 3.5-year-old children's ability to identify the correct referent from storybook illustrations then we would expect children presented with the simpler illustrations to learn more words than children presented with the more complex illustrations. If, however, visual complexity does not affect children's ability to identify the correct referent from storybook illustrations then we would expect all children to perform the word learning task to similar levels.

If complexity hinders word learning because children find it more difficult to identify the referents for new words, then making target objects more salient should help children identify them faster, and therefore improve word learning, and making competitors more salient should hinder word learning. In Experiment 2a children were read three 10-page, richly-illustrated storybooks. As in Experiment 1, the same two novel objects were named and depicted four times in each storybook. Importantly, all children heard the same three stories and encountered novel objects the same number of times, however we made some alterations to the illustrations. Half the children saw the original versions of the storybook illustrations, and half saw illustrations in which the

target objects were made more salient using increases in saturation or lightness. If increasing the salience of target objects helps children identify relevant information more quickly then we would expect children to learn more new words than children presented with original illustrations. If, however, increasing the salience of target objects does not help children identify the target objects more quickly, then we would expect no difference between conditions.

In Experiment 2b we extend our investigation to include the effects of salience manipulations. If manipulating the salience of target objects can improve word learning by helping children identify the referents for new words, we hypothesised that increasing the salience of competitor objects could make this more difficult and therefore reduce word learning. We tested this in Experiment 2b. Because children learn more words from repeated stories than different stories (e.g., Horst et al., 2011; McLeod & McDade, 2011), this time, all children heard three stories repeated to ensure any effects of the salience manipulation were not lost due to floor effects. Half the children saw the unaltered storybook version used in Experiment 2a, and half saw illustrations in which competitor objects were made more salient using increases in saturation or lightness. If increasing the salience of competitor objects hinders children's ability to identify the correct referent, children seeing the storybook illustrations with salience manipulations should reduce word learning levels. If, however, salience manipulations have no effect then word learning performance should be the same between conditions.

Experiment 1

Method

Participants

Twenty-four 3.5-year-old children (M = 41 months, 18 days, SD = 1 month, 4 days) participated. Children were typically developing, monolingual, British-English speakers from predominantly middle-class families. Half of the children were randomly assigned to the simple illustrations condition (M = 41 months, 16 days, SD = 1 month, 1 day, 5 girls), and the other half to the complex illustrations condition (M = 41 months, 14 days, SD = 1 month, 5 days, 6 girls). There was no difference in maternal education levels between conditions, Fisher's Exact Test, p = .72. Five mothers in the simple and four mothers in the complex illustrations condition had completed high school (GCSEs and/or A-levels). Five mothers in the simple and four mothers in the complex illustrations condition had an undergraduate degree. One mother in the simple and three in the complex illustration condition had post-graduate qualifications (e.g., Postgraduate Certificate in Education (PGCE), an additional teaching qualification). One mother in each condition failed to provide this information on the questionnaire.

Parents reported typically reading to their children daily or almost daily (n = 20) or, more than once per week (n = 1), with no difference between conditions, Fishers exact test, p = 1. Ten parents in each condition reported reading almost daily, and one parent in the simple illustrations condition reported reading less than daily, but more than weekly. Three parents did not respond. Parents reported the length of a typical reading session to last M = 19.10 mins (SD = 12.33 minutes, range = 5 to 30 mins) and this did not differ between conditions $t(19)$=1.22, p = 0.24. Parents reported first reading regularly to their children at M = 1.45 months (SD = 2.93, range birth to 12 months) and this did not differ between conditions, $t(19)$ = 1.22, p = .24. Parents were reimbursed for

travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli

   Storybooks. Stimuli included three 10-page storybooks slightly modified from Horst, Parsons, and Bryan (2011) *The Very Naughty Puppy, Nosy Rosie at the Restaurant,* and *Rosie's Bad Baking Day*. Each storybook depicted and named two novel objects four times: an inverted sling shot that was used like a hand mixer (*sprock*) and a kinetic wheel that was used like a rolling pin (*tannin*). We used real photographs edited with the poster edges feature in Photoshop to make them look like drawings typical of a commercially available children's book. Across storybooks there was no difference in the number of words per page, $M = 45$, $SD = 9.34$, $F(2,24) = 0.98$, $p = .39$.

   Stories for both conditions were printed as two-page spreads (e.g., with one illustrated scene on the left and one on the right). The illustrated scenes for the complex condition were the original scenes used in Flack and Horst (2017). These scenes typically included one or more characters, interacting with everyday objects (e.g., cooking utensils) in everyday settings (e.g., kitchen). For the simple condition we used Photoshop to remove the background and any extra characters, along with any extraneous foreground objects, paring them down to much simpler scenes (see Figure 1 for an example). We simplified all pages, to ensure storybook consistency whether or not they depicted target objects.
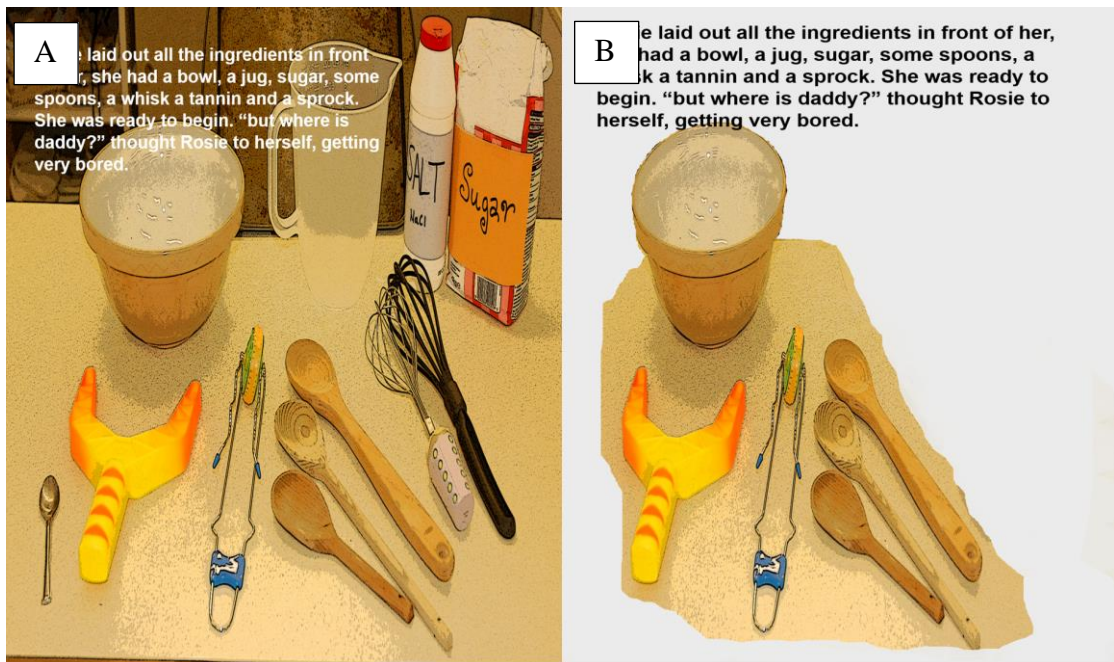
Figure 1. Example complex (Panel A), and simple (Panel B) page from *Rosie's Bad Baking Day*.

Enjoyment ratings. Three emoticons were printed in a row on a single laminated card and each paired with the responses "liked a lot", "liked a little", and "didn't like" (see also, Williams & Horst, 2014).

Test stimuli. An A4 test booklet with images of four novel objects per right-hand page was used on the test trials (the left-hand pages were blank). Objects were presented on a plain white background without any other contextual information. Across test trials the targets (*tannin* and *sprock*) were presented with four additional novel objects that the children had not previously seen. Finally, a practice trial page included images of four known objects: a dog, a plane, a duck and a chair.

Procedure

Each child was tested individually in a children's lab at the university. During the reading phase, the experimenter sat beside the child with the book on a desk in front of them, so both adult and child had a clear view of all the pages. The parent was seated

in a corner of the room. All children were read each of the three stories. For each child

all three stories were presented in the same format (e.g., either all simple, or all complex

illustrations). Story-order was counterbalanced across children. No dialogic techniques,

such as giving definitions for novel words or pointing, were used during the readings.

After each story the experimenter showed children the enjoyment ratings cards

and asked children whether they "liked the story a lot," "liked the story a little," or

"didn't like the story at all," while simultaneously pointing to the corresponding

emoticon. Children indicated their choices by pointing to the emoticon, often with

verbal confirmation. For half of the children the order enjoyment ratings were presented

from "liked the story a lot" to "didn't like the story at all" and for half the children the

order was reversed.

After reading the final story, the experimenter proceeded to the test phase, which

began with four warm-up trials to get the child used to pointing to pictures in the test

booklet and to ensure the child understood the task. The experimenter opened the test

booklet to one of the warm-up trial pages and asked the child to point to one of the

familiar objects (e.g., "can you point to the plane?"). Across the four counterbalanced

warm-up trials, children were asked to point to an object in each quadrant of the page.

Next, the experimenter tested word learning using the test booklet. On each trial the

experimenter turned to a different test page and asked the child to point to one of four

novel objects. In total children were asked to point to each target novel object twice.

Trial order, page and quadrant were counterbalanced across participants.

Results

Individual story reading durations ranged from 120 to 223 seconds ($M = 150.38$

seconds, $SD = 19.47$ seconds). A mixed design ANOVA with illustration type (simple,

complex) as an independent measure, and story order (first, second, third) as repeated

measure found no significant effect of, either illustration type, $F(1,22) = 0.17$, $p = .69$, or story order $F(2,44) = 1.41$, $p = .26$, on reading durations between conditions.

Enjoyment Ratings. Overall, children generally reported that they liked the stories a little (25%) and liked them a lot (51%). There was no difference between conditions in the total numbers of "a lot," "a little" and "not at all" in children's enjoyment ratings, Fisher's Exact Test, $p = .15$.

Word Learning. Word learning results are depicted in Figure 2. Children in the simple condition ($M = 0.48$, $SD = 0.35$, $t(11) = 2.303$, $p = .042$, $d = 0.665$) and the complex condition ($M = 0.52$, $SD = 0.33$, $t(11) = 2.86$, $p = .015$, $d = 0.826$), chose the target objects more than expected by chance (.25). There was no significant difference between the illustration types, $t(22) = 0.303$, $p = .581$. So, although children in both conditions showed evidence of having learned the words, we found no effect of illustration complexity on word learning.
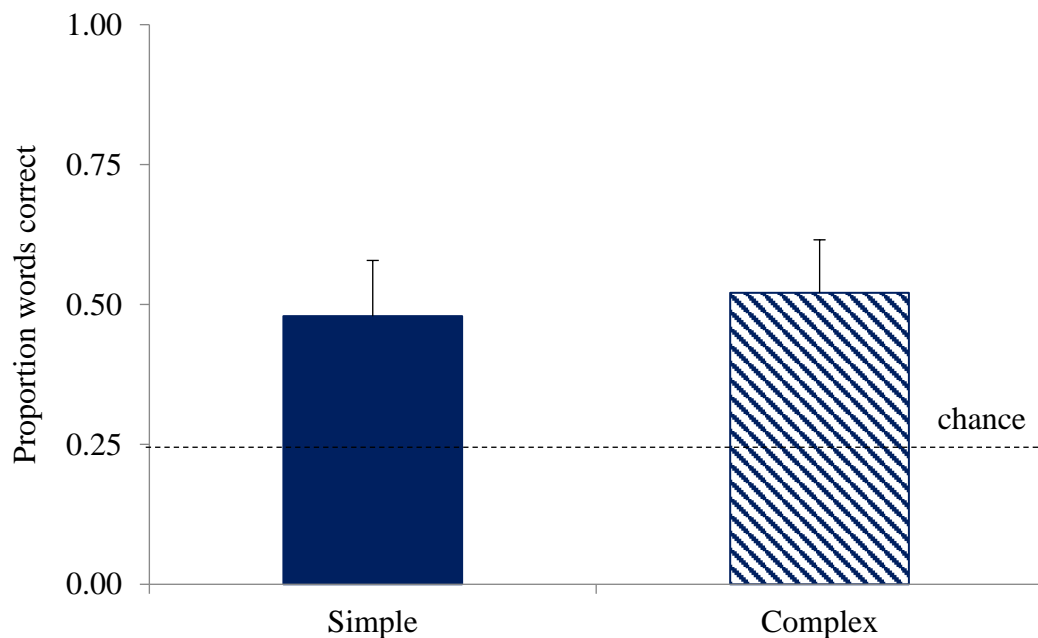
Figure 2. Proportion of correct word learning trials +/- 1 SEM

Discussion

We did not find the effects of illustration complexity on word learning from shared storybooks that we had expected. One possible explanation for this is that there was insufficient difference in complexity levels between the two storybook sets. Here we used storybooks from Horst et al. (2011) which featured photographs of scenes depicting the plot of the story and included key characters. For our simplified version, we used photo-editing software to remove as many extraneous aspects of each illustration as possible, while still retaining an illustration which looked like it could appear in a commercial storybook. The original images may not have contained enough complexity or provided enough competing visual information to make identifying the target objects difficult for children.

In Experiment 2a, we conduct a more detailed investigation of how the salience of individual target objects within the illustrations affects word learning from shared storybook reading. We considered that making target objects more salient should have a similar effects to reducing complexity, by helping children prioritise important information.

Experiment 2a

Method

Participants

Twenty-four 3.5-year-old children (M = 41 months, 24 days, SD = 1 month, 24 days, 6 girls) participated. Children were typically developing, monolingual, British-English speakers from predominantly middle-class families. Half the children were randomly assigned to the salient target condition (M = 41 months, 25 days SD = 1 month, 27 days), and half to the original condition (M = 42 months, 4 days, SD =, 1 month, 24 days, 5 girls). There was no significant difference between conditions, $t(22)$ =

0.40, $p = .69$. There was no difference in maternal education levels between conditions, Fisher's Exact Test, $p = .91$. Three mothers in each condition had completed high school (GCSEs and/or A-Levels). Three mothers in each condition had an undergraduate degree. Two mothers in the control condition, and four mothers in the salient target condition had post-graduate qualifications (e.g., Postgraduate Certificate in Education (PGCE), an additional teaching qualification) and one mother in the control condition had a PhD. Three mothers in the control condition, and two in the salient target condition failed to provide this information on the questionnaire.

Mothers reported reading to their children daily ($n = 20$), although three mothers in the control condition and one in the salient illustration condition failed to respond. Mothers reported the length of a typical reading session to last $M = 20.20$ mins ($SD = 8.67$ minutes, range $= 10$ to 45 mins) and this did not differ between conditions $t(18) = 0.73$, $p = .47$. Mothers reported beginning to read regularly to their children at $M = 1.58$ months of age ($SD = 3.92$ months, range $=$ birth to 12 months). Regular reading onset did not differ between conditions, $t(17) = 0.25$, $p = .08$. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a colouring book).

Stimuli

Storybooks. Stimuli were created from the same three 10-page storybooks used in Experiment 1. Stories for both conditions were printed as two-page spreads. We used Photoshop to increase the salience of the target objects in the salient target condition books. Due to the naturalistic nature of the illustrations, we used different methods to make some objects appear more salient. We either increased the saturation/lightness of target objects or decreased the saturation or lightness of the remaining picture. Pages which did not feature a target object were matched to similar lightness and saturation

levels to ensure pages within each storybook appeared consistent. Examples are shown

in Figure 3.

Figure 3. Example page from *Rosie's Bad Baking Day* in the control condition from
Experiment 2a and 2b (Panel A), the salient target condition from Experiment 2a (Panel
B) and the salient competitor condition from Experiment 2b (Panel C).

Enjoyment ratings, and test stimuli. We used the same enjoyment ratings, and

test stimuli as in Experiment 1.

Procedure

We used the same procedure as in Experiment 1.

Results

Individual story reading durations ranged from 108 to 229 seconds ($M = 131$

seconds, $SD =18$ seconds). A mixed-design ANOVA with illustration type (salient

target, control) as independent measure, and story order (first, second, third) as repeated

measure found no significant effect of, either illustration type, $F(1,19) = 0.39$, $p = .54$,

or story order $F(2,38) = .30$, $p = .74$, and no significant interaction, $F(2,38) = 0.36$, $p =$

.70, on reading durations between conditions.

Enjoyment ratings. Overall, children generally reported that they liked the

stories (35%) and liked them a lot (41%). There was no difference between conditions

in the total numbers of "a lot," "liked" and "not at all" in children's enjoyment ratings,

Fisher's Exact Test, $p = .91$.

Word Learning. Word learning performance is depicted in Figure 4. Children

correctly identified the correct target objects significantly better than by chance in both

the salient target ($M = 0.72$, $SD = 0.25$, $t(11) = 6.56$, $p < .001$, $d = 1.89$) and control

conditions ($M = 0.56$, $SD = 0.30$, $t(11) = 3.56$, $p = 0.004$, $d = 1.03$) . There was no

significant difference in word learning between children in the salient target condition,

and those in the control condition, $t(22) = 1.41$, $p = 0.17$.
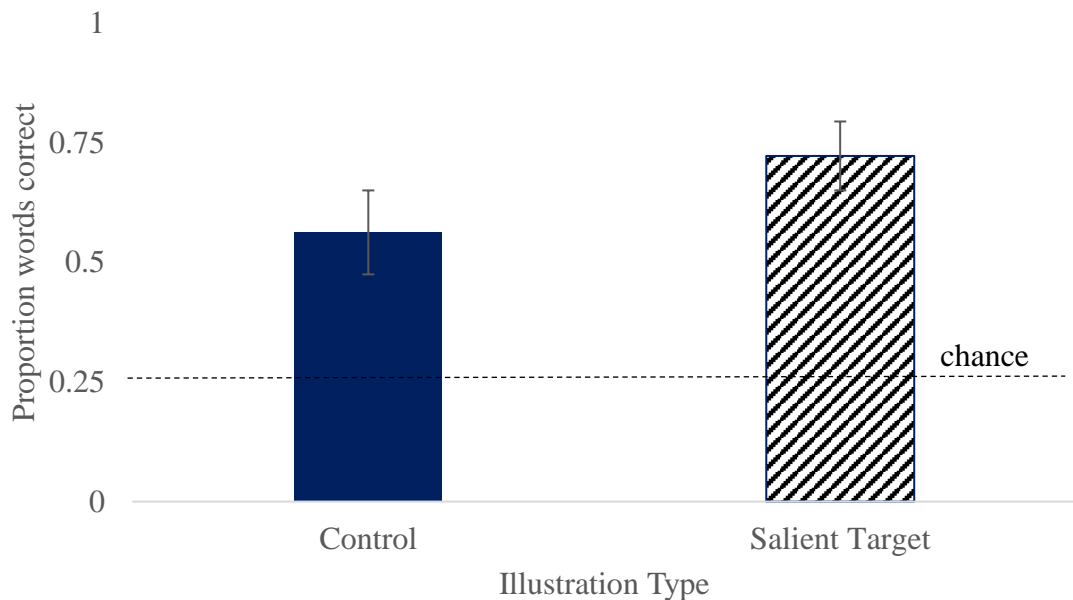
Figure 4. Proportion of correct word learning trials +/- 1 SEM

Discussion

Children seeing both sets of illustrations showed evidence of word learning.

Word learning did not differ significantly for children who saw the salient target

illustrations than children who saw the control illustrations, although the pattern of

results were in the direction we had predicted. As in Experiment 1, it is possible that the

lack of complexity in the control illustrations meant there was not enough contrast in

the manipulation between conditions.

In Experiment 2b we decided to approach the same question from a different angle. This time we investigated whether the salience of non-target objects (i.e., competitors) could *reduce* word learning. If illustration complexity makes identifying target referents more challenging, and if making objects more salient leads them to be identified faster, then it follows that making competitor objects more salient should interfere with the process of correctly identifying the correct referent.

Previous research indicates children struggle to learn words synthesized from different stories with two illustrations (e.g., Horst et al., 2011; Williams & Horst, 2014; Flack & Horst, 2017), but not from the same stories repeatedly. Therefore, to ensure children's performance levels would not be at floor, we read children repeated stories in Experiment 2b.

Experiment 2b

Method

Participants

Twenty-four 3.5-year-old children (M = 41 months, 24 days, SD = month, 24 days) participated. Children were typically developing, monolingual, British-English speakers from predominantly middle-class families. Twelve children were randomly assigned to the salient target condition (M = 41 months, 16 days, SD = 1 month, 25 days, 5 girls), and the remaining twelve to the control condition (M = 41 months, 20 days, SD = 1 month, 22 days, 6 girls). There was no significant difference in age between conditions, $t(22)$ = 0.22, p = .85. There was no difference in maternal education levels between conditions, Fisher's Exact Test, p = .61. Three mothers in each condition had completed high school (GCSEs and/or A-Levels). Two mothers in the control condition and six mothers in the salient competitor condition had an undergraduate degree. Three mothers in the control condition, and three mothers in the salient

competitor condition had post-graduate qualifications (e.g., Postgraduate Certificate in Education (PGCE), an additional teaching qualification) and one mother in the control condition had a PhD. Three mothers in the control condition, and two in the salient competitor condition failed to provide this information on the questionnaire.

Mothers overwhelmingly reported reading to their children daily ($n = 18$), although three mothers in each condition failed to respond. Mothers reported the length of a typical reading session to last $M = 19$ mins ($SD = 7.46$ minutes, range = 8 to 30 mins) and this did not differ between conditions $t(15) = 0.77$, $p = .45$. Mothers reported beginning to read regularly to their children at $M = 5.00$ months of age ($SD = 5.01$ months, range = birth to 19 months). Reading onset did not differ between conditions, $t(12) = 1.08$, $p = .30$. Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., a coloring book).

Stimuli

Storybooks. The same storybooks as in Experiments 1 and 2a were used. As in Experiment 2a, we used Photoshop to adjust lightness and saturation levels of the illustrations. However, this time for each page that contained a target (or two target objects) we selected a competitor object (or two where appropriate) from the page and instead applied the same adjustments to make this object appear to be more salient than the background or target objects. Competitors included a kettle in Nosy Rosie at the Restaurant, and a bag of sugar in Rosie's Bad Baking Day (see Figure 3).

Enjoyment ratings and test stimuli. We used the same stimuli as in Experiment 1.

Procedure

We used the same procedure as in Experiment 1.

Results

Individual story reading durations ranged from 84 to 209 seconds ($M = 130$ seconds, $SD = 19$ seconds). A mixed-design ANOVA with illustration type (salient competitor, control) as independent measure, and story order (first, second, third) as repeated measure found no significant effect of, either illustration type, $F(1,20) = 0.001$, $p = .98$, or story order $F(2,40) = .21$, $p = .81$, and no significant interaction, $F(2,40) = 1.64$, $p = .21$, on reading durations between conditions.

Enjoyment ratings. Overall, children generally reported that they liked the stories (26%) and liked them a lot (42%). There was no difference between conditions in the total numbers of "a lot," "liked" and "not at all" in children's enjoyment ratings, Fisher's Exact Test, p = .48.

Word learning. Word learning performance is depicted in Figure 5. Children correctly identified the correct target objects significantly better than by chance in the control condition ($M = 0.58$, $SD = 0.34$, $t(11) = 3.37$, $p = 0.006$, $d = .97$) but not the salient competitor condition ($M = 0.42$, $SD = 0.36$, $t(11) = 1.61$, $p = .14$). There was no significant difference in word learning between children in the salient competitor condition and control condition, $t(22) = 1.16$, $p = 0.26$.
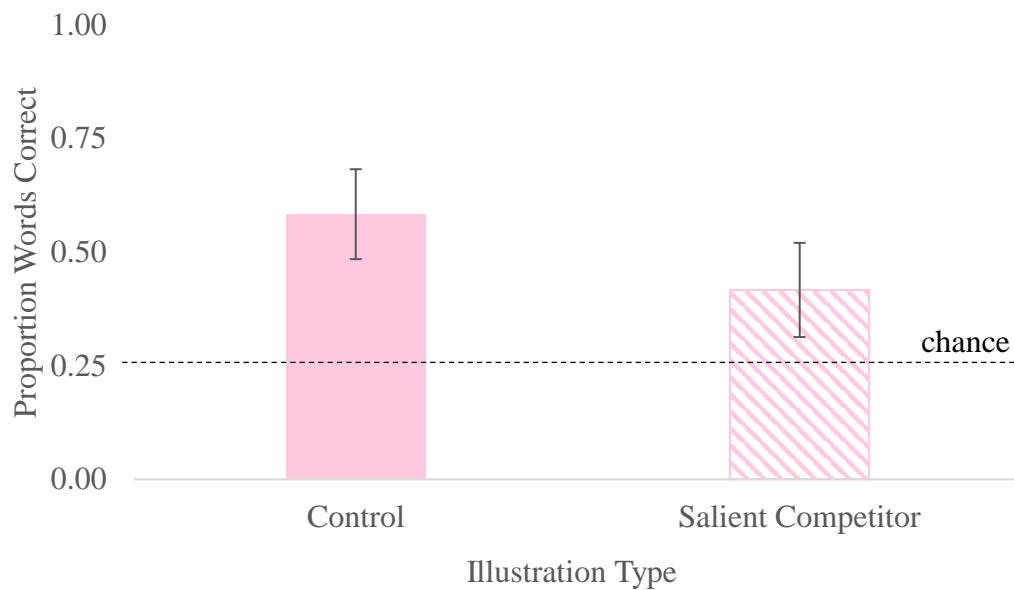
Figure 5. Proportion of correct word learning trials +/- 1 SEM

Discussion

In Experiment 2b, as in Experiment 2a, we did not find differences in word learning between conditions which suggests that increasing the salience of competitor objects does not hinder word learning. However, unlike in Experiment 2a, children in the control condition showed evidence of word learning, but children in the experimental condition did not. Thus, even though we would expect children hearing repeated stories to show high levels of word learning, when these stories contained illustrations with salient competitors, children no longer learned the new vocabulary. This provides some evidence that there may be effects here that our experimental manipulation was unable to expose. This may be due to limitations with our stimuli. We discuss this further in our General Discussion.

General Discussion

Three experiments tested the impact of complexity and salience in the illustrations in a set of storybooks, on 3.5-year-old children's ability to learn new words

from shared storybook reading. In Experiment 1 all children were read three storybooks, but with either simple or complex illustrations. We found no significant effect of illustration complexity on word learning. In Experiment 2a, all children were again read three storybooks, but with either the original illustrations or illustrations in which target objects had been made more salient. We found no significant effect of target salience on word learning. In Experiment 2b, children were read the same story three times. Children either saw the original illustrations or illustrations in which competitor objects had been made more salient. Although children seeing the control illustrations learned words and those seeing illustrations with salient competitors no longer did, there was no significant difference in word learning between the conditions.

We expected illustration complexity and the salience of target and non-target objects to contribute to differences in word learning from shared storybook reading. Cognitive Load Theory (Paas et al., 2003; Paas, Renkl, & Sweller, 2004; Sweller, 1988) outlines the importance of providing just the right level of information when learning is taking place, by ensuring extraneous information is minimised. Several developmental studies have shown support for this theory by reducing visual complexity for children (e.g., Fisher et al., 2014; Kaminski & Sloutsky, 2013; Kidd, Piantadosi, & Aslin, 2012). For example, Chiong and DeLoache (2012) found children learned more from simpler alphabet books than alphabet books with manipulative features (i.e., a pop-up book, see also Tare et al., 2010). However, picture-books such as alphabet books typically contain decontextualized pictures, which are already highly simplistic, rather than richly illustrated scenes designed to support the understanding of a narrative, like the storybooks used here. Flack and Horst (2017) found that when 3.5-year-old children were read storybooks containing richly-illustrated, realistic scenes, they learned more words when presented with a single illustration at a time, than when presented with two

illustrations simultaneously. These findings are consistent with the idea that visual complexity is important to word learning, as children's word learning improved when visual complexity was reduced.

One possible explanation for the current findings is that the contrast between our illustrations was not great enough in the current storybooks. These storybooks were modified from those used in Horst et al. (2011). The storybooks are illustrated with staged photographs. As such, some illustrations contained relatively few 'complexities' for us to remove when attempting to simplify the illustrations, and few competitor objects to distract children from the target objects. In addition, some of the competitor objects (e.g., electric kettle) were not as complex or colourful as the target objects. Future research should provide a greater contrast between simple and complex illustrations.

An alternative explanation is that some complexity can help learning too. Perhaps our simplified storybooks were just *too* simple. A lack of complexity can lead to a lack of stimulation or interest, which can negatively impact learning (e.g., Paas et al., 2005). For example, Kidd et al. (2012) found that infants' learning benefited from just the right level of complexity; not too much, not too little. The idea that some complexity can be particularly helpful is not new to the literature on learning (e.g., E. Bjork & Bjork, 2011; R. A. Bjork, 1999) and in particular to that of vocabulary learning (see, e.g., R. A. Bjork & Kroll, 2015; Vlach & Sandhofer, 2010). For instance, according to the 'desirable difficulties' account (R. A. Bjork, 1999) reducing elements which increase difficulty may sometimes be detrimental to word learning, particularly over time. Our findings are consistent with this theoretical account. Specifically, the results from the current studies suggest that finding a sweet spot where complexity interacts most effectively with a child's individual capability is key to promoting the

best possible learning from storybook reading. Simple solutions such as highlighting

key information (Flack & Horst, 2017) may yet prove to have some value.

This paper explored how illustration content affected children's word learning

from shared storybook reading. Although we did not find evidence that having more

visual information hindered word learning, the pattern of results suggests it merits

further investigation. Understanding the effects of complexity on word learning could

be particularly valuable for commercial storybook and educational material design, as

well as adding to a growing literature on the role of visual complexity in development.

Paper 5:

The Effects of Repeated Readings on Pre-Schoolers' Word Learning and Story

Retelling

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RETELLING REPEATED STORIES

Abstract

Children learn more new words from hearing repeated than different stories. Despite a rich literature investigating the benefits to comprehension, fewer studies have explored the effects of repetition on language production and narrative skills. In the present study 3- and 4-year-old children ($N = 42$) were read either three different stories or the same story three times. After each reading, children were asked to retell the story they had just heard. Children's word comprehension did not differ between conditions. We also found no differences between conditions for children's production of the target words during story retelling. Differences in production with successive readings suggest some benefit of repetition may support aspects of narrative skills. One possible explanation for the lack of repetition effects we consider is the additional exposure to the stories children gain as a result of retelling the stories themselves.

The Effects of Repeated Readings on Pre-schoolers' Word Learning and

Story Retelling

Children from less advantaged homes encounter a much more limited range of

vocabulary in the early years than children from more affluent homes (e.g., Hart &

Risley, 1995). This, in turn, has implications for vocabulary skills at school entry. One

particularly effective way pre-school children's vocabulary can be enhanced is through

shared storybook reading with an adult (e.g., Robbins & Ehri, 1994). Frequency of

shared reading during the preschool years is a predictor of later language, reading and

emergent literacy skills (Bus, van Ijzendoorn, & Hurley, 1996). This is important,

because the difference in vocabulary skills at school entry widens over time, affecting

children's chances of success in later life.

Storybooks provide a more expansive supply of new vocabulary for children to

learn from than the everyday conversation they may encounter (Montag et al., 2015).

Increases in vocabulary acquisition from shared storybook reading are well documented

(e.g., Elley, 1989; Robbins & Ehri, 1994; Sénéchal et al., 1995). Robbins and Ehri

(1994) showed that increasing the number of times children encounter new vocabulary

through storybooks increases their chances of successful acquisition. This is most likely

by providing additional opportunities to make associations and encode the new word

(Sénéchal et al., 1995). One way to increase children's exposure to new vocabulary is to

read the story again (e.g., Sénéchal & Cornell, 1993), something children report really

enjoying (Williams & Horst, 2014).

Early research into the benefits of repeated readings lacked a suitable control to

measure solely the effects of story repetitions (e.g., Elley, 1989; Sénéchal, 1997).

McLeod and McDade (2011) read children either one long story or the same short story

three times, but in both conditions children encountered the same number of new words

the same number of times. The authors found that children who heard the same short

story repeated learned more new words than those who heard one longer story. Horst et

al. (2011) conducted a similar study but all children heard three stories; either three

different stories or the same story three times. Again, children in both groups heard the

same number of new words the same number of times. Horst et al. (2011) found that

children hearing the same stories repeated, learned more words than children who heard

the different stories. Taken together these studies suggest repeated readings are

particularly helpful for word learning.

When books are repeated the context becomes more familiar, which could support

children's acquisition of new information. Nagy, Anderson, and Herman (1987)

suggest that books with familiar contexts enable children to focus on any new material

better. Horst (2013) and Horst et al. (2011) referred to this as a contextual cueing effect.

This account suggests that with each repeated reading children can explore new aspects

of the story. An alternative theoretical account is that of Cognitive Load Theory (Paas et

al., 2003; Sweller, 1988, 1989). This theory describes learners as having limited

cognitive resources available to deal with new information. The more they have to think

about, the more challenging they find the task. With experience, learners develop

schemas for previously encountered information, freeing up their limited cognitive

resources to handle increasingly complex materials. In this case, repetition of stories

may be more helpful for building schemas than hearing different stories. Both

contextual cueing and cognitive load theory can account for existing findings. In earlier

readings children can identify key information for comprehension of the story, such as

plot and characters, but with subsequent readings they can begin to attend to other

aspects of the content in greater depth. When hearing three different stories each reading

requires concentration on the plot and key characters, meaning children have less opportunity to learn the new vocabulary.

Although several studies now demonstrate an advantage for repeated readings (e.g., Justice, Meier, et al., 2005; Maynard, Pullen, & Coyne, 2010) they offer a rather limited account of the benefits as most focus exclusively on vocabulary acquisition (Horst et al., 2011; McLeod & McDade, 2011; Penno et al., 2002; Wilkinson & Houston-Price, 2013; Williams & Horst, 2014). In addition, these studies typically test children at the completion of the repeated readings, neglecting the progress children may be making with each successive reading. Many different aspects of shared reading may contribute to different aspects of children's language development (Sénéchal, 1997). If story repetition facilitates children's comprehension of new words, it may also facilitate other aspects of learning from storybooks, which should be investigated more fully.

Eller, Pappas, and Brown (1988) asked children to listen to, and then retell the same story three times over three consecutive days. Although adult reading style, children's prior knowledge of the target vocabulary, and number of exposures to target words were not controlled, the authors reported that children used the new vocabulary more with each retelling. Leung and Pikulski (1990) reported similar findings from a more tightly-controlled replication of Eller et al.'s (1988) experiment. The use of retellings to measure children's learning not only provides a measure of children's learning at a number of time-points, which is important for understanding development (Adolph et al., 2008), but provides a wealth of very rich data with which to investigate children's production of new vocabulary, as well as other aspects of their language development, such as narrative skill and mean length of utterance.

In the current study we read preschool children stories and asked them to retell these stories (for another example of this method, see Reese, Sparks, & Suggate, 2012). Children heard either one story three times or three different stories. Importantly, in both conditions, children encountered two novel words the same number of times. After each reading children were asked to retell the story. We investigated whether children in these two groups differed in their use of vocabulary, the novel words, and how well their stories reflected the key content from the original stories at each time point.

If repeating stories aids word learning because repeating story contexts allows children to attend to, and learn from, new aspects of the stories, then children hearing the same stories repeated should use a greater volume of words, with a wider range of vocabulary and increasing utterance lengths, to make greater use of new vocabulary and to provide a more accurate rendition of the original story with each retelling. We would also expect children hearing the same stories repeated to include more, or at least, novel aspects of content with each retelling.

Method

Participants

Forty-two 3- to 4-year-old children participated ($M = 50.1$ months, $SD = 2.9$ months, range = 45.0 to 55.25 months). Children were monolingual, British-English speakers from predominantly middle-class families. All children were typically developing with no reported speech or language difficulties. Storybooks and storybook order were counterbalanced within and between conditions. Therefore, an equal number of children will have heard each of the stories in each ordinal position, across both conditions. Twenty-one children were assigned to the same stories condition ($M = 49.16$ months, $SD = 2.7$ months, range = 45.0 to 54.3 months) and 21 to the different stories condition ($M = 50.16$ months, $SD = 2.9$ months, range = 46.23 to 55.25 months).

There was no difference in age between conditions, $t(40) = 1.41$, $p = 0.17$. There was no difference in maternal education levels between conditions, Fisher's Exact Test, $p = .613$. Four mothers in the different stories condition and one in the same stories condition had completed school high school (General Certificates of Secondary Education and/or A-levels). Seven mothers in the different stories condition and eight in the same stories condition had completed undergraduate degrees. Seven mothers in each condition had completed post-graduate qualifications, and one mother in the different condition and two in the same stories condition had completed doctorates. A further two mothers in the different stories condition and three in the same stories condition declined to answer. One family in each condition consisted of two mothers, so we analysed the educational information for the parent who attended.

Parents were reimbursed for travel costs and children chose a small gift as a thank you for participating (e.g., sticker book). An additional 8 children were tested but not included due to fussiness or inattention ($n = 5$), experimenter error, ($n = 2$) or equipment failure ($n = 1$). All of these children were from the same stories condition.

Stimuli and Apparatus

Storybooks. Stimuli included three 10-page storybooks slightly modified from Horst et al. (2011): *The Very Naughty Puppy, Nosy Rosie at the Restaurant,* and *Rosie's Bad Baking Day*. Each story included an age-appropriate moral, e.g., listen to your parents or do not go off by yourself. The protagonist, Rosie, is a young girl and plots are those children would be familiar with (getting a new pet, going out for dinner, baking at home) all set in everyday locations. Each storybook depicted and named two novel objects four times: an inverted sling shot that was used like a hand mixer (*sprock*) and a kinetic wheel that was used like a rolling pin (*tannin*). We used real photographs edited with the poster edges feature in Photoshop to make them look like drawings typical of

commercially available children's books. Across storybooks there was no difference in the number of words per page, $M = 45$, $SD = 9.34$, $F(2,24) = 0.98$, $p = .39$. Storybook pages were presented as single PowerPoint slides on a Dell laptop. A separate PowerPoint file for each combination of three story orders was designed to reduce experimental error. Each of these featured a full version including text (read by the experimenter), followed immediately by a text free version, which was used to provide a structured visual reminder to support the children retelling the events related to that page (Reese et al., 2012). For example, for the same condition, three PowerPoint slideshows were set up with each story presented six times, and for the different condition, six PowerPoints were set up for each of the possible combination of orders of the three storybooks with each story being presented twice, once for the experimenter to read, then once to support the child's retelling of the story.

Puppets. To give children a reason to retell the story we used three hand puppets, a duck (Alex), a mouse (Trixie) and a frog (Felix).

Test stimuli. An A4 test booklet with images of four novel objects per right-hand page was used on the test trials (the left-hand pages were blank). On each page, four objects were presented on a plain white background without any other contextual information. Across test trials the targets (*tannin* and *sprock*) were presented with four additional novel objects that the children had not previously seen, so that each trial would present children with a different combination and it would not appear that a question was being repeated. Finally, a practice trial page included images of four known objects: a horse, a car, a cup and glasses.

Procedure

Storybook reading. Each child was tested individually in a children's lab at the university. During the reading phase, the experimenter sat beside the child, at a table

and read the stories aloud from the laptop. The experimenter advanced the pages using the keyboard. The parent sat in a corner of the room. All children were read three stories, either one story three times or three different stories. If children asked questions during the reading, the experimenter said "Let's wait and see" before continuing with the story.

Retelling. After each reading, the experimenter reached behind the laptop to put on one of the puppets (e.g., mouse, frog or duck). The experimenter said "Oh look, this is my friend (puppet's name)." The experimenter then, effected a voice for the puppet and used the following script:

"Why hello there, my name is (puppet's name). What's your name? [Experimenter allowed child to respond]. Are you here to listen to stories too? Story time is my favourite. Oh no I think I overslept! I can't hear anything in my house, have I missed story time? [Experimenter allowed child to respond] Oh no! Did I miss any stories? [Experimenter waited for response]. Did you listen to the story? [Experimenter allowed child to respond]. Please can you tell me what happened in the story?" The experimenter then advanced to the second, text-free version of the first story.

The experimenter listened and nodded while children responded, and waited until children finished responding, before providing prompts such as "Did anything else happen?" or "Can you remember any more?" until children had nothing more to add. When children were not forthcoming in retelling the story the experimenter pulled a sad face and asked again, up to a maximum of twice. This procedure was repeated with the second and third story. To minimize experimenter error the puppets were always used in the same order (Alex the duck, then Trixie the mouse, finally Felix the frog), which also allowed the experimenter to keep track of how many stories had been read and retold.

Testing. After hearing the final story retold, the experimenter moved the laptop away to make room for the test trial booklet. The test phase began with four warm-up trials to get children comfortable pointing to pictures in the test booklet and to ensure children understood the task. The experimenter opened the test booklet to one of the warm-up pages and asked the child to point to one of the familiar objects (e.g., "can you point to the horse?"). After each correct answer, children were provided with positive feedback for correct answers. (Two children in the same stories condition answered the first warm-up trial incorrectly, but all the remaining children answered all of the warm-up trials correctly.) Children completed four warm-up trials, thereby pointing to an object in each quadrant of the page. Next, the experimenter tested word learning using the test pages. For each trial the experimenter turned to a different test page and asked the child to point to one of four novel objects. After each of the four practice trials the experimenter provided feedback for children, to encourage engagement. During test trials, however, no feedback was given for correct or incorrect answers. In total children were asked to point to each target novel object twice (see also, Werchan & Gómez, 2014). Trial order, page and quadrant were counterbalanced across participants for both warm-up and test trials.

Transcriptions and coding.

Storybook coding. We identified key units of information (i.e., content units) throughout each story. For example, in *The Very Naughty Puppy* we coded the first page into four separate content units: 1) Rosie wanted a pet, 2) She didn't care what kind of pet, 3) she asked "Mummy, can I have a pet?", 4) she said "I will take good care of it." Each of the three stories contained 41 such content units (See Appendix A).

Transcription coding. We transcribed the sessions using CHAT (developed by MacWhinney, 2000; CHILDES Project). We only included the verbal exchanges for

children's retellings (rather than including the experimenters' readings as well). The first author provided training on transcription conventions for two coders until a minimum reliability of 90% was achieved.

We coded both the total number of words and the number of unique words used by each child per story retelling (i.e., if children repeated a word during the same retelling this would count only once). We coded children's speech to identify target word usage as either the correct target word that was used (e.g., "*sprock*"), or an alternative word was used (e.g., "roller"). We also coded speech content matching the content points from the stories.

Inter-coder reliabilities. To assess inter-coder reliability, a random sample of ~20% were selected and coded by a second coder. Reliability for transcriptions was very good ($n = 10$, $M = 94.83\%$, $SD = 3.41\%$, range: 90.42% to 99.1%). Inter-coder reliability of content points inclusion in retells was excellent ($n = 8$, $M = 97\%$, $SD =$ Cohen's kappa = 92.30).

Results

We measured the time taken for the experimenter to tell each story ($M = 106.93$ seconds, $SD = 12.18$ seconds). We used a mixed-design ANOVA with story order (first, second, third) as a repeated measure and condition (repeated, different) as an independent measure to analyse experimenter reading durations. Repeated stories ($M = 108.03$, $SD = 13.72$) and different stories ($M = 105.83$, $SD = 10.40$) did not differ significantly in duration, $F(1,40) = 0.40$, $p = .53$, nor with successive readings $F(1.67, 66.79) = 2.25$, $p = .12$. There was no significant interaction between condition and story order $F(1.67, 66.79) = 1.30$, $p = .28$ (Huynh-Feldt corrected for sphericity).

The time taken for children to retell stories was much more variable ($M = 121.90$ seconds, $SD = 40.50$ seconds). We used a mixed-design ANOVA with story order (first,

second, third) as a repeated measure and condition (repeated, different) as an independent measure to analyse the duration of children's retellings. Children retelling repeated stories (M = 126.38 seconds, SD = 37.82) and different stories (M = 117.40 seconds, SD = 42.83) did not differ in the duration of their story retellings, $F(1, 40)$ = 0.67, p = .42, nor with successive readings, $F(1.71, 68.55)$ = 2.28, p = .18. There was also no significant interaction between condition and story order, $F(1.71, 68.55)$ = 0.42, p = .63. (Analyses all Huynh-Feldt corrected for sphericity).

Here we first present an analysis of the total words used, then the proportion of those words which are unique. Next, we investigate whether children's language developed more generally over the course of the experiment by measuring any changes in their mean length of utterance. We then consider how well children retold the content of the stories, and whether children who heard repeated stories included greater levels of detail than children who heard different stories. Finally, we consider children's use of the target words and analyse performance on the word comprehension task.

Because children hearing the same stories repeated would be retelling one story several times we might expect them to expand the vocabulary used with each progressive reading by retelling new aspects of the story. Conversely, children hearing different stories are retelling three different stories, so a wider range of vocabulary is required with retellings, simply because the key points of each story are different. This means similar behaviour may be reflected in each condition for different underlying reasons. For example, practice effects may support children's general retelling skills, but the changing story may mean children use a wider range of vocabulary to provide the three different retells.

Total Words

We measured the total number of words, the number of these words which were unique as part of each retelling and the mean length of utterance. There was a great deal of variability in the volume of speech produced by children in both conditions. Children produced an average of 235.57 words (SD = 189.29, SE = 41.31, range 1-667) following different stories, and 228.1 words (SD = 152.43, SE = 33.26, range 9-567) after hearing repeated stories. A mixed-design ANOVA with story order (first, second, third) as a repeated measure and condition (same or different stories) as an independent measure revealed a significant main effect of story order $F(2, 80) = 7.76$, $p < .001$, $\eta_p^2 = .16$, but no effect of condition $F(1, 40) = 0.004$, $p = .95$ and no interaction, $F(2, 80) = 0.44$, $p = .65$. Tukey's post hoc test on the effects of story order revealed significant differences between the first story and the second ($p < .001$) and third stories ($p = .01$). There were no significant differences between the speech volumes of the second and third stories. Overall, children produced growing volumes of words, particularly after the first story, but no difference between conditions.

Unique Word Production

Greater use of unique words should reflect more creative use of language or a more elaborate understanding of the story. Unlike total speech, the number of unique words spoken by children in both conditions increased with each story reading, see Figure 1. A mixed-design ANOVA with story order (first, second, third) as a repeated measure and condition (same or different stories) as an independent measure found a significant main effect of story order, $F(2, 80) = 3.79$, $p = .03$, $\eta_p^2 = .09$. There was no significant effect of condition, $F(1, 40) = 0.32$, $p = .57$ and no significant interaction, $F(2, 80) = .77$, $p = .47$. Tukey's post-hoc test revealed a significant difference in the number of unique words used by children only between the first and third stories ($p =$

.03). Therefore, children became increasingly creative by using more unique words with successive readings, but this did not differ depending on whether they heard repeated or different stories.
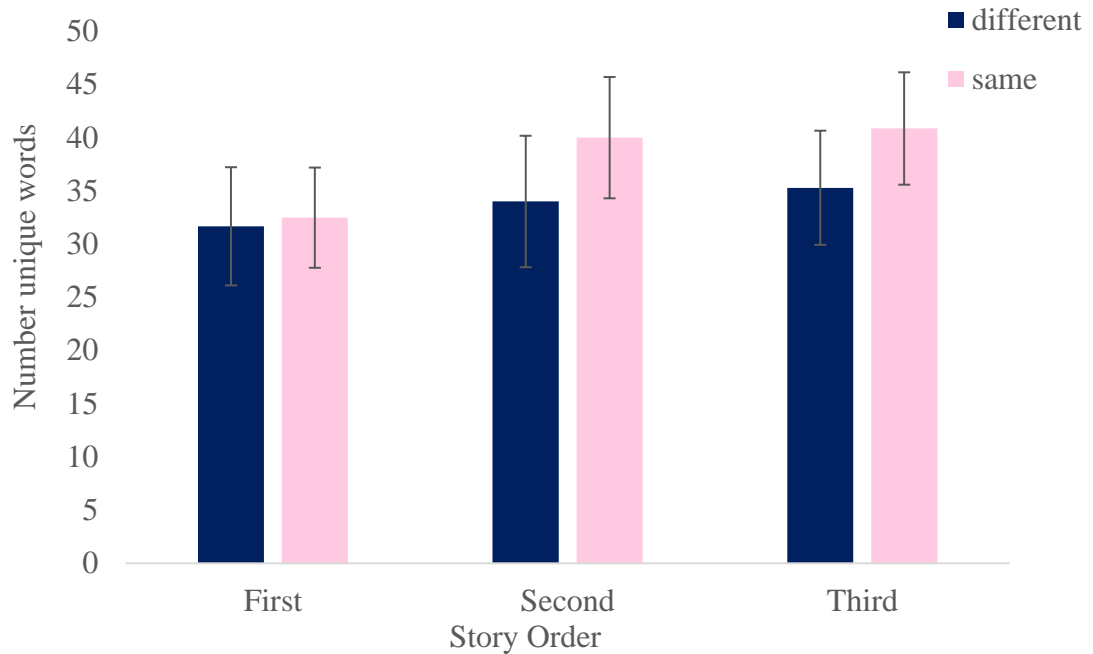
Figure 1. Unique word production for same and different stories by story order +/- 1 SEM.

Mean Length of Utterance

Mean length of utterance provides a good indicator of a child's language acquisition, either at the level of the word or the morpheme (Rice, Smolik, Thompson, Rytting, & Blossom, 2010). We chose to measure this at the level of the word (see Figure 2) and calculated this as the ratio of words to utterances, as this was most relevant to our research questions. Where children did not utter a single word for a particular retell, this resulted in no mean length of utterance, but wherever possible this was analysed here ($n = 17$). A mixed-design ANOVA with story order (first, second, third) as a repeated measure and condition (same or different stories) as an independent measure found a significant main effect of story order, $F(2, 64) = 5.09$, $p = .009$, $\eta_p^2 =$

.13 on mean length of utterance, but no effect of condition, $F(1, 32) = 1.75$, $p = .20$ and

no significant interaction, $F(2, 64) = 1.78$, $p = .18$. Tukey's post hoc test on the effects

of story order revealed significant differences between the first story and the second (p

$= .01$) and third stories ($p = .03$), but no significant difference between second and third.
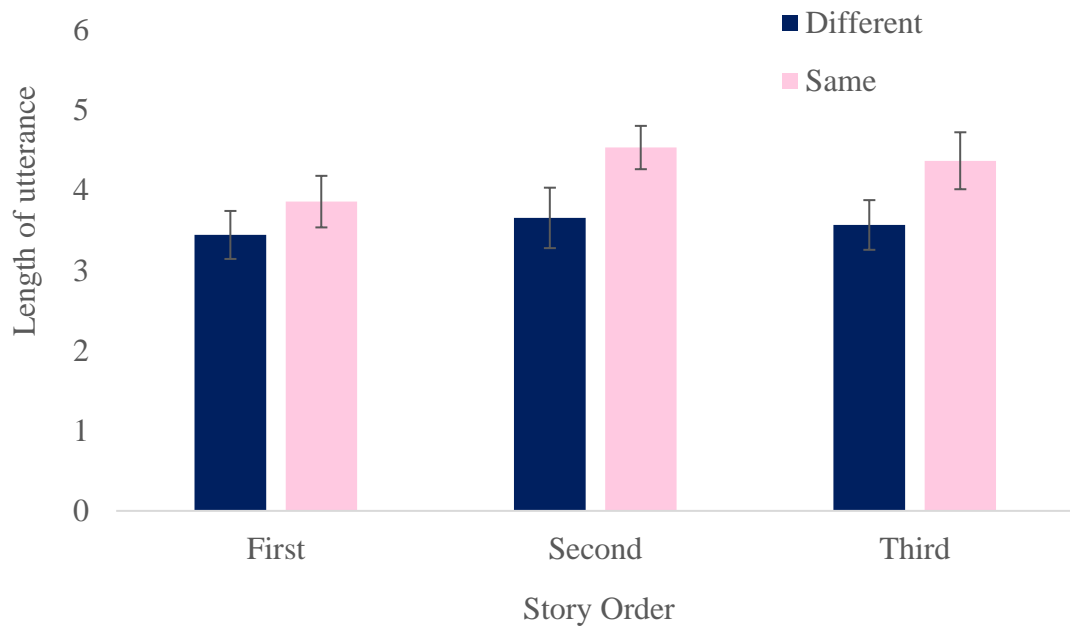
Figure 2. Mean length of utterance for same and different stories by story order

Retelling Story Content

In addition to analysing children's volume and variety of speech, we were

interested in whether repeated retellings of stories provided different levels of detail in

their retelling of story content. Recall, each story provided 41 such content units, which

children might include in a retelling.

Overall, children retold 56% ($M = 23.05$, $SD = 17.28$, $SE = 3.77$, range 0-24) of

the 41 possible content units from each story. Children hearing repeated stories retold

57% ($M = 23.52$, $SD = 17.58$, $SE = 3.84$, range 0 - 24) and children hearing different

stories retold 55% ($M = 22.57$, $SD = 16.98$, $SE = 3.71$, range = 0 - 19) of content units.

Figure 3 depicts content unit production by condition for each story with each

RETELLING REPEATED STORIES

successive story retold. A mixed-design ANOVA with story order (first, second or

third) as a repeated measure and condition (same or different) as an independent

measures variable found a significant effect of story order on the number of content

units retold, $F(1.63, 65.19) = 6.017$, $p = .007$, $\eta_p^2 = .13$ (sphericity corrected using

Huynh-Feldt correction). Tukey's post-hoc tests revealed a significant difference in the

number of content points retold between the first story and the second ($p = .006$) and

third ($p = .017$). There was no difference between the second and third story. We found

no effect of condition $F(1, 40) = 0.032$, $p = .86$ and no interaction, $F(1.63, 65.19) =$

1.00, $p = .36$. This suggests that children may benefit from practice effects in both

conditions.
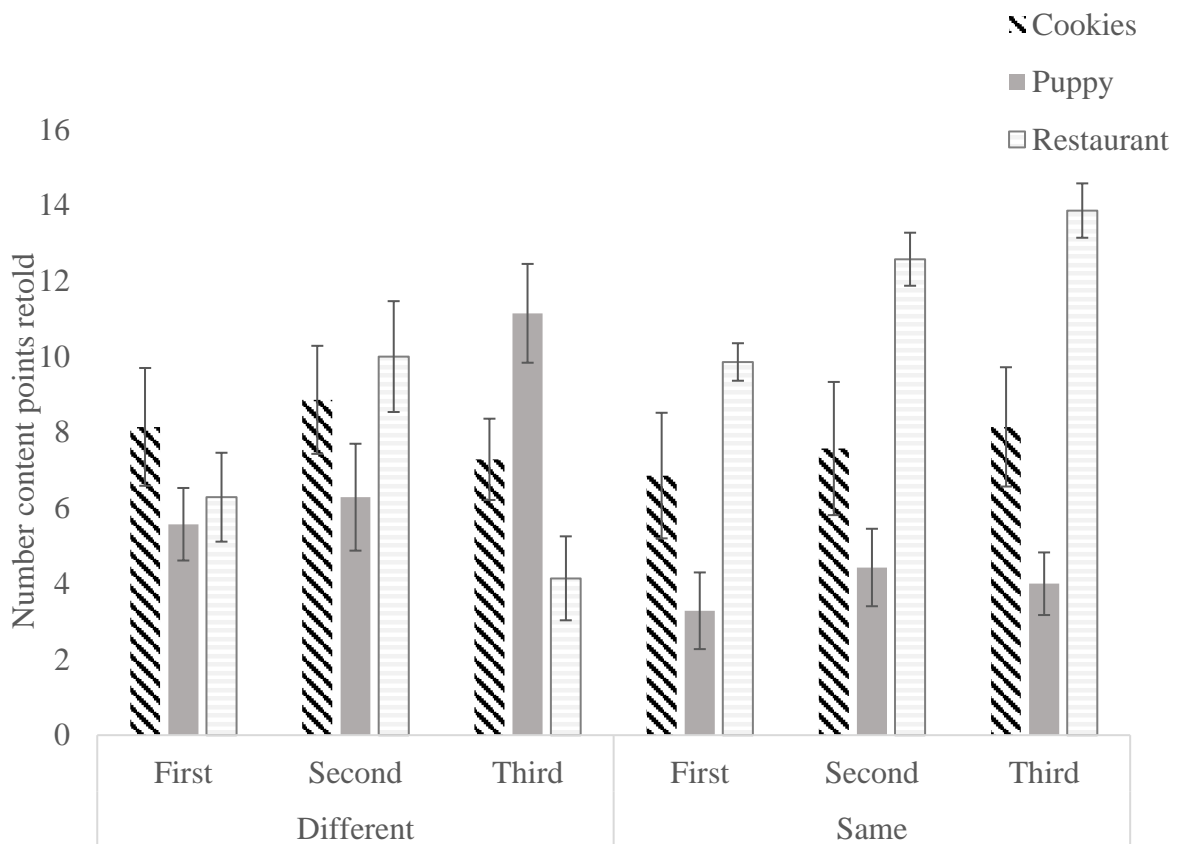
Figure 3. Content units retold by participants for each story in ordinal position, +/- 1
SEM

Target Word Attempts

We tested for differences between conditions in the number of times children successfully used the target words within their retelling of each of the stories. Target word attempts were low in both the same stories condition ($M = 0.33$, $SD = 1.35$) and different stories condition ($M = 0.62$, $SD = 2.53$) with only 6 children (2 in same stories condition) producing either of the target words, *sprock* or *tannin*. We performed a mixed-design ANOVA with story order (first, second or third) as repeated measure and condition (same or different) as an independent measure. We found no significant effect of story order ($F(2,56) = 1.07$, $p = .35$) or condition ($F(1,28) = 1.46$, $p = .24$) and no interaction, $F(2,56) = 1.90$, $p = 0.16$, on the number of times children used the target words during their story retellings.

In some cases, whilst children did not produce the target word itself, they provided an alternative word for the target object, showing they had correctly identified the referent from the story, suggesting some level of comprehension but perhaps were not able to produce the word themselves. We therefore extended the coding to include what we deemed to be intentional references to the target objects. With this more inclusive coding, levels of production of target words were considerably higher for children in both the same ($M = 5.95$, $SD = 6.77$) and different stories conditions ($M = 5.24$, $SD = 6.65$). Overall, 30 children (14 in same stories condition) made some reference to the target objects in their retellings. We used a mixed-design ANOVA with story order (first, second or third) as a repeated measure and condition (same or different) as an independent measure. We found no effect of story order $F(2,58) = 1.04$, $p = .36$ or condition $F(1,29) = 1.88$, $p = .18$ and no interaction, $F(2,58) = 0.32$, $p = .73$.

Children's production of the novel words was not improved by repeated stories over different stories, or practice from successive readings.

Target Word Learning

We analysed children's performance in the word comprehension test. Children who heard both three different stories ($M = 0.86$, $SD = 0.25$, $t(20) = 11.38$, $p < .001$, $d = 2.48$) and the same three stories repeated ($M = 0.73$, $SD = 0.31$, $t(20) = 7.15$, $p < .001$, $d = 1.56$) correctly identified the target object more than would be expected by chance (0.25). There was no difference in word learning between the same stories and different stories conditions, $t(40) = 1.53$, $p = .13$. Thus, although children in both conditions learned the words, we found no evidence of an advantage for children hearing the same stories repeated. The rate of word learning for children in the same stories condition is similar to rates from previous studies with these books (e.g., Horst et al., 2011; Williams & Horst, 2014). However, the rate of word learning for children in the different stories condition was very high, for an explanation, see Flack and Horst (2017).

Discussion

In the current study we investigated whether the benefits of hearing the same story repeated rather than hearing several different stories, could be helpful for more than just vocabulary comprehension. Specifically, we investigated children's speech volumes, the range of unique vocabulary, use of the novel words and how well children recounted the key content of the stories they heard. Children in both conditions used similar volumes of words to retell their stories, similar numbers of unique words and similar mean length of utterances. Although children produced increasing volumes of speech, unique words and the mean length of utterances increased with each reading, we did not find evidence of an effect of storybook repetition on their speech production volumes or

the use of unique words. Children's retelling of story content also increased with each retelling, but again, we found no evidence that children hearing repeated stories retold content more fully than children hearing different stories.

When we looked at children's production of the target words, we found no effects of story order or condition, but children's use of the target words was fairly minimal, so may reflect floor effects. As word comprehension typically precedes production (Huttenlocher, 1974) we would expect children to understand words before they use them (Pinkham, Neuman, & Lillard, 2011). This is consistent with our finding that children in both conditions, despite producing the novel words in so few cases, appeared to have learned the words in the comprehension test. There was no difference in comprehension levels between conditions.

Overall we found no differences in children's performance across a number of measures whether they heard one story repeated, or three different stories, but we did find evidence of increased production with each progressive retelling. Cognitive Load theory provides a compelling and parsimonious account for these findings and how they fit with prior research.

Cognitive Load theory (Paas et al., 2003; Paas et al., 2004; Sweller, 1988, 1989) posits that learners have limited resources available with which to process new information from learning materials. If that information is highly interactive or complex this requires a good deal of working memory resources. However, if learning materials present new information in formats that are less challenging, or as these formats become less challenging with experience, available cognitive resources can be used to build schemas. Schemas can be used to store complex information in long term memory, thereby freeing up further availability in working memory to handle increasing levels of complexity.

In our study, the lack of an effect between conditions in speech volumes, unique word usage and content is consistent with cognitive load theory and may not be particularly surprising. Although we might expect children to benefit from the repeated contexts, there are a number of other potential alternative explanations which could be affecting the outcomes. For example, children in both conditions may benefit from practice at retelling; essentially developing schemas for retelling stories. This could help make cognitive resources available for allocation to other aspects of the task such as identifying other key aspects of story content. The development of schemas in both conditions could be supporting attention to plots and new words with each story reading. Although we presented children in the different condition with three different stories, these stories featured the same protagonist, Rosie. Children hearing the different stories therefore encountered the same character, which may have provided less 'difference' than if we had presented three books with completely different characters. Thus, similarities between books and practice effects at storytelling could result in the observed increases in levels of speech produced, and the variety (unique words) of words children produced with each reading in both conditions.

Another possible explanation for why we found no differences between conditions could be because the process of retelling works in a similar fashion to a repeated reading by an adult. In this case, even children in the different stories condition 'experienced' each story twice, and in particular revisited the illustrations twice, which in itself might have contributed considerably to their overall learning. This also fits with a cognitive load account as children are actively engaging in the story during the retelling, rather like we see with dialogic reading (e.g., Whitehurst et al., 1988).

Furthermore, children in the same stories condition are exposed to the story a total of six times if their own retellings are included. The benefits of repetitions may vary

with other factors (Flack, Field & Horst, under review). Karweit and Wasik (1996) suggested the number of repetitions required may vary according to ability. For example, the benefit of repetitions may be maximal with only two or three repetitions, so further readings may be superfluous. This certainly fits with our findings. We found effects of story order most commonly between the first and second story, or at least between the first and third, but no significant differences between the second and third stories in any of our measures. Leung and Pikulski (1990) also found evidence of increases in vocabulary learning following retellings between the first and second readings but not between the second and third. The benefits of repetition may be limited to an optimal number. From a cognitive load perspective (Sweller, 1988, 1989, 2010), children may have now developed schema, and are ready for more challenging material.

Similarly, children's more general cognitive skills, and general experience with books will have increased with age (Stanovich, Cunningham, & Feeman, 1984). Older children may therefore be quicker to detect the novel information because they are more experienced at getting what they need from storybook readings. We might therefore predict age to interact with the effects we found with a cognitive load account. This would provide an interesting area for future research.

Even if children hearing repeated contexts are learning more, they may consider the listener does not need to hear information repeated, which might lead them to add fewer embellishments. Although we asked children to retell the story to a different puppet each time, this make-believe may not have elicited the fullest retellings. Children knew the experimenter knew the story, so perhaps they were less likely to expand. Children aged 6-, 9- and 11-years of age were found to modify aspects of their narratives according to the level of shared knowledge with the listener (Kail &

Hickmann, 1992; Kail & Lopez, 1997). We are not aware of evidence of this in younger children, however 7-year-old children questioned in focus groups following a similar retell method reported not believing that a listener did not already know the story, and limiting their narratives accordingly (Klop, Eksteen, Adams, Botman, & Brink, 2017). These authors recommend using naïve listeners for each story, to elicit a narrative to the best of children's ability.

This experiment was demanding. Children had to maintain attention, listen to and retell three stories, and then complete a word learning task—all with a relative stranger. Some children found this task more challenging than others, and this is reflected in our higher than usual attrition rates. Earlier experiments requiring children only to listen to stories, and measuring only comprehension have had very low attrition rates (e.g., none reported in Horst, Parsons & Bryan, 2011; McLeod & McDade, 2011). Studies including repeated readings with retelling have typically been conducted over different days so children are less likely to become disengaged (e.g., Eller et al., 1988; Penno et al., 2002). For example, Penno et al. (2002) report attrition of 11% but this was due to absence in school, rather than failing to complete the task. Oddly, only children from the same stories condition failed to complete the whole experiment. We did not specifically measure enjoyment in this experiment, but Leung and Pikulski (1990) report that children expressed boredom by the third reading. This may have had an effect on our findings. Paas et al. (2003) suggest motivation and effort can increase cognitive resource availability, so it is possible that children's over exposure to the same stories had the opposite effect, thereby reducing their performance in the retelling and comprehension task. Westerveld, Gillon, and Miller (2004) describe story retelling as challenging even for a 5-year-old child, but we were guided by Reese et al. (2012) who had successfully used a similar method with 3- and 4-year-old children. We were

keen to ensure any results were relevant to existing research with pre-school-aged children, but cautiously chose to target slightly older children than in previous experiments to provide the best chance of children being willing to speak up during the experiment.

The current findings add to a growing literature on both the effects of repeated shared reading and the real-time development of narrative skills in preschool aged children. Although we did not find group differences between those children who heard the same stories and those who heard different stories, it seems likely the role of repetition plays a positive role in the initial stages of learning from shared storybook reading. Our findings suggest further research is needed to unpick the finer details of how the many factors interact to help children get the most out of shared storybook reading.

General Discussion

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DISCUSSION

General Discussion

This thesis adds to a growing understanding of how children's word learning can be optimised from shared reading interactions. Using a variety of methods, I investigate which factors from the existing literature *really* help improve word learning, such as reading style, tokens and the number of words tested (Paper 1). I also identify topics which merit further investigation in new research, such as the role of storybook repetition (Paper 1). In Paper 2, I use these findings to extend our current understanding of the role of storybook reading on word learning using eye movement analysis. Surprisingly, I found that 3.5-year-old children's word learning was much improved with the display of only one page at a time from earlier experiments which displayed two storybook pages simultaneously. This exciting possibility has implications for e-book research, so in Paper 3, I investigated this directly, finding that the number of storybook pages displayed simultaneously, significantly affected 3.5-year-old children's word learning from shared storybook reading. In a second experiment in Paper 3, I found that a simple gesture to the correct page helped children perform as well as if they were only seeing a single page at a time. In Paper 4, I extended this research to see if using the same principles of reducing visual content to improve word learning could be adopted elsewhere as effectively. I found no differences between the complexity levels (Paper 4, Experiment 1), or salience manipulations (Paper 4, Experiments 2a & 2b). However, the lack of word learning resulting from the manipulation in Paper 4, Experiment 2b suggests there may be an effect I was unable to reveal with the stimuli I used. In the final paper, I returned to address the topic of storybook repetition highlighted in Paper 1. Paper 5 investigated wider ranging learning effects which might be present from storybook repetition, such as benefits to children's language production during story retelling. I found little evidence that storybook repetition had benefits over

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more general practice effects, although this may be because the repetition became rather excessive when children's own story retelling was considered.

In the introduction, I outlined a set of over-arching questions to be addressed by the Papers within my thesis. These were as follows:

a.) Which aspects of storybooks and storybook reading are most important in helping children learn words from shared storybook reading?

b.) To what extent does storybook repetition help word learning?

c.) What is the role of simplicity and complexity in word learning from shared storybook reading?

In the introduction I responded to each of these questions individually, based on the findings from the various methods within the current thesis and explored the relevant theory. Here, I revisit these, summarising how my work adds to what we already know. Then, I note some important issues for the field, including issues of reproducibility, and consider possibilities for future directions as well as limitations for the thesis.

Which aspects of storybooks and storybook reading are most important in helping children learn words from shared storybook reading?

Shared storybook reading provides children with opportunities to encounter a wide range of vocabulary (Montag et al., 2015), making such moments valuable learning opportunities (Niklas et al., 2016; Stanovich & Cunningham, 1993). Meta-analysis and behavioural experiments in the current thesis highlight some aspects of word learning which play a particularly influential role in increasing word learning from shared reading with 3- and 4-year-old children. Dialogic reading styles, such as pointing (e.g., Sénéchal, 1997) or providing definitions for words (e.g., Coyne et al., 2004), were identified as particularly important in Paper 1. In Paper 3, consistent with this I found

DISCUSSION

that use of a simple gesture to direct children's attention to the correct page also helped improve word learning. This suggests the reading style can play a significant role in helping children get the best out of shared reading situations.

Paper 1 also found that the number of new words, and the number of times these words are heard are both important to word learning outcomes. In the case of the number of words, this suggests that selecting suitably matched language content is important when selecting books for young children. Papers 2, 3 and 4 provide evidence that visual information shapes word learning. Taken together, these findings suggest that providing just the right level of information to children, both in what they hear, and what they see, can really benefit word learning. These findings support both cognitive load theory (Plass et al., 2010; Sweller, 1988, 1989) and desirable difficulties theory (R. A. Bjork, 1999; R. A. Bjork & Kroll, 2015) as both suggest that providing a gradual increase in challenge is advisable for the best learning outcomes.

The findings from this thesis also support a Dynamic Systems approach to word learning (Thelen & Smith, 1994; Thelen & Smith, 1998). Although experimental design was largely supported by Cognitive Load theory, Dynamic Systems theory played an important role when considering the broader, developmental implications for the work in the thesis. For example, Paper 5 provides evidence that some findings may be dependent on multiple interactions. Although the thesis shows that generally storybook repetition resulted in higher word learning levels than hearing different storybooks (see Figure 1), in Paper 5 this finding was not replicated. This may be because children were slightly older, or for the reasons discussed in the next section, but, regardless of the reason, this shows that word learning relies on the coming together of many factors at the right time.

DISCUSSION

Smith and Thelen (2003) suggest that Dynamic Systems theory has applications both metaphorically, and mathematically. In the current thesis, the theory is limited to rather more metaphorical use than mathematical application. The theory is also used to consider the possibilities for expanding the current research in the Future Directions section.

To what extent does storybook repetition help word learning?

Multiple exposures are needed before a word is learned (Pinkham et al., 2011). When learning from storybooks, words can be repeated within a storybook, or the storybook can be repeated. Many studies suggest repeating a storybook confers particular benefits for word learning (Horst et al., 2011; Maynard et al., 2010; McLeod & McDade, 2011; Sénéchal, 1997) not otherwise achieved by repetitions of a word within a storybook.

In Paper 1, meta-analysis of word learning demonstrated that effects of storybook repetition were of a moderate size, but bootstrapped confidence intervals suggested the true effect could be zero. This result was the same, even after removal of suspected outliers, and even when corrected for suspected publication bias. This suggested that repetition of storybooks was not a reliable moderator of word learning, contrary to a substantial literature suggesting considerable effects (e.g., Biemiller & Boote, 2006; Horst et al., 2011; Leung & Pikulski, 1990; Maynard et al., 2010; McGee, Schickedanz, & McGee, 2007; McLeod & McDade, 2011; Sénéchal, 1997; Williams & Horst, 2014). This motivated the additional research into storybook repetition in Paper 2 and Paper 5. Interestingly, both these papers failed to provide definitive evidence of effects of repetition improving word learning from shared storybook reading, although in both cases these reveal interesting data which suggest additional factors interacting

DISCUSSION

with the effects of storybook repetition: number of illustrations displayed at a time (Paper 2) and story retelling (Paper 5).

Paper 2 did produce the expected pattern: children hearing stories repeated performed better at the word learning task than children hearing different stories, but this difference was not significant. In Paper 5, however, the direction of effects was contrary to expectations: children hearing stories repeated performed worse than children hearing different stories. The method was extended to consider wider ranging effects of storybook repetition on different aspects of word learning and language production. Children performed well across the measures, but I found no differences between conditions. I concluded that children in Paper 5 may have benefitted from the process of retelling the story as a storybook repetition, so in this case children were hearing even the different stories more than once, so any benefit the children had of hearing the same stories did not give them an advantage. A recent paper indicates even as few as two repetitions aid word learning (James & Henderson, in press).

From a theoretical perspective, cognitive load theory (Paas et al., 2004; Sweller, 1988) predicts that repeatedly reading the same storybook should facilitate word learning because some extraneous information is reduced (i.e., because one story is repeated rather than seeing and hearing multiple plots, characters and illustrations). However, cognitive load theory also offers schema acquisition (Paas et al., 2004; Plass et al., 2010) as a suitable explanation for why results differed in Paper 5. Cognitive load theorists suggest that with experience, learners use any spare cognitive resources to gradually develop schema (Kalyuga, 2010; Sweller, 2010). Schema enable storage of larger and more complex units of knowledge to be stored as though they are smaller 'chunks' of information (e.g., Chase & Simon, 1973); essentially short-cuts to learning from previous relevant experience. With growing expertise these 'chunks' store greater

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quantities of information, which thereby saves cognitive load resources elsewhere (Plass et al., 2010). In Paper 5 there are two key reasons the repetition effect may not have been replicated. Firstly because this study showed children only one page at a time (which we now know from Paper 3 improves word learning) and secondly, because children get to see each storybook once when the experimenter reads, and once again as the child attempts to retell the story. These two repetitions may be adequate for children to develop schema, in both conditions, but children in the same stories condition then revisit these same stories many more times. These two factors; the reduced visual information caused by single page presentations, and the repeated exposures to the visual information, both serve to make the learning task easier, perhaps in this case, too easy, leading to lower levels of subsequent enjoyment and engagement with the task (Paas et al., 2005). A desirable difficulties account (R. A. Bjork, 1999) would also suggest that too many repetitions may reflect too little challenge which in turn negatively effects learning outcomes. Taken together, these findings suggest storybook repetition may be a powerful but complex tool in word learning from shared reading. Future research should investigate how learning emerges with successive repetitions.

What is the role of complexity in word learning from shared storybook reading?

Achieving a balance between simplicity and complexity is important in word learning. For example, children learn words better when presented with fewer competitors (Horst et al., 2010), but benefit from having some additional information (Zosh et al., 2013). Cognitive load theory suggests small incremental increases in complexity allow for a balance between having enough resources, and being able to develop schema which support subsequent learning (Kalyuga, 2010).

Paper 3 in this thesis was the first paper to consider that presenting children with two illustrations at a time rather than one illustration at a time might affect word

DISCUSSION

learning. In Paper 3, children presented with storybook illustrations one page at a time learned words better than children who saw two illustrations at a time. This finding, and the related finding that this can be overcome with a simple gesture, has important implications for educators, providers of educational materials, parents, or anyone who might read to a young child.

These findings could also explain some variation in findings in research comparing word learning from traditional print books and e-books (e.g., Korat, 2008; Segal-Drori et al., 2010). Finding that illustration content can create such impact on word learning prompts the question of whether illustration layout might impact (either positively or negatively) other outcomes from shared reading such as comprehension. For example, although we know illustrations are helpful for older children's comprehension (e.g., Gambrell & Jawitz; Ollerenshaw & Aidman, 1997), the number of illustrations has not been considered, and this may well vary with both age and reading ability. Future research should investigate these interactions.

Paper 4 considered the issue of illustrations in more detail. In Paper 4, Experiment 1, I tested whether presenting children with simplified illustrations rather than the original, more visually complex illustrations would improve word learning. In Experiment 2a and 2b the effect of the salience of target and competitor objects was tested. Although I found no direct evidence of effects, this may be because the difference in stimuli between conditions was not great enough. For example, storybook stimuli may not have been complicated enough to obtain a great enough contrast when simplified in Experiment 1. Similarly, in Experiment 2a and 2b, the salience manipulations were rather subtle. Future research may benefit from using stimuli with more marked differences in complexity and salience.

DISCUSSION

Taken together, this thesis has demonstrated that complexity plays a pivotal role in word learning from shared storybook reading. When considering the contrast of complexity and simplicity, it seems this can come in many forms. In Papers 3 and 4, the type of complexity in question was visual complexity, such as the number of things to look at or how easy to identify the target object was, but the repetition of storybooks in Papers 2 and 5 also supports children by reducing the volume of new materials, which also simplifies the task. Both desirable difficulties (E. Bjork & Bjork, 2011; R. A. Bjork, 1999) and cognitive load theory (Paas et al., 2004; Sweller, 1988, 1989) suggest that materials should start simple, and increase gradually in difficulty to provide the best learning outcomes. Thus the findings in this thesis appear to fit well with theory.

Important Issues

Interest in word learning from shared reading has a long standing history (e.g., Eller et al., 1988; Elley, 1989; Highberger & Brooks, 1973; Nagy et al., 1987). More recent research has benefitted from taking different approaches to addressing the important questions. For example, Whitehurst et al. (1988) trained parents to use a dialogic reading style with books from their homes and measured general vocabulary increases at several time points up to nine months later. Sénéchal (1997) measured the learning of specific target words from specific commercially available books, but target words were synonyms for familiar concepts, such as *fang* for a tooth and *skiff* for a boat. Whilst a variety of approaches has provided a rich literature, Paper 1 of the current thesis suggests some refinement of design features could be beneficial.

If we are to be able to draw conclusions from word learning research, then it is important that we are clear about exactly what children are learning. How do we decide which words children should learn? There are two key issues which are particularly

DISCUSSION

relevant here. Firstly, if target words are used to refer to objects for which children already know a word (e.g., Y. Chen & Liu, 2014; Sénéchal, 1997; Suggate, Lenhard, Neudecker, & Schneider, 2013) then the required learning may be rather different from that needed to attach an entirely new word to an entirely new referent (Ard & Beverly, 2004; Horst, 2015b). Children take longer to pair a novel label with a known object than a novel one (Halberda, 2003; Markman et al., 2003) and even very limited exposure to an object can result in some learning (Bornstein & Mash, 2010). Therefore, in studies using synonyms, if children already know a label for the referent, the process of matching the new word to the object is likely to differ from studies presenting novel objects which in turn would affect word learning measurement. This means the resulting estimates of word learning may differ across studies because of the novelty of the depicted object.

The second issue is that of how unknown—or novel, the target words really are. In studies measuring learning of specific target words (rather than general vocabulary increases) there is a great deal of variety in target word selection. Many researchers ensure the relative novelty of target words by pre-testing participating children's knowledge (C. Houston-Price et al., 2014; Sénéchal & Cornell, 1993) which I refer to in Paper 1 as "confirmed novelty". Studies using entirely novel vocabulary such as the verb *lumming* or the noun *mape* (McLeod & McDade, 2011) control for children's pre-experimental exposure to target words because children cannot have had any prior exposure to the target words. This ensures that any word learning effects reflect learning from the experiment, rather than learning, or partial learning from earlier experiences (Bornstein & Mash, 2010). However, if target words are selected as "sophisticated" words which children of a particular age would not be expected to know and the words are not checked by pre-test (e.g., Walsh & Blewitt, 2006), then, pre-experimental

DISCUSSION

exposure cannot be ruled out. As children's word learning is incremental from repeated

exposures to a word (Pinkham et al., 2011), they may already have some pre-

experimental advantage. For example, words such as *bunny* and *bear* for 2- to 4-year-

old children (Read, Macauley, & Furay, 2014) are unlikely *not* to have been

encountered pre-experimentally. In Paper 1, I found word novelty was a strong

moderator of word learning from storybooks, which provides convincing empirical

evidence that supports my concerns that target word selection in studies has an impact

on how we interpret the literature.

Reproducibility

Concerns about the lack of reproducibility of findings are widespread across

many scientific disciplines, including psychology (Ioannidis, 2005). If experiments

cannot be replicated, then the value of such findings in the real world, where conditions

are less controlled becomes rather meaningless. Open Science Collaboration (2015)

suggest reproducibility and scientific openness are fundamental to the health of

psychology as a discipline.

The current thesis embraces this ethos wholeheartedly by sharing data and code

(Paper 1) and re-using established stimuli (a key feature of the replication protocol from

Open Science Collaboration, 2015). In Papers 2 (Experiment 1), 3, 4 and 5, I used

storybooks from Horst et al. (2011), allowing cross comparison of closely related

effects on immediate recall of words from earlier studies as well as those contained here

(see Figure 1). I conducted a multi-level meta-analysis of these studies, using the

method and effect size calculations in Paper 1. This revealed a positive effect of shared

storybook reading on word learning, ($k = 20$) raw change = 1.360 words [1.272, 1.493],

$p < .001$. There was evidence of heterogeneity in the sample, $Q(19) = 88.77$, $p < .001$.

Storybook repetition was a significant moderator of word learning effects in this

DISCUSSION

sample. Children learned 0.397 [0.007, 0.617], $p < .004$ more words when stories were

repeated, which reflects a moderate and significant effect. This evidence suggests

storybook repetition *is* important in word learning, and perhaps methodological

differences may have made these differences less stable to find when stimuli and

methods were not consistent across studies in the sample in Paper 1.

DISCUSSION
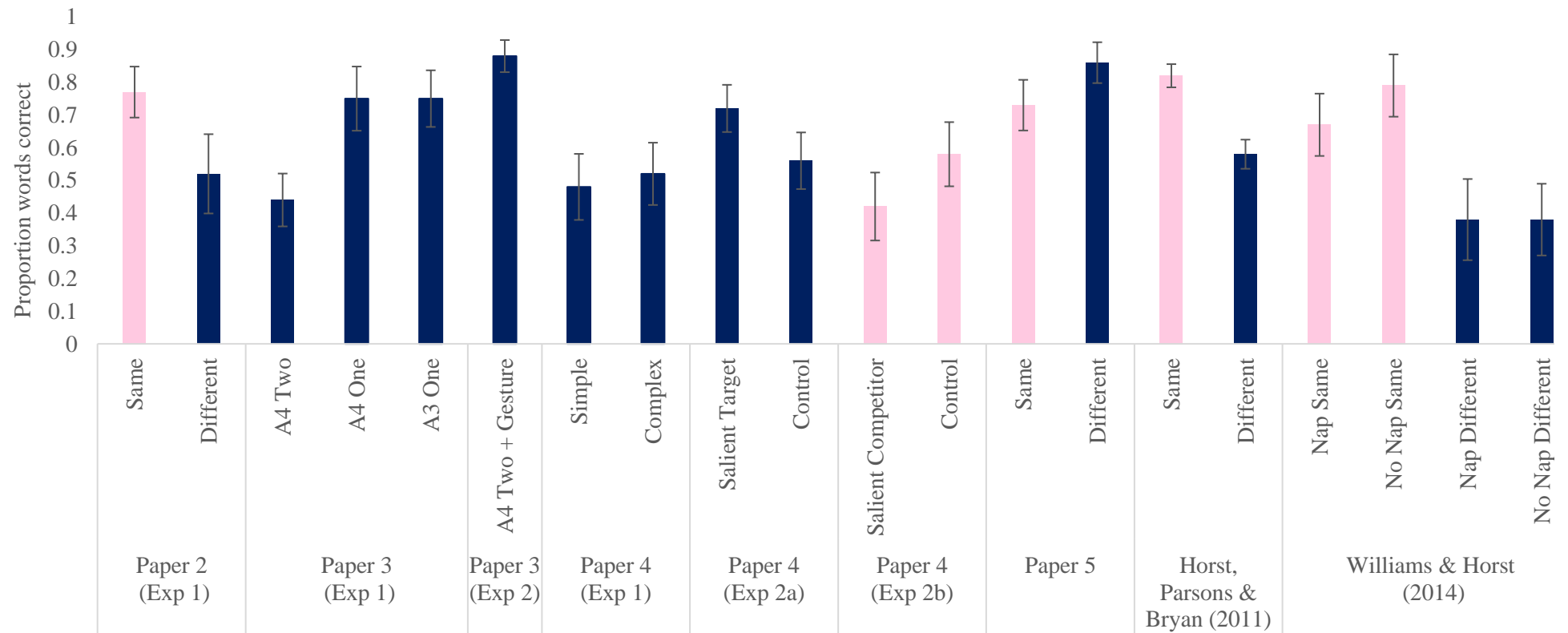
Figure 1. Experimental studies published, and from this thesis, using books from Horst et al. (2011). Those where children heard repeated stories are shown in pink, and different stories in blue.

DISCUSSION

Limitations

A full discussion of sample sizes in the current thesis and developmental psychology more broadly, was included in the Introduction. Although sample sizes were calculated based on effect sizes from published empirical work, larger sample sizes could have provided additional confidence in the effects in the thesis.

Studies in the current thesis were all conducted in a lab setting on a university campus set in the Sussex Downs in the South of England. This is a geographical area with a relatively diverse and well educated population (ONS, 2016). Henrich, Heine, and Noranyazan (2010) noted that psychological research typically reflects population samples of what they termed "WEIRD" participants (Western, educated, industrialised, rich and democratic). The generalisation of research findings from such biased populations to the wider population has important implications for many effects, and developmental psychology is not immune from this problem (Nielsen & Haun, 2016; Nielsen, Haun, Kärtner, & Legare, 2017). Although few researchers find this acceptable, obtaining rich and diverse populations for testing is challenging. Developmental research in particular relies on parent volunteers to bring their children into labs for studies for little recompense. Parents who are interested in participating, who can arrange the time and are willing to travel into labs rarely reflect the diversity of the local population. In addition, limited research budgets rarely allow for data collection to take place in culturally variant locations unless investigating cultural variance is part of the research question. Studies in the current thesis are constrained by these issues. The samples typically comprise "WEIRD" families; an issue rather typical of much of the developmental literature. For this reason caution should be taken when generalising the findings to a broader population.

Cultural variance in early development is evident in the cognitive development literature (Haun, Rapold, Call, Janzen, & Levinson, 2006; Hespos & Spelke, 2004). Haun and colleagues found evidence of search strategy variation in children aged 7-11 which reflected differences in spatial language and adult research has found mixed evidence for some cultural variation in eye movements (Chua, Boland, & Nisbett, 2005; K. Evans, Rotello, Li, & Rayner, 2009; Rayner, Li, Williams, Cave, & Well, 2007). Taken together, this suggests that even visual processing during childhood could reflect previous experience. In Paper 2, looking behaviours of 3-year-old children were investigated. If visual processing in young children is affected by cultural experience, then such looking behaviours may differ elsewhere. Similarly, the storybook reading experience may also elicit different behaviours in children from a variety of backgrounds. Social interactions (e.g., Farver, Kim, & Lee, 1995; Mu, Kitayama, Han, & Gelfand, 2015), and parent-child interactions (e.g., X. Chen et al., 1998) have also been shown to reflect cultural diversity. For this reason, findings from other papers in the thesis could lack generalisability to a broader population. Such cultural variation can be seen as part of the pre-experimental history which contributes to the resulting behaviours displayed when this is interpreted using Dynamic Systems theory (Smith & Thelen, 2003).

Future Directions

This thesis considered how various aspects of storybooks and storybook reading can be altered to affect word learning, by manipulating attention to the critical information—the novel objects and words. The effects of complexity and salience manipulations appear to be rather promising, and suggest future research could expand this line of research quite considerably. If changes to the complexity of surrounding imagery, or making target objects more salient can influence children's attention, and

therefore improve word learning, then perhaps other manipulations could also be beneficial. In real life, children's learning of new words is influenced by their own embodied experience (Thelen & Smith, 1998), for example, children typically bring objects of interest into view for exploration e.g., Yoshida and Smith (2008). But children also make use of physical cues from their social partners. Cues such as another's gaze direction can support their learning of new words (Carmel Houston-Price, Plunkett, & Duffy, 2006) or use of manual actions in others to prioritise visual information (Yu, Smith, Shen, Pereira, & Smith, 2009). It is possible that such cues could be useful to children when learning from storybook reading. For example, using characters in a storybook to hold, gesture or look at novel objects could result in greater word learning. This is an interesting and novel idea for future research which could expand the work in the current thesis into a much more substantial programme of research.

Other future research could pursue the nuanced effect of repetition suggested by Paper 1, 2 and 5. The lack of clear effects here could be due to multiple interactions such as those described by Dynamic Systems Theory (Smith & Thelen, 2003). How repetitions interact over the course of a child's development, the number of new words, the child's attention or motivation and a myriad of other factors could all affect the resulting behaviour.

The findings from the papers investigating the effects of complexity on word learning from shared storybook reading (e.g., Paper 3 and 4) suggest that the level of complexity is important too. Complexity is a broad term, which could refer to visual content, such as the amount of visual information children need to process, or the complexity of the story, or the ambiguity of the illustrations. Here too, the effects of complexity likely interact with a child's previous experience and other factors (Smith &

Thelen, 2003; Thelen & Smith, 1998). Effects of complexity and those of repetition provide scope for additional future research.

A Dynamic Systems theory account of development typically describes change over a period of time, and brings together many nested systems. When considering word learning from shared storybook reading, these systems include visual, perceptual, attentional, social and environmental systems which are all developing on their own trajectories. This results in change over time which is non-linear, and may involve periods of flux, and periods of stability. Future research in this area should consider the shape of change over time. For example, by considering whether reducing visual complexity is still helpful for older children, or whether they more skilled at 'diagnosing' illustrations.

Future directions already suggested have included more work on illustration content, and taking a more detailed look at the role of successive repetitions in word learning, amongst others. However, the role of storybooks in child development is wide-reaching. Storybooks play an important role in providing children with even more than a chance to improve their vocabularies. Whilst reducing illustration complexity may benefit word learning, illustration complexity could be really important for enjoyment, or story comprehension. For this reason, future research should consider the impact of the issues discussed in this thesis on wider ranging outcomes, beyond those of word learning.

Conclusion

In the current thesis I use several converging methods to identify a number of key aspects of shared reading design and practices which can lead to improved word learning in pre-school aged children. These include practices for parents and Early Years educators, such as using gesture to compensate for multiple illustrations or

support for interactive reading styles. In addition, I provide an in-depth analysis and discussion of the existing literature, which can be used to direct future research in the area. Beyond that, I demonstrate the effect of illustration complexity on word learning, beginning a new and exciting avenue for future research. Every shared storybook reading encounter is a gift already, but one we can fill with lots of little extras, if we really put our minds to it.

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Appendix A

Story Content Units

Rosie's Bad Baking Day:

1. Rosie and her dad
2. decided that they wanted to bake
3. either cake or cookies
4. for mother's day.
5. They eventually decided to make
6. white and dark chocolate chip cookies.

7. They put the cooking utensils on the work surface.
8. "I'll just get the sprock out" said Rosie.
9. "Oh no, we don't have any chocolate chips"
10. "I'll just have to go get them", said Rosie's dad.
11. "Now don't do anything until I get back, please".

12. Rosie didn't pay her dad much attention
13. as she was too busy laying out the sprock and other utensils.
14. She saw the tannin on the top shelf
15. and remembered that she needed it,
16. so she got a chair to reach for it.

17. Rosie laid out all the ingredients in front of her,
18. she had (a bowl, jug, sugar, a whisk, a tannin and a sprock)
19. "Where is dad?", thought Rosie to herself,
20. Getting very bored.

21. Rosie decided to start the cookies herself.
22. Rosie began by breaking the eggs into the bowl,
23. And then mixing them together with the tannin.
24. she reached over for the big bag which she thought said sugar,
25. and began to pour it in.

26. Dad was a little annoyed when he got back.
27. He said, "You should have waited for me, Rosie,
28. you could have hurt yourself reaching for this tannin
29. or messed up the recipe starting without me!".

30. Rosie's dad placed the cookies in the oven.
31. And Rosie went and began to clean the kitchen
32. Before her mum came home.

33. "I better wash the sprock,

34. or mum will know we have been up to something", said Rosie.

35. Rosie's mum arrived home.

36. "Happy mothers day", said Rosie,

37. handing mum the plate of cookies.

38. "Thank you my darling", replied her mum,

39. As she went to take a bite of a cookie,

40. but she spat it out in disgust.

41. "Oh honey I think you added salt instead of sugar!", said Rosie's mum.

42. Rosie felt bad for not listening to her dad.

43. Rosie's mum and dad thought it was funny

44. and joked about who would eat the cookie.

45. they all went out for a nice meal to celebrate mothers day.

The Very Naughty Puppy:

1. Rosie wanted a pet.

2. She didn't care if it was

3. Big, small, scaly or furry

4. All of her friends had pets

5. And Rosie longed for one of her own.

6. "Mummy, can I please have one?

7. I will take such good care of it. Please, please, please!!" she begged.

8. "Please stop asking me Rosie", her mum replied.

9. "Why don't you help me make dinner for this evening?"

10. Rosie tried hard to forget about having a pet, like her friends

11. And passed the tannin to her mum.

12. Rosie asked her mum what she could do to help.

13. "Start rolling the pastry out with the sprock, please sweetheart", her mum instructed.

14. "Your dad will be home soon from work".

15. When Rosie's dad arrived home,

16. he brought with him a great surprise….

17. an adorable little puppy for Rosie.

18. "He will have to stay in the kitchen tonight", her dad said.

19. "We need to keep things out of his reach.

20. So can you put the tannin in the drawer please Rosie?"

21. Rosie was too distracted by the puppy to listen

22. And left it on the table.

23. Whilst everyone was sleeping peacefully,
24. The new puppy was very naughty.
25. He pulled the tannin onto the floor
26. So it crashed with a thud.
27. He began to chew the sprock
28. Until it broke apart.

29. The next morning.
30. They found the broken equipment on the floor.
31. Rosie and her mum began to tidy the kitchen
32. Whilst her dad tried to fix the broken tannin.
33. Sadly, the sprock was too broken to fix
34. So Rosie's mum had to throw it in the bin.
35. "Daddy told you to put the things away last night, Rosie
36. I wish you had done what you were told", her mum said sadly.
37. "Sorry mummy", Rosie replied.

38. Luckily, later that day,
39. after everything had been tidied,
40. Rosie's dad returned home with a brand new sprock for mum.
41. Rosie's mum was now happy again.

42. She decided that the puppy could stay, but on one condition…
43. He had to go to puppy training classes.
44. Rosie passed her mum the phone
45. He never ruined the kitchen again.

Nosy Rosie at the Restaurant:

1. Rosie's family were on a visit
2. To a new fancy restaurant that had just opened in town.
3. Whilst they were waiting for the waiter to come over,
4. Rosie asked her mum if she could go to the toilet.
5. "I'll be very quick mummy" she said.

6. On her way, Rosie walked past the kitchen
7. And saw something lying on the floor,
8. She walked up to it
9. And realised it was a sprock,
10. Just like the one her mum has at home.

11. Rosie looked down at the sprock,

12. And wondered whether or not she should pick it up.
13. Nobody was around though,
14. So she wouldn't get in trouble.

15. Rosie decided to pretend to cook with the sprock.
16. Rosie loved to play cooking games,
17. Sometimes she thought she might grow up to be a chef.

18. After playing around for a while,
19. Rosie put the sprock back on the floor
20. And then spotted a new object.
21. It was a tannin.
22. Rosie was curious
23. and reached out to have a look at it.
24. Though just as she did she heard some footsteps behind her.

25. 'Excuse me, young lady, what are you doing here?' asked the chef.
26. She walked over to Rosie
27. Who was still holding tannin.
28. "You can't have this I'm afraid,
29. I need this for my cooking" said the chef
30. As she took it away from Rosie.
31. The chef reached down to pick up the sprock from the floor.

32. Rosie was sad
33. As the tannin was a great cooking tool
34. And she thought it would be fun to practice cooking with at home.

35. The Chef took Rosie back to her parents,
36. And they apologised to the chef for Rosie's nosy behaviour.
37. "Rosie I thought you were just going to the loo" her mother said.
38. We have been getting worried about you.
39. Rosie sat down and
40. They decided what to order for dinner.

41. After everybody had ordered their food,
42. The chef came back out to see Rosie.
43. To Rosie's surprise the chef came out to give Rosie the tannin.
44. 'I decided you can have this' young lady.
45. "Hopefully you will make a great chef some day"