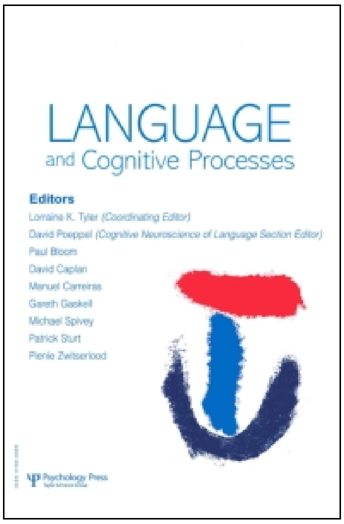

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Basic processes in reading: On the relation between spatial attention and familiarity

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Basic processes in reading: On the relation between spatial attention and familiarity

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Two experiments combined a spatial cueing manipulation (valid vs. invalid spatial cues) with a stimulus repetition manipulation (repeated vs. nonrepeated) in order to assess the hypothesis that familiar items need less spatial attention than less familiar ones. The magnitude of the effect of cueing on reading aloud time for items that were repeated throughout the experiment was smaller than the magnitude of the cueing effect for items that were not repeated within the experiment. These results are consistent with the idea that familiarity within an experiment modulates the spatial attentional demands of word processing. Implications for understanding spatial attention's role in reading are discussed.

Keywords: Attention; Reading.

The spatial attentional requirements of visual word processing have long been a topic of considerable debate. A number of investigators have concluded that visual word processing does not require spatial attention (e.g., Brown, 1996; Brown, Gore, & Carr, 2002; Lachter, Ruthruff, Lien, & McCann, 2008; Shaffer & LaBerge, 1979). Conversely, there is also support for the view that spatial attention is a necessary preliminary to visual word processing (e.g., Besner, Risko, & Sklair, 2005; Lachter, Forster, & Ruthruff,

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2004; McCann, Folk, & Johnston, 1992; Risko, Stolz, & Besner, 2005; Stolz & McCann, 2000; Stolz & Stevanovski, 2004). One way to reconcile these very different accounts can be found in the "familiarity sensitive" view of the relation between attention and visual word processing (e.g., Auclair & Siéroff, 2002; Brown et al., 2002; LaBerge & Brown, 1989; LaBerge & Samuels, 1974; McCann et al., 1992; Siéroff & Posner, 1988). According to this account, as words become more familiar they require less attention in order to be read. Applied to spatial attention, this view suggests that familiar words should place fewer demands on spatial attention than unfamiliar words.

The reduction in the need for spatial attention as a function of increasing familiarity is typically attributed to the stronger top–down support available for familiar items (Auclair & Siéroff, 2002; Brown et al., 2002; McCann et al., 1992; Mozer & Behrmann, 1991; Siéroff & Posner, 1988). This top–down support may reduce the need for bottom–up information, and thus ameliorate the influence of a manipulation held to influence the quality of that information (e.g., spatial attention and stimulus quality). The hypothesis that the spatial attentional requirements of word processing should decrease as "familiarity" increases can be assessed in the context of Posner's (1980) spatial cueing paradigm. In this paradigm a cue is used to direct attention to a particular location. On *valid* trials the target appears at the cued location, whereas on *invalid* trials the target appears at an uncued location. Performance is typically better on valid trials than on invalid trials and this difference in performance, the cueing effect, can be used to index the spatial attentional requirements of word processing. The familiarity sensitive view predicts that drawing spatial attention away from a word should be more detrimental to performance for unfamiliar words than for familiar words.

In a test of this idea, McCann et al. (1992) combined a manipulation of cue validity with word frequency, and lexicality (words vs. nonwords) in the context of lexical decision. Both word frequency and lexicality are considered manipulations of familiarity. Word frequency is an index of the frequency of occurrence of words in print. High frequency words (e.g., house) appear more often and are thus more familiar than low frequency words (e.g., abode). Lexicality represents the difference between words and nonwords. Nonwords are unlikely to have been encountered by the participant before the experiment and are thus less familiar. McCann et al. (1992) found that the cueing effect was the same size for high and low frequency words, and for words and nonwords. The additivity between the effects of cue validity and word frequency and cue validity and lexicality has been replicated numerous times (Lindell & Nicholls, 2003; Nicholls & Wood, 1998; Nicholls, Wood, & Hayes, 2001; Ortells, Tudela, Noguera, & Abad, 1998; Stolz & McCann, 2000; Stolz & Stevanovski, 2004). These results are inconsistent with the standard familiarity sensitive account.

McCann et al.'s (1992) experiment dealt with what can be considered *extra-experimental familiarity*. Specifically, some items are more familiar than others given that participants have encountered that item more often *prior* to the experiment (e.g., word frequency). The use of an extra-experimental manipulation of familiarity is consistent with theorising about the putative role of familiarity in modulating the spatial attentional demands of word processing. For example, frequent encounters with a word before the experiment could lead to a strengthening of the connections between letter and word level representations of those items (e.g., McCann et al., 1992). These stronger connections could help reduce the impact of drawing attention away from that item.

While tests of the familiarity sensitive view have typically relied on extra-experimental manipulations of familiarity, familiarity can also be manipulated *within* an experiment (e.g., via stimulus repetition). In the present experiments, we use a manipulation of stimulus repetition whereby some items are presented numerous times within the experiment while others are presented only once. Familiarity manipulations like repetition can be referred to as manipulations of *intra-experimental familiarity*. While both *extra*-experimental and *intra*-experimental manipulations can be considered manipulations of "familiarity", the mechanism underlying their effects may be different.[1] Extra-experimental manipulations might rely on stable changes to the word processing system, and intra-experimental familiarity may rely more on transient changes.

PRESENT INVESTIGATION

In the present investigation, we compared the attentional requirements (as indexed by the cueing effect) of word processing as a function of whether the word was repeated numerous times within the experiment or was novel. Specifically, participants were presented with a word that appeared either above or below a fixation mark and were asked to read that word aloud. The presentation of the word was preceded by a valid or invalid spatial cue (see Figure 1). Critically, in the *repetition condition*, the word on each trial was selected from a set of two words so that throughout the experiment each item was presented numerous times. In the *no repetition condition*, the word on each trial was selected from a set, the size of which was equal to the number

[1] The terms extra-experimental and intra-experimental familiarity are used as a means by which to classify different types of familiarity manipulations and not as a theoretical statement about the underlying mechanisms.

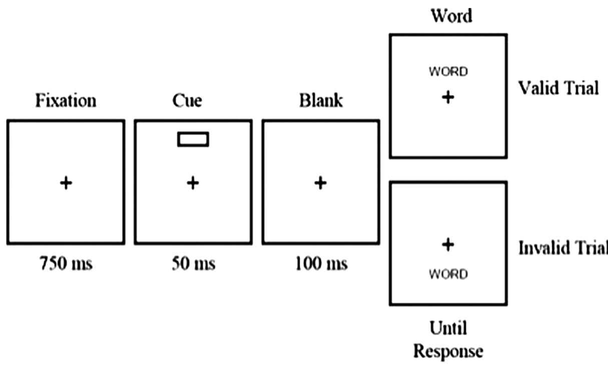

Figure 1. Trial sequence.

of trials so that a new word was presented on each trial. If stimulus repetition modulates the spatial attentional requirements of visual word processing, then the effect of cueing on reading aloud should be smaller in the repetition condition than in the no repetition condition.

EXPERIMENT 1

Method

Participants

Thirty-two undergraduate students received course credit for their participation.

Apparatus

E-Prime experimental software (Schneider, Eschmann, & Zuccolotto, 2002) controlled timing, presentation of stimuli and logged responses, and response times (RTs). Stimuli were presented on a standard 17″ SVGA colour monitor.

Design

A 2 (cue validity: valid vs. invalid) $\times$ 2 (stimulus repetition: repetition vs. no repetition) mixed design was used. Stimulus repetition was manipulated between subjects. Participants in the repetition condition received one out of the same two words on every trial. Participants in the no repetition condition received a different word on every trial. Cues were valid on 50% of the trials and invalid on the other 50% of the trials.

Stimuli

The experimental display consisted of a fixation (+) presented at the centre of the screen. The cue consisted of a white rectangle presented either 2.5 cm (centre to centre) or approximately 2.7 degrees of visual angle above or below fixation. The target letter string was presented either 1.2 cm or approximately 1.3 degrees of visual angle above or below fixation and was presented in white on a black background. Viewing distance was approximately 53 cm.

One hundred seventy six monosyllabic four-letter words were used (available upon request). In the *no repetition* condition, 168 of these words were used (average frequency 45 occurrences per million; all reported frequency counts are Kucera–Francis from Davis, 2005), eight words for practice trials and 160 words for experimental trials. In the *repetition* condition, the remaining eight words were used (average frequency 43 occurrences per million). Each participant was presented with two of the eight words and these two words were used throughout the experiment. There were four subgroups of participants in the repetition condition; each received a different set of two words. Words were presented in upper case 12-point Arial font. Two words were inadvertently repeated in the no repetition word list and were removed prior to analysis.

Procedure

Participants were tested individually. They were instructed to read the presented word aloud as quickly and accurately as possible. Each trial began with the presentation of the fixation symbol at the centre of the screen for 750 ms. The fixation symbol remained on the screen for the entire trial and participants were encouraged to maintain their gaze on the fixation mark. The cue was then presented for 50 ms followed by a 100 ms inter-stimulus-interval with only the fixation present. The word was then presented and remained on the screen until the participant made his/her vocal response (see Figure 1). After the participant's response the experimenter keyed in his/her accuracy. The experiment consisted of eight practice and 160 experimental trials.

Results

Spoiled trials (i.e., trials in which the voice key was unintentionally tripped, for example, by a cough; 2.8%) were removed prior to analysis. RT analysis was conducted on trials in which the response was correct. Correct RTs were subjected to a recursive trimming procedure (Van Selst & Jolicoeur, 1994). This trimming procedure resulted in 2.0% of the correct RT data being discarded. Mean RTs and percentage errors are presented in Figure 2. A 2

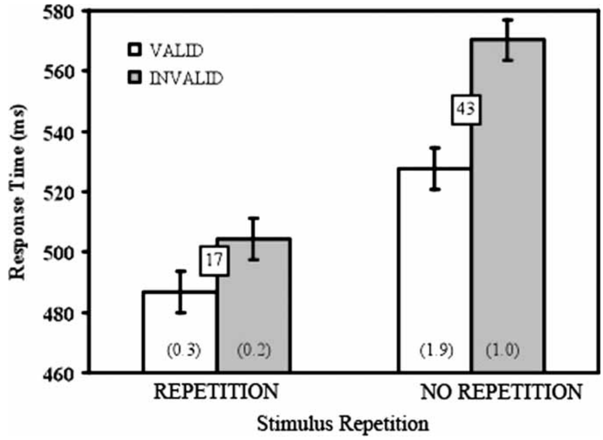

Figure 2. Mean response times (in ms) with 95% confidence intervals (following Masson & Loftus, 2003) and percentage error (in brackets) as a function of cue validity and set size in Experiment 1. Cueing effects (invalid–valid) are presented in boxes.

(cue validity: valid vs. invalid) $\times$ 2 (stimulus repetition: repetition vs. no repetition) mixed-design ANOVA was performed on mean RT and percentage error data. The error analyses are included for completeness but the small number of errors make it difficult to draw strong conclusions.

For RTs, the main effect of cue validity was significant and the main effect of stimulus repetition was marginal, $F(1, 30) = 77.82$, $MSE = 186.10$, $p < .05$; $F(1, 30) = 2.66$, $MSE = 17{,}214.32$, $p = .11$, respectively. Participants responded faster on valid trials (507 ms) than on invalid trials (537 ms). Critically, there was a significant interaction between the effects of cue validity and stimulus repetition, $F(1, 30) = 13.62$, $MSE = 186.10$, $p < .05$. The cueing effect (invalid–valid) with repeated words (17 ms) was smaller than the cueing effect with novel words (43 ms). Both of these cueing effects were significant, $t(15) = 4.25$, $p < .05$; $t(15) = 7.84$, $p < .05$, respectively.

For percentage error, the main effect of cue validity was marginal and the main effect of stimulus repetition was significant, $F(1, 30) = 3.12$, $MSE = 1.19$, $p = .09$; $F(1, 30) = 21.63$, $MSE = 1.07$, $p < .05$, respectively. Participants made fewer errors on invalid trials (0.6%) than on valid trials (1.1%) and made fewer errors with repeated words (0.3%) than with novel words (1.5%). The interaction between cue validity and stimulus repetition was not significant, $F(1, 30) = 2.1$, $MSE = 1.19$, $p = .15$.

Discussion

The joint effects of cue validity and stimulus repetition interacted such that the cueing effect was smaller when a word was repeated than when it was novel. This result is consistent with the idea that words that are "familiar" *within* an experiment place less demands on spatial attention than words that are "unfamiliar" *within* the experiment. There is one potentially important difference between Experiment 1 and previous studies that tested the effects of *extra*-experimental familiarity. Specifically, stimulus repetition in Experiment 1 was manipulated *between*-subjects whereas previous studies have used *within*-subject manipulations of familiarity. Experiment 2 therefore used a within-subject manipulation of set size. Experiment 2 also provides an opportunity to address two possible concerns with Experiment 1. First, the items in the repetition condition and the no repetition condition were different, thus leading to the possibility that some item-level difference is responsible for the observed results (e.g., initial phonemes). To address this concern in Experiment 2, the repeated items were rotated across participants from the repetition condition to the no repetition condition. Lastly, there was a trend towards a speed-accuracy trade-off in terms of the interaction between cue validity and stimulus repetition in Experiment 1. A replication without such a trend would put the results on a stronger footing.

EXPERIMENT 2

Experiment 2 was a replication of Experiment 1 using a *within-subject* manipulation of stimulus repetition. The word on each trial was selected from either a repeated set or a non-repeated set and these trials were intermixed.

Methods

Participants

Twenty undergraduate students received course credit for their participation.

Design

The design was the same as Experiment 1 but the stimulus repetition manipulation was within-subject such that the word on each trial was drawn from either a two-word set that was repeated throughout the experiment or a set wherein each word was novel. The items were drawn from the repetition set on 50% of the trials and the no repetition set on 50% of the trials.

Stimuli

Ninety words from the four-letter word list used in Experiment 1 were used (available upon request). Twenty of these items (average frequency 47) were divided into 10 sets of two items to be used in the repetition condition. The remaining 70 words (average frequency 45 occurrences per million) were used in the no repetition condition only. Eight of these words served as practice stimuli leaving 62 for the experimental trials. Each participant received one of the 10 two-item sets. The remaining nine sets (i.e., 18 words) were assigned to the no repetition condition. Thus, there were a total of 80 items in the no repetition condition and two items in the repetition condition for each participant.

Procedure

The general procedure was the same as in Experiment 1. There were 16 practice trials and 160 experimental trials.

Results

Spoiled trials (2.7%) were removed prior to analysis. The outlier procedure led to the removal of 1.1% of the correct RT data. Results are presented in Figure 3. A 2 (cue validity: valid vs. invalid) $\times$ 2 (stimulus repetition: repetition vs. no repetition) repeated measures ANOVA was performed on mean RT and percentage error data. Again, the error analyses are included for completeness but the small number of errors make it difficult to draw strong conclusions.

In RT, the main effects of cue validity and stimulus repetition were significant, $F(1, 19) = 29.03$, $MSE = 465.97$, $p < .05$; $F(1, 19) = 47.64$, $MSE = 1{,}033.43$, $p < .05$, respectively. Participants responded faster on valid trials (536 ms) than on invalid trials (562 ms) and faster with repeated words

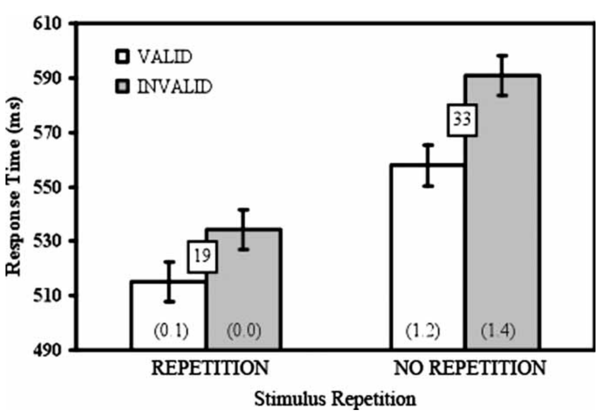

Figure 3. Mean response times (in ms) with 95% confidence intervals (following Masson & Loftus, 2003) and percentage error (in brackets) as a function of cue validity and set size in Experiment 2. Cueing effects (invalid–valid) are presented in boxes.

(525 ms) than with novel words (574 ms). Critically, there was a significant interaction between the effects of cue validity and stimulus repetition, $F(1, 19) = 4.68$, $MSE = 201.86$, $p < .05$. The cueing effect (invalid–valid) with repeated words (19 ms) was smaller than the cueing effect with novel words (33 ms). When the analysis was confined to words in the no repetition condition that also appeared in the repetition condition (across participants), the interaction remained significant (marginally), $F(1, 19) = 3.51$, $MSE = 219.39$, $p < .08$. The cueing effect (invalid–valid) with repeated words (19 ms) was smaller than the cueing effect with novel words (46 ms). Both cueing effects were significant, $t(19) = 5.43$, $p < .05$; $t(19) = 4.44$, $p < .05$, respectively.

For percentage error, the main effect of stimulus repetition was significant, $F(1, 30) = 13.21$, $MSE = 2.31$, $p < .05$. Participants made fewer errors with repeated words (0.1%) than with novel words (1.3%). No other effects were significant.

Discussion

The effects of cue validity and stimulus repetition interacted in Experiment 2 such that the cueing effect was smaller when the word was repeated throughout the experiment than when it was novel. Thus, the results of Experiment 1 generalise to a condition in which stimulus repetition is manipulated within-subjects and to a condition in which the repeated and nonrepeated items are intermixed. Furthermore, the nonsignificant trend towards a speed-accuracy trade-off in Experiment 1 was not seen in Experiment 2, adding further support to the validity of the pattern in RTs in Experiment 1.

GENERAL DISCUSSION

The present results demonstrate that when reading aloud the effect of cue validity was reduced when words were repeated throughout the experiment. In Experiment 1, this was demonstrated using a between subjects manipulation of stimulus repetition and in Experiment 2, this was demonstrated using a within-subject manipulation. Thus, the pattern is replicable across at least two different contexts. The present results demonstrate clearly that at least one putative manipulation of familiarity (stimulus repetition) can reduce the spatial attentional demands of visual word processing thus providing some evidence for a familiarity sensitive view. In addition, the present results have important implications for previous research using (massive) stimulus repetition in tasks like Stroop to make inferences about the attentional requirements of reading. We turn now to a discussion of potential explanations of the interaction between cue validity and stimulus repetition and their implications for studies of spatial attention and visual word processing.

Relation to previous work

Converging evidence that stimulus repetition can influence the spatial attentional demands of word processing can be gleaned from previous work. Shaffer and LaBerge (1979) asked participants to semantically categorise a central word target that was flanked by words (e.g., Eriksen & Eriksen, 1974) that were either semantically related or unrelated to the target. Responses to targets flanked by same category exemplars were faster than responses to targets flanked by different category exemplars. This result was taken as evidence that an unattended word (the flanker) can be processed to the semantic level. However, Broadbent and Gathercole (1990) demonstrated that the flanking words needed to be repeated a number of times in order to observe this effect. This result is consistent with the idea that stimulus repetition *within* the experiment reduced the attentional demands of word processing, thus making it easier for the "unattended" word to be processed.

In related work, Strayer and Grison (1999; see also Malley & Strayer, 1995) demonstrated that stimulus repetition was needed to observe negative priming. They argued that stimulus repetition leads to a high level of item activation and that this high level of activation was needed to engage inhibitory mechanisms (and produce negative priming). Thus, consistent with Broadbent and Gathercole (1990) and the present results, stimulus repetition is hypothesised to increase the likelihood that an unattended stimulus will be processed. Thus the present work converges on the idea that stimulus repetition is an important factor that needs to be considered in paradigms designed to study the operation of attention (see Section "Does word processing require spatial attention?" for a specific example of this idea). In the next section, we develop an account of the cue validity by stimulus repetition interaction in terms of models of word processing.

Locus of the cue validity by set size interaction

Most computational models of word processing are composed of a number of components or levels. For example, there is typically a feature level, a letter level, a lexical level (e.g., orthographic and phonological), and a semantic level (see Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; McClelland & Rumelhart, 1981; Perry, Zeigler, & Zorzi, 2007). Processing in these models unfolds by first detecting the features present at each letter location in the word. These features are typically thought to represent simple line segments (e.g., | \/-). The activation of a feature leads to the activation of letters that share that feature. Activation of a letter activates words that contain that letter, and activation from the lexical level feeds forward to semantic representations. There are assumed to be both feed-forward and feed-back connections between adjacent levels and feed-forward processing is cascaded. However, some of these assumptions have been challenged (particularly the idea that processing is always cascaded and always engaged in interactive activation), and it has been argued that processing in this framework is rather more dynamic and sensitive to the local context than widely envisioned to date (e.g., Borowsky & Besner, 2006; Ferguson, Robidoux, & Besner, 2009; O'Malley & Besner, 2008; O'Malley, Reynolds, & Besner, 2007).

The stimulus repetition manipulation used here could presumably influence a number of component processes in such a word processing system (e.g., feature, letter, and lexical) and thus the interaction with cue validity may arise at a number of different loci. For example, Morton (1969) claimed that stimulus repetition affects processing at the lexical level. Specifically, he argued that the threshold for activation of a word's lexical representation was reduced for repeated items. Thus, the activation from feature and letter levels that is needed to activate an item's lexical representation would be reduced. McCann et al. (1992) and others (Lindell & Nicholls, 2003; Nicholls & Wood, 1998; Nicholls et al., 2001; Ortells et al., 1998; Stolz & McCann, 2000; Stolz & Stevanovski, 2004) have demonstrated that lexical level manipulations do not interact with cue validity, thus it is unlikely that the cue validity by stimulus repetition interaction as seen here arises from a mutual influence on lexical processing.[2]

Our account of the Cue Validity by Stimulus Repetition interaction attributes it to a mutual influence of cue validity and stimulus repetition on *prelexical* processing (e.g., feature and/or letter level). For example, stimulus repetition may lead the participant to adopt a "set" that facilitates the encoding of features and or letters for the repeated items. The participant's "set" can be thought of as a state of preparedness or expectation adopted by the participant in response to the experimental context (Gibson, 1941; Risko & Besner, 2008). Thus, stimulus repetition leads to an expectation for the repeated stimuli. Evidence consistent with the idea that expectation can influence feature processing was provided by Dykes and Pascal (1981). Using a stimulus probability manipulation, Dykes and Pascal (1981) reported that when participants prepared for a probable letter it facilitated the processing of visually similar letters. For example, if "C" was the probable stimulus then

[2] Another potential explanation is that the cueing effect in the repetition condition is smaller simply because the RTs are much faster than in the no repetition condition. This account ignores the large number of results in the spatial attention and word processing literature, and the cognitive literature as a whole, demonstrating additive effects of two factors when there are substantial sized main effects on RT (e.g., Borowsky & Besner, 2006; McCann et al., 1992).

responses to a visually similar letter like "G" were faster than a visually dissimilar letter like "F" despite the fact that "G" and "F" themselves were equally probable. Thus, preparation for a given letter facilitated the processing of the visual features that composed that letter. In the context of extant computational models of word processing, this facilitation could represent improvements in the speed and/or the accuracy with which features in the input string are detected. In terms of spatial attention, Ashby, Prinzmetal, Ivry, and Maddox (1996) have argued that removing spatial attention influences noise in the encoding of feature location. Thus, conceivably both expectation and spatial attention can be held to have their influence at the feature detection level (see also Stolz & Stevanovski, 2004).

Whereas an account of the stimulus repetition effect in terms of expectancy is consistent with the present results, the stimulus repetition effect may also be due to more passive repetition priming (Scarborough, Cortese, & Scarborough, 1977). As suggested by Malley and Strayer (1995) and Strayer and Grisson (1999), stimulus repetition likely leads to a heightened state of activation of the repeated item's representation. If this repetition priming is causing the interaction with cue validity then we would argue that the locus of this priming is likely prelexical (i.e., feature and/or letter level) rather than lexical. An alternative claim would be that stimulus repetition and cue validity are interacting via a mutual influence on a postlexical stage of processing. For example, both manipulations could influence the efficiency of articulatory motor programming. This alternative account is inconsistent with more traditional views of the influence of spatial attention in terms of a relative early locus (e.g., Hillyard & Anllo-Vento, 1998), nevertheless we are unaware of any direct test of the idea. That said, we would argue that the bulk of the evidence is consistent with a prelexical interpretation of the influence of spatial attention on visual word processing (see also McCann et al., 1992; Stolz & Stevanovski, 2004).

The account of the cue validity by stimulus repetition interaction in terms of a mutual influence on prelexical processing differs from previous conceptions of the role of familiarity in modulating the spatial attentional demands of word processing. In previous conceptualisations, familiarisation leads to *long-term* changes to the word processing architecture in such a way that more familiar items require less attention (Auclair & Siéroff, 2002; Brown et al., 2001; McCann et al., 1992; Mozer & Behrmann, 1991; Siéroff & Posner, 1988). The account of familiarity's role provided here is more short term. Here, we consider familiarisation *within* the experiment as leading to a *temporary* change in the item's processing such that expected items come to require less in terms of the services of spatial attention. Importantly, although the account proposed here of the interaction between familiarity and spatial attention differs from previous accounts, it is nevertheless consistent with the general idea that increased top–down support (i.e., expectation) can modulate the spatial attentional demands of word processing. However, the claims being made here are much more specific in terms of what the nature of that top–down support must be (i.e., prelexical). More generally, the current results are consistent with the idea that the spatial attentional requirements of reading are dynamic rather than static.

The prior discussion raises an important conceptual issue with respect to the familiarity sensitive view of the relation between spatial attention and word processing. Specifically, if different manipulations of the same construct (i.e., familiarity) behave differently when combined with a manipulation of spatial attention (e.g., word frequency vs. stimulus repetition) then the use of the generic term familiarity to refer to all of these manipulations is not prudent. Thus, claiming that familiarity influences the spatial attentional demands of word processing does not capture the nuances of the empirical landscape. Not all putative manipulations of familiarity influence the spatial attentional demands of word processing. A better approach is to define the specific mechanism through which a given manipulation of familiarity influences the spatial attentional demands of word processing. Here, we have argued that the cue validity by stimulus repetition interaction arises from a mutual influence on *prelexical* processing.

Does word processing require spatial attention?

The present results also provide a potential explanation for a large number of discrepant results in the spatial attention and reading literature. There is a consistent trend wherein results from studies that have used tasks like Stroop (e.g., Brown, 1996; Brown et al., 2002; Lachter et al., 2008) have typically supported the view that spatial attention *is not* a prerequisite for word processing whereas studies that used tasks like lexical decision and reading aloud (e.g., Besner et al., 2005; Lachter et al., 2004; McCann et al., 1992) have supported the view that spatial attention *is* a prerequisite for word processing to occur.

A clear demonstration of this pattern is available in recent work by Lachter et al. (2004, 2008). Following an exhaustive review of the selective attention literature, Lachter et al. (2004) argued that the majority of the studies that have supported a late selection view of attention have not controlled spatial attention adequately. In a series of experiments using more stringent controls on attention, Lachter et al. (2004) found no evidence that a word could be processed without being attended. However, in a related study using similar stringent controls on spatial attention, Lachter et al. (2008) concluded exactly the opposite, namely, that a word could be processed without attention. What was the major difference between these experiments? Lachter et al. (2004) used a lexical decision task, whereas Lachter et al. (2008) used a Stroop task. Critically, the lexical decision task involves the use of word sets in which no items are repeated whereas the Stroop task involves the use of word sets in which items are repeated numerous times. As the present results clearly demonstrate, stimulus repetition reduces the spatial attentional requirements of word processing. Thus, the tendency for researchers to find evidence consistent with a lesser role for spatial attention when using the Stroop task and a greater role when using lexical decision and reading aloud tasks, may well reflect the difference in stimulus repetition across these tasks. In this respect, the present results provide the basis for a simple explanation of the inconsistent findings regarding the relative need for spatial attention in word processing.[3]

CONCLUSION

The results of the present experiments demonstrate that the effects of cue validity on reading aloud interact with the effect of stimulus repetition. In addition, we developed an account of the cue validity by stimulus repetition interaction in terms of a mutual influence on prelexical processing. Future work testing this account will move our theoretical understanding of spatial attention in word processing further forward. At present, the reported results represent a new finding that will need to be integrated into extant theories of the role of spatial attention in word processing and raises important questions about the use of small word sets in studies of spatial attention.

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[3] The present results do not, of course, rule out alternative explanations for these inconsistent findings (e.g., selection for action; see Brown et al., 2002; task differences).

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