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# The effects of bilateral presentations on lateralized lexical decision

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## Abstract

We investigated how lateralized lexical decision is affected by the presence of distractors in the visual hemifield contralateral to the target. The study had three goals: first, to determine how the presence of a distractor (either a word or a pseudoword) affects visual field differences in the processing of the target; second, to identify the stage of the process in which the distractor is affecting the decision about the target; and third, to determine whether the interaction between the lexicality of the target and the lexicality of the distractor (''lexical redundancy effect'') is due to facilitation or inhibition of lexical processing. Unilateral and bilateral trials were presented in separate blocks. Target stimuli were always underlined. Regarding our first goal, we found that bilateral presentations (a) increased the effect of visual hemifield of presentation (right visual field advantage) for words by slowing down the processing of word targets presented to the left visual field, and (b) produced an interaction between visual hemifield of presentation (VF) and target lexicality (TLex), which implies the use of different strategies by the two hemispheres in lexical processing. For our second goal of determining the processing stage that is affected by the distractor, we introduced a third condition in which targets were always accompanied by ''perceptual'' distractors consisting of sequences of the letter ''x'' (e.g., xxxx). Performance on these trials indicated that most of the interaction occurs during lexical access (after basic perceptual analysis but before response programming). Finally, a comparison between performance patterns on the trials containing perceptual and lexical distractors indicated that the lexical redundancy effect is mainly due to inhibition of word processing by pseudoword distractors.


*Keywords:* Lateral dominance; Lexical decision; Word recognition; Hemispheric interaction; Bilateral presentation

## 1. Introduction

Since its original formulation by Hughlings Jackson (1865), the idea that the two cerebral hemispheres perform different and complementary functions has driven an enormous amount of research focused on the nature of functional asymmetry in the brain. Characterizing the differential roles of the hemispheres in human cognition, however, has proven to be a remarkably challenging effort. Investigators of hemispheric specialization have uncovered a complex pattern of shared and unique abilities, and the search for a basic set of principles underlying the functional differences and similarities between the hemispheres is still in progress. Numerous distinctions have been proposed to describe the division of labor between the hemispheres, such as verbal vs. spatial, conscious vs. unconscious and analytical vs. holistic processing (Hellige, 1993).

Much progress has been made through the study of comissurotomy patients, which allows independent testing of the hemispheres. Work with these patients has largely confirmed and expanded the insights provided by studies of focal brain lesions, such as the prominent role of the left hemisphere in linguistic processing and analytical thinking, and the superiority of the right hemisphere for visuospatial tasks and emotional processing. However, although

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valuable information on hemispheric asymmetry has been achieved by studies of the split-brain, the functioning of the disconnected hemispheres differs in important ways from that of the intact brain (Zaidel, 2001). This fact imposes limitations in generalizing the findings on hemispheric competence from the split-brain to the normal brain.

Studies of normal subjects show that the two hemispheres usually interact during execution of a task, each contributing to the final outcome (Zaidel, 2001). The implication is that, if the two hemispheres work together when performing a task, differences in performance related to the lateralization of the stimuli, by themselves, do not tell us anything about what processes are being carried out by each hemisphere.

In lateralized lexical decision tasks, for instance, right-handed subjects show a right visual field advantage (RVFA), indicating superiority of the left hemisphere for the task. The RVFA, however, does not inform us about the competence of the right hemisphere for the task. The right hemisphere could, in principle, be capable of the same computations performed by the left hemisphere during lexical decision, although with lower efficiency. In this case, the difference in performance between the two visual hemifields (RVFA) would be due to a difference in the efficiency with which the two hemispheres execute the same computations (“direct access” model). On the other extreme, it would be possible that the right hemisphere completely lacks the ability to perform the task, and the RVFA reflects slowing down and/or degradation of the information presented to the right hemisphere as it is relayed to the left hemisphere (“callosal relay” model; Zaidel, 1983; Zaidel, Clarke, & Suyenobu, 1990).

One way to tease apart the differential abilities of the cerebral hemispheres in the intact brain is to test subjects in conditions of maximal hemispheric independence. In the normal brain, most cognitive processes are the result of a complex cooperation between the two hemispheres, each contributing in a unique way. We can think of the relative contributions of the hemispheres as being determined by two sets of factors: (a) task-related factors, such as lateralization of sensory input and demand for specific modes of cognitive processing (e.g., linguistic vs. spatial) or motor output (left hand vs. right hand), and (b) contextual factors, such as total cognitive load, time of day, and the presence of task-irrelevant stimuli (Clarke, McCann, & Zaidel, 1997; Iacoboni & Zaidel, 1996; Corbera & Grau, 1993; Shub, Ashkenazi, & Reinberg, 1997) to name a few. Therefore, the pattern of hemispheric contributions to cognitive function is not invariant, but is dynamically determined by the specificities of the situation. By manipulating task-related and contextual factors, we can create conditions that will maximize the contributions of a hemisphere and minimize the contributions of the other, giving us insights about the differences in their organization.

Boles (1983, 1987, 1990) has shown that bilateral presentations accentuate laterality effects in a number of verbal and non-verbal cognitive tasks. Boles (1990) suggests that this increase may be due to simultaneous activation of homologous areas of the two hemispheres, disrupting transcallosal communication between these areas, therefore maximizing the contribution of the hemisphere that receives the stimulus and minimizing the contribution of the opposite hemisphere.

Consistent with this hypothesis, Iacoboni and Zaidel (1996) found that bilateral presentations increased hemispheric independence in a lexical decision (LD) task, as indexed by an interaction between response hand and visual hemifield of presentation. However, this study did not report whether bilateral presentations produced overall stronger laterality effects for lexical decision.

Lateralized LD tasks typically show a right visual field advantage (RVFA)—i.e., target stimuli presented in the right visual field are processed faster and more accurately than targets in the left visual field—as well as an advantage in the processing of words over pseudowords (pronounceable but meaningless character strings). An interaction between lexicality of the target (TLex) and visual field (VF) is sometimes observed, in which words are processed faster than pseudowords in the right VF, with no significant differences in the left VF (Iacoboni & Zaidel, 1996; Weems & Zaidel, 2005). This interaction suggests that the two hemispheres are using different strategies to perform the task. These effects have been shown in English (Iacoboni & Zaidel, 1996), German (Mohr, Pulvermuller, Cohen, & Rockstroh, 2000), and Hebrew (Barnea, Mooshagian, & Zaidel, 2003).

The first goal of the present study was to determine how these results observed in lateralized LD tasks are affected by the presence of a distractor in the opposite VF. For this purpose, we compared performance in a lateralized LD task between conditions with unilateral and bilateral presentations.

Second, in order to determine the stage in the processing of the target that is affected by the distractor—through facilitation or inhibition of resource-sharing between the two hemispheres—we included a condition in which all distractors consisted of sequences of the letter “x” equal in length to the target (e.g., “xxxx”). These “perceptual distractors” are intended to place a demand on the earlier stages of stimulus processing without recruiting the processes required by lexical decision (lexical access). Therefore, if lexical distractors (bilateral presentation) affect only the stages prior to lexical access, they should produce VF differences similar to those produced by perceptual distractors. On the other hand, if they affect the lexical access stage itself, they should produce larger VF differences compared to perceptual distractors.

Furthermore, if the interaction between distractor and target processing is at the stage of response programming, late in the information processing sequence, pseudoword and word decisions would be affected similarly by a lexical distractor of the same lexical status (“congruent distractor”, i.e., word–word or pseudoword–pseudoword), and they should be affected similarly by a lexical distractor of different lexical status ("incongruent distractor", i.e., word-pseudoword).

The study by Iacoboni and Zaidel (1996) showed an interaction between TLex and lexicality of the distractor (DLex). Word targets were processed faster and more accurately when accompanied by word than by pseudoword distractors, while pseudoword targets were not affected. The third goal of the present study was to determine whether this "lexical redundancy" effect was due mainly to facilitation of the lexical processing of word targets by congruent distractors or to the inhibition of processing by incongruent distractors, or both. Facilitation of decision about the target by a distractor of the same lexical status (congruent) would lead to shorter response times relative to an appropriate "baseline" condition, which we take to be the perceptual distractor condition. In the current study, that would be reflected as shorter reaction times for word targets accompanied by word distractors, when compared to the ones accompanied by perceptual distractors. In turn, inhibition of decision about the target by a distractor of the opposite lexical status (incongruent) would lead to longer response times relative to the targets accompanied by perceptual distractors. This would be reflected as longer response times for word targets accompanied by pseudoword distractors compared to word targets accompanied by perceptual distractors. Naturally, these two possibilities are not mutually exclusive, in which case both effects would be present.

## 2. Methods

### 2.1. Participants

Eighty-three undergraduate UCLA students participated in this experiment. Each subject had normal or corrected-to-normal vision, and all of them were right-handed, as determined by the modified version of the Edinburgh Handedness Inventory (Oldfield, 1971), as well as native English speakers. The subjects received course credit for their participation.

### 2.2. Apparatus

Subjects were seated at a distance of 57 cm from a high resolution RGB color monitor of a Macintosh G3 computer, with their chins in a chinrest, their eyes aligned with the fixation cross in the middle of the screen, and index and middle fingers of both hands poised on keys of the computer keyboard placed symmetrically at midline ("c" and "d" for the left hand, "m" and "k" for the right hand). Computer software for Macintosh, MacProbe (Hunt, 1994), was used to present stimuli and to record responses.

### 2.3. Procedure

A central fixation cross was displayed during the entire experiment. The stimuli consisted of horizontal strings of lower case letters, and were flashed to the left and/or to the right of the fixation cross. Stimuli were black on a gray background, and were presented for 120 ms. The innermost edge of the letter string appeared 1.5° away from the fixation cross. The strings subtended from 1.5° to 3.0° of visual angle. The target stimulus was underlined. The subject's task was to decide whether the underlined letter string was a word or not by pressing the corresponding keys ("c" and "m" for words, "d" and "k" for pseudowords). Subjects were instructed to use both hands simultaneously. The experiment was divided into three blocks, each one with 120 trials, and implementing one of the three conditions (unilateral, perceptual distractor, and lexical distractor). The order of presentation of the three conditions was counterbalanced as a between-subjects factor, while visual field of presentation and lexicality of the target were within-subject factors. Within each condition, the order of presentation of the stimuli was randomized for each subject. Each subject participated in a practice session before the experimental session.

### 2.4. Stimulus materials

Stimuli were 240 letter strings, three, four and five letters long; 120 were words and 120 were pronounceable, orthographically regular pseudowords that were matched for length. Frequency and regularity were counterbalanced across all three-, four-, and five-letter words. The original list of stimuli came from lexical lists composed by Seymour, Bunce, and Evans (1992). Some of the original stimuli were replaced because their frequency in British English was higher than in American English.

In the perceptual distractor and lexical distractor conditions, each target string was accompanied by a distractor string of the same length in the opposite VF. In the perceptual distractor condition, distractors were always a sequence of Xs. In the bilateral distractor condition, distractors were always words or pseudowords. Targets and lexical distractors were equally often words or pseudowords, but never the same string. Stimuli used as targets were never used as distractors, and vice-versa.

### 2.5. Data analysis

Analyses of variance (ANOVA) with repeated measures were performed for accuracy (percentage of correct trials) and latency (the median of reaction times of correct trials).

## 3. Results

We carried out a 2 (TLex: word, pseudowords) × 2 (VF: left, right) × 3 (Condition: unilateral, perceptual distractor, lexical distractor) ANOVA for accuracy and latency, as well as a separate analysis of the data from the bilateral condition in order to look at the interaction between TLex and DLex. All significant effects for these analyses are list-

Table 1
Significant effects of the ANOVAs and follow-up analyses—Accuracy

| ANOVA | Effect | df | *F*-value | *P*-value |
|---|---|---|---|---|
| TLex × VF × Condition | VF | 1, 82 | 43.534 | .0001 |
| | Condition | 2, 164 | 40.899 | .0001 |
| | TLex × VF (overall) | 1, 82 | 16.856 | .0001 |
| | TLex × VF (lexical distractors)[a] | 1, 82 | 24.513 | .0001 |
| | VF × Condition (words)[a] | 1, 82 | 7.323 | .0075 |
| | TLex × VF × Condition | 2, 164 | 6.404 | .0021 |
| TLex × DLex × VF | DLex | 1, 82 | 4.421 | .0386 |
| | TLex × DLex | 1, 82 | 4.182 | .0441 |

Abbreviations: VF, visual field; DLex, distractor lexicality; TLex, target lexicality.
[a] Planned comparison.

Table 2
Significant effects of the ANOVAs and follow-up analyses—Latency

| ANOVA | Effect | df | *F*-value | *P*-value |
|---|---|---|---|---|
| TLex × VF × Condition | VF | 1, 82 | 29.667 | .0001 |
| | Condition | 2, 164 | 15.912 | .0001 |
| | TLex | 1, 82 | 113.112 | .0001 |
| | TLex × VF (lexical distractors)[a] | 1, 82 | 29.329 | .0001 |
| | TLex × VF (perceptual distractors)[a] | 1, 82 | 9.189 | .0033 |
| | TLex × VF × Condition | 2, 164 | 5.301 | .0059 |
| | VF × Condition (words)[a] | 1, 82 | 6.044 | .0150 |
| | VF × Condition (pseudowords)[a] | 1, 82 | 4.243 | .0410 |
| TLex × DLex × VF | TLex × DLex | 1, 82 | 7.696 | .0069 |

Abbreviations as in Table 1.
[a] Planned comparison.

ed in Tables 1 and 2. The significant effects for accuracy are presented in Table 1 and the ones for latency are presented in Table 2.

### 3.1. Accuracy

There was a main effect of VF (Table 1), with targets in the RVF being processed more accurately (84.6% correct) than targets in the LVF (80.2%). There was also a main effect of Condition, in which both perceptual (81.2%) and lexical (80.1%) distractors decreased performance relative to unilateral presentations (85.9%). There was no main effect of TLex ($F(1, 82) = 1.23$, $p = .27$), and no VF × Condition interaction ($F(2, 164) = 1.85$, $p = .16$).

Although the overall TLex × VF interaction (Table 1) was significant, follow-up analyses disclosed that the interaction was significant only for targets paired with lexical distractors, where word targets were processed more accurately in the right VF than in the left VF. By contrast, pseudoword targets did not differ between the visual fields. Thus, planned comparisons show a significant TLex × VF interaction for the bilateral (lexical distractor) condition (Fig. 1c) and a non-significant TLex × VF interaction for the unilateral condition ($F(1, 82) = 3.28$, $p = .07$; Fig. 1a).

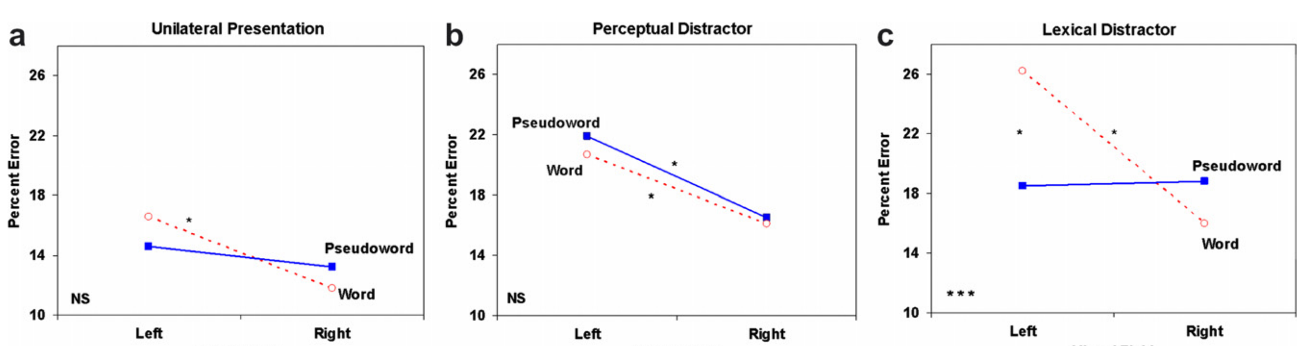


Fig. 1. Effect of distractors on hemispheric independence for accuracy. The lines represent word (dashed) and pseudoword (solid) targets. Asterisks on the lower left corner indicate the two-way interaction is significant ([*]indicates $p < .05$, [***]indicates $p < .0005$). An asterisk next to a line indicates the difference between the two connected points is significant. An asterisk between two unconnected points (vertically) indicate the difference between these two points is significant. The interaction between target lexicality and visual field for accuracy was significant with the presence of the lexical distractor but not with the presence of the perceptual distractor or in the unilateral condition. Lexical distractors increased the right visual field advantage for word targets but not for pseudoword targets, causing the overall interaction between condition and visual field to be non-significant.

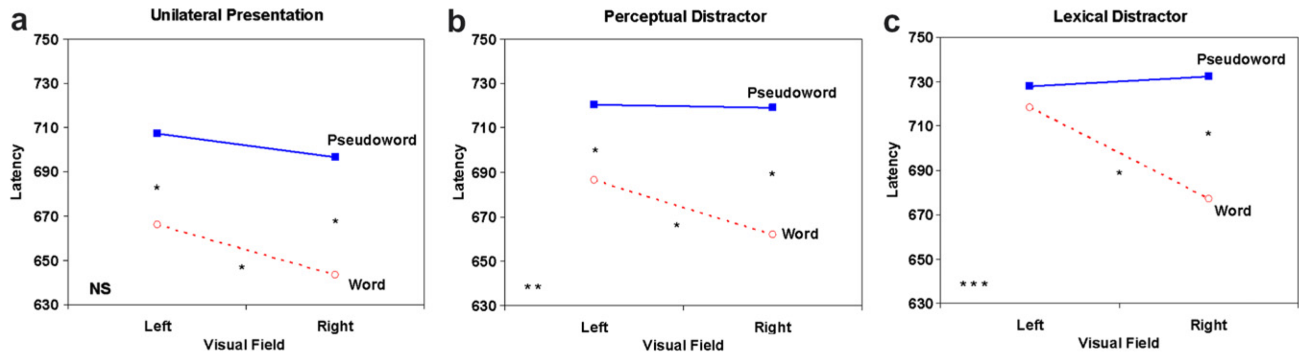


Fig. 2. Effect of distractors on hemispheric independence for latency. The lines represent word (dashed) and pseudoword (solid) targets. The meaning of the asterisks is the same as in Fig. 1 (** indicates $p < .005$). Perceptual distractors increased hemispheric independence relative to unilateral presentations, but lexical distractors produced the strongest independence between the hemispheres.

There was no significant TLex × VF interaction for the perceptual distractor condition ($F(1, 82) = .17$, $p = .68$). Planned comparisons also show a significant VF × Condition (unilateral, lexical distractor) interaction for word targets, in which the RVFA is accentuated in the lexical distractor condition compared to unilateral presentations. No such interaction was found for pseudoword targets ($F(1, 82) = .78$, $p = .37$). There was a significant TLex × VF × Condition interaction.

### 3.2. Latency

There was a main effect of VF (Table 2), with targets in the RVF being processed faster (688 ms) than targets in the LVF (704 ms). There was also a main effect of condition, in which both perceptual (697 ms) and lexical (714 ms) distractors decreased performance relative to unilateral presentations (678 ms). A significant main effect of TLex (Table 2), with words (675 ms) being processed faster than pseudowords (717 ms), was also found. There was no significant VF × Condition interaction ($F(2, 164) = .516$, $p = .6$).

There was a significant TLex × VF × Condition interaction (Table 2). Planned comparisons show that the TLex × VF interaction was significant for lexical (Fig. 2c), and for perceptual distractors (Fig. 2b), but not for unilateral presentations ($F(1, 82) = 2.34$, $p = .13$). Planned comparisons also show a significant VF × Condition (unilateral, lexical distractor) interaction for word targets, in which the RVFA is accentuated in the lexical distractor condition compared to unilateral presentations, as well as a significant VF × Condition (unilateral, lexical distractor) interaction for pseudoword targets, in which the effect of VF is decreased (or maybe even reversed) in the lexical distractor condition.

### 3.3. Lexical redundancy effect

We also analyzed the data from the bilateral condition separately in order to look at the interaction between TLex and DLex (lexical redundancy). We carried out a 2 (TLex: word, pseudoword) × 2 (DLex: word, pseudoword) × 2 (VF: left, right) ANOVA for both accuracy and latency for the lexical distractor condition.

### 3.4. Accuracy

A main effect of DLex was found (Table 1), with the processing of targets being less accurate in the presence

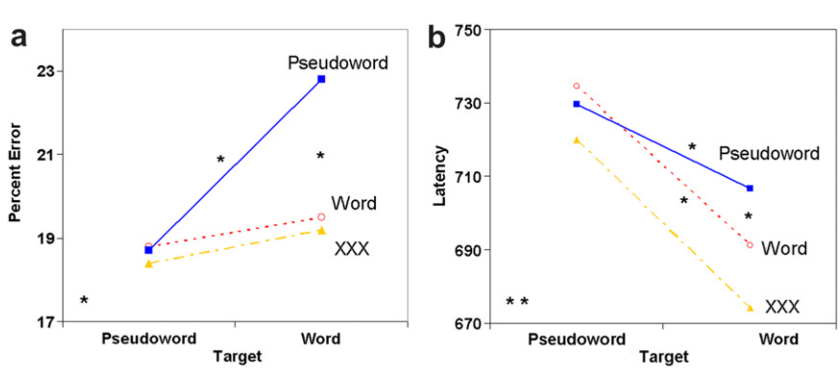


Fig. 3. Effect of distractor lexicality on accuracy (a) and latency (b). The three types of distractors are represented by the three lines (word—open circles; pseudoword—solid squares; and perceptual—solid triangles). The meaning of the asterisks is the same as in Fig. 1. The 2 (word, pseudoword) × 2 (word × pseudoword) ANOVAs between target lexicality and distractor lexicality were carried out separately for the lexical distractor condition. The data for the perceptual distractor condition (xxx) is displayed here for comparison.

of pseudoword distractors (79.3% correct) than in the presence of word distractors (80.9%). There was a TLex × DLex interaction, in which word targets were processed less accurately when accompanied by pseudoword distractors than by word distractors, while pseudoword targets were affected equally by word and pseudoword distractors. The TLex × DLex interaction was stronger for word targets than for pseudoword targets. No higher order interaction was found (Fig. 3a).

### 3.5. Latency

There was no main effect of DLex ($F(1) = 1.94$, $p = .17$). There was a TLex × DLex interaction (Table 2), in which the lexical redundancy is stronger for word targets than for pseudoword targets (Fig. 3b). No higher order interaction was found.

## 4. Discussion

In order to characterize behaviorally the respective competencies of the cerebral hemispheres in the normal brain, it is useful to test them in conditions of maximal hemispheric independence. Contrary to the split-brain, the intact brain displays an intricate pattern of interaction between the two hemispheres, in which both of them contribute to some degree to virtually all cognitive tasks. Therefore, the identification of experimental conditions that minimize interhemispheric interaction is important for studies of hemispheric asymmetries.

It has been shown that when task-irrelevant stimuli (distractors) are presented simultaneously with the target stimuli, in the opposite visual hemifield, laterality effects can be enhanced for a number of tasks (Boles, 1983, 1987, 1990). The present study investigated how bilateral presentations affected laterality effects in a lateralized lexical decision task. Specifically, we were interested in finding out (a) how bilateral displays affect VF asymmetries compared to unilateral displays, (b) at which point during the processing of the stimuli the interaction between target and distractor representations occurred, and (c) whether the "lexical redundancy" effect observed in previous studies was due mainly to facilitation of the lexical processing of word targets by congruent distractors or to the inhibition of processing by incongruent distractors, or to both.

### 4.1. Visual field asymmetries

We found that, although bilateral displays did not increase laterality effects in reaction time or accuracy for the task as a whole, relative to unilateral presentations, bilateral presentations did increase the right visual field advantage for word targets (cf. Boles, 1983, 1987, 1990). In fact, bilateral displays produced somewhat opposite effects on words and pseudowords, increasing the RVF advantage for the former and decreasing it for the latter, as described below.

For targets presented in the left visual field, the presence of lexical distractors (compared to unilateral presentations) impaired the processing of words relative to pseudowords, increasing the right visual field advantage for words and decreasing it for pseudowords. This was evidenced by the planned comparisons showing interactions between VF and Condition (unilateral, lexical distractor) in opposite directions for word and pseudoword targets, although the effect on pseudowords was only significant for latency (Tables 1 and 2, Figs. 1a–c, and Figs. 2a–c). Bilateral presentations thus affected the processing of words and pseudowords in different ways.

Like Iacoboni and Zaidel (1996), we found an overall word advantage in latency. However, we found that the TLex × VF interaction erased the overall word advantage in accuracy. This reflects a LVFA for pseudowords, presumably mediated by a right hemisphere bias to respond "pseudoword". A similar positive left hemisphere bias has been observed frequently in behavioral laterality experiments (Eviatar & Zaidel, 1994).

Iacoboni and Zaidel (1996) found that bilateral displays increased hemispheric independence in a lateralized lexical decision task, as evidenced by an interaction between Response Hand and VF. The current study extended this finding by showing that bilateral, but not unilateral, presentations produced a significant interaction between TLex and VF. Although performance in all conditions was somewhat decreased in bilateral trials—as expected from the sheer increase in cognitive load—responses to word targets presented in the left VF were disproportionately affected by the presence of the distractor, indicating that interhemispheric cooperation is more crucial for the processing of words by the right hemisphere than by the left, and more crucial for the processing of words than for the processing of pseudowords by either hemisphere. The absence of a significant TLex × VF interaction in the unilateral condition is consistent with the task being performed either by direct access or via callosal relay. However, the existence of a significant TLex × VF interaction in the bilateral condition strongly indicates that these trials were performed via direct access.

In sum, bilateral displays appear to increase hemispheric independence in lexical decision. Increased independence may or may not lead to a larger RVFA depending on the lexical competence of the RH. Such competence is likely to exhibit larger individual differences than does left hemisphere competence (Weems & Zaidel, 2004).

Iacoboni and Zaidel (1996) used unimanual responses and observed a significant Response Hand × VF interaction in the bilateral but not in the unilateral condition. We used bimanual responses instead. Our rationale was that the Response Hand × VF interaction is often non-significant, and when it is, it can exhibit either an ipsilateral or a contralateral Response Hand–VF advantage (Zaidel, Weekes, Capetillo-Cunliffe, Rayman, & Iacoboni, 1998). Indeed, Weems and Zaidel (2005) showed that response mode (unimanual, bimanual, "congruent" (hand responding to targets in the ipsilateral VF), and "incongruent" (hand responding to contralateral VF)) had no effect on the RVFA.

For latency only, perceptual distractors increased hemispheric independence relative to unilateral presentations, though not as much as lexical distractors did. It is surprising that, for accuracy, the perceptual distractor condition showed less hemispheric independence than the unilateral condition. The reasons for this remain to be explored.

### 4.2. Target–distractor interaction

Interestingly, even when performed via direct access (as it certainly is in the bilateral condition) the task showed residual interhemispheric interactions due to the presence of the distractors, as indicated by the interaction between TLex and DLex (lexical redundancy effect). Here, the target is initially presented to one hemisphere and the distractor presented to the opposite hemisphere. Zaidel et al. (1999) showed that there is no lexical redundancy when the target and the distractor were presented in the same visual field. Thus, assuming direct access, the distractor in the bilateral condition appears to affect target decisions either by preventing access to homologous representations in the opposite hemisphere or by transfer of some competing representation from that hemisphere. These interactions are presumed to occur subsequent to early perceptual analysis of the stimuli by each hemisphere but before the stage of response programming. (If the crucial interaction took place during response programming, the effect would have been symmetric between word targets and pseudoword targets.) Specifically, we found that incongruent distractors delayed lexical decision relative to the perceptual distractors. This most likely places the interhemispheric interaction responsible for the lexical redundancy effect at a stage of word recognition subsequent to perceptual analysis. Further, Zaidel et al. (1999) showed that illegal non-words (a sequence of different consonants) create a different, smaller lexical redundancy effect than pseudowords, suggesting that the effect of the latter occurs subsequent to processing by the "visual analysis system" (which assigns an abstract identity and a position to each letter in the input string; Ellis & Young, 1998).

### 4.3. Nature of lexical redundancy

Finally, the finding that perceptual distractors behave like the congruent lexical distractor for both word and pseudoword targets (Fig. 3) suggests that the lexical redundancy effect is largely due to inhibition of processing by the incongruent distractor. Relative to the perceptual distractor condition, both congruent and incongruent distractors seem to slow down the processing of the target. As Fig. 3 shows, this increase in response time is smaller for the congruent target–distractor pair (word–word) than for the incongruent one (word–pseudoword), which is what we would expect if the lexical redundancy effect was mainly due to inhibition by the incongruent distractor. Furthermore, the interference due to incongruent distractors occurs for word targets but not for pseudoword targets. This argues against speed-of-processing or automaticity accounts of the lexical redundancy effect, since words are processed faster and more automatically than pseudowords.

In summary, bilateral presentations introduced a difference in hemispheric processing strategies, producing stronger laterality effects for words, though not for pseudowords. It is possible to explain the differences between the TLex $\times$ VF interaction in the unilateral and bilateral conditions by positing a shift towards a greater pseudoword bias in the bilateral condition. Alternatively, as noted above, it is possible that different processes are engaged for word identification and for pseudoword identification in a given hemisphere. Since bilateral presentations provide the strongest hemispheric independence, they present an advantage over unilateral presentations for investigators interested in differential hemispheric contributions to cognition.

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