

## COMMENT

# Where Are the Effects of Frequency in Visual Word Recognition Tasks? Right Where We Said They Were! Comment on Monsell, Doyle, and Haggard (1989)

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Balota and Chumbley's studies led them to conclude that category verification, lexical decision, and pronunciation tasks involve combinations of processes that cause them to produce differing estimates of the relation between word frequency and ease of lexical identification. Monsell, Doyle, and Haggard challenged Balota and Chumbley's empirical evidence and conclusions, provided empirical evidence to support their challenge, and presented an alternative theoretical position. We show that Monsell et al.'s experiments, analyses, and theoretical perspective do not result in conclusions about the role of word frequency in category verification, lexical decision, and pronunciation that differ from those of Balota and Chumbley.

According to the connectionist theory of word recognition outlined by Monsell, Doyle, and Haggard (1989), printed word frequency should influence the ease of word identification. Because of this theoretical position, Monsell et al. apparently believed that word frequency and response time should be about equally related in all tasks involving word identification. Thus they were troubled by the findings and task analyses of Balota and Chumbley (1984, 1985; Chumbley & Balota, 1984) and others that indicate that the size of the effect of word frequency on response latency varies across different tasks involving word identification. In support of their theoretical position, Monsell et al. presented several criticisms of the empirical basis for Balota and Chumbley's conclusions about the impact of word frequency in the lexical decision task and the pronunciation task.

Our commentary on Monsell et al.'s (1989) article includes two major lines of discussion. First, we briefly summarize the data and arguments that led us to conclude that estimates of the word-frequency effect provided by the lexical decision and pronunciation tasks are affected by components of the tasks other than the lexical access (what Monsell et al. referred to as "lexical identification") component of models that we were considering. Second, and more important, we delineate differences between the tasks used by Monsell et al. and those that we used that may be responsible for the differences in the patterns of data observed. We conclude that Monsell et al.'s studies do not undermine our conclusion that neither the lexical decision task nor the pronunciation task provides a pure estimate of the degree to which word frequency has a localized effect on lexical identification.

### Balota and Chumbley's Results and Conclusions

In a series of 10 experiments, using three different sets of words and nonwords, we obtained three major results relevant to Monsell et al.'s (1989) study. First, we (Balota & Chumbley, 1984) found that different tasks yielded different estimates of the relation between word frequency and response latency even though, according to the models that we were considering, each task required lexical identification. Second, we (Chumbley & Balota, 1984) found that subtle differences in stimulus materials (e.g., a small difference in the lengths of the words and nonwords) could influence the impact of other variables (e.g., frequency and instance dominance) on lexical decision latency. Finally, we (Balota & Chumbley, 1985) found that the latency to pronounce a visually presented word was related to the word's printed frequency even though subjects had sufficient time to recognize the to-be-pronounced word before receiving a signal to pronounce it. On the basis of these findings, we concluded that data from lexical decision and pronunciation tasks overestimated the relation between word frequency and the speed of lexical identification.

It is critical to note that we did not conclude that word frequency has *no* relation to speed of lexical identification. This can be seen from the following quotation from our first article (Balota & Chumbley, 1984): "It is important to reiterate here that we are not arguing that word frequency has no impact on lexical identification. Our data do not support that conclusion, and our model takes no position with respect to such a claim" (p. 355). Furthermore, we (Balota & Chumbley, 1985) stated that "it is important to note that we are not arguing that word frequency has no impact on lexical identification, but rather, that one must be very cautious in unequivocally attributing the frequency effect found in this task [pronunciation] to lexical access" (p. 104). Thus we did not wish to dismiss the "commonly held" assumption that word

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frequency influences lexical identification. Instead, we argued that one must be cautious in using data from the lexical decision and pronunciation tasks to unequivocally estimate the degree to which word frequency and lexical identification are related.

In accounting for our findings, we analyzed the tasks in terms of their requirements and what people might do to conform to instructions to make rapid and correct responses. Although the empirical evidence was important, the task analyses were equally important to our conclusions.

### *Analysis of the Lexical Decision Task*

We (Balota & Chumbley, 1984; Chumbley & Balota, 1984) argued that the lexical decision task is not simply a word identification task but rather is a discrimination task. When the task is viewed this way, one must ask what types of information are available to discriminate words from nonwords. Two obvious dimensions of information available to the subject are the familiarity and the meaningfulness of the stimulus; that is, words are more familiar and meaningful than nonwords.

The familiarity dimension is particularly important in the present context. If subjects used familiarity to discriminate words from nonwords in the lexical decision task, then there is a confounding between the manipulated variable, frequency (a strong correlate of familiarity), and the word/nonword discrimination entailed in this task. Low-frequency words are more similar to nonwords in the relevant familiarity dimension than are high-frequency words. Thus, in comparison with high-frequency words, low-frequency words are more difficult to discriminate from the nonwords, which thereby exaggerates the frequency effect.

In order to further illustrate the problem encountered in unequivocally attributing the effect of a type of information to the lexical identification process, consider the following hypothetical experiment. A researcher hypothesizes that lexical identification is faster for words printed in red than for words printed in purple. To test this hypothesis, red and purple words along with blue nonwords are presented in a lexical decision task. The results support the hypothesis; that is, the words printed in red produce faster response latencies than do the words printed in purple. Therefore, the researcher argues that red words are *identified* more quickly than purple words. The obvious interpretive problem here is that the purple words are more difficult to discriminate from the blue nonwords than are the red words. Thus the obtained pattern does not necessarily indicate that color is influencing lexical identification, but rather it indicates that color is a dimension available to subjects and that this dimension is correlated with the discrimination between words and nonwords. We are simply making a similar argument with respect to familiarity.

### *Analysis of the Pronunciation Task*

There are *at least* two logically separable aspects of the pronunciation task: The word (usually) must be identified, and this identified word must be output. (Here, *output* refers

to "all" processes after identification but before the onset of vocalization.) If a manipulation has an effect on pronunciation latency, the effect may be due to the impact of the manipulation on lexical identification, output processes, or both. Our experiments (Balota & Chumbley, 1985) were an attempt to specify the loci of the effect of word frequency in the pronunciation task, and our general strategy was quite simple: to separate experimentally the lexical identification and output components and then to look for any residual effect of word frequency on the output components. We attempted to isolate the output components (i.e., eliminate the need for lexical identification) by allowing the subject sufficient time to recognize the word before its pronunciation was required. Then, on cue, the subject pronounced the word previously identified. In a series of three experiments, significant frequency effects were obtained even though subjects had sufficient time to recognize the to-be-pronounced stimulus word (also see Balota & Shields, 1988). Therefore, we argued that frequency can influence processes beyond identification in the pronunciation task. Connine, Mullennix, Shernoff, and Yelen (in press) recently made the same argument regarding the impact of familiarity in naming.

### *Summary*

The task analyses by Balota and Chumbley (1984, 1985; Chumbley & Balota, 1984) yielded specific reasons for expecting word frequency to affect processes other than those intrinsic to lexical identification in both the lexical decision and pronunciation tasks. In addition, our task analyses were buttressed with empirical results. Finally, we note that variables other than word frequency are now viewed by many researchers as having postidentification influences in both lexical decision and pronunciation tasks. The accumulating evidence suggests that some semantic priming effects are the result of processes occurring after lexical identification in lexical decision (e.g., Balota & Lorch, 1986; de Groot, 1983; Forster, 1981; Lorch, Balota, & Stamm, 1986; Lupker, 1984; McNamara & Altarriba, 1988; Neely, 1990; Seidenberg, Waters, Sanders, & Langer, 1984; West & Stanovich, 1982) and in pronunciation (e.g., Balota, Boland, & Shields, 1989; Dallas & Merikle, 1976; Midgley-West, 1979). Thus the thrust of this literature is that latency data from these tasks cannot be used as a "pure" measure of the degree to which variables influence the lexical identification component of word processing.

### *Monsell et al.'s Critique and Experimental Evidence*

#### *Critique of Balota and Chumbley's Comparison of Category Verification and Lexical Decision*

As noted earlier, we (Balota & Chumbley, 1984) found that the effect of word frequency on response latency in category verification was significantly less than its effect on lexical decision time. Monsell et al. (1989) expressed three concerns with this finding.

First, Monsell et al. (1989) suggested that "certain features of Balota and Chumbley's (1984) experiment may have reduced their chances of detecting a significant effect of frequency on semantic categorization. The set of 72 words used came from a relatively restricted frequency range" (p. 48). This point is obviously irrelevant because the same 72 words were used in our lexical decision experiment, and a substantial frequency effect was observed. Later in the same paragraph, Monsell et al. acknowledged this fact. It is worth noting here that we originally selected our words so that the words would likely be in our subjects' lexicons. Not all researchers have taken this precaution, and we noted that sometimes a word-frequency effect for words familiar to subjects has been confused with effects produced by words that are not adequately represented in subjects' lexicons. Of course, it is nearly impossible to ensure that all subjects know all low-frequency words. In fact, Monsell et al. (1989) had such a problem with some of their words. In their Appendixes, several words were designated as having been replaced in subsequent experiments because of error rates as high as 44% in tasks in which chance is 50%.

The second criticism raised by Monsell et al. (1989) is that repeated use of only nine relatively small categories (e.g., *clothing, fruit, vegetable*) resulted in the exemplars' being semantically "primed" so that categorization decisions could sometimes be made "on the crude degree of overlap between the semantic attributes of the set of active candidates (for identification) and the attributes activated by the category label without differentiating among the candidates" (p. 48). Monsell et al. reasoned that because the full lexical identification process would not be carried out on such trials, the word-frequency effect would be diminished.

Balota and Chumbley (1984) detailed a series of converging lines of evidence to address the possibility that semantic priming was diminishing the frequency effect in their category verification task (p. 345). We now note four of the points. First, it is unclear how priming could be effective on "no" response trials when the exemplar is being incorrectly primed by the name of another category. Second, there was little evidence that the frequency effect was disappearing across trials as subjects became more and more familiar with the categories. Third, subjects should have actually been misprimed by 10 unrelated categories because they received 65 buffer/practice trials with exemplars from these unrelated categories before they received any exemplars from the target categories. Fourth, Becker (1979) found a highly significant frequency effect (49 ms) in a lexical decision task, albeit reduced in comparison with an unrelated condition, when each word was primed on a given trial by a highly related associate. It is unclear how implicit priming for misdirected category exemplar "no" trials could produce more semantic priming than that produced by highly related associates. These considerations, along with evidence from other studies that there is very little cross-trial semantic priming (e.g., Foss, 1982; Meyer, Schvaneveldt, & Ruddy, 1972), lead us to reject the contention that priming by the category name was producing the Task  $\times$  Frequency interaction.

Monsell et al.'s (1989) third objection involved a review of the literature on category verification performance. They

argued that the literature did not support our (Balota & Chumbley, 1984) argument that there are typically small word-frequency effects in category verification. First, Monsell et al. suggested that because Millward, Rice, and Corbett (1975) displayed the category label with the instance, the frequency effect of the instance alone was somehow masked. However, for the word recognition model that we were addressing, the effect of instance frequency and any effect of length of the category label should have been additive. Second, Monsell et al. believed that we did not accurately represent Anderson and Reder's (1974) results when we indicated that Anderson and Reder failed to find an impact of instance frequency on category-instance "no" decisions. An examination of Anderson and Reder's correlation matrix (p. 680) reveals that the correlation between instance frequency and instance negation time is a nonsignificant  $-.11$ . Third, Monsell et al. acknowledged a study in which Landauer, Ross, and Didner (1979) found smaller frequency effects in category verification than in lexical decision. In fact, Monsell (1985) reported a failure to obtain a significant frequency effect for syntactic decisions and obtained only an approximately 30-ms frequency effect for semantic decisions, an effect very close to the 24-ms effect that we reported. Finally, Forster (1985) reported a failure to find a significant frequency effect on the important "no" responses in a category decision experiment. It is unclear why Monsell et al. did not discuss Forster's study, inasmuch as it seemed to meet the specifications that they suggested: (a) Forster did not present the category items on each trial, and (b) his subjects made a very general category decision (e.g., "Is it larger than a brick?") to eliminate the possibility of a decision based on activated semantic features before lexical identification. Thus on the basis of our review of the literature, we reaffirm our conclusion that frequency effects are relatively limited in the category-verification task in comparison with the 100-ms frequency effects that are common in the lexical decision task.

Finally, there are other tasks that appear to demand lexical identification and yet do not produce large frequency effects (cf. Brown, Carr, & Chaderjian, 1987; Gunther, Gfroerer, & Weiss, 1984; Manelis, 1977). In fact, Chumbley and Balota (1984; also see Balota & Chumbley's 1984 category dominance measure) found that the latency to produce an associate to a word is less related to word frequency than is the time to make a lexical decision to the same word ( $r_s = -0.26$  and  $-0.56$ , respectively). It is unclear how subjects can somehow bypass lexical identification of the word and yet be able to produce an associate to it. De Groot (1989) recently replicated this pattern. Thus the conclusions that we reached on the basis of category-verification performance have been bolstered by data from other tasks requiring assignment of meaning to a word but not the discrimination of words from nonwords.

### *Monsell et al.'s Categorization and Lexical Decision Experiments*

In Monsell et al.'s (1989) first experiment, they compared the frequency effect in a semantic categorization task (categorizing words as "persons" vs. "inanimate things") to the

frequency effect in a lexical decision task. They found that the frequency effect in the categorization task was slightly smaller than the frequency effect in the lexical decision task, but the Frequency  $\times$  Task interaction did not approach significance. In their second experiment, they compared the frequency effect in a syntactic categorization task (categorizing words as "nouns" vs. "adjectives") with the frequency effect in a lexical decision task. The results of this experiment yielded a significant frequency effect in both tasks and a significant Frequency  $\times$  Task interaction; the frequency effect, as we would predict, was significantly smaller in the syntactic decision task than in the lexical decision task. Although the results of the first experiment were in the predicted direction and the second experiment produced a significant Task  $\times$  Frequency interaction, Monsell et al. appeared to accept the null hypothesis concerning Frequency  $\times$  Task interactions, as illustrated by the following statement: "We conclude that the time taken to access conceptual/functional properties from print can be as frequency sensitive as lexical decision time" (p. 43).

Our major concern with Monsell et al.'s (1989) first two experiments is that they did not partial out the correlation between frequency and other variables known to be related to categorization performance. In particular, we believe that correlations between semantic variables (e.g., category dominance and typicality) and frequency may have exaggerated the latency differences between the high-frequency and low-frequency words in Monsell et al.'s categorization tasks. Although it is clear that word frequency may affect lexical identification during category verification, it is equally clear that semantic variables influence performance in the categorization task. Because we (Balota & Chumbley, 1984) were interested in the unique effect of frequency on lexical identification, independently of its relation to other variables known to affect accessibility of the meaning of the exemplar, we partialled out the influence of potentially confounding semantic variables on category-verification response latencies. For example, in our study, instance dominance, a variable clearly related to categorization performance, was highly correlated with word frequency ( $r = .45$ ). By partialing out such variables, we were able to obtain an estimate of word-frequency effects that were relatively unconfounded by the relation between word frequency and relevant semantic variables.

Monsell et al. (1989) did not take any precautions to control for the impact of such semantic variables. In fact, a review of Monsell et al.'s materials indicates that a relation may exist between frequency and typicality within their materials. For example, it appears that some of Monsell et al.'s low-frequency "person" words (e.g., *goblin*) are less personlike and more thinglike than some of their high-frequency "person" words (e.g., *father*).

To address this possibility, we had 12 subjects rate on a 9-point scale the degree of "animacy" of each of Monsell et al.'s (1989) words. Subjects were encouraged to use all points on the scale, and in the instructions for the task, we described the notion of a prototype color "red," whereby some colors might be called "red" although they are not "perfect reds." The results (see Table 1) reveal a clear relation between word frequency and rated animacy. Low-frequency words were

rated significantly less animate than high-frequency words,  $F(2, 22) = 55.59$ ,  $MS_e = 0.050$ ,  $p < .001$ . This relation between a word's frequency and its position on a semantic dimension relevant to the categorization task would make "person" decisions more difficult for low-frequency words than for high-frequency words.

The major point is very simple: There is a relation between an underlying relevant semantic dimension (animateness) and word frequency in Monsell et al.'s (1989) materials. There may, of course, be other such relations. In order for Monsell et al. to convincingly demonstrate that the effects of word frequency are equivalent in the semantic categorization task and the lexical decision task, the effect of correlated semantic variables must be partialled out in both tasks, as we (Balota & Chumbley, 1984) advocated.

### *Critique of Balota and Chumbley's Comparison of Pronunciation and Lexical Decision*

Balota and Chumbley (1984) noted that frequency effects are typically smaller in the pronunciation task than in the lexical decision task and suggested that this may be due to the exaggerated influence of frequency in the lexical decision task. Monsell et al. (1989) explained the smaller frequency effects in pronunciation than in lexical decision by noting that the pronunciation of "regular" words can be determined in two ways: "(a) unique identification, followed by retrieval of a learned pronunciation, and (b) assembly of pronunciation from knowledge of sublexical orthography-phonology correspondences" (p. 49). Only the former process requires lexical identification and is sensitive to printed word frequency. Therefore, if there is a large proportion of regular words that can bypass lexical identification in pronunciation and if lexical decision requires lexical identification for all words, then one should find a reduced frequency effect in pronunciation in comparison with lexical decision.

### *Monsell et al.'s Pronunciation and Lexical Decision Experiment*

To test this account, Monsell et al. (1989) presented disyllabic words in their third experiment. Most disyllabic words are "stress-initial" (i.e., the first syllable is stressed), and orthography-phonology correspondence patterns should reflect this bias. Hence for words stressed on the first syllable, both the spelling-to-sound route and the lexical identification route lead to the same pronunciation. On the other hand, disyllabic words that are stressed on the second syllable require lexical

Table 1  
*Mean Animateness Ratings as a Function of Word Type (Person vs. Thing) and Word Frequency*

Word type	High	Medium	Low	<i>M</i>
Persons	7.99	7.69	7.26	7.65
Things	2.79	2.23	2.16	2.39
<i>M</i>	5.39	4.96	4.71	

identification because they cannot be pronounced correctly through the spelling-to-sound route. Because the common effect of word frequency for pronunciation and lexical decision is primarily due to processes associated with lexical identification, there should be similar frequency effects in pronunciation and lexical decision for irregular words (in which stress is on the second syllable), whereas there should be a reduced frequency effect for regular words (in which stress is on the first syllable). Overall, this was the pattern obtained by Monsell et al.

Although Monsell et al.'s (1989) suggestion about alternative routes was well taken, their data were not totally in agreement with this analysis. Our major concern is that it is unclear why they did not find a main effect of syllable stress. They argued that second-syllable stress occurs less frequently in the language. Hence response latencies should be slower to words with second-syllable stress because only the lexical identification route can be used to pronounce the words. Their data do not support this prediction, inasmuch as there was no significant main effect of stress. Of course, it could be that Monsell et al. did not succeed in equating the first- and second-syllable-stressed words on other dimensions; however, Monsell et al. argued that the items were well equated across the two levels of stress. In this light, their data were not totally consistent with Seidenberg, Waters, Barnes, and Tanenhaus's (1984) finding of interactive effects of spelling-to-sound regularity and frequency. The major discrepancy is that Seidenberg et al. reported highly significant main effects of the variables that should slow response latency (i.e., regularity/consistency).

### *Critique of Balota and Chumbley's Delayed-Pronunciation Experiment*

As described earlier, we (Balota & Chumbley, 1985) used a delayed-pronunciation task to establish that a portion of the word frequency effect in the pronunciation task is attributable to processes that occur after lexical identification. Monsell et al. (1989) criticized our procedure on the grounds that our subjects were simply not adequately prepared or motivated to respond quickly. Hence the delayed pronunciation frequency effect that we reported was in part due to subjects' re-identifying the target words.

### *Monsell et al.'s Delayed-Pronunciation Experiment*

To maximize articulatory preparation, Monsell et al. (1989) made four important changes in the procedure that we used. First, instead of using varying delays between presentation of the word and the cue to respond, they used a constant, 2,500-ms interval. Second, two additional countdown signals were given 1,500 ms and 1,000 ms before the "go" signal. Third, subjects pronounced each word on three successive trials (except when interrupted with "no-go catch" trials). Last, to ensure that their data were from subjects who were fully prepared, Monsell et al. used data from the second and third consecutive pronunciations of the word for the primary analyses. Thus even if subjects were not fully prepared for the first

pronunciation, they certainly should have been prepared by the second and third pronunciations. Under these conditions, Monsell et al. (1989) did not find a significant delayed pronunciation frequency effect.

Several aspects of the design and analysis of Monsell et al.'s (1989) Experiment 4 lead us to discount the relevance of its data to examining word-frequency effects localized in a component of the pronunciation task after lexical identification. First, the subjects were given 2,500 ms to rehearse the word that they were to produce, and rehearsal was not suppressed by subvocalization, as we (Balota & Chumbley, 1985) required in our Experiment 3. Repetition can produce substantial reductions in the word-frequency effect (e.g., Scarborough, Gerard, & Cortese, 1979). Second, and more important, Monsell et al.'s primary analyses involved only the second and third consecutive pronunciations of the same word. Although Monsell et al. observed a significant effect of word frequency in the first production of words stressed on the second syllable, they dismissed this finding, attributing it to the possibility that subjects were not fully prepared. Finally, Monsell et al. did not report analyses for stress-initial words on the first pronunciation because the same subjects saw these items 10–40 min earlier in either a pronunciation or a lexical decision task. In sum, Monsell et al.'s fourth experiment produced the following pattern of data: The only words that were not seen or pronounced earlier were those stressed on the second syllable, and those items produced a significant delayed pronunciation-frequency effect in highly prepared subjects even after an unfilled delay of 2,500 ms. We believe that this pattern of data is quite consistent with our conclusion that printed word frequency has an effect after lexical identification in pronunciation tasks.

As we noted in our original article (Balota & Chumbley, 1985, p. 103), normal conversation appears to require the retrieval of an abstract code to implement a motor program for pronunciation of a word. It is possible that the frequency effect in delayed pronunciation is associated with this process of code retrieval, inasmuch as time to retrieve a code could be dependent on frequency of usage. Thus it is of the utmost importance that subjects not be fully prepared, if fully prepared means simply holding the motor program or its product in an output buffer. If subjects are simply holding the production in an output buffer, as was likely in Monsell et al.'s (1989) study, retrieval of the information required to pronounce the word aloud would have already occurred before the signal to pronounce, and therefore a potential locus of the word frequency effect would be bypassed.

But how can we be sure that our subjects identified the word during the delay between presentation of the word and presentation of the cue to respond? One line of evidence is the results of research on automatic lexical processing (e.g., Stroop, 1935). This research indicates that subjects have little choice but to engage in semantic processing of words presented at fixation. In addition, we found that response latency decreased by a full 160 ms during the first 400 ms of the delay period. This could not happen unless subjects were doing something to prepare themselves to pronounce the word aloud. Finally, there was a relation between the length of a word and pronunciation latency for delays of 0 ms and 150

ms but not for longer delays. Thus, unlike frequency, one variable that presumably influences lexical identification (cf. Gough & Cosky, 1977) lost its influence after the 150-ms delay.

Finally, it is interesting that McRae, Jared, and Seidenberg (1990), who shared with Monsell et al. (1989) the same parallel distributed processing perspective, found a significant delayed pronunciation-frequency effect of homophonic pairs (e.g., *days* vs. *daze*) after moderate delays (calibrated separately for each subject) ranging between 568 ms and 973 ms. The delay reduced the frequency effect by 7 ms (from 23 ms in an online condition to 16 ms in the delayed condition), although this reduction in the frequency effect was largely eliminated by an additional 200-ms delay. McRae et al. took Balota and Chumbley's (1985) arguments a step further and suggested that all frequency effects in pronunciation are in output processes and none are in lexical identification. It is interesting that Monsell et al. and McRae et al., researchers with similar ideas about how lexical processing should be represented, arrived at such divergent interpretations of a body of data.

### Conclusions

In this commentary, as in our earlier articles, we have argued that the demand characteristics of the tasks used to study word recognition cannot be ignored and that the lexical decision and pronunciation tasks involve components other than lexical identification that are sensitive to word frequency. Thus, using these tasks to estimate the relation between word frequency and lexical identification can result in exaggerated estimates of the size of the relation. Our goal has not been to provide a model of word recognition or lexical identification but rather has been to contribute to the understanding of the characteristics of the tasks that are widely used to study word recognition. We firmly believe that theoretical progress in understanding word recognition is highly dependent on accomplishing this goal.

It is unclear to us why the impact of frequency would be limited to the identification process in word recognition tasks. The question here concerns the underlying mechanism through which frequency exerts its influence on the processing system. If there is something special about the characteristics of the identification process with respect to this mechanism, then one might expect frequency effects to be limited at that level in the system. However, we have yet to see a description of a system that would predict such a narrow impact of frequency. Basically, the frequency with which one sees a word, retrieves a concept associated with a word, and retrieves information associated with a pronunciation of a word should have an influence on each of these components of word processing. In fact, the parallel distributed processing framework presented by Monsell et al. (1989) seems to be especially sensitive to word frequency at several levels (see pp. 67–68).

Neither we nor Monsell et al. (1989) have argued that all of the frequency effect is either in identification or in post-identification processing in the lexical decision task. The major difference between Monsell et al.'s view and ours

appears to be in emphasis. Monsell et al. apparently are comfortable using the lexical decision task to estimate the relation between word frequency and processes involved in lexical identification. We, in contrast, feel uncomfortable using this task as a window into the theoretical moment of lexical identification. We hope that this exchange of views with Monsell et al. will ultimately lead to a clearer understanding of the issues that are important in developing adequate models of word processing.

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