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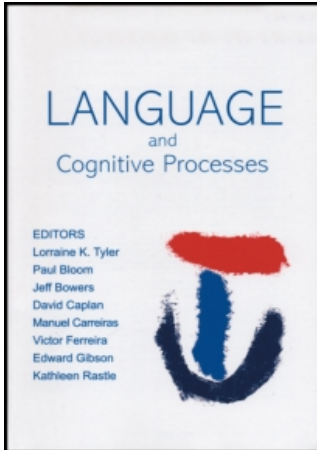
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The processing of familiar and novel senses of a word: Why reading Dickens is easy but reading Needham can be hard

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We investigated how easy it was for people to understand familiar and novel senses for words by monitoring participants' eye movements while they read short texts. To do this, we compared the processing of names (e.g., *Dickens*) where sentential context gave them literal interpretations (e.g., *met Dickens*) versus metonymic interpretations (e.g., *read Dickens*). Familiar metonyms were straightforward to process, but unfamiliar metonyms (e.g., *Needham* in *read Needham*) caused processing difficulty unless context made it clear that the metonymic interpretation would be appropriate (introducing *Needham* as an author). The results suggest that readers can use contextual information immediately to extend a word's interpretation by rule.

Words are constantly being used in novel ways. Why is it that people can often understand such novel interpretations with apparent ease? While any serious theory of semantic processing should be able to address this issue, surprisingly little is known about the on-line processes that are involved. Good evidence exists suggesting that comprehending an entirely novel word or expression is costly. However, there has been no investigation of the

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on-line processes involved in obtaining a novel interpretation of a word that is systematically related to an existing interpretation of that word. We might expect that processing such a novel interpretation might depend on the extent to which it is related to established interpretations (i.e., interpretations that are already known). In this article, we explore whether people can exploit systematic relationships between an existing and a novel sense of a word in a way that facilitates processing of the novel sense. (We use the term *sense* to refer to an interpretation that is semantically related to another interpretation of that same word, and *meaning* to refer to a semantically unrelated interpretation.)

Not surprisingly, processing novel words is hard. Using the eye-tracking paradigm, Chaffin, Morris, and Seely (2001, Experiment 2) showed that learning a new word in a neutral context involves extra processing effort. Compared to a control condition containing a familiar word (*guitar*), sentences with a novel word (*asdor*) showed longer initial reading times on the novel word (presumably a kind of frequency effect; Rayner & Duffy, 1986) as well as on the definitional associate *instrument* in (1). In addition, longer rereading times were observed for the novel word *asdor*.

1. Joe picked up the asdor and began to walk home. He played the instrument to relax.

Even strong contextual information which allowed readers to deduce the novel word's meaning (*Joe picked up the asdor and began to strum a tune*) did not completely eliminate the extra processing effort: while no initial reading time differences were found any more for the definitional associate, *asdor* still elicited longer rereading times than *guitar*. Other evidence of difficulty comes from work exploring the way in which people interpret novel verbs, such as *crutched*, that have been derived from nouns (Kaschak & Glenberg, 2000; see Clark & Clark, 1979), how novel words are acquired in an adult learning task (Frisson, Sandra, Brisard, & Cuyckens, 1996), and how eponyms like *do an Albert Einstein* are interpreted (Clark & Gerrig, 1983; Rapp & Gerrig, 1999). Together, these findings indicate that people experience difficulty understanding an entirely novel word, even in a restrictive context. Additionally, processing an *existing* word or expression can be hard when it is used in a way that is unrelated to an existing or established interpretation. For example, Gerrig (1989) found that people experienced difficulty with readily accessible conventionalised compounds with a novel interpretation (e.g., *cave man* to refer to a new faculty member who teaches about caves). For novel two-word compounds placed in context, factors influencing out-of-context interpretations, such as the frequency of the modifier relation, are still apparent (Gagné & Spalding, 2004, Gagné & Shoben, 2002; Gerrig & Bortfeld, 1999, Experiment 4; though see Gerrig & Bortfeld, 1999, Experiment 3). This

finding indicates that context does not completely override the interpretation obtained when the compound is presented in isolation.

But what if the novel interpretation of a word or expression has a regular relationship with its established interpretation? For example, English has metonymic rules (or heuristics) that allow places to stand for events, places for institutions, parts for wholes, and producers for products. For example, the place-for-event rule allows the name of a place (e.g., *Vietnam*) to refer to a salient event that occurred there (the Vietnam War), and the producer-for-product rule allows the name of a producer (e.g., *Dickens*) to refer to his or her characteristic product (Dickens' writings). If people can apply such rules during comprehension, they should be able to construct novel senses that are regularly related to established senses without difficulty.

Good evidence suggests that established metonyms do not cause difficulty. Frisson and Pickering (1999) found no reading time differences between *Vietnam* used literally (as in *I hitchhiked around Vietnam*) or metonymically (as in *Americans protested during Vietnam*), and there was no indication that the frequency of the different interpretations affected processing (see also Frazier & Rayner, 1990; McElree, Frisson, & Pickering, 2006; and Pickering & Frisson, 2001, for corroborating evidence with other types of sense ambiguous words). In this case, people may of course store such metonyms in their lexicons rather than apply the relevant metonymic rule during comprehension. However, when *Vietnam* was replaced by *Finland*, a place name that did not have a known or salient metonymic interpretation, processing times were inflated, as evidenced by longer rereading times of the place name. The question we address here is whether people can apply metonymic rules on-line and thereby remove the difficulty associated with the computation of novel interpretations.

APPLYING METONYMIC RULES DURING COMPREHENSION

Let us consider producer-for-product relationships, and first consider a case where a name already has an established 'product' sense, as in *Dickens*. In (2a), *Dickens* refers to the books written by Dickens; in (2b), *Dickens* refers to the person:

2a. I heard that my great-grandmother often read Dickens when she had the time.

2b. I heard that my great-grandmother often met Dickens when she had the time.

Frisson and Pickering (1999) showed that processing the metonymic interpretation of established place-for-institution and place-for-event

metonyms does not require additional effort. Hence, if this pattern holds for established producer-for-product metonyms, we predict no processing difficulties for *Dickens* in (2a) compared to (2b).

Now consider a name that does not refer to a familiar producer, such as *Needham*.

3a. I heard that my great-grandmother often read Needham when she had the time.

3b. I heard that my great-grandmother often met Needham when she had the time.

Whereas (3b) should be straightforward, because *Needham* is an acceptable name, (3a) should not be, because there is no generally known writer with this name. We assume that before encountering *Needham* in (3), people will assume that *Needham* refers to a person (about whom they may know very little). Readers might be able to initially interpret *read Needham* to mean 'read something by Needham' when they do not know that Needham is a producer, but they should eventually become aware of the incongruity of this interpretation. According to this view, we do not expect an early effect as there is no immediate semantic anomaly. Rather, readers will presumably search their lexicon for information about Needham being a producer and, upon coming up empty, infer that Needham must be a producer they have never heard of. Because this search may take time, the indication of difficulty with (3a) may occur late in the eye-tracking record. Such results would accord with Frisson and Pickering's (1999) finding of delayed difficulty with *Americans protested during Finland*, where readers presumably spent time unsuccessfully searching for an event associated with Finland. Notice that this situation is different from that involved in interpreting *asdor* in (1), because people do not know what an *asdor* is except that it can be picked up (Chaffin et al., 2001). There is immediate difficulty with *instrument* because there is no reason to assume that an *asdor* is an instrument, and therefore *instrument* appears incongruous.

But now imagine that prior context made it clear that Needham was a writer:

4. My great-grandmother has all the novels written by Needham in her library. I heard that she often read Needham when she had the time.

Needham is used literally in the first (context) sentence. When they first encounter *Needham*, people may already assume that the name refers to a person, but it is also possible that they draw this inference from its context. Having done this, they have a representation of Needham as a person. In the second sentence, *Needham* is used metonymically. If people can apply the

metonymic producer-for-product rule during comprehension, they should be able to determine that *Needham* refers to Needham's novels and hence avoid some or all difficulty associated with (3a). This would suggest that expressions can be given novel interpretations when they are systematically associated with established interpretations for those words.

Our experiment used six conditions (see Table 1), designed to manipulate first, whether the name referred to a familiar producer or not; second, whether the name was used metonymically or literally; and third, for the metonymic conditions, whether context did or did not support the metonymic interpretation.

A pretest (see below) indicated that Dickens was a familiar producer (a writer) and Needham was not. We make three predictions, of which the third is most crucial, but depends on the establishment of the first two predictions. As a result of our experimental design, these predictions need to be examined in separate factorial designs.

First, we predict an effect of *name familiarity*, with the less familiar name *Needham* causing more difficulty than the more familiar name *Dickens* in both the first and second sentences. Assuming that name familiarity differences are akin to frequency differences (e.g., Just & Carpenter, 1980; Rayner & Duffy, 1986), this effect should emerge very early in the reading data (as in Chaffin et al., 2001).

TABLE 1
Sample stimuli

Unsupported metonym, unfamiliar producer (U-U)

Not so long before she died, my great-grandmother met Needham in the street.
I heard that she often read Needham when she had the time.

Supported metonym, unfamiliar producer (S-U)

My great-grandmother has all the novels written by Needham in her library.
I heard that she often read Needham when she had the time.

Literal, unfamiliar producer (L-U)

My great-grandmother confessed that she once kissed Needham on the cheek.
I heard that she often met Needham when she had the time.

Unsupported metonym, familiar producer (U-F)

Not so long before she died, my great-grandmother met Dickens in the street.
I heard that she often read Dickens when she had the time.

Supported metonym, familiar producer (S-F)

My great-grandmother has all the novels written by Dickens in her library.
I heard that she often read Dickens when she had the time.

Literal, unfamiliar producer (L-F)

My great-grandmother confessed that she once kissed Dickens on the cheek.
I heard that she often met Dickens when she had the time.

Second, there should be an effect of *sense familiarity*, in accord with Frisson and Pickering (1999). Whereas the literal and metonymic senses of *Dickens* are familiar, only the literal sense of *Needham* is familiar in the unsupported metonym condition (U-U) as *Needham* has been used to refer to a person in the context sentence. Assuming that familiar metonyms are lexicalised but that unfamiliar metonyms are not, and that any lexicalised sense can be accessed straightforwardly, we predict an effect of sense familiarity, with difficulty with the second mention of *Needham* in (U-U) versus (L-U), but no difficulty with the second mention of *Dickens* in (U-F) versus (L-F). These four conditions (i.e., excluding S-U and S-F) are comparable to Frisson and Pickering (1999) (with *Dickens* corresponding to *Vietnam* and *Needham* to *Finland*), and this finding would therefore extend their findings to a different type of metonymy. Just as Frisson and Pickering found delayed effect of difficulty with *Americans protested during Finland*, we predict that effects of sense familiarity will also be delayed in the current experiment, emerging during re-reading of *Needham*.

Finally, and most interestingly, if participants immediately use the contextual information of *Needham* being a producer in (S-U), then the novel product sense of *Needham* should be an acceptable interpretation in *read Needham* given the producer-for-product rule. Assuming that the difficulty with an unsupported *Needham* (U-U) occurs during late processing, we predict that the difference between the unsupported (U-U) and the supported (S-U) metonymic interpretation will also occur during late processing.

EXPERIMENT

Method

Participants. Forty-two native British English-speaking students from the University of Glasgow were paid to participate. All had normal or corrected-to-normal vision.

Items. We constructed 24 two-sentence texts like in Table 1; see Appendix. A range of different types of familiar producer were used (novelists, scientists, artists, musicians, etc.). Names of familiar versus unfamiliar producers were matched for length.

Familiarity pretest. Twenty-one further participants were presented with a list of names; 96.6% of these participants knew the people referred to by the familiar names (e.g., *Dickens*) and what they were famous for (minimum 81.0%), and 8.4% of participants knew anyone that the less familiar names (e.g., *Needham*) referred to (maximum 19.0%).

Sense frequency. We randomly selected 25 instances of each of the 24 familiar names in the experiment from the British National Corpus. A classification revealed that the names were used literally 85.3% of the time (range 48–100%); note that we excluded references to other people with the same name (e.g., *Mrs. Dickens*), where uses were almost entirely literal.

Design. Each participant saw four items from each of the six conditions, and exactly one version of each item (and no participant saw any name in more than one item). Forty-six filler texts were included that did not contain familiar names or metonyms. Items were presented in a fixed random order. The two sentences of the critical items were presented together on separate lines.

Procedure. We monitored the movements of participants' right eyes during reading using a Fourward Technologies Dual Purkinje Generation 5.5 eye-tracker (angular resolution: 10 min arc). Items were displayed on a VGA colour screen 77 cm from participants' eyes (4 characters per degree of visual angle). Gaze location was monitored every millisecond, and the software sampled the tracker's output to determine the time and location of fixations. The experimenter calibrated before the experiment and performed a check before each item. Participants were instructed to read at their normal rate for comprehension and were kept in place with a bite bar and head restraint. A yes-no question (without feedback) followed half the sentences (accuracy 81.9%).

An automatic software procedure pooled short contiguous fixations. Fixations that were less than 80 ms and within one character of another fixation were incorporated into one larger fixation. Fixations of less than 40 ms and not within one character space of another fixation were deleted as, presumably, readers hardly extract any information during these short fixations (see Rayner & Pollatsek, 1989). We set the lower cutoff value at 120 ms, and upper cutoff value at 1200 ms for first-pass reading time, and at 2500 ms for total reading time. We decided to use these slightly higher cutoffs because of the peculiar spelling and low frequency of some of the names.

Data analysis. We analysed the time spent reading the name in the first sentence (*name 1 region*) and the second sentence (*name 2 region*). As we were interested in contrasting early and late processing, we measured first-pass time (time fixating a region before leaving that region, either to the right or the left) and contrasted these with second-pass time (time spent fixating that region after having fixated to the right of that region) and total reading time (the total amount of time spent in a region; see Rayner & Pollatsek, 1989). Trials with major track losses and trials on which 2 consecutive regions were skipped were excluded (5.4% of the data). We report ANOVAs treating participants (F_1) and items (F_2) as random effects, with the relevant factors

as within-participants and -items factors. On the participants' analysis, two missing cells for the first-pass measures on the first name region were replaced by the means for the relevant conditions. Analyses without these replacements did not change the significance of the results.

RESULTS

We tested the three predictions in turn. Table 2 presents an overview of the reading times using participants' means.

Name familiarity tests whether an unfamiliar name like *Needham* is read more slowly than a familiar name like *Dickens*. These tests involve comparing the three conditions containing a familiar name (U-F, S-F, L-F) with the three conditions containing an unfamiliar name (U-U, S-U, L-U). Name familiarity immediately affected processing, with more time being spent on the unfamiliar than familiar producers for both the name 1 region: first-pass time difference of 38.7 ms: $F_1(1, 41) = 11.00, p < .01$; $F_2(1, 23) = 8.73, p < .01$, and the name 2 region: first-pass time difference of 20.9 ms: $F_1(1, 41) = 10.47, p < .01$; $F_2(1, 23) = 4.04, p < .06$.¹ In fact, this effect was already apparent in the very first fixation in these regions (all $ps < .05$) and was also found in the second-pass (all $ps < .01$) and the total reading times (all $ps < .01$).

Sense familiarity tests whether, in the absence of a supporting context, an unfamiliar sense like the product sense of *Needham* in *read Needham* requires extra processing effort while a familiar sense like the product sense of *Dickens* in *read Dickens* does not. In order to test the effect of sense familiarity, we performed 2 Name (familiar vs. unfamiliar) \times 2 Sense (unsupported metonym vs. literal) ANOVAs (i.e., comparing U-F, L-F, U-U, and L-U). The second-pass reading times for the name 2 region revealed a marginal interaction, $F_1(1, 41) = 3.17, p = .08$; $F_2(1, 23) = 3.64, p < .07$. Planned comparisons demonstrated that the familiar metonymic sense was as easy as the literal sense ($ts < 1$), but the unfamiliar metonymic sense was harder than the literal sense, difference: 47.3 ms, $t_1(41) = 2.67, p = .01$; $t_2(23) = 3.48, p < .01$. Though total time did not show a significant interaction on the name 2 region, $F_1(1, 41) = 2.00, p > .10$; $F_2(1, 23), p > .10$, the means comparisons indicated a difference between the unfamiliar metonymic sense and its literal counterpart, with the literal sense being read 61.9 ms faster, $t_1(41) = 2.67, p = .01$; $t_2(23) = 3.01, p < .01$, and no difference between the familiar metonymic and literal sense ($ts < 1$). No effects emerged on first-pass time ($Fs < 1$).

¹ This 2 (Name: Familiar vs. Unfamiliar) \times 3 (Context Type: Unsupported vs. Supported vs. Literal) ANOVA revealed no effect of Context Type, $F_1(2, 82) = 1.08, p > .34$; $F_2(2, 46) = 1.46, p > .24$ and no interaction, $F_1(2, 82) = 1.21, p > .30$; $F_2(2, 46) < 1$.

TABLE 2
First-pass, second-pass, and total reading times

	<i>Condition</i>					
	<i>Unsupported metonym – unfamiliar name (U-U)</i>	<i>Supported metonym – unfamiliar name (S-U)</i>	<i>Literal – unfamiliar name (L-U)</i>	<i>Unsupported metonym – familiar name (U-F)</i>	<i>Supported metonym – familiar name (S-F)</i>	<i>Literal – familiar name (L-F)</i>
First-pass						
Name 1	417.4 (16.6)	383.1 (18.4)	392.3 (16.9)	369.6 (14.7)	348.5 (17.4)	358.6 (13.8)
Name 2	295.0 (9.7)	299.4 (10.7)	288.0 (12.1)	285.8 (11.2)	262.8 (9.2)	271.4 (8.6)
Second-pass						
Name 1	156.9 (23.9)	169.1 (34.7)	157.9 (24.5)	95.0 (24.9)	91.7 (27.8)	68.9 (14.1)
Pre-name 2	196.1 (28.8)	153.3 (28.6)	116.9 (28.2)	103.5 (14.7)	106.3 (27.4)	107.5 (22.4)
Name 2	115.2 (26.1)	70.8 (19.2)	67.9 (16.4)	56.3 (15.4)	49.3 (17.8)	52.6 (17.2)
Total time						
Name 1	588.6 (37.3)	583.4 (44.4)	551.2 (32.1)	464.7 (30.0)	444.3 (38.8)	429.8 (21.8)
Pre-name 2	555.0 (30.7)	465.8 (30.3)	436.2 (30.8)	423.0 (19.5)	448.5 (29.5)	422.0 (29.9)
Name 2	414.5 (28.7)	391.1 (23.3)	352.6 (20.2)	345.6 (20.8)	313.2 (21.0)	330.2 (21.2)

Notes: Reading times are in milliseconds. Standard errors are in parentheses. Name 1 = reading times for the name (e.g., *Needham*) in the first (context) sentence. Name 2 = reading times for the name in sentence 2. Pre-name 2 = the region before the name in sentence 2 that helped constrain the interpretation of Name 2 (e.g., *read*).

We also analysed a region (labelled *pre-name region* in Table 2) just before this second name region which contained material that would constrain the interpretation of the name (e.g., the verb). It was defined as the previous word if five characters or more, and the two preceding words otherwise. We hypothesised that readers would re-read this constraining information more often if the name could not be easily integrated with it, and hence examined only the second-pass and total time data. The same factorial design for second-pass reading times revealed a significant interaction, $F_1(1, 41) = 6.30$, $p < .05$; $F_2(1, 23) = 7.16$, $p < .05$, with no difference between the unsupported metonymic and literal senses of a familiar name ($ts < 1$), but with the unsupported metonymic sense of an unfamiliar name taking 79.2 ms longer than its literal sense, $t_1(41) = 3.04$, $p < .01$; $t_2(23) = 2.45$, $p < .05$. Similarly, a significant interaction emerged on total time, $F_1(1, 41) = 6.64$, $p = .01$; $F_2(1, 23) = 8.63$, $p < .01$, with no difference between the familiar metonymic sense and the familiar literal sense ($ts < 1$), but with the unsupported metonymic sense of an unfamiliar name taking 118.8 ms longer than its literal sense, $t_1(41) = 3.55$, $p < .01$; $t_2(23) = 2.52$, $p = .02$.

Finally, we tested whether the presence of a context containing information that the person is a producer facilitated processing for the novel sense of unfamiliar names. We performed 2 Name (familiar vs. unfamiliar) \times 2 Context (supported vs. unsupported metonym) ANOVAs, together with planned comparisons, to assess whether contextual information was used differently in the unfamiliar name conditions compared with the familiar name conditions. No effects emerged on first-pass time. While the interaction was only suggestive for the second-pass data on the name 2 region, $F_1(1, 41) = 2.12$, $p = .15$; $F_2(1, 23) = 2.86$, $p = .10$, planned comparisons showed that when the novel metonymic sense was supported by context, the name was reread less often than when it was not [S-U vs. U-U: difference: 44.4 ms, $t_1(41) = 2.53$, $p < .05$; $t_2(23) = 2.36$, $p < .05$]. This context effect was absent for the familiar name conditions (S-F vs. U-F: difference: 7.0 ms, $ts < 1$). The same picture emerged from the total reading time analyses on the pre-name region. This time, the interaction was fully significant, $F_1(1, 41) = 9.53$, $p < .01$; $F_2(1, 23) = 7.40$, $p = .01$, with planned comparisons showing a beneficial effect for the unfamiliar name conditions when preceded by a supportive context, S-U vs. U-U: difference: 89.2 ms, $t_1(41) = 3.10$, $p < .01$; $t_2(23) = 1.77$, $p = .09$, but no effect for the familiar name conditions, S-F vs. U-F: difference -25.5 ms, $t_1 < 1$; $t_2(23) = -1.32$, $p = .20$. Hence, when the name was unfamiliar, a single mention of the producer was enough to admit a producer-for-product sense. To see whether the novel sense was processed in the same way as its established counterpart, we conducted 2 Name (familiar vs. unfamiliar) \times 2 Sense (supported metonym vs. literal) ANOVAs (i.e., comparing S-F, L-F, S-U, and L-U) on the name 2 region. No interaction emerged on first-pass time ($F_s < 1$), second-pass time ($F_s < 1$), or total time, $F_1(1, 41) = 3.25$, $p = .08$;

$F_2 < 1$. Similarly, means comparisons between the supported metonymic and literal conditions (S-U vs. L-U) revealed no effects for first-pass time ($t_s < 1$), second-pass time ($t_s < 1$), or total time, $t_1(41) = 1.90$, $p = .06$; $t_2(23) = 1.07$, $p > .29$. Hence, we could detect no special difficulty with unfamiliar metonymic senses when context supported the unfamiliar sense (i.e., when context rendered the unfamiliar metonymic sense familiar).

We also performed second-pass and total time analyses treating Half (first vs. second half) of the experiment as an additional (within-participants and between-items) factor to determine whether the relatively frequent use of the producer-for-product rule (16/70 trials) led to an experiment-specific strategy for processing references to unfamiliar producers. However, the interactions between Half and Condition were non-significant (all $F_s < 1$, both on the pre-name and the name 2 region), indicating comparable reading patterns in both halves of the experiment.

DISCUSSION

Our results show that (1) unfamiliar names are harder to process than familiar names; (2) a familiar metonym is processed as fast as a literal interpretation but an unfamiliar metonym is not; and (3) the presence of an appropriate context, in combination with a metonymic rule, can facilitate the processing of an unfamiliar metonym. The first finding is presumably closely related to the well-established frequency effect in eye-movements (Rayner & Duffy, 1986).² The second finding generalises the findings of Frisson and Pickering (1999) to producer-for-product metonymy and has clear implications for theories of figurative language processing. For example, literal-first models (Grice, 1975, 1989; Searle, 1979), which maintain that one always tries to obtain a literal interpretation first before attempting a figurative one, cannot explain why no differences were found between the established metonymic and the literal sense of the same word. Similarly, as the familiar producers were almost six times more likely to appear in the literal sense than the figurative sense, any model that maintains that sense frequency is an integral part of the sense selection procedure will have difficulties explaining these results (and, *a fortiori*, the results of the novel metonymic senses with supporting context). The absence of a frequency effect also supports the finding that words with multiple senses are processed differently from words with multiple meanings, with clear effects of frequency bias for the latter but

² A possible concern is that there could be a sense-specific repeated name penalty, which would cause more difficulty in the literal condition than the metonymic condition. But this account is incompatible with Frisson and Pickering (1999), who found no difficulty with the first mention of familiar metonyms versus literal senses.

not the former (Duffy, Morris, & Rayner, 1988; Frazier & Rayner, 1990; Pickering & Frisson, 2001; though see Klein & Murphy, 2001, 2002, for a different view of how senses are *represented*).³

Our most striking finding concerns the processing of a novel sense. Difficulty with *reading Needham* was reduced drastically simply by referring to novels written by Needham, and hence implying that Needham is a writer. Note that *Needham* was used to refer to the person itself in the context sentence (as was the case in the unsupported contexts), hence the novel product sense had not been established yet and readers cannot merely have accessed this sense. To our knowledge, this is the first evidence that a novel interpretation of a word can be processed on-line without any noticeable extra effort.

Our data differ from Chaffin et al.'s (2001) experiments on the processing of a novel word in two respects. First, while they found longer rereading times indicating a lingering cost for learning a novel word in a constraining context, the novel senses in our experiment, when preceded by a supporting context, did not engender such a cost. This suggests that a novel, though systematically related, sense of an existing word can be learned or comprehended more easily than an entirely novel word. Second, whereas Chaffin et al. (2001) found an immediate cost on the definitional associate, *the instrument*, for a novel word *asdor* in a neutral context, we did not detect any immediate effects on the second mention of the name, except for a name familiarity effect. As we have argued, we suggest that this difference occurs because Chaffin et al.'s readers do not know what an *asdor* is, and hence referring to an *asdor* as *the instrument* appears incongruous. In contrast, our readers know that *Needham* refers to a person. Note that readers may have previously known some of the names referring to unfamiliar producers (e.g., *Needham*) but not known others (e.g., *Ambrogini*). However, the context sentence in all conditions made it clear that the names referred to people.

The verb *read* requires a complement that refers to an object or objects that can be read. We propose that readers assess whether the complement can refer to suitable objects or not. As the established metonymic sense of *Dickens* refers to such objects, readers can select this sense (possibly via the initial activation of a meaning that is underspecified for sense; see Frisson & Pickering, 1999, 2001). *Needham* does not have an established metonymic sense that refers to such objects, but readers know that many names can refer to products, because the producer-for-product rule is very prolific. They therefore initially assume that *read Needham* is coherent. They then search for an existing object sense. But this search fails, and leads to delayed

³ It is also possible that this effect in part reflects a tendency to use bare surnames to refer to more familiar people, so that *Dickens* is more felicitous than *Needham* (given that 19 out of 24 items use bare surnames).

difficulty with *read Needham*. At this point readers might infer, on the basis of the metonymic producer-for-product rule, that the name must refer to a writer that they have never heard of. In contrast, when contextual information indicates that Needham is a producer, readers apply the producer-for-product rule, and thus extend the meaning of *Needham*. Hence they experience no difficulty with *read Needham*.

It is not entirely clear when exactly the rule-application occurs. One possibility is that this happens when the need arises. In this case, application would occur at *read Needham*, because it then becomes clear that the product sense of *Needham* is required. However, the rule application might also have happened earlier: once readers have the information that someone is a producer, they can 'place' it together in conceptual space with other, well-known producers like Dickens. Since there exists a systematic relationship between producers and their products, Needham will inherit this property so that the product sense will be set up automatically. The linguistic representation of Needham will then be expanded so that it now becomes compatible with both senses. In this view, the producer-for-product rule is a description or formalisation of systematic patterns found in the conceptual structure.⁴

In conclusion, our findings of straightforward processing of a novel, rule-derived sense of an existing word in a supporting context indicate that sense extension is not necessarily more costly than sense selection and that it is possible to access a novel sense of a word before processing (and rejecting) all existing senses. They suggest that sense extension can be straightforward, and that people need not experience difficulty understanding novel senses that are systematically related to existing senses.

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⁴ On a slightly different account, it might also be possible to interpret our data in the context of mental models (e.g., Garnham, 1987; Johnson-Laird, 1983). On this account, *books by Needham* would set up an entry for Needham in this model, with the associated information that Needham is a writer. The metonymic rule would be applied within this model, so that the model would also include an entry for Needham's writings, and it would be possible to refer to this entry using *Needham*.

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APPENDIX: EXPERIMENTAL ITEMS

For each item, then Unsupported metonym conditions appear first, followed by the Supported metonym conditions, followed by the Literal conditions. The familiar names come before the ‘|’ mark; the unfamiliar names come after the ‘|’ mark. The / marks delimit the regions of analysis.

1. One of the strengths of/ Darwin | Henley/ was his profound knowledge of many things. Nowadays, people make/ use of/ Darwin | Henley/ in different scientific domains.

The ideas of/ Darwin | Henley/ on evolution have had a huge impact on science in general. Nowadays, people make/ use of/ Darwin | Henley/ in different scientific domains.

One of the strengths of/ Darwin | Henley/ was that he often asked for more information. For example, someone had to/ explain to/ Darwin | Henley/ the workings/ of the eye.

2. It is said that the extravagant lifestyle of/ Dali | Burt/ was just one big act. A rich friend of mine, who/ collects/ Dali | Burt/, is convinced of this.

It is said that the abstract paintings by/ Dali | Burt/ are amongst the best ever. A rich friend of mine, who/ collects/ Dali | Burt/, is convinced of this.

It is said that the extravagant lifestyle of/ Dali | Burt/ was just one big act. A rich friend of mine, who/ befriended/ Dali | Burt/, is convinced of this.

3. Born in a wealthy family,/ Descartes | Covington/ had much time to debate issues with people. People who/ studied/ Descartes | Covington/ at length tended to accept the arguments.

A number of the philosophical texts by/ Descartes | Covington/ deal with the existence of God. People who/ studied/ Descartes | Covington/ at length tended to accept the arguments.

Once over dinner,/ Descartes | Covington/ complained about the utter incompetence of the King. People who/ listened to/ Descartes | Covington/ at length tended to accept the arguments.

4. Apparently,/ Pavarotti | Ambrogini/ must have amassed an enormous personal fortune by now. According to statistics, shops have /already sold/ Pavarotti | Ambrogini/ by the million.

All records by/ Pavarotti | Ambrogini/ are of a high quality and his voice is exceptional. According to statistics, shops have/ already sold/ Pavarotti | Ambrogini/ by the million.

Apparently,/ Pavarotti | Ambrogini/ is reported to have evaded paying tax on his huge income. According to the newspapers, the state has/ fined/ Pavarotti | Ambrogini/ many millions.

5. John is fascinated by the decadent lifestyle of Oscar | Walter/ Wilde | Reece/ and his friends. In fact, he thumbs/ through/ Wilde | Reece/ each night when he gets home.

John always loves to read the witticisms by Oscar | Walter/ Wilde | Reece/ and his friends. In fact, he thumbs/ through/ Wilde | Reece/ each night when he gets home.

John watched the movie that tells the story of Oscar | Walter/ Wilde | Reece/ many times. In fact, he talks a bit/ more like/ Wilde | Reece/ each time I see him somewhere.

6. Honestly, I am not that interested in/ Freud | Levin/ or other people like him. Indeed, I find/ explaining/ Freud | Levin/ to fellow students quite a chore.

I honestly think that the theories of/ Freud | Levin/ do not make that much sense. Indeed, I find/ explaining/ Freud | Levin/ to fellow students quite a chore.

Someone told me once that/ Freud | Levin/ did not like undergraduates that much. Apparently,/ chatting with/ Freud | Levin/ about them was a waste of time.

7. Not long after she became a mother,/ Madonna | Lucinda/ went back to work. The company that/ distributes/ Madonna | Lucinda/ now also handles all the press contacts.

The new CD by/ Madonna | Lucinda/ did extremely well in North America. The company that/ distributes/ Madonna | Lucinda/ now also handles all the press contacts.

Not long after she became a mother,/ Madonna | Lucinda/ went back to work. The company that was set/ up by/ Madonna | Lucinda/ did very well during her absence.

8. Mr. Frost, one of my father's friends, is a descendant of/ Chopin | Henley/, I believe. He claimed that he first/ performed/ Chopin | Henley/ in public when he was not yet ten.

Mr. Frost won a major prize with a piano piece written by/ Chopin | Henley/, I believe. He claimed that he first/ performed/ Chopin | Henley/ in public when he was not yet ten.

My wife's grandfather was a close personal friend of/ Chopin | Henley/, I believe. He claimed that he often/ played with/ Chopin | Henley/ in the park when they were young.

9. Because of his outspoken political views, George/ Orwell | Sander/ was not liked by many. My father, who/ translated/ Orwell | Sander/ into Dutch, shares the same opinions.

Due to their controversial topics, novels by George/ Orwell | Sander/ are often discussed. My father, who/ translated/ Orwell | Sander/ into Dutch, shares the same opinions.

It is not a well-known fact that George/ Orwell | Sander/ was an excellent journalist. My father, who/ worked with/ Orwell | Sander/ once, still talks very highly of him.

10. Not so long before she died, my great-grandmother met/ Dickens | Needham/ in the street. I heard that she/ often read/ Dickens | Needham/ when she had the time.

My great-grandmother has all the novels written by/ Dickens | Needham/ in her library. I heard that she/ often read/ Dickens | Needham/ when she had the time.

My great-grandmother confessed that she once kissed/ Dickens | Needham/ on the cheek. I heard that she/ often met/ Dickens | Needham/ when she had the time.

11. A lot of people considered/ Picasso | Carlson/ to be one of the most eccentric individuals. Maybe that is why hardly anyone dared to/ exhibit/ Picasso | Carlson/ for many years.

Many people thought the paintings of/ Picasso | Carlson/ depicted the absurdity of mankind. Maybe that is why hardly anyone dared to/ exhibit/ Picasso | Carlson/ for many years.

A lot of people considered/ Picasso | Carlson/ to be one of the most eccentric individuals. Maybe that is why hardly anyone dared to/ phone/ Picasso | Carlson/ for many years.

12. The old thief wanted to learn all the biographical details of/ Renoir | Simons/ from me. This man, who also specialised in/ forging/ Renoir | Simons/, got caught yesterday.

The old thief heard almost all the details of the paintings by/ Renoir | Simons/ from me. This man, who also specialised in/ forging/ Renoir | Simons/, got caught yesterday.

The old thief wanted to learn all the biographical details of/ Renoir | Simons/ from me. This man, who claimed to be a/ descendant of/ Renoir | Simons/, got caught yesterday.

13. That snob repeatedly claimed that W. B. I M. G./ Yeats | Hodge/ was an extremely boring figure. But I was told that he/ re-reads/ Yeats | Hodge/ whenever he has the chance.

That snob claims that he hates the poetry of W. B. | M. G./ Yeats | Hodge/ and other famous poets. But I was told that he/ re-reads/ Yeats | Hodge/ whenever he has the chance.

That man claims that he has never had a meeting with W. B. | M. G./ Yeats | Hodge/ or his friends. But I was told that he/ dined with/ Yeats | Hodge/ whenever he had the chance.

14. My dad knows everything about the life of/ Shakespeare | Cuthbertson/ and is totally fascinated. Once, he was/ reciting/ Shakespeare | Cuthbertson/ in a loud voice when a dog jumped at him.

The actor learned lots of lines from plays by/ Shakespeare | Cuthbertson/ at the drama school. Once, he was/ reciting/ Shakespeare | Cuthbertson/ in a loud voice when a dog jumped at him.

King James consulted with many people, including/ Shakespeare | Cuthbertson/ and his wife. Once, he was/ speaking to/ Shakespeare | Cuthbertson/ in a loud voice when a dog jumped at him.

15. Before he retired, the old professor often went to see/ Einstein | Levinson/ at his home. But at university, he/ simplified/ Einstein | Levinson/ so that his students could follow.

The professor really understood the scientific theories of Einstein | Levinson/ in detail. But at university, he/ simplified/ Einstein | Levinson/ so that his students could follow.

It was sometimes difficult to get hold of/ Einstein | Levinson/ when he was working at home. In fact, no-one was allowed to/ bother/ Einstein | Levinson/ when he was in his office.

16. Ed has an enormous admiration for/ Mozart | Simons/, but does not talk about such things. But he was elated when he was asked to/ conduct/ Mozart | Simons/ on Christmas Day.

Ed interprets the compositions by/ Mozart | Simons/ in his own, uncharacteristic way. But he was elated when he was asked to/ conduct/ Mozart | Simons/ on Christmas Day.

As the chef of the court, Tom served people like/ Mozart | Simons/, but often felt uneasy. But he was elated when he was asked to/ socialise with/ Mozart | Simons/ on Christmas Day.

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17. It is certainly true that/ Hitchcock | Redington/ adored all kinds of mysteries. When they last/ scheduled/ Hitchcock | Redington/ at the local cinema, it was a huge success.

Almost all movies directed by/ Hitchcock | Redington/ have become real classics. When they last/ scheduled/ Hitchcock | Redington/ at the local cinema, it was a huge success.

My godparents were close friends of/ Hitchcock | Redington/ for a number of years. When they last/ invited/ Hitchcock | Redington/ over for dinner, it was a huge success.

18. Everyone acknowledges that the way/ Bach | Dunn/ structured his work is very complicated. Even the most talented people have to/ practise/ Bach | Dunn/ more than once a week.

Some difficult pieces were composed by/ Bach | Dunn/ after he was employed at the court. Even the most talented people have to/ practise/ Bach | Dunn/ more than once a week.

Whenever he was working on something new,/ Bach | Dunn/ did not like to be disturbed. Even the most talented people were forbidden/ to see/ Bach | Dunn/ more than once a week.

19. The opinion of Salman | Martin/ Rushdie | Needham/ is that free speech is a fundamental right. However, the company that/ publishes/ Rushdie | Needham/ was asked to retract his books.

The novels by Salman | Martin/ Rushdie | Needham/ have been awarded some major prizes. However, the company that/ publishes/ Rushdie | Needham/ was asked to retract his books.

The opinion of Salman | Martin/ Rushdie | Needham/ is that free speech is a fundamental right. However, some people tried/ to kill/ Rushdie | Needham/ because of his writings.

20. My grandmother can tell you everything about the life of/ Vivaldi | Carlson/, if you want. Whenever/ they play/ Vivaldi | Carlson/ on Classic FM, she starts crying a bit.

My grandmother adores the type of music written/ Vivaldi | Carlson/, but I do not. Whenever/ they play/ Vivaldi | Carlson/ on Classic FM, she starts crying a bit.

During her long and happy marriage, the wife of/ Vivaldi | Carlson/ stayed in the shadows. Every time/ she told/ Vivaldi | Carlson/ how much she loved him, she cried a bit.

21. My girlfriend told me that/ Verdi | Bower/ put his heart and soul in his work. It is true that whenever she/ sings/ Verdi | Bower/ to me, I get goosebumps.

In my girlfriend's opinion, operas by/ Verdi | Bower/ are the best of all time. It is true that whenever she/ sings/ Verdi | Bower/ to me, I get goosebumps.

My girlfriend admits that I look like/ Verdi | Bower/ when he was young. It is true that whenever she/ mentions/ Verdi | Bower/ to me, I get goosebumps.

22. I was impressed by the thoroughness of/ Aristotle | Patterson/, and by his sharp analyses. Whenever I can, I browse/ through/ Aristotle | Patterson/ to find some stimulating ideas.

I think the best philosophy is in the works by/ Aristotle | Patterson/, and many people agree. Whenever I can, I browse/ through/ Aristotle | Patterson/ to find some stimulating ideas.

Inhabitants of that city admired men like/ Aristotle | Patterson/, and held them as examples. Whenever they could, they/ asked/ Aristotle | Patterson/ for his opinion on something.

23. A lecture was planned about/ Monet | Reece/ and his peculiar method of working. The plan was to/ display/ Monet | Reece/ and some others all at the same time.

That museum has bought some works by/ Monet | Reece/ and other painters. The plan was to/ display/ Monet | Reece/ and some others all at the same time.

It is a fact that/ Monet | Reece/ preferred to be alone as much as possible. No-one dared to/ intrude upon/ Monet | Reece/ when he was busy working.

24. The man from the shop is fascinated by/ Michelangelo | Ellingsworth/ and his contemporaries. Now he makes money by/ reproducing/ Michelangelo | Ellingsworth/ at a low price.

The man from the shop studied the paintings by/ Michelangelo | Ellingsworth/ and a contemporary. Now he makes money by/ reproducing/ Michelangelo | Ellingsworth/ at a low price.

Many rich merchants were acquainted with/ Michelangelo | Ellingsworth/ and his closest friends. Sometimes, they went/ to see/ Michelangelo | Ellingsworth/ to ask for his advice.