PART II

Psychological reality

The psycholinguistic reality of collocation and semantic prosody (2)

Affective priming

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1. Introduction

Corpus linguistics has clearly demonstrated that natural language makes considerable use of recurrent patterns of words and larger constructions. Lexical context is crucial to knowledge of word meaning and grammatical role. One type of pattern is *collocation*, described by Firth (1957) as the characterization of a word from the words that typically co-occur with it. Sinclair (1991: 100), summarized the results of corpus investigations of such distributional regularities in the *Principle of Idiom:* "a language user has available to him or her a large number of semi-preconstructed phrases that constitute single choices, even though they might appear to be analyzable into segments," and suggested that for normal texts, the first mode of analysis to be applied is the idiom principle, as most of text is interpretable by this principle. Kjellmer (1987: 140) reached a similar conclusion: "In all kinds of texts, collocations are indispensable elements with which our utterances are very largely made". Erman & Warren (2000) estimate that about half of fluent native text is constructed according to the idiom principle. Comparisons of written and spoken corpora suggest that collocations are even more frequent in spoken language (Biber, Johansson, Leech, Conrad & Finegan 1999; Brazil 1995; Leech 2000).

Collocations are patterns of preferred co-occurrence of particular words, like *blazing row* and *heated dispute* (but not *heated row* or *blazing dispute*). Other patterns, deriving from generalization across collocations, are more abstract. *Semantic prosody* refers to the general tendency of certain words to co-occur with either negative or positive expressions, "the consistent aura of meaning with which a form is imbued by its collocates" (Louw 1993: 157). A famous example, by Sinclair, is *set in*, which has a negative prosody: *rot* is a prime exemplar for what is going to set in. *Cause* (something causes an accident/catastrophe/other negative event), *commit* (suicide, crime, offence), and *happen* (things go along smoothly, then 'something happens', shit happens) similarly have a negative semantic prosody. These patterns come from usage – there are no defining aspects of the meaning of *cause*, *commit*, or *happen* which entails that they will take negative rather than positive objects. Hoey (2005) refers to such generalizations when a word or word sequence is associated in the mind of a language user with a semantic set or class as *semantic association*.

Corpus linguistic and cognitive linguistic analyses of the phenomena of collocation, formulaic language, semantic prosody, and other aspects of phraseology in language *texts* demonstrate how lexis, grammar, meaning and usage are inseparable ~~(Ellis in press, 2008;~~ Granger & Meunier 2008; Hunston & Francis 1996; Robinson & Ellis 2008; Sinclair 1991, 2004). Such observations have naturally provoked inferences about language *users* and about the cognitive processes of meaning, speech production and comprehension. The statement of the *Principle of Idiom* is a good example, others include:

1. Meaning by collocation is an abstraction at the syntagmatic level and is not directly concerned with the conceptual or idea approach to the meaning of words. One of the meanings of *night* is its collocability with *dark*… (Firth 1957: 196)
2. In the store of familiar collocations there are expressions for a wide range of familiar concepts and speech acts, and the speaker is able to retrieve these as wholes or as automatic chains from the long-term memory; by doing this he minimizes the amount of clause-internal encoding work to be done and frees himself to attend to other tasks in talk-exchange, including the planning of larger units of discourse… (Pawley & Syder 1983: 192).
3. … for a great deal of the time anyway, language production consists of piecing together the ready-made units appropriate for a particular situation and … comprehension relies on knowing which of these patterns to predict in these situations. (Nattinger 1980: 341).

(4) Every word is primed for use in discourse as a result of the cumulative effects of an individual's encounters with the word. If one of the effects of the initial priming is that regular word sequences are constructed, these are also in turn primed… The(se) are claims about the way language is acquired and used in specific situations. (Hoey 2005: 13)

(5) Corpus-based analysis can throw light on the nature and extent of collocational bonding between words… In addition, data of the kind considered here can reveal something of the cognitive processes which lie behind language learning and use, and which enable us to become fluent language users, and it is these insights which can be among the most satisfying of all. (Kennedy 2003: 485)

But these statements overstep the data. While there is no denying that texts have been produced by language users, and thus must somehow reflect their thinking, corpus analyses say nothing about the cognitive loci of sensitivity of language users to these patterns of co-occurrence. The analysis of whether word recognition and lexical access, semantic activation, and the processes of production of speech and writing are sensitive to collocations and the more abstract schemata potentially derivable from them is an empirical matter, one that falls into the domain of investigation of psycholinguistics.

Psycholinguistic research broadly confirms language users' sensitivity to various distributional aspects of orthographic, phonological, morphological and syntactic form (Ellis 2002a, 2002b, ~~in press, 2008~~): There are effects of bigram frequency in visual word identification and of phonotactic knowledge in speech segmentation, effects of spelling-to-sound correspondences in reading, and cohort effects in spoken word recognition. There are effects of neighbors and the proportion of friends (items which share surface pattern cue and have the same interpretation) to enemies (items which share surface pattern but have different interpretations) in reading and spelling, morphology, and spoken word recognition. At higher levels, it can be shown that language comprehension is determined by the listeners' considerable knowledge of the statistical behavior of the lexical items in their language. In comprehending language, people make use of their knowledge of the relative frequencies with which individual verbs appear in different tenses, in active vs. passive structures, and in intransitive vs. transitive structures, the typical kinds of subjects and objects that a verb takes, and many other such facts, and thus they perceive the most probable syntactic and semantic analyses of a new utterance on the basis of frequencies of previously perceived utterance analyses (Seidenberg 1997). In production too, language users tend to generate the most probable utterance for a given meaning on the basis of frequencies of utterance-representations. Thus it has been argued that "Psycholinguistics is the testament of rational language processing and the usage model" (Ellis 2005, 2006).

Nevertheless, psycholinguistic research also identifies a wide variety of largely separable processes of language cognition (Altman 1997; Gernsbacher 1994), and it demonstrates that these are *differentially* affected by factors such as type and token frequency, phonological, orthographic, morphosyntactic, grammatical and pragmatic consistency of pattern, cohort density and consistency, word class, imageability, age of acquisition, etc. (Harley 1995; Levelt 1989). Our research program therefore investigates the degree to which various broad neighborhoods of language processing are affected by these patterns of collocation and semantic prosody identified by corpus linguists. We use the processing divisions illustrated in Figure 1 – word recognition and lexical access, semantic processing, and speech production – and determine whether these are separately sensitive (1) to particular patterns of collocation, and (2) to the abstract generalizations of semantic prosody, in order to determine the psycholinguistic reality of these textual phenomena. This is a large enterprise and we have therefore attacked it piecemeal.

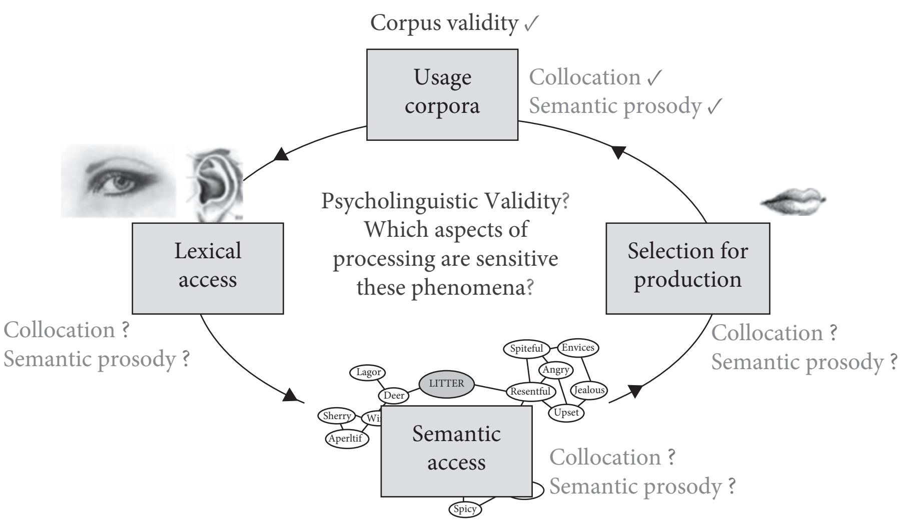

Figure 1. The bounds of investigation: To what extent are these different psycholinguistic processes sensitive to the separate corpus-valid phenomena of collocation and semantic prosody?

The first stage of our work (Ellis, Frey & Jalkanen in press) investigated the effects of these phenomena upon lexical access. We found that processing in a lexical decision task, where two letter strings were presented simultaneously and the participant had to decide whether both were words or not (Meyer & Schvaneveldt 1971), was clearly sensitive to patterns of usage of booster/maximizer-adjective and verb argument collocations. Native speakers were quicker to decide that *blameless* was a word when it followed a frequent collocate like *entirely,* or *mauled* following *badly*, than when the same pool of words was re-sorted as controls which contained the same words combined randomly, thus removing the sequential patterning of English collocational usage (e.g., *badly blameless, entirely mauled*) while nevertheless maintaining sense and grammaticality. They were similarly faster to decide that *maturity* was a word when it followed a frequent verb collocate like *attain* than they were when it followed a non-collocate like *cause*. Given that the lexical decision task minimally requires word recognition and access to the lexicon, we concluded that these processes are tuned by experience of particular collocations in usage, so that higher frequency collocations are more readily perceived than lower-frequency ones. The language recognition system tallies the co-occurrence of these particular words in usage (Ellis 2002a) and so tunes itself accordingly to preferentially process them as collocations on future encounters. But this research also showed that the same paradigm which so readily showed sensitivity to particular collocations failed to demonstrate generalization – people were no faster at judging that *good* was a word when preceded by a verb like *attain* that did not specifically collocate with it, but which nevertheless was strongly of a matching semantic prosody. Thus we concluded that there were no top-down generalizations upon the level of processing required for lexical access.

The current experiment therefore extends the investigation of semantic prosody deeper into the system (Figure 1) by determining the degree to which it might affect semantic access.

Our measure of semantic prosody was grounded in the work of Kjellmer (2005) whose analyses of patterns of collocation of English verbs in the BNC allowed him to identify twenty verbs that were strongly negative in their semantic prosody (e.g., *cause*: something causes an accident/catastrophe/other negative outcome) and twenty strongly positive verbs (e.g., *achieve*: one achieves objectives/goals/success/other positive outcomes). We took these verbs as candidate stimuli and then operationalized various corpus statistics measuring direction and strength of semantic prosody, as described in the method section below, in order to determine the degree to which fluency of semantic access is affected by prosodic valence.

Our investigation of semantic processing was based on the affective priming paradigm, a psycholinguistic technique for investigating implicit positive or negative attributions. Fazio, Sanbonmatsu, Powell, and Kardes (1986) reasoned that a priming effect similar to that found with lexical decision should also be apparent for automatic evaluative attitudinal semantics. Presentation of an attitude object (any object – *spider*, *alcohol*, *The President*, or whatever) as a prime should activate any associated evaluations and, hence, facilitate a related judgment. The paradigm that Fazio et al. (1986) developed, and that has been commonly employed since, involved participants' performance on an adjective connotation task. The target word presented on each trial is an evaluative adjective (any adjective, for example, *pleasant*, *frightening*, *corrupt, incompetent*) and participants are instructed to indicate whether the word is positive or negative as quickly as possible. The focus of these experiments was on the latency with which this judgment is made and, in particular, the extent to which it is facilitated by the presentation of an attitude object as a prime. In three experiments, Fazio et al. (1986) found evidence of automatic attitude activation. Responding was faster on trials for which the participants' evaluations of the primed attitude objects were congruent with the connotation of the targets than on trials for which they were incongruent. For example, if the attitude object *pain* is evaluated negatively by an individual, then presentation of *pain* as the prime automatically activates the negative evaluation. If a subsequently presented target adjective is also negative (e.g., *disturbing*), then the individual is able to indicate the connotation of the target adjective relatively quickly, more so than if a positive adjective (e.g., *appealing*) serves as the target word. Subsequent research (De Houwer & Hermans 2001; De Houwer, Hermans, Rothermund & Wentura 2002; Fazio 2001; Hermans, De Houwer & Eelen 1994) shows this to be a robust phenomenon, although the size of the effect does vary as a result of stimulus exposure times and their stimulus onset asynchrony (SOA), stimulus type (words, pictures, etc.), and the nature of the response (evaluation, naming, etc.). For evaluative categorization, brief SOA's reveal stronger priming effects (Hermans, De Houwer & Eelen 2001). The subsequent lore of affective priming research using evaluative responses for word stimuli has it that it is best to use SOAs of 150 or 200 ms., i.e., to present primes for 150 or 200 ms. and have the target immediately following prime offset (without an inter-stimulus interval), to use an external response box since keyboards can introduce a lot of error in the latencies, and to register response latencies as well as error data and to analyze them as a composite measure because effects are often distributed over these two dependent variables.

The current experiment thus used an affective priming task to measure the speed and accuracy with which participants rate a target word as generally positive (pleasant) or negative (unpleasant), and to see if reaction time and accuracy were affected by the degree to which a prime matched the target in semantic prosody. A composite measure of these two dependent variables (AccSpeed) was made by summing the standarized scores for accuracy and speed, with positive values of the composite AccSpeed measure reflecting good performance and negative values reflecting bad performance. We predicted that target words with a positive valence would be processed faster and more accurately after verbs with positive semantic prosody than those with a negative semantic prosody, and conversely, that words with a negative valence would be processed faster and more accurately after verbs with a negative semantic prosody than verbs with a positive semantic prosody.

A related question of interest, that of Firth (1957) quoted above, concerned the dissociable contributions of conceptual and syntagmatic knowledge to semantics.

Propositional meaning, perceptual reference, and syntagmatic usage provide three different sources of word meaning. (1) *Propositionally*, a dog is, by definition, a canine, any of various fissiped mammals with nonretractile claws. (2) *Referentially*, the word *dog* automatically awakens perceptual memories, sights, touches, smells, and these imagery associations affect our understanding. Words with high imageability are represented not only propositionally but also in an imagery code, as "sensory images awakened" (James 1890). "Concrete terms such as *house* readily evoke both images and words as associative (meaning) reactions, whereas abstract words such as *truth* more readily arouse only verbal associations. The meaning of the latter is primarily intraverbal." (Paivio 1971: 85). Propositional meanings and imagery associations have been shown to be dissociable and additive sources of meaning and memory in a wide range of cognitive psychological (Ellis 1991; Paivio 1990), and brain imaging studies (Pulvermüller 1999), as well as in neuropsychological dysfunction. For example, Warrington (1975; 1981) describes three cases of visual object agnosia where there was impairment in knowledge of pictorial representations of objects from visual presentation *and* from memory, where knowledge of subordinate categories was more vulnerable than superordinate categories ("to refer to the often-quoted example of the *canary*, these patients could correctly categorize it as living, animal, and bird [the attributes of these superordinates still being known] but could not reliably classify it as yellow, small and pet", [1975: 655]; other examples included *bucket* being defined as 'container', but on further questioning no details of its size, weight or function, and *pigeon* -> 'I know it is a bird but not which one'). Given that these symptoms could neither be accounted for by intellectual impairment, sensory or perceptual deficit, or expressive language disorder, Warrington argues that there are two functionally distinct modality-specific meaning systems, i.e., a particular concept, say *canary*, would be represented in two semantic memory hierarchies, the one primarily visual and the other primarily verbal. These cases' cerebral lesions result in their loss of the former while preserving the latter – visually imageable words have become abstract. (3) *Syntagmatically*, the word *dog* also awakens associations with words experienced as its common collocates in language usage, with meaning deriving from the company it keeps with *walk*, *leash*, *vet*, and even *hot*, and *tired* (Firth 1957; Hoey 2005).

Usually, since language describes the world, these three sources of meaning converge, which is why corpus analytic techniques like Latent Semantic Analysis put words into the same meaning space as do more conceptual analyses (Landauer & Dumais 1997). But syntagmatic and paradigmatic evidence do not always align. As already mentioned, *lack* is negatively evaluated yet has a positive semantic prosody in that its collocates are all positive (*lack resources*, *lack money*, *lack experience*), while *arouse* and *cure* are positive in their semantics but of a negative semantic prosody. There follows a variety of interesting psycholinguistic questions relating to the effects on their processing of nice words like *cure* falling into the bad company of *cancer*, *disease*, *ills* and the like.

In this particular study, we hoped to exploit these dissociations to investigate whether affective priming is a conceptual phenomenon arising from matching meanings, or a syntagmatic one stemming from experience of collocations. Thus, we also gathered participants' explicit ratings of pleasantness for the verbs in order to determine whether corpus-derived semantic prosody measures or subjective evaluations of the emotional valence were better predictors of affective priming.

In summary, our specific goal was to determine whether fluent language users have implicit knowledge of semantic prosody that is automatically brought to bear as a top-down facilitative influence in the semantic processing of language input which accords to these usage norms.

2. Experiment: The effects of a verb's semantic prosody on semantic processing

2.1 Method

2.1.1 *Participants*

The experiment involved 15 adult volunteers (9 male, 6 female) recruited from the student population of the University of Michigan-Ann Arbor. They were native speakers of English aged around 20 years (M = 20.9, SD = 1.7). They were paid $10 for their participation.

2.1.2 *Materials*

Verbs judged to have strong positive and negative semantic prosody were selected as follows. Kjellmer (2005) analyzed 20 positive and 20 negative semantically prosodic verbs and described methods of determining their degree by assessing their most frequent collocates and the relative numbers of these that were positive or negative. After he kindly sent us a draft list of these verbs, we developed these operationalizations further. Each usage of these verbs was determined in the British National Corpus (BNC) using Davies' (2007) interface (http://corpus.byu.edu/bnc/): (1) All collocates following the verb within 3 words were extracted. We recorded the frequencies of the verb, the frequencies of the words with which it collocated, and the frequencies of the particular collocations themselves. We ordered the latter by decreasing frequency. (2) For all collocations with token frequency >= 2, or the top 500 most frequent of these if more than that, two independent raters judged each collocate for whether they thought it was positive, neutral, or negative. These raters, one of whom is the second author of this study, were undergraduates studying topics in psychology, linguistics, and anthropology. Interpretation of words out of context is variable; this indeed is the central theme of the Idiom Principle and of constructional/phraseological approaches to language, thus there was some variability in these judgments. Nevertheless, the two raters showed enough accord to warrant continuation: the inter-rater agreement was 79% for the positive items, and 85% for the negative items. For each verb we then summed the number of positive, negative, and neutral collocates and computed a variety of indices of prosodic valence and strength, including the total number of collocate types of the verb's valence, the percentage of overall collocate types that were of its valence, and its ratio of positive to negative collocate types. Pooling these various indices, we selected ten strongly positively semantically prosodic of the original verb set: *restore, attain, live, achieve, guarantee, advise, grant, gain, regain, lend*, and ten strongly negative: *wreak, inflict, contract, battle, commit, provoke, wage, suffer, cause, cure*. These and their collocation analyses are shown in Table 1.

Table 1. Determination of semantic prosody

	Frequency (per million words)					
Prime	**as verb**	**all tokens**	**Semantic prosody valence**	**Total n collocates of that valence**	**% of all collocates of that valence**	**Ratio +/– collocates**
attain	452	452	+	41	37	13.7
cause	5738	12876	–	568	57	0.1
lack	1009	9871	+	121	41	11.0
cure	521	1472	–	55	72	0.0
gain	3663	5137	+	316	32	5.1
suffer	3421	3421	–	400	58	0.1
guarantee	1435	3911	+	108	30	8.3
fight	3871	6706	–	194	30	0.4
grant	1294	7594	+	106	32	3.3
provoke	588	588	–	74	51	0.1
restore	1648	1648	+	197	26	7.0
encounter	667	1670	–	12	29	0.2
lend	1254	1254	+	42	24	6.0
ease	1078	3020	–	120	49	0.1
achieve	6715	6715	+	321	32	6.2
contract	505	11882	–	26	30	0.3
secure	2773	4548	+	250	32	6.4
commit	1339	1341	–	78	44	0.1
emphasize	654	654	+	57	24	4.1
arouse	310	310	–	26	41	0.3

Each of these twenty verbs were then combined with various other words as stimuli for an affective priming task based on the paradigm of Fazio et al. (1986) and De Houwer et al. (2002) in which participants were briefly presented a prime followed by a target noun, which they were asked to rate as either positive or negative.

Some of the paired items involved specific collocates of the verbs. These included matched pairs (made with the two most common collocates of the polarity of the particular prime, e.g., *attain-goals, attain-maturity, cause-problems, cause-damage*) and two mismatched pairs (made with the two most common collocates of a prime of opposite polarity, e.g., *attain-problems, attain-damage, cause-goals, cause-maturity*). This generated a total of 80 prime-target pairings, with 40 'positive' responses and 40 'negative' responses (see Table 2).

Table 2. Prime-target pairings with the top collocates

	Matched collocates		Mis-Matched collocates	
Prime	**Target 1**	**Target 2**	**Target 1**	**Target 2**
attain	goals	maturity	problems	damage
cause	problems	damage	goals	maturity
lack	confidence	resources	problems	disease
cure	problems	disease	confidence	resources
gain	access	understanding	loss	damage
suffer	loss	damage	access	understanding
guarantee	success	safety	war	battle
fight	war	battle	success	safety
grant	permission	relief	crisis	violence
provoke	crisis	violence	permission	relief
restore	confidence	pride	problems	difficulties
encounter	problems	difficulties	confidence	pride
lend	hand	support	pain	burden
ease	pain	burden	hand	support
achieve	success	growth	cancer	disease
contract	cancer	disease	success	growth
secure	knowledge	access	suicide	offence
commit	suicide	offence	knowledge	access
emphasize	importance	value	suspicion	controversy
arouse	suspicion	controversy	importance	value

To assess semantic prosody/association rather than specific collocation, each verb was also paired with four generalization items of positive valence (*good, benefit*, *virtue,* and the emoticon J, generating, e.g., the polarity matching *attain-good,* *attain-benefit, attain-virtue, attain-J* and mismatching *cause-good, cause-benefit, cause-virtue,* and *cause-J*), four generalization items of negative valence (*bad, harm*, *evil*, and L generating, e.g., the polarity mismatching *attain-bad, attain-harm*, etc. and matching *cause-bad, cause-harm,* etc.). This created a total of 160 prime-target pairings, with 80 'positive' responses and 80 'negative' responses.

In all, the experiment thus involved 240 prime-target pairings. During the task, presentation consisted of one prime-target pairing at a time, and trials were randomized for each participant to avoid potential order effects.

The present paper concerns semantic prosody and so we need to restrict our analyses to participants' performance *on generalization items only*. It is important that we are not looking at effects of specific collocation. Therefore we went back to the BNC and checked for any particular occurrences of collocation between our verbs and the generalization items *good, benefit*, *virtue, bad, harm*, and *evil* in a 3 subsequent word window. Whenever such collocations were evident (e.g., 36 occurrences of *gain + benefit*), we removed this pair from the analysis. There were 37 collocation types so identified. All the analyses in this paper are therefore restricted to the 123 prime-target trials which involve novel verb-object pairings that are not found in the BNC.

2.2 Procedure

The task was programmed in E-prime (Schneider, Eschman & Zuccolotto 2002) running under Windows XP on standard desktop PCs. SuperLab response boxes were used as the input device, allowing participants' reaction times to be recorded with millisecond accuracy.

Upon arrival at the lab, participants were briefed about the nature of the experiment (to investigate people's knowledge of the ways words combine in English phrases) and asked to sign a consent form. They were instructed as follows: "On each trial you will see a word on the computer screen followed by a colored target word. Your task is to judge whether this colored word is positive or negative. You will be asked to do this as quickly and accurately as possible by pressing the relevant key on the keyboard". There followed an initial practice session of 12 verb-object/prime-target pairings consisting of non-study words. This gave participants a chance to get used to the requirements of the task. The experiment instructions were shown again before the main session of 240 prime-target trials began. The task measured how fast and accurately participants judged a target word (e.g., *goals, confidence*) to be generally positive (pleasant) or negative (unpleasant), and assessed whether they did this faster when it was primed by a verb of the matching valence of semantic prosody (e.g., *attain-goals*, *lack-confidence, cause-evil*) than by a mismatching one (e.g., *attain-problems*, *lack-disease, cause-benefit*). On each trial, the verb prime was presented for 200 ms, followed immediately by a target word to be rated as either positive (1) or negative (2) on the SR box. They were given a maximum of 2000 ms to input an answer. A brief pause followed each response with an on-screen message reading "Press SPACE BAR to Continue" so that they could rest between trials as they felt appropriate. The trial sequence is illustrated in Figure 2. The program recorded individual reaction times (in milliseconds) and accuracy of response. In order to combine accuracy and reaction time into one measure (AccSpeed), we standardized the reaction time and accuracy data. Standardized variables (z-scores) have a mean of zero and a standard deviation of 1. High values of the standardized accuracy measure reflect good performance. High values of RT reflect bad performance, and so the z-scores on RT were multiplied by –1 to turn them into a speed measure. A composite measure was then made by summing the z-scores for accuracy and the z-score for speed. Thus positive values of the composite AccSpeed measure reflect good performance and negative values reflect bad performance.

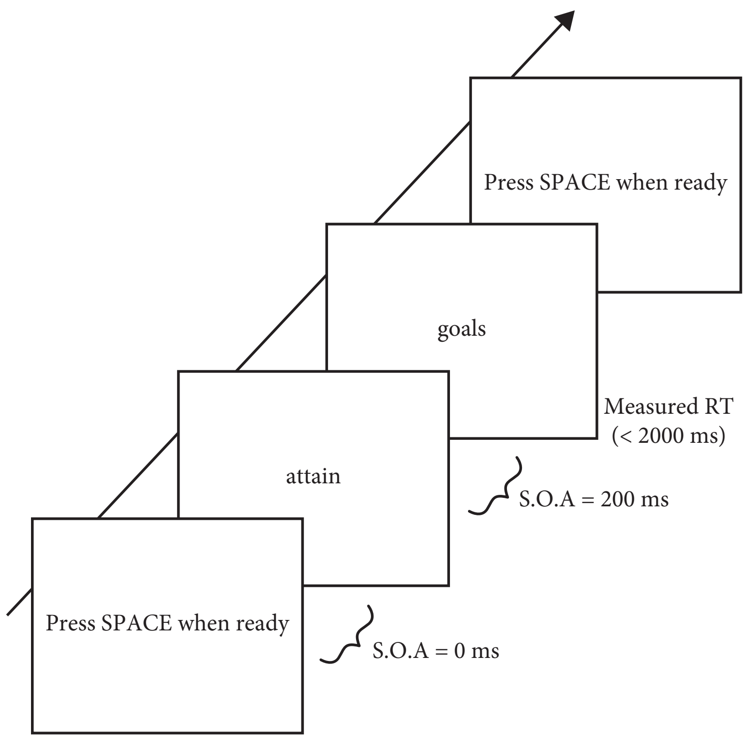

Figure 2. Sequence of presentation in affective priming task.

In a supplemental task after the main experiment, participants were asked to rate the 20 verb primes on a nine point scale of pleasantness from most positive (+4) to most negative (–4). The verbs were presented individually mid-screen in randomized order and the participants were given as long as they wished to consider and rate them. These explicit ratings indexed the degree to which respondents assessed the verbs to be emotionally positive or negative in their conceptual meaning.

Our four specific questions, which direct the sections of the Results section, were as follows:

Question 1. To what extent are semantic prosody and conceptual meaning associated, and to what extent can they be dissociated? In our discussion of lexical semantics, above, we identified the separate contributions of syntagmatics (collocation and semantic prosody) and reference. In our experiments we separately measured these – the syntagmatics in the corpus analyses, the referential aspects in respondents' explicit evaluations of verb pleasantness. Regression analyses can thus be used to determine the degree to which these two measures are associated.

Question 2. Are there measurable effects of the semantic prosody of verbs upon speed and accuracy of semantic processing of subsequent words in an affective priming task? Regression analyses can investigate the association between semantic prosody and reaction time and, separately, between semantic prosody and AccSpeed. Effects of congruence between prime and target in the affective priming task should show themselves as high values on AccSpeed when the negative generalization items (*bad, harm*, *evil*, and ☹) are primed by more negative semantic prosody verbs, and decreasing AccSpeed when these negative targets are primed by verbs of increasing positive semantic prosody. Equally, there should be low values of AccSpeed when positive generalization items (*good, benefit*, *virtue,* and ☺) are primed by verbs of more negative semantic prosody, and increasing AccSpeed values the more positive the semantic prosody of the verbs. These predictions are illustrated in the top panel of Figure 5. The predicted slope is negative for the negative generalization items and positive for the positive generalization items. The critical test of semantic prosody effects, therefore, is whether these two regression lines are of opposite sign and differ significantly from each other.

Question 3. Are there measurable effects of the conceptual evaluations of verbs upon speed and accuracy of semantic processing of subsequent words in an affective priming task? As for Question 2, the test of congruence is whether there is greater AccSpeed when more negatively evaluated verbs precede negative generalization items and when more positively evaluated verbs precede positive generalization items. The critical tests is again whether there is a significant slope difference between these two graphs.

Question 4. Are there *independent* affective priming effects of semantic prosody and conceptual meaning? This question involves the determination of whether semantic prosody explains additional variance in AccSpeed beyond conceptual evaluation, and vice versa. Hierarchical regression analysis is the appropriate technique here. Thus, for example, step 1 might involve the regression of AccSpeed upon conceptual evaluation and then, with this relationship statistically controlled, step 2 could test whether there is significant extra prediction of AccSpeed if semantic prosody is then entered into the equation.

2.3 Results

2.3.1 *The relationship between semantic prosody and conceptual meaning*

In order to assess the relationship between semantic prosody, as operationalized in our corpus analyses, and subjective explicit evaluations of conceptual meaning, we averaged the participants' ratings of the verbs' pleasantness in the supplemental tasks and plotted these against two measures of semantic prosody. The top panel of Figure 3 shows the relationship with the absolute number of positive or negative collocates where there is a strong positive relationship between conceptual meaning and semantic prosody (= 0.57, $p < .001$, $R^2 = 0.32$). The bottom panel shows the relationship with the percentage of total collocations which were positive or negative; again the relationship is positive and significant (= 0.29, $p < .001$, $R^2 = 0.08$). It is clear that, for the present sample of 20 verbs at least, semantic prosody and conceptual meaning are positively associated, although there are odd exceptions to this rule, particularly ***cure***, a positively evaluated word which is of negative semantic prosody, and ***lack***, a negatively evaluated word that is of strong positive semantic prosody.

2.3.2 *The effect of semantic prosody on affective priming*

We operationalized affective priming in two ways, firstly in terms of effects upon response time, and secondly, since effects can be distributed across both latency and accuracy, upon their composite measure AccSpeed.

Response time. For each verb prime we calculated the mean reaction time for all positive generalization items minus the mean speed rating for all negative generalization items. Thus, greater priming of positive targets results in a more negative value, greater priming of negative targets in a more positive value, and little, if any priming benefit results in a mean value close to zero.

The top panel of Figure 4 shows the association with the absolute number of positive or negative collocates, where there is a negative relationship between semantic prosody and RT Mean difference ($\beta = -0.36$, $R^2 = 0.13$, n.s.). The bottom panel shows the association with the percentage of total collocations which were positive or negative; again the relationship is negative ($\beta = -0.27$, $R^2 = 0.07$, n.s.).

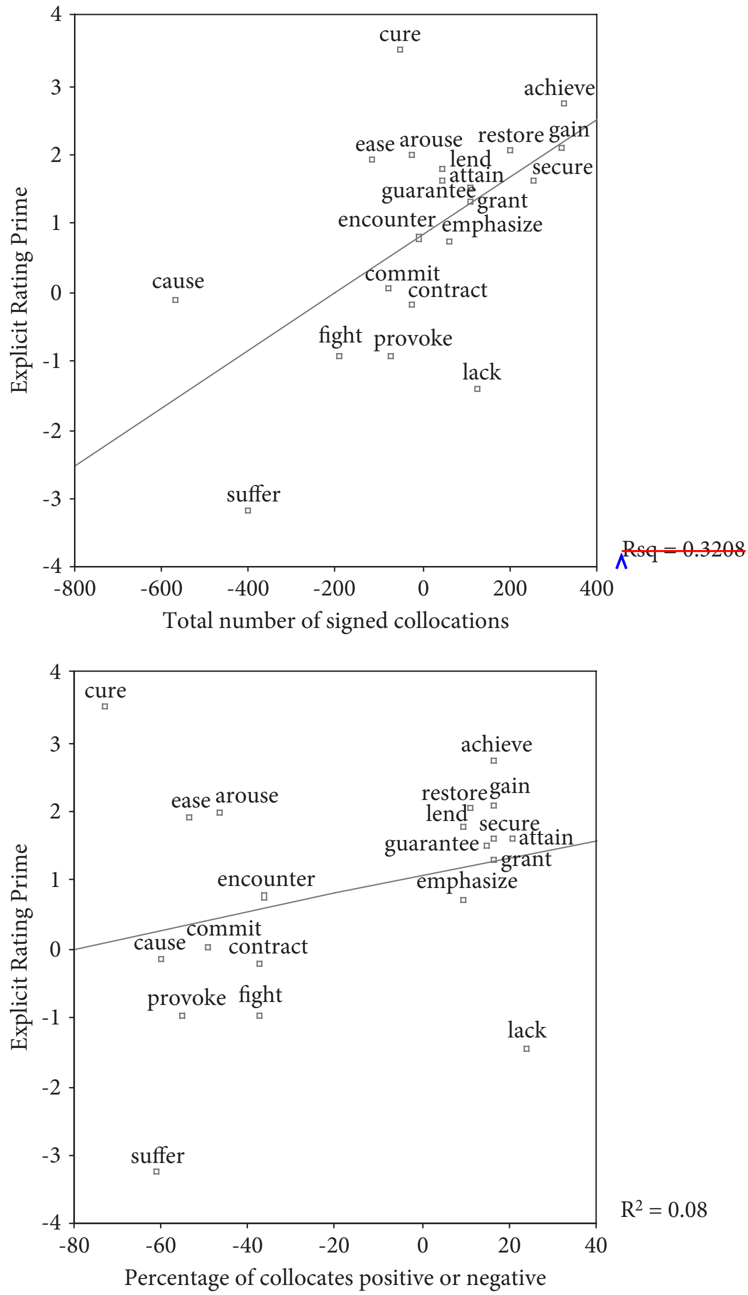

Figure 3. The relationship between participants' explicit ratings of the pleasantness of the verbs and their semantic prosody as defined (top) as the number of positive (negative) collocates in the BNC, or (bottom) the percent of collocates which were positive (negative).

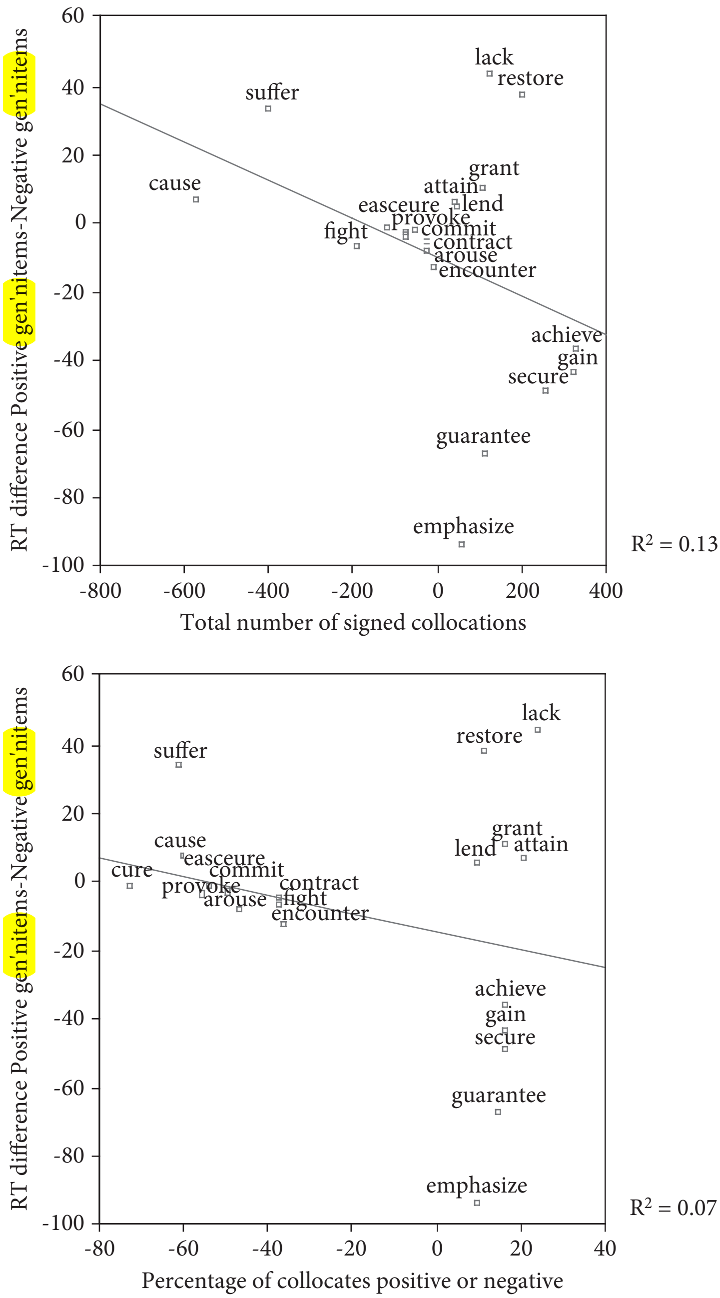

Figure 4. The mean difference of reaction times (ms.) between positive generalization items and negative generalization items plotted as a function of two different indices of semantic prosody: total number of signed collocates (top), percentage of signed collocates (bottom). Points labeled by prime.

In both analyses, as the number positive collocates increases, so does the priming advantage for positive targets over negative targets; equally, as the number of negative collocates increases, so there is a priming advantage of negative targets over positive ones. However, despite explaining 13% and 7% of the variance in RT difference respectively, neither of these regressions reaches significance.

Response time and accuracy composite. As explained above for Question 2 and illustrated above the graphs in Figure 5, the test of congruence is whether there is greater AccSpeed when verbs of more negative prosody precede negative generalization items and when verbs of more positive semantic prosody precede positive generalization items.

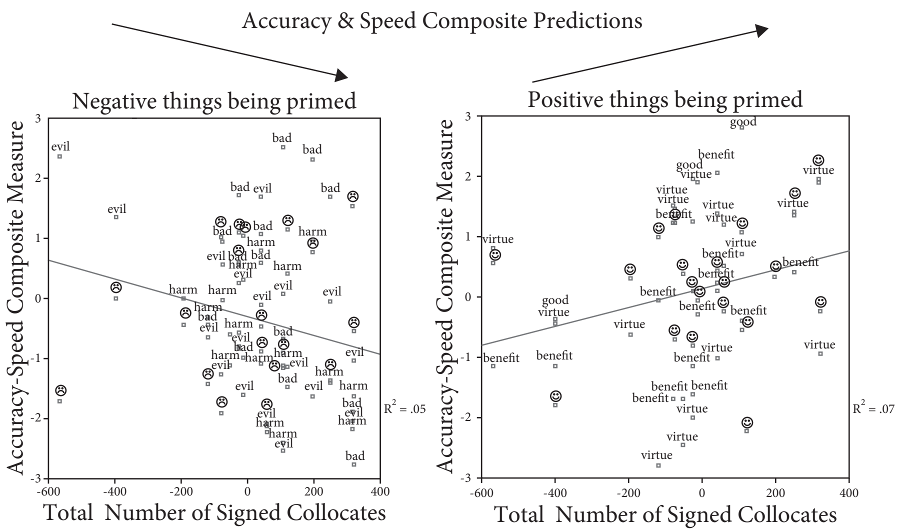

Figure 5. Accuracy and Speed in evaluating "Negative" generalization targets (left panel) and "Positive" generalization targets (right panel) as a function of the semantic prosody of the prime measured as total number of signed collocates.

The graphs in Figure 5 follow the predicted patterns of affective priming for semantic generalizations, for both positive and negative generalized items. For the negative generalization items (left panel), a linear regression shows a negative correlation between the composite accuracy-speed score, AccSpeed, and increasingly positive semantic prosody ($\beta = -0.22$, $p = 0.07$), explaining roughly 5% of the variance. For the positive generalized items, linear regression shows a positive correlation between strength of positive semantic prosody and AccSpeed ($\beta = .26$, $p = .06$), explaining about 7% of the variance.

The major test of our predictions is whether the slopes of the two regression lines, that for the negative and positive generalization items, differ significantly from each other. We tested the difference between these two correlations following the procedure outlined in Howell (1982: 197–198) and this was indeed the case ($z = 2.67$, $p < .01$).

These data thus demonstrate affective priming results where the affective valence of the prime (in this case determined by semantic prosody of the verb) is, in the interpretation of Fazio et al. (1986), automatically awakened upon its presentation. Remember that in this task participants did not have to rate the prime, indeed they were not oriented to the primes at all and there was no systematic relationship between primes and target since the design had them match and mismatch in valence 50 % of the time following a random, unpredictable, schedule. Nevertheless, on trials where prime and target matched in valence, accuracy and speed was superior to that when they mismatched.

These results suggest that the affective value of a verb prime is automatically and quickly (it is at least initiated within 200 ms.) activated, thus to facilitate the semantic evaluation of subsequent words. Given that the affective value of the verb primes here is defined corpus linguistically in terms of the percentage of overall collocation objects of the verb that were positive (or negative), we conclude that semantic prosody has psychological reality in that the semantic prosody of a verb is automatically accessed and its spreading activation automatically affects the processing of subsequent material.

2.3.3 *The effects of conceptual meaning upon affective priming*

While there is no denying the effects observed in Section 2.3.3, there is still the possibility that they are attributable to a confounding source. In the introduction we discussed the tendency for syntagmatic and conceptual relations to be positively associated. This should come as no surprise since language evolved to describe the world. Thus, nice words tend to go with nice words, just as the nice things they relate to tend to co occur. As we showed in Section 2.3.1, this applied to our sample too, with the correlation between corpus-derived measures of semantic prosody and participants' conscious evaluations of whether words are conceptually positive or negative being $r = 0.57$, $p < .001$.

Could it be, therefore, that it is the conceptual meaning of the primes that is driving affective priming rather than their semantic prosody?

In order to determine this, we ran the same analyses as in Section 2.3.2, but with the participants' evaluations of the affective valence of the verbs as the predictor variable rather than their semantic prosody. The results are shown in Figure 6.

The graphs in Figure 6 also follow the predicted patterns of affective priming for semantic generalizations, for both positive and negative generalized items. For the negative generalization items (left panel), a linear regression shows a negative correlation between the composite accuracy-speed score, AccSpeed, and increasingly

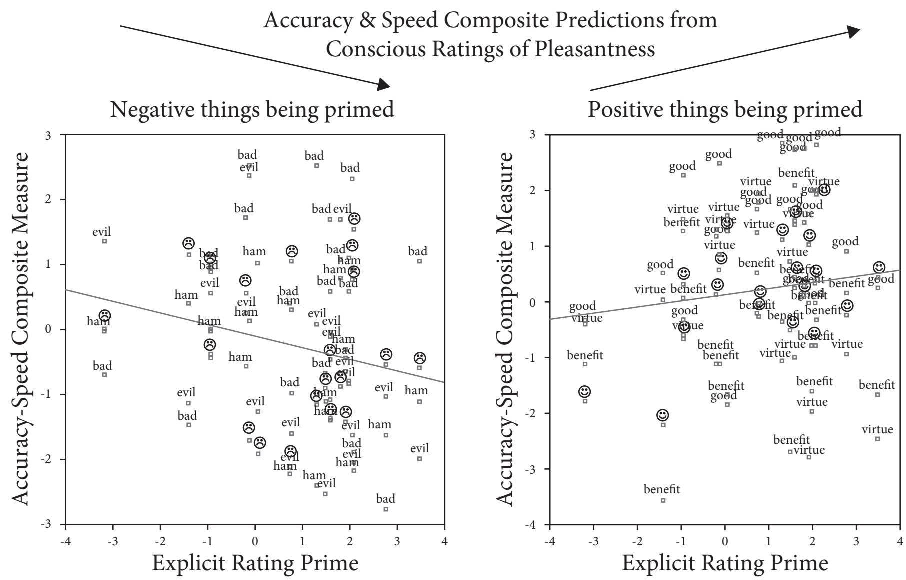

Figure 6. Accuracy and Speed in evaluting "Negative" generalization targets (left panel) and "Positive" generalization targets (right panel) as a function of the Participant's consciously considered conceptual evaluation of the prime as measured in the subsidiary task.

positive semantic prosody ($\beta = -0.21$, $p = 0.09$), explaining roughly 4% of the variance. For the positive generalized items, linear regression shows a marginally positive correlation between strength of positive semantic prosody and AccSpeed ($\beta = .01$, ns), although this fails to differ significantly from a slope of zero.

As with the semantic prosody results, here too the two correlations, that for the negative generalization items and that for the positive ones, differ significantly from each other, albeit only just so ($z = 1.67$, $p < .05$ one tailed).

2.3.4 *Direct comparisons of conceptual meaning and semantic priming*

Combined analyses. It is possible to align the combined accuracy and speed data for the positive and negative generalization items, simply by multiplying those for the negative generalization items by –1. Then the data for all 123 generalization trials where there were no actual collocations between the prime and target in the BNC can be analyzed at once. When we do this we see that semantic prosody (signed N +/ –) correlates with aligned AccSpeed $r = 0.25$, $p < .01$), and that explicit rating correlates with aligned AccSpeed $r = 0.16$, $p = .08$).

We used hierarchical stepwise regression to determine whether semantic prosody or explicit rating were independently associated with AccSpeed. When semantic prosody was entered first in a multiple regression equation predicting aligned AccSpeed as the dependent variable it was a significant predictor ($\beta = 0.25$, $p < 0.01$) and stepwise regression failed to enter explicit rating at a second stage. However, when explicit rating was entered first ($\beta = 0.16$, $p = 0.08$), explaining only .025 of the variance in AccSpeed, stepwise regression entered semantic prosody at a second stage ($\beta = 0.25$, $p = 0.01$) with this second model explaining .062 of the overall variance in AccSpeed. This additional variance explained by semantic prosody on top of that provided by explicit rating was significant at $p < .05$.

3. Conclusions

The primary aim of this experiment was to investigate the degree to which native language users are sensitive to semantic prosody in their language processing. In the affective priming task Section 2.3.4, the accuracy and speed with which participants judged target words to be semantically positive or negative was consistently superior when these were primed by verbs of a matching rather than mismatching valence of semantic prosody. In the combined analyses of Section 2.3.4, semantic prosody correlated with aligned AccSpeed $r = 0.25$, $p < .01$. The standard interpretation of affective priming (Fazio et al 1986) is that the affective value of the prime is implicitly and automatically activated, thus to facilitate the semantic evaluation of the subsequent target. Given that the affective value of the verb primes in this experiment were defined corpus linguistically in terms of the percentage of overall collocation objects of the verb that were positive (or negative), we must conclude that the corpus-derived concept has psychological reality in that the semantic prosody of a verb is automatically, implicitly, and quickly (it is at least initiated within 200 ms.) accessed and its spreading activation automatically gives top-down support in the semantic processing of subsequent material that accords with usage norms.

We also observed that the 'aura of meaning' imbued upon words by their collocates is usually in accord with their conceptual meaning – people usually evaluate words of positive semantic prosody as pleasant, and words of negative semantic prosody to be unpleasant. In our small sample in Section 2.3.1 the correlation was $r = 0.57$, $p < .001$. It is a challenge therefore to disentangle the contributions of these two sources of meaning and this important confound raises the general need for caution in the interpretation of any effects of corpus derived measures of semantic prosody.

Given the inseparability of grammar and lexis, and that of grammar and meaning, as corpus linguistic, cognitive linguistic, and phraseological analyses have so pervasively demonstrated (e.g., Conklin & Schmitt 2007; Ellis ~~in press;~~

Ellis, Simpson-Vlach & Maynard in press), it should come as no surprise that a word's semantic prosody is entangled with its conceptual meaning. Nevertheless, there are good theoretical motivations for trying to disentangle their effects at different levels of psycholinguistic processing. When we directly assessed the effects of conceptual meaning upon accuracy and speed in the affective priming tasks we obtained a correlation between participants' explicit ratings of verb pleasantness and aligned AccSpeed $r = 0.16$, $p = .08$, only marginally significant. Furthermore, the stepwise regressions of Section 2.3.4 demonstrate that while semantic prosody has significant effects upon AccSpeed above those of explicit rating, the reverse is not true. Comparing these two causal variables in this experiment, therefore, we must conclude that semantic prosody has both a numerical and statistically significant edge over conceptual meaning in its effects upon the semantic processing of subsequent words in this affective priming task.

Ellis, Frey & Jalkanen (in press) found that lexical decision was sensitive to patterns of collocation, and thus concluded that processes of word recognition and lexical access are tuned by experience of combinations of particular words in usage, so that higher probability collocations are more readily perceived than lower-frequency ones. The language recognition system tallies (Ellis 2002a) the co-occurrence of these particular words in usage and tunes itself accordingly to preferentially process them as collocations on future encounters. Thus the corpus linguistic phenomenon of collocation is psycholinguistically real, evidencing itself in processing as early as word recognition.

But lexical decision was not sensitive to semantic prosody – Ellis, Frey and Jalkanen (in press) could identify no such top-down effects upon processes of word recognition. However, the current experiment gives credence to the psycholinguistic reality of this corpus linguistic phenomenon too: there are effects of semantic prosody, albeit later in processing, at semantic access.

Such psycholinguistic validation of phraseological analyses has important consequences for our understanding of language as a dynamic system (Bybee & Hopper 2001; de Bot, Lowie & Verspoor 2007; Ellis 2007,2008; Ellis & Larsen Freeman 2006; Larsen-Freeman 1997; MacWhinney 1999) wherein there are rich interactive effects of language use, language processing, language learning, and language structure. Usage shapes our construction of mental grammars, mental lexicons and meaning (Goldberg 2006; Hoey 2005; Langacker 2000; Robinson & Ellis 2008; Tomasello 2003). Language users have an extensive implicit knowledge of particular language sequences. The mental lexicon (Elman 2004) and the mental grammar (Spivey 2006) are entirely dynamic and contextualized, with processing ever sensitive to the sequential dependencies experienced in usage (Christiansen & Chater 2001; Ellis 2002a; Seidenberg & MacDonald 1999).

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Abstract

We investigate the psycholinguistic reality of the corpus linguistic phenomena of collocation and semantic prosody. Ellis, Frey & Jalkanen (in press) used lexical decision tasks to demonstrate that word recognition processes were sensitive to collocation, but not semantic prosody. The current research used an affective priming task to investigate whether semantic prosody affected later stages of semantic processing. Verbs' semantic prosody correlated with conceptual evaluations of their pleasantness. Verbs positive or negative in semantic prosody caused significant affective priming, effects that were independent of conceptual evaluation. We conclude that people acquire through language usage implicit knowledge of the types of word with which verbs collocate, and this can facilitate subsequent semantic processing of material which accords with these usage norms.