

The Processing of Fixed Expressions During Sentence Comprehension

DIETER HILLERT AND DAVID SWINNEY¹
University of California, San Diego

1. Fixed Expressions -- Issues of Representation and Processing

Understanding language involves recognition and access to not only individual words, but also to a vast array of fixed expressions-idioms, collocations, proverbs, common quotations, names, titles, slogans, song lyrics, etc. The purpose of the present paper is to examine the question of how fixed expressions-particularly those with non-literal interpretations-are understood during on-line sentence comprehension. The work we present examines cases of both truly fixed expressions and those which are deemed somewhat more malleable but still 'idiomatic', with a focus on the processing of these expressions in a language that has a highly productive (active) use of word collocation, particularly for compounds-German. We begin by outlining some general assumptions and issues underlying our work.

To begin with, there is no clear ground upon which to firmly establish definitions of what constitutes a purely 'literal' vs. 'figurative' (non-literal) expression. Such definition ultimately awaits a monolithic (universal and correct) theory of semantics/syntax. Similarly, distinguishing what ate

¹ The authors gratefully acknowledge support from the grant NIH DC02984 to the second author for the work reported herein. Correspondence to dhillert@ucsd.edu or to dswinney@ucsd.edu.

truly fixed expressions vs. expressions with some productive features vs. expressions that are highly productive and malleable is equally problematic, and awaits a universally descriptive theory of language. However, the cases we deal with in the research presented below do not fall on the grey areas of any such descriptive generalizations—we use cases for which there will be wide agreement (backed by empirical data) as to the degree of non-literal and fixedness of interpretation, and we take such clear cases to be important end points in developing a processing theory of figurative expressions. Thus, while we acknowledge the ongoing tension between approaches that hold that 'literal' and 'metaphoric/figurative' processes are different processing *types* vs. simply different endpoints on a single *continuum* of processing, (see, e.g., Clark 1978; Gibbs 1984; Lehrer 1974; Newmeyer 1972; Weinreich 1967 for variations on such approaches) the work we present is intended to be independent of either viewpoint (although it -is designed to illuminate the debate).

Similarly, while much literature has debated the degree of (de)compositionality (or, 'frozenness') inherent in idioms (see, e.g., Frase, 1974; Gibbs and Nayak 1989; Heringer 1976), we accept the problem of heterogeneity among 'non-literal' expressions with regard to current linguistic compositional theory—our approach is independent of (but, again, may shed light on) the resolution of such issues.

One traditional way in which non-literal (figurative) expressions have been treated is as merely one of a heterogeneous bundle of pragmatic phenomenon that are stored and computed outside of 'standard language processing' per se (see, e.g., Katz & Fodor 1963). This view of metaphoric processing has been extended by some theoreticians to include figurative expressions that have become fixed forms (idioms) in the language. Other approaches have assumed such fixed-form expressions to have a representation all their own (whether as part of the language system or not; e.g., Bobrow & Bell 1973). Still other approaches have assumed that fixed-form expressions, whether literal or figurative in interpretation, are simply lexical entries precisely like those assumed for standard literal interpretation of individual words (see, e.g., Di Sciullo & Williams 1987; Swinney & Cutler 1979). Our work is designed to examine certain aspects of this issue.

Finally, in its simplest description, a fixed figurative expression (for simplicity, the term "idiom" will be used hereafter to refer to such an expression) is a string of words for which the interpretation is not (entirely) derived from the individual meanings of the words comprising the string (even if there can be seen some historical linkage of the literal words to the overall expression). Further, this non-literal interpretation has become 'fixed' in the language by use. Thus, the idiom "trip the light fantastic" (meaning, roughly, "to dance") has little relationship to the current individual meanings of the words in that phrase. The work we present in this paper concerns word compounds that have idiomatic meaning. The work will be focused on idiomatic compounds in German, a language that, in contrast

to English, has a highly productive use of compounding in natural language. Thus, the study of these forms in German provides a strong laboratory for examining the operation of a processing device that must deal with both highly literal and highly non-literal compounding of words on a regular basis. We note here that, as in all idioms, an idiom compound's meaning may be: a) entirely independent from the 'literal' meanings of the individual words in the compound, or b) partially related to one of the 'literal' meanings of the compound via either structural or semantic analysis, or c) entirely ambiguous—having both a 'literal' and a 'figurative' meaning.

Consider, for example, the English compound "redhead". This has the structurally decomposable literal meaning involving a head that is red in color (perhaps from sunburn or dye), the partially decomposable meaning of "having hair that is red", and the non-decomposable figurative meaning of "hot tempered"—a meaning derivable only by 'knowledge' of personality features stereotypically associated with persons who have red hair. The latter meaning has come to be 'fixed' by use—and is thus idiomatic. Consider also the English compound "horse-laugh". With the exception of the small class of individuals who deal closely with horses (and who might attribute the human descriptor of laughter to a horse) there is no literal (decomposable or otherwise) interpretation of this compound. Yet the fixed idiom is easily understood to mean a loud annoying (braying) laugh by a human. Overall, we are not primarily concerned here with the compositional origins of a metaphoric derivation of these fixed forms, but we note that it is clear that no single concept of (de)composition will easily work in describing interpretation for such a variety of forms (see, e.g., Lehnert 1986). Relatedly, we want to note that neither representation nor processing of putatively compositional lexical concepts necessarily induces more computational costs than non-decompositional ones (see, e.g., Fodor, Fodor, & Garrett 1975; Fodor, Garrett, Walker, & Parkes 1980), and thus measures of processing *load*, per se, will not be sufficient to differentiate processing models concerning such entities. It will, rather, take direct evidence about the activation (or lack thereof) of various non-literal and literal meanings of individual (and joint) elements in the compounds—and the time-course of their activations—to distinguish among such models. The present work is focused on providing an analysis of the computational processes involved in the interpretation of fixed compound expressions during sentence processing, using on-line measures that are sensitive to the temporal constraints of sentence processing, and which reveal activation of individual words and concepts during such processing.

2. Idiom Processing Accounts

There are two broadly differing accounts of idiom processing, accounts that might best be distinguished as 'literal-meaning-dependent' vs. 'literal-meaning-independent' models. The former all hold that access to idiomatic meanings is, in one way or another, tied to an attempted literal analysis of

the items comprising the idiom. In some approaches, this takes the form of a claim that the perceiver accesses first the literal meaning(s) of the words the idiom is composed of before s/he accesses the non-literal (idiomatic) meaning (e.g., Clark & Lucy 1975; Fraser 1970; Weinreich 1967). In a related approach, it is assumed that there is a separate 'idiom list' (perhaps outside of the lexicon) which will be accessed when the processing of a literal interpretation fails (e.g., Bobrow & Bell 1973). All approaches within this model essentially assert a form of two-stage serial access/processing in which the idiomatic interpretation is achieved only in the second stage. In some cases this two-stage processes is viewed as cascaded (somewhat temporally overlapping), but in all such models, some temporal distinctions between initial literal analysis and later idiomatic analysis all hold. In this approach, idioms are treated much as non-fixed figurative language forms would be.

There are also several types of literal-meaning-independent hypotheses about idiom processing that have been proposed. The lexical representation hypothesis (LRH) holds that idiomatic and literal meanings of words and word compounds are simultaneously activated upon encountering the idiom (see, e.g., Swinney & Cutler 1979). In this, idioms are simply large (multi-segment) words stored in the lexicon much as meaning is stored for any word. Given that the lexical ambiguity literature provides strong evidence that all meanings associated with a word are accessed upon encountering the 'form' of the word (e.g., Ahrens 1998; Seidenberg, Tanenhaus, Leiman and Bienkowski 1982; Swinney 1979; among others), the idiom meaning is accessed along with the other meanings of words-based on complete identification of the form of the word.

In a somewhat different but related view, the "direct access hypothesis" holds that linguistic analysis can be completely bypassed if the perceiver immediately recognizes the relevant expression as an idiom (Gibbs 1980; 1984; 1986). This approach does not specify whether this is considered to be lexical access or not, and it has variants in which semantic and syntactic aspects of idiom use can be considered in the access process. The latter are "idiom decomposition approaches" in which a perceiver analyzes decomposable idioms by accessing first the figurative meaning of parts of the idioms. For example, in interpreting the idiom "pop the question" the perceiver would access the figurative meanings of "pop" (suddenly utter) and "the question" (marriage proposal) and interpret the entire idiom from these (e.g., Gibbs, Nayak, & Cutting 1989).

Overall, both off-line as well as on-line processing evidence has tended to support the literal-meaning-independent accounts over the literal-meaning-dependent approaches, largely via evidence that access to the idiomatic meaning takes either about the same time as (or is even faster than) access to the literal counterpart of the expression (e.g., Gibbs 1980; 1986; Ortony, Schallert, Reynolds & Antos 1978; Swinney & Cutler 1979). (Note, this is a considerably different model than the evidence about non-

idiomatic figurative language processing supports-but that is not the issue of relevance here.) Clearly, such evidence is highly dependent on a clear understanding of the experimental methods applied to studies of idiom processing, and we examine such concerns below. However, overall, there is considerable evidence that idiomatic meanings are not made available any less rapidly than literal interpretations of these words, a fact that can only be taken as support for the literal-meaning-independent models.

For example, Gibbs et al. (1989) have examined processing for three types of idioms (normal, abnormally decomposable idioms and non-decomposable idioms) in a reaction time study. The example "pop the question" is considered to be a normal decomposable idiom as each part contributes to the overall meaning of the idiom; in contrast, "to carry a torch" would be an abnormal decomposable idiom because only one part ("torch") would express a figurative relationship ("warm feelings"); and, independent from etymological considerations, the parts of non-decomposable idioms appear not to contribute the idiomatic meaning directly at all (e.g., "to chew the fat"). Exemplars of these idiom types were presented visually to subjects who were asked to verify (acceptable/unacceptable judgments) such phrases, along with their literal counterparts (e.g., "ask the question", "light the torch"). It was found that decomposable (normal and abnormal) idioms were verified faster than their literal counterparts, thus leading the authors to support a literal-meaning-independent model in which idioms do not need to be analyzed into their literal readings. In this study, it was found that the non-decomposable idioms were verified significantly slower than their literal control phrases. This and similar findings have often been argued to demonstrate that subjects would perform a compositional analysis on the idiomatic word strings to determine their figurative meaning, and their attempt (and inability) to do so causes slower processing. However, such an interpretation of these interesting results may not have sufficiently considered critical methodological aspects of the task used. For example, the idiomatic phrases that are used in these studies are presented in isolation, out of sentential context. After seeing a large number of items which are compositional (two-thirds of the experimental materials and all of the matched controls) and being required to make a conscious decision about each of them, it appears highly likely that subjects will tend toward a conscious 'compositional analysis' mode of evaluating these short phrases. Such conscious processing, however, is most likely to take place only subsequent to actual unconscious comprehension of the phrases. Thus, it may simply be that finding something unusual (e.g., the few non-decomposable items) in this list causes the conscious processing and analysis of these expressions to 'hiccup' (so to speak), and make for longer conscious decisions. In general, isolated phrase verification techniques of this type can lead to many specialized strategies that are not used in normal language understanding, a point which leaves unanswered the question of how such materials are processed during normal

language comprehension. We strongly feel that the existing evidence suggests that more sensitive tasks—particularly those which do not cause conscious introspection about the stimulus materials in question—need to be utilized in order to provide stable answers to these fundamental questions underlying sentence comprehension. (For more detailed arguments and evidence concerning methodology see: Nicol, Fodor, Swinney 1994; Fodor 1995; Nicol & Swinney 1989; Swinney 1981.)

There are a few studies that applied sensitive and non-consciously introspective on-line paradigms to the examination of how idiomatic phrases are processed during sentence comprehension (see, e.g., Cacciari & Tabossi 1988; Colombo 1993; 1998; Swinney 1981; Tabossi & Zardon 1993; 1995; Titone & Connine 1994). Most of these have used a cross-modal-lexical-priming methodology (CMLP); Swinney, Onifer, Prather & Hirshkowitz 1979; Swinney 1979; Swinney 1981) in which subjects listening to spoken sentences (or larger discourse units). The sentences contained idioms, and at selected points while the idiom is being heard, a visual 'target' is displayed to which subjects make a binary decision (usually: word/non-word decision task) or 'name' it as fast as possible. The visual target is a word that is associatively related to either a part of the idiom (e.g., a literal word occurring in the idiomatic word string) or to the figurative meaning of the idiom overall. (Necessarily, the target may also be a 'control' word which is unrelated to any part of the idiom, but matches to the 'associated' word on all other grounds—a priori (isolated) reaction time, frequency, concreteness, category, etc.; if the task involves a lexical decision, a non-word letter string may be displayed; see for related issues Borsky & Shapiro 1998; Hillert 1997). Decision reaction times to 'classify' the visual target (word/non-word) or 'name' the visual target are recorded. When priming (speeded responses to the associated word vs. the control word) is found, it is taken as evidence that the 'associated material' in the idiom has been accessed and is available to 'prime' the decision made to the target word. Such priming, where found, constitutes *prima facie* evidence for access and activation of various aspects of the phrase comprising the idiom in the sentence. Even with use of these techniques, however, there is disagreement over the nature of the process by which idioms are comprehended.

Swinney (1981) for example, used the CMLP paradigm to examine access to idiomatic meanings in sentence contexts, probing at the offset of the first word and last word of a 'grammatical idiomatic phrase' (one with both literal and idiomatic interpretations) that occurred in the middle of a sentence. Consider, for example, the phrase "kick the bucket". Swinney found that target words related to the literal meaning of the first word ("kick") were primed at the offset of that word but not at the offset of the last word in the idiom ("bucket"). Further, he found priming for the overall idiomatic meaning ("die") at the offset of the idiom phrase (at "bucket"), but not at the offset of "kick". It was argued from this that literal meanings of idioms

are always accessed along with idiomatic meanings (at least for 'grammatical' idioms). This evidence was also argued to demonstrate that the cohort model of lexical access proposed by Marslen-Wilson and Tyler (1976) is not, at the least, comprehensive, in that it does not accurately describe access to lexicalized idiom meanings. (Under the cohort model the entire idiomatic word meaning ("die") should have been accessed from the initial consonant-vowel cluster of "/ki.../" (in "kick").)

In fact, Titone and Connine (1994) interpreted the above finding as evidence against the LRH for idioms because of the failure to find priming for the idiom meaning at the offset of the *first* word of the idiom phrase. Their reasoning however, hinges on a belief that the cohort model of lexical access is correct (namely, that all meanings for all words having an initial consonant-vowel cluster will be accessed when that cluster is heard), a prediction that has not been universally supported in the literature for simple words, much less for multi-segmental words such as idioms. In fact, the Swinney (1981) evidence stands against the cohort model as an overall account of lexical access. The issue here really is one of what constitutes the basis for lexical access—the first consonant cluster, the initial syllable (e.g., Foss and Swinney 1973) the first stressed syllable (e.g., Cutler & Norris 1988), the entire form of the word (Swinney 1981), or the basic orthographic syllable (Taft and Forster 1975). The answer is simply not definitively known at this time. Certainly, however, the Swinney data do not in any way stand against the notion that idioms are stored and accessed as words from the lexicon; the data, however, do not tell precisely how lexical access takes place, and thus do not directly support the LRH (see, however, work by Swinney & Cutler 1979). The data do suggest that, at least for grammatical idioms, a literal analysis is attempted along with whatever constitutes idiomatic processing.

Cacciari and Tabossi (1988; see also Cacciari & Glucksberg 1991; Titone & Connine 1994) have proposed a "configuration model" of idiom processing, which holds that idiom meaning is not a separate lexical entry but is meaning 'associated with a particular configuration of the words', a meaning which is accessed only when the perceiver encounters an "idiom key" in a phrase. An idiom key is a portion of an idiom that allows access to this idiomatic meaning. Consider, for example, the idiom "kick the bucket" The idiom interpretation of this phrase is more frequent than that for its literal counterpart, and thus, it is argued that hearing the initial part of the phrase ("kick the...") will more likely lead to an association and completion with the word "bucket" than (for example) with the word "ball". This idiom key / configuration model is clearly a type of literal-meaning-dependent model, but one which holds as a central tenant the assumption that language processing takes place via use of associative prediction.

Cacciari and Tabossi (1988), for example, used a modified CMP (cross modal priming) task to examine online access to predictable idiomatic

phrases in Italian. "Predictable" in this case means that the first words of the idiom indicate/suggest the figurative meaning. In an initial study, they probed for activation of words related to the idiomatic and literal meaning of the idiom at the offset of the idiomatic phrase (PP, probe point; e.g., "Il ragazzo pensava che il suo fratello fosse nato con la camicia." APP; gloss: "The boy believed that his brother was born with the shirt"; tr. "The boy believed that his brother was born with a silver spoon in his mouth"). Cacciari and Tabossi reported that they found priming only for the idiomatic meaning but not for the literal meaning at the end of sentence probe point. In interpreting these data, we want to emphasize that the test point in this study was at the end of the sentence/trial, a point that is usually avoided in most CMP studies precisely because of sentential/trial 'wrap-up', 'reconsideration' and 'conscious interpretation' effects that come in at this point. (See e.g., discussions in Hillert & Swinney 2000; Swinney 1981; Swinney, Nicol, Love, & Hald 1999; Balogh, Zurif, Prather, Swinney, & Finkel 1998 on many of these issues). Overall, ignoring any other experimentally-related concerns, we note that the effect of priming between literal and control probes reached a significance level of $p < .08$, but the possibility of a Type II error cannot be discounted. Thus, although it stands against 'configurational' hypothesis, it appears that the literal meanings are likely activated in these material conditions, thus supporting the LRH. In a second study involving low-predictable idioms Cacciari and Tabossi report significant priming only for the literal meaning of the idiom, although, again, a strong trend ($p < .09$) for significance of the idiomatic meaning was effectively discounted. Prudence suggests that such a strong trend should not be dismissed lightly. A third study which had a 300 ms delay between offset of the idiom and the probe found priming for both literal and idiomatic meanings. Thus, it appears that all meanings of the idioms-literal or figurative-were eventually accessed in these studies, thus supporting a multiple-access hypothesis in some form (e.g., LRH). The question remains, however, as to the precise time course of the availability of each of the literal and idiomatic interpretations during sentence comprehension.

In addition to the lack of robust evidence about the nature of the operations involved in the processing of idioms, a number of important overarching issues remain that are of concern. For example, the existing studies of sensitive, on-line examinations of idiom processing have all taken place only on a limited number of languages. For example, English and Italian are hardly representative of the range of language structures and processes that a universal theory of figurative language (even fixed figurative language) processing needs to consider. Further, the range of idiomatic structures that have been examined is extremely limited-limited enough that significant generalizations may easily be missed, even if all of the data would be in agreement. In what follows, we describe new evidence that is intended to move in a direction to correct these holes in the empirical literature.

3. On-line Examination of Idiom Compounds in German

Languages significantly differ with respect to the degree of lexical composition. For example, English and Chinese prefer single words to compounded words while German tends to use (and create) compounds of great length and complexity with high frequency. Although in Standard European Languages (SEL) 80-90 percent of nominal compounds contain only two elements, German has a relatively high percentage of compounds that consist of more than two elements. For example, the complex compound "Tonnentaschenfederkernmatratzenladenverkaufspreis" (discovered in a German furniture store) can be relatively easily parsed by a native speaker. The individual parts of this compound are: Tonnen-taschen-feder-kern-matratzen-laden-verkaufs-preis; gloss: Tons-bags-feather-pit-mattress-shop-selling-price). At least in SEL it is a general rule that the second element of a nominal compound (head) dominates the first element (as it typically does in English, e.g., "shrimboat" is a type of boat). In the German example "Bienenhonig" (bee-honey) the second element "-honig" can be analyzed as the head and the first element "Biene-" as the modifier/subject (honey produced by bees); conversely, in "Honigbiene" (honey-bee) the second element "-biene" is the head and the first element "Honig-" is the descriptor/modifier (bees of a type that produce honey). Sometimes adult speakers actively use/create novel compounds in a metaphoric sense and apply a 'literal' compositional strategy (e.g., "Peter sucht sich Wortblumen für den Strauß seiner Rede"; gloss: Peter is looking for word-flowers for the bouquet of his speech). Similarly, children often create new words to describe an object for which they have not yet acquired an existing word (e.g., "Wolkenwasser" (clouds-water) instead of "Regen" (rain)), and second language speakers actively (de)compose foreign words to create (understand) new meanings which results sometimes in funny constructions (e.g., "cloud scraper" (German: "Wolkenkratzer") instead of "sky scraper").

Again, a very large number of compounds with idiomatic meanings exist in German. For these, a speaker typically cannot apply a decompositional strategy to understand the idiomatic meaning. As with most phrasal idioms some idiomatic compounds assign only an idiomatic meaning but no literal meaning. For example, "Lampenfieber" (gloss: lamp-fever; "stage-fright") has no literal counterpart. However, "Eselsohren" (literal: "donkey's ears"; idiomatic: "dog's ear") does have a literal counterpart ("donkey's ears" are real things). The range of idiom compounds is enormous-and they represent a particularly vexing problem for models of language processing in a highly compound-productive language such as German to account for. It is precisely in this domain, however, that we feel we can most profitably examine the time course and nature of idiom processing.

The initial work we report here examines the LRH by measuring the time course of access to the literal and idiomatic meaning of German nominal compounds during spoken sentence comprehension. The CMLP para-

digm was employed throughout. In an initial study, we examined ambiguous compounds (compounds with both a literal and an idiomatic interpretation) such as "Bienenstich" (literal: "bee-sting"; idiomatic meaning: "a particular cake") in a sentence context biased toward the idiomatic interpretation, as shown in (1).

- (1) Zu Weihnachten backte die Mutter stets einen *Bienenstich* ^ PP and einen Stollen.

(At Christmas baked the Mother always a "bee-sting" and a fruit loaf.)

Probe words related to the idiomatic meaning of the compound (related: KUCHEN/cake; control: KANZEL/pulpit) and to the literal meaning of the compound's head (related: HONIG/honey; control: ANKER/anchor) appeared at the offset of the idiomatic compound in the figuratively biased sentence.² Mean reaction times for 50 native (German) speakers (who saw only a single probe with the sentence for each exemplar) can be seen in Table 1. The priming effect for both the idiomatic-related target ($p < .01$) and the literal-related target ($p < .01$) strongly support the argument that both the literal and idiomatic interpretations of these ambiguous idioms were accessed in this study, even in the presence of a context biased only toward the (more frequent) idiomatic interpretation.

Table 1. Priming patterns (mean difference of reaction time to control-related probes) of ambiguous idiomatic compounds in figuratively biased sentence contexts.

Idiomatic Meaning	87 ms
Literal Meaning	48 ms

A second study, which used the same procedures and methods as the first experiment, was run to examine a dramatically stronger case—that of the processing of idiomatic compounds which only have idiomatic interpretations (idioms without literal interpretation) such as "Lackaffe" (gloss: 'lac-monkey'; someone who shows off). These idioms have fixed meanings and are frequently used in everyday German conversation. In this study, such idiomatic compounds were presented in a neutral sentence context.

- (2) Hans war nach der Ansicht der meisten Mitschuler ein Lackaffe ^PP im aus gesprochenen Sinne.

(Hans was after the view of the most class mates a "lac-monkey" in a decisive sense.)

² We used a display time of 300 ms, a zero interstimulus-interval (0-ISI) and an intertrial interval of 2000 ms). Because of space limitations, we discuss in the present context only a part of the conditions examined (see for further details Hillert & Swinney 2000).

For example, in (2) we probed for the activation of the idiomatic meaning (related: EITEL/vain; control: BUNT/colorful) and for the activation of the literal meaning of the head noun (related: BAUM/tree; control: SAMT/velvet) at the offset of the idiom compound. As in the previous study, this experiment was designed so that no subject hears/sees more than one probe/experimental word with any exemplar sentence. The mean reaction times of fifty native German speakers to the idiomatic meaning and to the literal meaning of the compounds' head in the neutral context condition can be seen in Table 2. We found significant priming for idiomatic ($p < .0001$) and literal ($p < .05$) interpretations in the neutral context with these 'idiom-only-interpretation' compounds. These results seem to strongly support the interpretation that the literal meaning of the head noun of these exclusively idiomatic compounds was accessed when the idiom was heard. This was so in spite of the fact that there was no possible literal interpretation for this compound. These data argue therefore strongly for the LRH, at least in the processing of German compounds.

Table 2. Priming patterns (mean difference of reaction time to control-related probes) for exclusively idiomatic compounds in a neutral sentence context.

Idiomatic Meaning	70 ms
Literal Meaning	67 ms

The outcome of both experiments together demonstrate that both idiomatic meaning and literal meanings of words comprising idiom compounds in German appear to be immediately activated when the idiom is heard during sentence comprehension. This strongly suggests that fixed meaning phrases act in much the same way as do lexical ambiguities—all meanings associated with the form of the word(s) are accessed automatically and exhaustively.

4. Conclusions

The research presented here, combined with prior work in the literature, suggests strongly that fixed form expressions are processed in a manner consistent with the literal-meaning-independent general models of idiom processing. Moreover, they support a 'multiple-form-driven-access' version of such models (all meanings—both idiom and literal—are accessed). The evidence we present does not demonstrate any particular support for an idiom key or configurational role in such access, and it is completely consistent with an account that holds that fixed idiomatic meanings are lexically stored (LRH). The current evidence provides no basis for speculation about a (de)compositional procedure involved in such access, but we note that we only examined one particular idiom type in our work—compounds). Finally, there is no evidence in our work supportive of an anticipatory-predictive process in the comprehension of idiom strings (such a process would have allowed only the idiomatic interpretation to be accessed in a

figuratively biased sentence context). The present work supports the LHR, that is, lexical access (whether of 'literal' or fixed 'idiomatic' meanings) is a strictly form-driven process.

References

- Ahrens, K.V. 1998. Lexical Ambiguity Resolution: Languages, Tasks, and Timing, in D. Hillert, ed., *Sentence Processing: A Crosslinguistic Perspective, Syntax and Semantics 31*. San Diego, CA: Academic Press.
- Balogh, J., E. Zurif, P. Prather, D. Swinney, and L. Finkel. 1998. End-of-Sentence Effects in Real-time Language Processing: A New Perspective on Blumstein et al.'s Findings. *Brain and Language* 61:169-182.
- Bobrow, S. & S. Bell. 1973. On Catching on to Idiomatic Expressions. *Memory & Cognition* 1:343-346.
- Borsky, S., & L. P. Shapiro. 1998. Context-independent sentence processing. In D. Hillert, ed., *Syntax and Semantics 31, Sentence Processing: A Crosslinguistic Perspective*. San Diego: Academic Press.
- Cacciari, C. & S. Glucksberg. 1991. Understanding Idiomatic Expressions: The Contribution of Word Meanings.. in G. Simpson, ed., *Understanding Word and Sentence*. Amsterdam: North Holland.
- Cacciari, C. & P. Tabossi. 1988. The Comprehension of Idioms. *Journal of Language and Memory* 27:668-683.
- Clark, H. 1978. Inferring What is Meant, in W. J. M. Levelt & G. B. Flores d'Arcais, eds., *Studies in the Perception of Language*. Chichester, UK: Wiley.
- Clark, H. & P. Lucy. 1975. Understanding What is Meant from What is Said: A Study on Conversationally Conveyed Requests. *Journal of Verbal Learning and Verbal Behavior* 14:56-72.
- Colombo, L. 1993. The comprehension of ambiguous idioms in context, in C. Cacciari & P. Tabossi, eds., *Idioms, Processing, Structure and Interpretation*. Hillsdale, NJ: Lawrence Erlbaum.
- Colombo, L. 1998. Role of Context in the Comprehension of Ambiguous Italian Idioms, in D. Hillert, ed., *Syntax and Semantics, 31, Sentence Processing: A Crosslinguistic Perspective*. San Diego: Academic Press.
- Cutler, A. & D. Norris. 1988. The Role of Strong Syllables in Segmentation for Lexical Access. *Journal of Experimental Psychology: Human Perception and Performance* 14:113-121.
- Di Sciullo, A.M. & E. Williams. 1987. *On the Definition of Words*. Cambridge, MA: MIT press.
- Fodor, J. A., J. D. Fodor, and M. Garrett. 1975 The Psychological Unreality of Semantic Representation. *Linguistic Inquiry* 6:515-531.
- Fodor, J. A., M. Garrett, E. Walker, & C. Parkes. 1980 Against Definitions. *Cognition* 8:263-367.
- Fodor, J. D. 1995. Comprehending Sentence Structure, in L.R. Gleitman, & M. Liberman, eds., *An Invitation to Cognitive Science, Language, Vol. 1*. Cambridge, MA: MIT Press.
- Foss, D. J., and D. A. Swinney. 1973. On the Psychological Reality of the Phoneme: Perception, Identification and Consciousness. *Journal of Verbal Learning and Verbal Behavior* 12:246-257.
- Fraser, B. 1970. Idioms with a Transformational Grammar. *Foundations of Language* 6:1. 22-42.
- Fraser, B. 1974. *The Verb-Particle Combination in English*. Tokyo: Taishukan.
- Gibbs, R. 1980. Spilling the Beans on Understanding and Memory for Idioms in Conversation. *Memory & Cognition* 8:449-456.
- Gibbs, R. 1986. Skating on Thin Ice: Literal Meaning and Understanding Idioms in Conversation. *Discourse Processes* 9:17-30.
- Gibbs, R. 1984. Literal Meaning and Psychological Theory. *Cognitive Science* 8:275-304.
- Gibbs, R. W., & N. P. Nayak. 1989. Psycholinguistic Studies on the Syntactic Behavior of Idioms. *Cognitive Psychology* 21:100-138.
- Gibbs, R., P. Nayak & C. Cutting. 1989. How to Kick the Bucket and not Decompose Analyzability and Idiom Processing. *Journal of Memory and Language* 28:576-593.
- Gibbs, R.W. & N. P. Nayak. 1989. Psycholinguistic Studies on the Syntactic Behavior of Idioms. *Cognitive Psychology* 21:100-138.
- Heringer, J. 1976. Idioms and Lexicalization in English, in J.P. Kimball, ed., *Syntax and Semantics, vol. 9: The Grammar of Causative Constructions*. New York: Academic Press.
- Hillert, D. & D. A. Swinney. 2000. Access to Idiomatic Meanings during Online Sentence Processing. (ms. submitted.)
- Hillert, D. 1997. Language in Time: Lexical and Structural Ambiguity Resolution, in M. Stamenov, ed., *Approaches to Language and Consciousness*. Amsterdam & Philadelphia: John Benjamins.
- Katz, J. J. and J. A. Fodor. 1963. The Structure of a Semantic Theory. *Language* 39:170-210.
- Lehnert, W. G. 1986. The Analysis of Nominal Compounds. *VS* 44/45:155-180.
- Lehrer, A. 1974. *Semantic Fields and Lexical Structure*. Amsterdam: North Holland.
- Marslen-Wilson, W. D. 1976. Linguistic Descriptions and the Psychological Assumption is the Study of Sentence Perception, in R. J. Wales and E. C. T. Walker, eds., *New Approaches to Language Mechanisms*. Amsterdam: North-Holland.

- Newmeyer, F., 1972. The Insertion of Idioms, in *Papers from the Eighth Regional Meeting*. Chicago: Chicago Linguistic Society, 294-302.
- Nicol, J., & D. Swinney. 1989. The Role of Structure in Coreference Assignment during Sentence Comprehension. *Journal of Psycholinguistic Research* 18:5-24.
- Nicol, J., J.D. Fodor, & D. Swinney. 1994. Using Cross-Modal Lexical Decision Tasks-to Investigate Sentence Processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 20:5.1229-1238.
- Ortony, A., D. Schallert, R. Reynolds, & S. Antos. 1978. Interpreting Metaphors and Idioms: Some Effects of Context on Comprehension. *Journal of Verbal Learning and Verbal Behavior* 17:465-478.
- Seidenberg, M., M. Tanenhaus, J. Leiman, & M. Bienkowski. 1982. Automatic Access of the Meanings of Ambiguous Words in Context: Some Limitations of Knowledge-based Processing. *Cognitive Psychology* 14:4.489-537.
- Swinney, D. & A. Cutler. 1979. The Access and Processing of Idiomatic Expressions. *Journal of Verbal Learning and Verbal Behavior* 18:523-534.
- Swinney, D. 1979. Lexical Access during Sentence Comprehension: (Re)consideration of Context Effects. *Journal of Verbal Learning and Verbal Behavior* 18:645-660.
- Swinney, D. and A. Cutler. 1979. The Access and Processing of Idiomatic Expressions. *Journal of Verbal Learning and Verbal Behavior* 18:523-534.
- Swinney, D., J. Nicol., T. Love, & L. Hald. 1999. Methodological Issues in the On-Line Study of Language Processing, in R. Schwartz, ed., *Childhood Language Disorders, N.Y.:* Erlbaum.
- Swinney, D., W. Onifer, P. Prather, and M. Hirshkowitz. 1979. Semantic Facilitation across Sensory Modalities in the Processing of Individual Words and Sentences. *Memory and Cognition* 7:3.54-178.
- Swinney, D.A. 1981. Lexical Processing during Sentence Comprehension: Effects of Higher Order Constraints and Implications for Representation, in T. Myers, J. Laver & J. Anderson, eds., *The Cognitive Representation of Speech*. Amsterdam: North Holland.
- Tabossi, P. & F. Zardon. 1993. The Activation of Idiomatic Meaning in Spoken Language Comprehension, in C. Cacciari & P. Tabossi, eds., *Idioms, Processing, Structure and Interpretation*. Hillsdale, NJ: Lawrence Erlbaum.
- Tabossi, P. & F. Zardon. 1995. The Activation of Idiomatic Meaning, in M. Everaert, E. van der Linden, A. Schenk, & R. Schreuder, eds., *Idioms. Structural and Psychological Perspectives*. Hillsdale, NJ: Lawrence Erlbaum.
- Taft, M., and K. I. Forster. 1975. Lexical Storage and Retrieval of Prefixed Words. *Journal of Verbal Learning and Verbal Behavior* 14:638-647.
- Titone, D. A. & C. M. Connine. 1994. Comprehension of Idiomatic Expressions: Effects of Predictability and Literality. *Journal of Experimental Psychology: Learning, Memory and Cognition* 20:1126-1138.
- Weinreich, U. 1967. Problems in the Analysis of Idioms, in J. Puhvc *ceedings of the Summer 1966 Linguistics Forum at UCLA*. Berkeley: University of California Press, vol. 11:23-81.