PRE-PUBLICATION DRAFT

WORDS AS ACTION: CONSEQUENCES FOR THE MONOLINGUAL AND BILINGUAL LEXICON

GARY LIBBEN

Abstract

Words can be considered to be the building blocks of language. But the term *building block* evokes a sense of words as things. I present a perspective on word structure and the mental lexicon that moves away from thing-like representations and toward a view in which words are seen as activities and the lexicon as a whole is considered to be a dynamic knowledge store. Within that store of knowledge, words may be described as being in a lexical superstate. Lexical superstates capture the morphological configurations that a word can have, based on patterns of language use. This perspective leads to a more dynamic view of lexical knowledge and has substantial consequences for models of lexical knowledge among bilinguals and multilinguals.

Introduction and overview

In a very important way, words are the building blocks of language. They constitute the fundamental and all-important associations between form and meaning upon which our overall language ability depends. Our capacity to acquire words in childhood and to expand, modify, and re-organize our lexical knowledge throughout the lifespan is a key component of language change and language growth. It is also a key component of an individual's ability to participate in language communities and cultural communities.

The notion of words as building blocks and the notion of word knowledge as being dynamic and self-organizing carries with it a particular

kind of tension. This is the tension between words as things and words as actions. In this chapter, I discuss the historical roots of this tension and the ways in which seeing words as actions opens up new ways to think about lexical knowledge. Thinking about words as actions may also lead us to new ways of seeing and understanding the morphology of words. If, for example, lexical knowledge within an individual is the result of his or her lexical action over time, then it may turn out to be the case that what we used to think of as morphological structures or morphological boundaries simply reflect how people make use of the potential sub-elements of words in reading, writing, listening or speaking. And, it is very likely that people would use these potential sub-elements in different ways at different times.

A perspective such as this would bring us to a much more dynamic view of the mental lexicon and of lexical knowledge. It would be a view in which words are just as much mental actions as they are mental representations. It would be a view in which words would not have a fixed structure in the mind and might indeed be in a continual state of flux as a result of new patterns of lexical action. The lexical system would thus have duality and indeterminacy at its core.

In the sections below, I discuss the historical roots of the words-as-things perspective as well as the characteristics of a words-as-action perspective. I propose ways in which some of the metaphors of early quantum physics could be useful in enabling us to build models of the lexicon that incorporate the duality of representation and action and the ways in which we can build these properties into psycholinguistic models of morphological structure and morphological processing. Finally, I explore the consequences of this perspective for the modeling of the bilingual lexicon.

2. Where we are coming from: words as things

There is an immediately intuitive sense in which words appear to be real 'things'. This places words in rather sharp contrast to other sorts of linguistic constructs. Indeed, almost all putative constructions in linguistics seem subject to debate both within the discipline and among persons with no formal training in linguistics. For example, we might feel a need for evidence to support the claim that *syllable*s are real things, that *rimes* and *codas* are real, that *morphemes* are real, or that *phrases* are real. But, *words* seem real to most everyone.

This sense of words as things is evident throughout modern culture in which words are everywhere. In the Roman alphabet that is used for most European languages, words are marked off in a manner that makes 'wordhood' visually salient from the very onset of reading. Parents seem to

naturally adopt the word as the measure of language development, so that they will be much more likely to estimate the number of words their children know, and quite unlikely to estimate the number of phonemes or the number of phrases. Indeed, from almost every perspective, there is considerable cultural pressure to conceive of words as things.

In the formal study of linguistics, there has also been considerable pressure to see words as things—and with that, to see the mental lexicon as a storehouse for things (in this case, the things that we call lexical representations). The notion of a lexicon as a list of exceptions emerged very early on in the history of generative linguistics. Bloomfield (1933) characterized the lexicon as an appendix to the grammar, a list of basic irregularities (p. 274). In Chomsky (1957), the lexicon was also seen as a list of irregularities, containing only simple (i.e., non-derived and uninflected) forms. Beginning with Chomsky (1970) and Halle (1973), there was a shift toward developing a notion of a distinct lexical component of the grammar that would also contain lexical rules. In this tradition, a number of proposals emerged regarding what is actually listed in the lexicon and what is derived by lexical or syntactic rules (e.g., Aronoff, 1976; Selkirk, 1982; Di Sciullo and Williams, 1987). In all these approaches, however, there is a clear sense that words are linguistic representations – *things in the mind*.

This notion of words as things was not only evident in early linguistic approaches to the lexicon. It was also evident in early psycholinguistic approaches, particularly those associated with models of reading and the characterization of acquired dyslexia (e.g., Morton, 1969; Coltheart, Davelaar, Jonasson, and Besner (1977); Coltheart 1987). In order to capture patterns of reading words aloud among unimpaired readers of English and persons with acquired dyslexia, these approaches typically contained more than one store of words, including an orthographic input lexicon, a phonological output lexicon and a somewhat less well defined 'semantic system'. This basic configuration continued to be evident in subsequent computationally implemented models such as the DRC model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001).

In the field of visual word recognition, the early contribution of Forster (1976) and the view that the mental lexicon could be conceived of as a frequency-ordered list of lexical entries (i.e., mental things) had enormous influence on the field. In this seminal work, Forster (1976) opened the door to a generation of work on functional properties of the mental lexicon, the processing of multimorphemic words, (Taft and Forster 1975, 1976) and the core characteristics of lexical access (Forster (2007). Researchers currently working in the field of lexical processing no longer typically use the

metaphor of a 'list' to characterize the organization of words in the mind. However, they very much continue to use the notion of a word as a mental representation with which to characterize lexical access. And, the construct of lexical access itself assumes that words are static representations in the mind.

Thus, the tradition that has its roots in the studies above, has offered a sense of 'obviousness' to the notion that words are things and that the mental lexicon is a storehouse of those things in the mind (see Aitchison 2012). This sense of the mental lexicon draws on the metaphor of a dictionary in the mind (Libben, Westbury and Jarema 2012). However, from the outset, it has been clear that this must be a metaphor of convenience, not a substantive claim about cognitive architecture.

The most important reason that the dictionary in the mind must remain a rough metaphor concerns the homunculus problem (Dennett 1978, Westbury 2016). This problem is perhaps easiest to assess in the domain of visual processing. Indeed, the manner in which I was taught, in elementary school, about how human vision works provides a convenient illustration of the problem. I was taught that light came in through my eye and an image was shown upside down on my retina and so my brain had to turn it right side up in order to see it. At the age of seven or eight, this struck me as a rather complete explanation. The problem is, of course, that it is not a complete explanation at all. What does my brain use to see the upside down picture? Might it be another eye?

In developing domains of research on cognition such as the study of lexical processing, the homunculus problem can present a formidable challenge to the articulation of deep levels of explanation. It is exceedingly unlikely that the mental lexicon can be a knowledge source that is consulted in the mind in the way that is similar to how a scholar might consult a physical dictionary. The reason for this is that such a view would require that, in addition to the mental lexicon, we would have to posit the little scholar in the mind who would consult it.

It seems, therefore, that when the cognitive details and their implications are considered, the mental lexicon could not really have the overall form that would make it similar to dictionaries in the outside world. Neither could it have the internal properties of dictionaries. A physical dictionary is typically composed of entries. Those entries have a fixed internal structure and fixed properties. The reason for this is that the content of a dictionary reflects the efforts of a lexicography team that has worked to make the dictionary as clear, as unambiguous, and therefore as useful as possible. One important difference in considering the mental lexicon, is that if there is no scholar homunculus in people's heads, there certainly will not be any

little lexicography team either. As a result, as I will discuss below, the mental lexicon is likely not well ordered and not static. Rather, it is dynamic, ambiguously structured, and richly interconnected.

3. Where we are going to: words as activities

An activity-based perspective on words requires that we think of words as something that people do, rather than something that people have. In this way, we are thinking about words as psycholinguists think about language as a whole. Fundamentally, psycholinguistics is the study of how people *do* language: how they learn and unlearn, how they understand and misunderstand, how they communicate and miscommunicate. These activities that characterize language as a whole, also characterize words. They are fundamentally things that we do.

As an example of this reasoning, we might consider other types of activities to which we give labels and which, as a result, appear to us to have the properties of things, when, in fact, they are activities. It seems to me that many of the words that we use in sports have such qualities. In tennis, for example, we use the term "backhand" as a noun. Thus, we consider sentences such as "I practiced my backhand" or "My backhand is weak" to be completely unproblematic. We know that a *backhan*d is actually an activity, but we treat it as a thing. That thing is actually a coordinated network of activities (e.g., foot movements, weight transfer, follow-through, etc.). But it serves us well to be able to capture that coordinated hierarchy of activities as a single construct. It has substantial advantages in enabling the tennis player to conceptualize and improve his or her performance.

I would like to suggest that this is exactly the manner in which we might want to think about the word *backhand,* as a purely lexical phenomenon, when we perform activities such as writing, reading, speaking, and listening.

This may be easy to see if we were to now bring together the construct *backhand* as a coordinated network of activities both physically on the tennis court and lexically in the mind. It seems to me that considering these together highlights the way in which it is sometimes very difficult to create sharp boundaries between the lexical activities in the mind and physical activities in the world.

In terms of physical activity in the tennis court, the construct *backhand* allows the player to conceptualize (and presumably more easily acquire and execute) movement alternatives such as *forehand* or variations such as *backhand slice* and *backhand drive.* It is noteworthy that in terms of lexical functioning in the mind, the morphological characteristics of the English words associated with these movements also facilitate the acquisition and

execution of related lexical events (or words). The fact that the word *backhand* is a compound in English makes it easier to relate it to the word *forehand* because the two words share a morphological head as their final element. What follows from this is that the two words *backhand* and *forehand* will be involved in the same actions. In speaking, they will be involved in the same actions to produce the final constituent -*hand* with the same compound stress patters. The words will also share activity in writing and we would expect that that there would be considerable overlap in the lexical recognition activities for the two words during word comprehension.

For the linguistic constructions *backhand slice* and *backhand drive*, the parallelism in morphological structure seems to facilitate cognitive linking related, again, to the overlap in lexical cognitive activities associated with both producing and comprehending these triconstituent compounds.

3.1.1 The status of lexical representations

In the discussion of the compound word above, I have sought to highlight the manner in which words can be discussed psycholinguistically in terms of lexical action. This accords with a good deal of experimental research that has revealed that compound word processing involves both activation of constituent morphemes and the activation of related words that share constituent forms and constituent meanings (Fiorentino Naito-Billen Bost and Fund-Reznicek 2014, Libben 2014, Libben, Gibson, Yoon and Sandra 2003, Schmidtke Van Dyke and Kuperman 2018). It also accords with research that has found that the processing of compounds is affected by the semantic relations among compound elements (Gagné and Spalding 2009, Marelli Gagné and Spalding 2017).

This psycholinguistic evidence suggests, for example, that processing the word *backhand* initiates coordinated activity that results in a spread of activation from words such as *tennis* (which is semantically related), compounds such as *background* (which shares the initial compound element *back*-), and compounds such as *freehand* and *shorthand* (which share the final compound element –*hand*).

Such activity speaks to the dynamicity of the lexical system as a whole. However, in our current state of knowledge, it is extremely difficult to discuss lexical activity without referring to lexical representations as things (even though we might believe that they will actually be shown to be hierarchies of action). For example, when we speak about the activation of morphemes within a compound word, those morphemes are treated as representations. When we talk about the spread of activation to other words in the mental lexicon, those other words are treated as lexical

representations. It seems to me that this is a situation that is very difficult to avoid. It, in fact, is a manifestation of the phenomenon that I discussed above. Although most everybody will agree that a *backhand swing* is an action, it is just more convenient to refer to it with a compound noun. Moreover, moving to lower component levels of the activity does not solve the problem, for here we simply find another set of hierarchies (e.g., *wind-up*, *follow-through*, etc.). The same seems to be the case for our description of lexical representations in the mental lexicon. Even though morphemes, letters, and even strokes within those letters are activities, by necessity, we use the language of representations to talk about them.

What then might be the best way to capture the nature of words in the mind? I think the first step would be to allow for the possibility that words (and perhaps many other types of cognitive representations) do not have a single unambiguous nature. As I have discussed above, there is a way in which words are fundamentally actions, but we need to refer to them as representations in order to capture those actions. Thus, words can be said to have a dual nature: They are actions and they are representations. We are best off considering them to be actions when we think about their status in the activities of language production and comprehension. We are also best off considering them to be actions when we think about their acquisition and perhaps their attrition. On the other hand, as I have noted above, there are clearly times in which it is necessary to see words as representations.

I would like to suggest that this issue of duality has some similarities to the issues of duality discussed in the relatively early days of quantum physics. These early quantum physicists tried to account for the observations that electrons behave in a manner that is consistent with them being waves and also consistent with them being particles. (Einstein 1905, Bohr 1934, Heisenberg 1958). The issue of wave/particle duality became a central conceptual issue in the development of quantum physics and, perhaps surprisingly, drew from the metaphors and perspectives of the American psychologist William James who, in his studies of consciousness, was also dealing with the dual nature of mental representations (Hunt 2001, Smith 2006). William James (1890) understood the danger of trying to capture mental activities as objects. In one of his many poignant similes, James described efforts to capture mental representations in consciousness as similar to trying to see how darkness looks by turning on a light very quickly (Hunt 2001).

It seems to me that the perspectives of William James on the nature of mental representations has important lessons for our treatment of lexical representations more than 125 years later. It also seems to me that the approach that early quantum physicists took to the interpretation of

wave/particle duality offers a useful lesson for the understanding of words in the mind and brain. That lesson is that it might be most appropriate to consider many lexical properties to not have a fixed state or representation in the mind, but rather have the potential to manifest in a number of different ways. Thus, words can behave as actions under certain circumstances and as representations under other circumstances. Moreover, even when words are manifested as representations, their structure will not be in a fixed state, but rather have the capacity to manifest in different configurations, depending on the circumstances.

In the section below, I discuss the consequences of this view for the representation of morphological structure in the mind.

3.2 Word structure as lexical superstates

The metaphor of a lexical superstate builds directly on the notion of superposition in quantum physics in which it is understood that characteristics of elements can remain indeterminate until they are observed. Applying this as a metaphor in the psycholinguistics of lexical processing, I suggest that seeing words in the mind as being in an indeterminate superstate until they are used in a language activity (i.e., speaking, listening, reading, or writing) can have substantial advantages in the interpretation of the results of psycholinguistic experiments and in the modeling of words in the mind (Libben 2017).
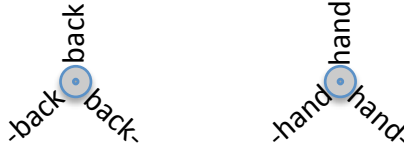
Let me illustrate by returning once again to the example compound word *backhand*. In terms of its lexical sub-organization, the word *backhand* is a noun composed of the elements *back* and *hand*. But what is the nature of those elements? Are they actually the words *back* and *hand*, the same words that appear in a sentence such as "The boy in the *back* of the class raised his *hand*"? Are the morphemes *back* and *hand* in the compound *backhand* the same as the morphemes in the compounds *payback* and *handstand*?

I think that the answer to these questions is truly both "yes" and "no". The reason for this is that the elements *back* and *hand* can be all those things. They can be free-standing words, compound modifiers and compound heads. But, seen from another perspective, they are none of these things, until actually used in a language event. Until that time, they are best described as being in a lexical superstate.

In Figure 1, a superstate configuration for the lexical elements *back* and *hand* is shown. As can be seen in this Figure, the free-standing word *back*, the compound modifier *back-* and the compound head   *-back.* By representing these as a lexical superstate, I am claiming that they are

represented in the mind as having the potential for any one (and perhaps all) of these manifestations in lexical activity.
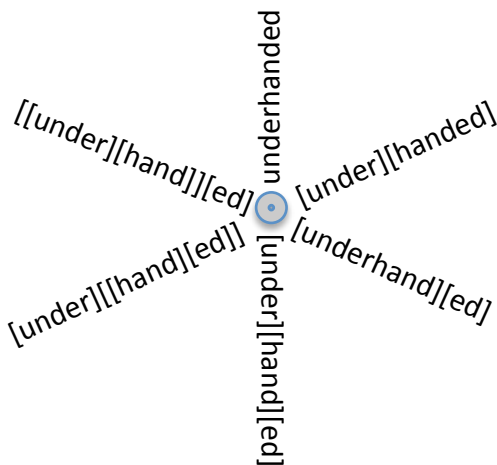

Figure 1. Lexical superstate representations for the elements *back* and *hand*. A hyphen to the right indicates modifier function. A hyphen to the left indicates head function. No modifier indicates a free-standing word.

The notion of a lexical superstate can be applied to many aspects of lexical structure and, in particular, to many morphological phenomena. Consider the word *underhanded* shown in Figure 2.

The word in Figure 2 may be structured in the mind of an individual in very different ways. It is conceivable that the word *underhanded* is processed as an unanalyzed whole for some individuals. One might imagine that it would thus be interpreted as a word that means "mean and sneaky", as in sentence (1a). There is, of course, another meaning for the word *underhanded*. This one refers to the throwing of a ball or similar object with the hand below the elbow, as in sentence (1b).

(1)   a.   That was an underhanded thing to do.
         b.   That was a fast underhanded throw.

Figure 2. Lexical superstate representations for the word *underhanded*. The representation at the top center shows the word as undecomposed and ungrouped. The representation at the bottom center shows it as fully decomposed, but ungrouped. On the right, the string is shown with two constituents (with two grouping alternatives). On the left, the string is shown with three constituents (with two grouping alternatives).

One would expect, however, that the meaning in (1b), which is so strongly linked to the word *underhand*, would be unlikely to be fully morphologically unstructured, but, rather, would have one of the structures [underhand][ed] or [[under][hand]][ed] in Figure 2. In both these structures, the internal substring *underhand* is isolated as a constituent. The difference is that in one case, *underhand* is an unanalyzed whole whereas in the other case, the substring *underhand* is internally structured as a compound.

It may be very difficult, if not impossible, to determine which is the correct morphological structure for the word *underhanded*. Even if only one of the meanings is used, say the throwing meaning, then one could easily imagine conditions under which a language user might ascribe a different structure to the word at different times and under different conditions of use. The key point is this: It may be the case that the way that a word is structured in the mind and the way in which a person uses a word are one and the same.

The claim above that morphological structure can correspond exactly to lexical use may have extensive consequences for the ways in which we view morphological structure. One reason for this is that morphological structure
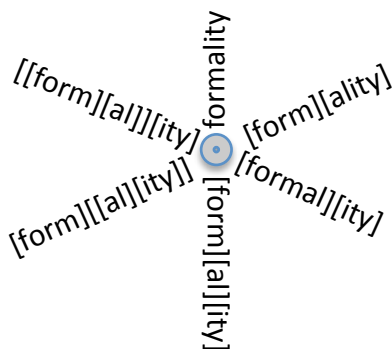
that is driven by patterns of use may diverge from those that are driven by purely formal considerations.

Libben et al. (2016) investigated such a possibility in a series of word recognition and production experiments. Their core stimuli were English words such as *formality*. The word *formality* can potentially be structured in a variety of ways, containing various configurations of the putative morphemes *form*, *-al*, and *-ity*. Libben et al. (2016) reasoned that if morphology is indeed related to patterns of use, the organization of a word such as *formality* in the mind could, in principle, include the suffix string *–ality*. Such an internal substring would not conform to a morphological unit in any existing theory of morphology, but it could indeed conform to a patterning in the mind based on language use (Derwing 2014).

Libben et al. (2016) used a progressive demasking technique to measure word recognition. This is a technique in which words are presented in a manner in which they seem to be emerging from a fog (Grainger and Segui 1990). Participants are asked to say the word aloud as soon as they can recognize it. The resulting naming latencies serve as the dependent variable in the experiment. Word production was measured in a typing task in which morphological structuring effects were detected by comparing letter typing at putative morphological boundaries to letter typing times within putative constituents.

The results of both the recognition and production components of the experiment were linked to possible morphological structures statistically. Using linear mixed effects modeling, the authors investigated whether recognition and production latencies are linked independently to whole word frequency (e.g., the frequency of *formality*), the frequencies of constituent words (e.g., the frequencies of *form* and *formal*) an the frequency and productivity of possible affixal elements (e.g., *-al*, *-it*y, and *–ality*). The results of the study showed that effects for all the possible elements were found to affect both recognition and production of words such as *formality*.

How is this possible? How could word processing be affected by all possible morphological structures? It seems to me that the answer to this question is that, as a result of lexical action, the best mental representation in the mind for words such as *formality* is that representation which enables all possible lexical actions. Thus, the optimal representation of a multimorphemic word in the mind is a superstate representation. Such a superstate representation for the word *formalit*y is shown in Figure 3.

Figure 3. Lexical superstate representations for the word *formality*. The representation at the top center shows the word as undecomposed and ungrouped. The representation at the bottom center shows it as fully decomposed, but ungrouped. On the right, the string is shown with two constituents (with two grouping alternatives). On the left, the string is shown with three constituents (with two grouping alternatives).
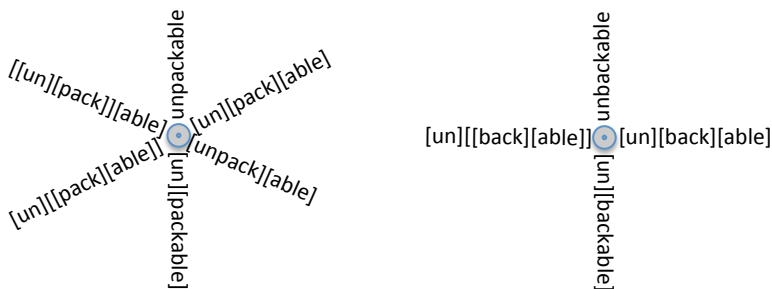
As a final example of the role of superstates and their relation to an action-based perspective on words, I turn to so-called ambiguous morphological structures. The word *unpackable* can be considered to be morphologically ambiguous. It can have two meanings based on the morphological configuration of its elements, as shown in examples (2a) and (2b).

(2)   a.   Unpackable: 'able to be unpacked'
                The trunk was *unpackable* in minutes.
        b.   Unpackable: 'not able to be packed'
                The trunk was broken and therefore *unpackable*.

Consider, by contrast, the word *unbackable,* which differs from *unpackabl*e by only one instance of voicing. It seems that *unbackable* is not ambiguous. It can only mean 'not able to be backed'. It cannot mean 'able to be unbacked'. The reason for this seems to be straightforward. The string *unback* is not an existing word of English.

I would like to claim here that this observation, which seems to have the effect of settling the matter and closing the conversation, actually does the reverse. The reason for this is that language use is in a continual state of change. Perhaps people will soon use the word *unback*. Perhaps they already do, and I have simply not heard or seen this (I do note, however,

there are already a few requests on the web for instructions on how to *unback-up* an iPhone). At present, for most speakers of English, the two words would have a superstate representation such as that shown in Figure 4.

Figure 4. Lexical superstate representations for the words *unpackable and unbackable*. The representations at the top center shows the words as undecomposed and ungrouped. The representation at the bottom center shows them as fully decomposed, but ungrouped. On the right, the strings are shown with two constituents. On the left, the strings are shown with three constituents. The difference is that for *unpackable*, there are alternative groupings. For *unbackable*, there are not.

There are obvious means by which the representations in Figure 4 could change so that they both look like the superstate for *unpackable*. That would be through a rise in the frequency of the word *unback*. This could happen through the use of sentences such as (3)

(3)   'I once considered it my moral obligation to *back* the candidate. Now, I considered it my moral obligation to *unback* him.'

The discussion above underlines the way in which lexical superstates are linked to lexical action. It is what an individual does with words, including the building of links among words, that shapes superstate configurations. Thus, the word *back* would only become associated with an initial compound constituent *back-* if and only if the activity of the language user has included the use of the string *back* as the first part of a compound. To take another example of how lexical action drives lexical superstate creation, consider the word *bat*. We might imagine that the word *bat* has been associated in the minds of speakers of English with a compound head

–*bat* for a very ling time. However, the use of *bat-* as a compound modifier probably only emerged after the creation of the character Batman by Bob Cane and Bill Finger in 1939 (e.g., *batmobile, batcave, batrope*).

The examples above demonstrate how an emphasis on lexical activity suggests a dynamic and potentially individualized perspective on the morphological structure of words and therefore on the overall nature of an individual's lexical knowledge. The language experience of an individual can change considerably through the lifespan and we would therefore expect that, with this, so would the nature of lexical knowledge. In the next section of this chapter, I discuss what is likely the most dramatic reason for an individual's language activity and for the lexical system as a whole to change. This is the development of bilingual proficiency.

4. Words as activities: consequences for bilingualism

It might seem surprising that the perspectives that I have discussed in this chapter concerning the fundamental character of lexical knowledge have their greatest consequences for lexical processing among bilinguals. The reason that this may seem surprising is that it is common in the psycholinguistic literature for fundamental aspects of lexical representation and processing to be treated in a monolingual framework and for less fundamental aspects to be treated as relating to the 'special case' of the bilingual lexicon.

There should, however, be no surprise. The reason for this is that the bilingual lexicon is not the special case, it is the general case.

Current estimates indicate that the majority of people in the world speak more than one language (Grosjean 2012). This has consequences for the understanding of lexical processing and lexical representation in the mind. It means that the default situation, at least in terms of descriptive statistics, is one in which the mental lexicon contains words of more than one language (Libben, Goral and Libben, 2017, Vaid & Meuter, 2017).

At first blush, it might seem that the consequences of the bilingual lexical system being the default system would be that the speaker of more than one language would need special strategies to manage the activation and deactivation of individual languages. Recent research on bilingual processing suggests that this is not the case. There is a large body of evidence that suggests that language activation in the bilingual is non-selective (Dijkstra and Van Heuven 1998, Dijkstra and Van Heuven 2002). The term *non-selectivity* in this context means that multilinguals exhibit parallel activation of lexical representations from all their languages during language comprehension and production. Thus, although multilinguals can

selectively produce utterances in speech and writing in one language only, the lexical system as a whole is 'on' at all times and, under normal circumstances, none of the individual's languages can be turned off (Libben, Goral and Libben, 2017).

If the mental lexicon is truly a single integrated store of knowledge, what then are the special psycholinguistic consequences of the view that the bilingual or multilingual lexicon is the default lexicon? The answer, it seems to me, is that it leads very much to the view that words are actions and lexical knowledge is dynamic.

The reason that the bilingual perspective leads us to this view of words is that the lexical knowledge of the bilingual is characterized by continual change. A bilingual acquires words at a high rate throughout the lifespan. According to views such as those articulated by Libben (2000), those new words must be incorporated into a linguistically integrated lexical system that itself is affected by every new act of lexical acquisition. Thus, lexical action is greater for bilinguals than for monolinguals and the consequences of that lexical action are greater as well.

It is noteworthy that, historically, almost all models of the bilingual lexicon have claimed that the functional architecture of the lexical system is driven by patterns of lexical action. This was evident in the earliest dichotomies between compound and coordinate bilingualism (Weinreich 1953; Ervin and Osgood 1954). It was also evident in models such as that proposed by Kroll & Stewart (1994), Kroll and de Groot (1997), and Pavlenko (2009). In the earliest models of the bilingual lexicon, emphasis was placed on the patterns of lexical use and dominance across languages and therefore between putative language stores. A view of bilingual lexicon processing that is centered on non-selectivity and homogeneity, however, tends to place greater emphasis on the dynamics of knowledge integration in the lexical system of a bilingual.

This integration may be one of the key active features of bilingual processing and the factor that makes bilingual lexical knowledge most dynamic. We may consider a simple inevitability that would arise in compound processing across language groups. In languages such as English, German and Dutch, all compound words have their morphological heads in initial position, so that the word *swordfish* must be sequenced as *sword* followed by *fish*. In languages such as Arabic and Hebrew, the sequencing must be in the opposite direction. All compound words are head-initial. Thus, the compound word for *swordfish* would be *fish-sword*. In languages such as Persian, compounds can be both head-initial and head-final.

Now, imagine the conflict of lexical action that a Hebrew-English

bilingual would experience daily. He or she would need to interpret some compounds in a head-initial manner and other compounds in a head-final manner. It seems as though this might be problematic, perhaps even impossible. But it is not impossible at all. Because, as I have noted above, Persian has both head-initial and head compounds, Speakers of Persian do this all the time. And so, we would expect that through lexical activity, Hebrew-English bilinguals develop an integrated lexical system that has the elements of Hebrew and English and the dynamics of Persian. Their system would be larger than that of a monolingual in either language, it would be different, and it would likely also be richer.

Why richer? It seems to me that the main reason for this is that the acquisition of a new language carries with it considerable opportunity for new lexical connections that have both within-language and between-language consequences. For example, a monolingual English speaker would likely not have semantic links for the lexical root *fin* in *finality*. By contrast, a French speaker would have semantic associations for the lexical root *fin* in *finalité* because the root corresponds to the free-standing French word *fin*, which means 'end'. It does not seem possible that the English-French bilingual can know this when speaking French and un-know it when speaking English. Rather, the lexical knowledge system of the bilingual will drive toward homogeneity and, as a result, the person's English lexical action will be influenced and changed so that, even among English words, *finality* and *end* will be linked

This picture of the bilingual lexicon is one that is characterized by dynamicity and complexity. However, it is not a special case. Rather, as noted by Libben Goral and Libben (2017) it is very likely the default configuration of the lexical knowledge system.

5. What is next?

I began this chapter with an historical sketch of the notion of a lexicon and the notion of a word in the linguistic and psycholinguistic literature. I concluded that the point of departure was the view that words are the simple things from which much of the complexity of language emerges. The perspective that I have presented in the subsequent sections of this chapter diverge form this historical perspective rather substantially. It shows words to be anything but simple and anything but static. It shows the bilingual lexicon as the default state. In my view, this perspective opens up many new theoretical and experimental opportunities. It suggests that actual functional architectures of mental lexicons will be highly individuated and dynamic. If this view of words and of the mental lexicon is correct, then the notion of

the mental lexicon as a store of words may be inappropriate, as may be the notion of words as things in that store. Rather, we should think of the mental lexicon as a dynamic system that enables the action/thing duality that characterizes lexical knowledge.

Funding

References

Aitchison, Jean. 2012. *Words in the Mind: An Introduction to the Mental Lexicon*. 4th edition, Oxford: Wiley-Blackwell.

Aronoff, Mark. 1976. *Word formation in Generative Grammar*. Cambridge, MA: MIT Press.

Bloomfield, Leonard. 1933. *Language*. New York: Holt.

Bohr, Niels. 1934. *Atomic Theory and the Description of Nature*. Cambridge: Cambridge University Press.

Chomsky, Noam. 1957. *Syntactic structures*. The Hague, The Netherlands: de Gruyter.

Chomsky, Noam. 1970. "Remarks on Nominalization". In Readings in English Transformational Grammar, edited by R. Jacobs and P. Rosenbaum, 184-221. Waltham, MA: Ginn.

Coltheart, Max. 1987. "Functional Architecture of the Language-Processing System. In Max Coltheart, Giuseppe Sartori, and Remo Job. (Eds.), *The Cognitive Neuropsychology of Language.* London: Lawrence Erlbaum Associates.

Coltheart, Max, Davelaar Eileen, Jonasson Jon and Besner, Derek. 1977. "Access to the Internal Lexicon". In *Attention and Performance VI*, edited by S. Dornic, 535-556. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Coltheart, Max, Rastle Kathleen, Perry Conrad, Langdon Robyn, and Ziegler Johannes. (2001). DRC: A Dual Route Cascaded model of visual word recognition and reading aloud. *Psychological Review,* 108: 204 – 256.

Dennett, Daniel. 1978. *Brainstorms: Philosophical Essays on Mind and Psychology*. Cambridge, Mass: MIT Press.

Derwing, Bruce 2014. "The role of suffix strings in the processing of multimorphemic words". Invited lecture presented at the *Spring Training in Experimental Psycholinguistics*, Edmonton, Canada.

Di Sciullo, Anna-Maria, and Williams, Edwin. 1987. *On the Definition of Word*. Cambridge MA: MIT Press.

Dijkstra, Ton, and Van Heuven Walter. 1998. "The BIA model and Bilingual Word Recognition". In *Localist connectionist approaches to human cognition* edited Jonathan Grainger & Arthur Jacobs, 189–225. Mahwah, NJ: Lawrence Erlbaum Associates.

Dijkstra, Ton, and Van Heuven Walter. 2002. The Architecture of the Bilingual Word Recognition System: From Identification to Decision. *Bilingualism: Language and Cognition*, 5: 175–197. doi: 10.1017/S1366728902003012

Einstein, Albert. 1905. "On a Heuristic Viewpoint Concerning the Production and Transformation of Light". In The Dreams that Stuff is Made of" edited by Stephen Hawking Stephen Hawking (2011). Philadelphia: PA: Running Press.

Ervin, Susan, and Osgood Charles. 1954. "Second Language Learning and Bilingualism". *Journal of Abnormal and Social Psychology, Supplement*, 49: 139-146.

Fiorentino, Robert, Naito-Billen Yuka, Bost Jamie, and Fund-Reznicek Ella. 2014. "Electrophysiological Evidence for the Morpheme-based Combinatoric Processing of English Compounds". *Cognitive Neuropsychology,* 31: 123–146. doi:10.1080/02643294.2013.855633

Forster, Kenneth. 1976. 'Accessing the Mental Lexicon'. In "*New Approaches to Language Mechanisms"* edited by Roger Wales and Edwin Walker, 257–287. Amsterdam: North-Holland.

Forster, Kenneth. 2007. "Visual word recognition: Problems and issues". In *Core perspectives on the mental lexicon,* edited by Gonia Jarema and Gary Libben, 56-78. Oxford: Elsevier.

Gagné, Christina. and Spalding, Thomas. 2009. "Constituent Integration during the Processing of Compound Words: Does it Involve the Use of Relational Structures?" *Journal of Memory and Language*, 60: 20–35. doi:10.1016/j.jml.2008.07.003.

Grainger, Jonathan, and Segui Juan. 1990. "Neighborhood Frequency Effects in Visual Word Recognition: A Comparison of Lexical Decision and Masked Identification Latencies". *Perception & Psychophysics*, 47, 191-198.

Grosjean, François. 2012. *Bilingual: Life and Reality*. Cambridge Mass: Harvard University Press.

Halle, Morris. 1973. "Prolegomena to a Theory of Word Formation". *Linguistic Inquiry*, 4, 3-16.

Heisenberg, Werner. 1958. *Physics and Philosophy: The revolution in modern science*. New York: Prometheus Books.

Hunt, Harry. 2001. "Some Perils of Quantum Consciousness - Epistemological Pan-experientialism and the Emergence-Submergence of Consciousness". *Journal of Consciousness Studies* 8, 35-45.

James, William. 1890. *The Principles of Psychology*. New York: Dover.

Kroll, Judith and de Groot Annette. 1997. "Lexical and Conceptual Memory in the Bilingual: Mapping Form to Meaning in Two Languages". In *Tutorials in Bilingualism*, edited by Annette De Groot and Judith Kroll, 169-200. Mahwah NJ: Lawrence Erlbaum.

Kroll, Judith and Stewart Erika. 1994. "Category Interference in Translation and Picture Naming: Evidence for Asymmetric Connections between Bilingual Memory Representations". *Journal of Memory and Language*, 33: 149-174.

Libben, Gary. 2000. "Representation and Processing in the Second Language Lexicon: The Homogeneity Hypothesis". In *Second Language Grammars* edited by John Archibald, 228-248. Oxford: Blackwell Press.

Libben, Gary. 2014. "The Nature of Compounds: A Psychocentric Perspective". *Cognitive Neuropsychology*, 31: 8-25.

Libben, Gary, Gibson, Martha, Yoon, YoBoom and Sandra Dominiek, 2003. "Compound Fracture: The Role of Semantic Transparency and Morphological Headedness". *Brain and Language,* 84: 26–43. doi:10.1016/s0093-934x(02)00520-5.

Libben, Gary, Jarema Gonia, Derwing Bruce, Riccardi Alessandra, and Perlak Danuta. 2016. "Seeking the –ational in derivational morphology". *Aphasiology,* 30:11*,* 1304-1324. DOI:10.1080/02687038.2016.1165179

Libben, Gary, Westbury, Chris, & Jarema, Gonia. 2012. "Embracing Complexity. In *Methodological and Analytic Frontiers in Lexical Research*, edited by Gary Libben, Gonia Jarema, & Chris Westbury, 1-12. Amsterdam: John Benjamins .

Libben, Maya, Goral, Mira and Libben, Gary. 2017.

Libben, Maya, Goral, Mira, & Libben, Gary. 2017. "The Dynamic Lexicon: Complex Words in Bilingual Minds". In *Bilingualism: A Framework for Understanding the Mental Lexicon*, edited by Maya Libben, Mira Goral, & Gary Libben, 1-7. Philadelphia, PA: Benjamins.

Libben, Maya. 2017. "Non-selective Language Activation and Bilingualism as the Default ⌜SEP⌟Mental Lexicon". In *Bilingualism: A Framework for Understanding the Mental Lexicon*, edited by Maya Libben, Mira Goral, & Gary Libben, 103-122. Philadelphia, PA: Benjamins.

Marelli, Marco, Gagné Christina, and Spalding Thomas. 2017. Compounding as Abstract Operation in Semantic Space: Investigating Relational Effects through a Large-Scale, Data-Driven Computational Model". *Cognition*, 166: 207-224.

Meade, Gabriela and Dijkstra, Ton. 2017. "Mechanisms Underlying Word Learning in Second Language Acquisition" In *Bilingualism: A Framework for Understanding the Mental Lexicon*, edited by Maya Libben, Mira Goral, & Gary Libben, 49-72. Philadelphia, PA: Benjamins.

Morton, John. 1969. "Interaction of Information in Word Recognition", *Psychological Review* 76: 165-178.

Pavlenko, Aneta. 2009. "Conceptual Representation in the Bilingual Lexicon and Second Language Vocabulary Learning". In *The bilingual mental lexicon: Interdisciplinary approaches*, edited by Aneta Pavlenko, 125-160. Bristol, England: Multilingual Matters.

Sandra, Dominiek. 1990. "On the Representation and Processing of Compound Words: Automatic Access to Constituent Morphemes does not Occur". *Quarterly Journal of Experimental Psychology*, 42: 529–567. doi:10.1080/14640749008401236

Schmidtke, Daniel, Van Dyke Julia, and Kuperman Victor. 2018. "Individual Variability in the Semantic Processing of English Compound Words". *Journal of Experimental Psychology: Learning, Memory, and Cognition.* doi:10.1037/xlm0000442

Selkirk, Lisa. 1982. *The Syntax of Words.* Cambridge, MA: MIT Press.⌜SEP⌟

Smith, Christopher. 2006. "The 'hard problem' and the Quantum Physicists. Part 1: The First Generation". *Brain and Cognition*, 61(2): 181–188.

Taft, Marcus and Forster Kenneth. 1975. "Lexical Storage and the Retrieval of Prefixed Words". *Journal of Verbal Learning and Verbal Behavior,* 14: 630-647.

Taft, Marcus and Forster Kenneth. 1976. "Lexical Storage and Retrieval of Polymorphemic and Polysyllabic Words". *Journal of Verbal Learning and Verbal Behavior*, 15: 607-620.

Vaid, Jyotsna., and Meuter Renata. 2017. "Languages without Borders: Reframing the Study of the Bilingual Mental Lexicon". In *Bilingualism: A Framework for Understanding the Mental Lexicon*, edited by Maya Libben, Mira Goral, & Gary Libben, 7-26. Philadelphia, PA: Benjamins.

Weinreich, Uriel. 1953. *Languages in Contact: Findings and Problems*.

New York: Linguistic Circle of New York.

Westbury, Chris. 2016. "Pay No Attention to that Man Behind the Curtain: Explaining Semantics without Semantics". *The Mental Lexicon*, 11(3): 350-374.