Understanding the Behavioral-Methodology/Language-Processing Interface

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The stated goal of this Special Issue (namely, addressing a key issue for the study of language and the brain in the next century) would seem to call for some type of linkage of behavioral research issues with brain research issues. Thus, dealing with concerns such as the contribution of the right hemisphere to language processing; the nature of the integration of LH and RH language information into a final ''percept'' during comprehension; the true underlying role of Broca's area in language processing; or, linking human genetic description to potential language and/or language–brain functions, would be critical and obviously meritorious goals for new millennium research. However, while research on the brain–behavior link is of obvious and central importance, a far more fundamental issue requires resolution before behavior–brain relationships can be fruitfully examined.

Simply put, we need to understand, *precisely,* how our behavioral methodologies reflect on, and interact with, the language processes we are attempting to study and define. While this issue may not appear at first blush to be as ''new-age'' as, for example, providing brain imaging maps of putative language functions, it is ever-current and arguably far more fundamental. The reason is simple: our behavioral research forms the basis upon which we define and select the inventory of language functions and properties we take to constitute comprehension and production. Our entire behavioral classification and description of language functions is thus dependent on knowing how well the methods by which we examine such putative functions

accurately reflect (or change) the function under observation. Put another way, the range of vocabulary by which we describe language processes is only as accurate as our measures of these processes, and, each and every ''method'' brings some different slant to our descriptions of language processing. Without knowing exactly how the methodologies we use interact with (slant the view of) the process under investigation, the enterprise of studying language is relegated to a type of ever-circular argumentation.

Now, this is not a novel observation. But, from time to time it urgently requires revisitation. An enormous amount of the language processing literature over the past three decades consists of argumentation purporting to support one or another diametrically opposed theoretical positions based on results from differing methodologies. In a few such cases, clear superiority of one methodology's ability to reflect the process being studied is self-evident. This is so, for example, in the use of on-line methods (as opposed to post-perceptual, off-line, methods) to determine *when* during ongoing comprehension certain operations (such as structural attachment, or, context effects) take place. However, in a vast number of cases little substantive evidence exists to demonstrate superiority of one methodology over another for demonstrating the underlying nature of any particular language process. This holds both for research focused on ''grand-scheme'' debates in language processing (e.g., learning vs innate properties, modularity vs interactivity, rule-driven vs probability driven) and for research examining ''minute detail'' levels of processing (e.g., minimal commitment vs parallel parsing, frequency-driven vs preference driven processes, minimal vs accretive speech segmentation). Without understanding the differences inherent in the tasks that support each ''side'' in these debates, there will be an inevitable failure to come to any realistic conclusions concerning answers to these questions (great and small).

Ultimately, at least three separate (but often interacting) issues must be detailed in order to understand what any particular methodology can and does reveal about language processes: (1) *sensitivity* of the task to the specific language process of interest, (2) ability of task to reflect the process-of-interest *independently* of other (often related) processes, and (3) *timing* of task as applied to (i.e., relative to) the time-course of the process-of-interest. There is simply not sufficient space to detail these further, but a brief example of the extremely disparate effects (and consequent disparate conclusions) of subtle methodological differences will help illuminate the depth and breadth of the problem. Consider the matter of the use of on-line priming techniques to examine sentence processes. Two seemingly quite similar on-line techniques often provide evidence which appears to support vastly different conclusions about processing. Let us examine the case of ''visual word-by-word presentation of a sentence'' vs ''auditory presentation of a sentence,'' each involving the additional presentation of a visual priming target (to which a ''lexical decision'' is made) at some point before the end of the ongoing sentence.

Such paradigms are widely used to determine, for example, details about precisely what information has been activated (or inferred, or elaborated) at various points in the sentence, as well as details about how contextual information is used during comprehension. The unimodal (all-visual) sentence presentation method results in primed (speeded) lexical decisions to visual targets that constitute ''good continuations'' of the sentence (at the point where they occur) relative to visual targets that constitute ''poor continuations'' of the sentence. The bimodal (auditory sentence, visual probe) method produces lexical decision reaction times to the visual target that are unaffected by its ''contextual contiguity'' (good or poor continuation) with the sentence. Thus, results from the all-visual unimodal on-line method might be used to support a view that contextual contiguity in sentences is used predictively on-line during comprehension to aid lexical access, whereas the results from the bimodal on-line method suggests that lexical access is unaffected by prediction based on sentential context. Sorting out a reliable answer from these conflicting data requires careful evaluation of the interaction of methodological task-demands and sentence-comprehension processes. In the case of the unimodal, all-visual sentence presentation method, the visual probe effectively becomes a continuation of the sentence, in that the subject must read this ''visual target'' word before continuing on to read the remainder of the sentence (this is true even if the visual target is presented off-set from the visual words comprising the sentence). That is, in the experience of the reader, the visual target is simply the ''next word'' in the sentence. Thus, the task-demands of this methodology require/allow the ease with which the visual target can be integrated into the prior sentential material an opportunity to contribute to the lexical decision reaction times made to the visual target itself. (Lexical Decision tasks are notoriously susceptible to post-lexical-access processes, such as checking for ''fit'' with context, unless exquisite care to eliminate such demand characteristics is taken). On the other hand, the bimodal approach does not allow intrusion or integration of the visual target into the auditory sentence because the auditory sentence is never paused or even briefly discontinued while the visual target is presented. Thus the continuous (noninterrupted) character of the sentence presentation, along with the fact that the target occurs in different modality than the sentence, does not present the listener with a task-demand in which integration of sentence material with the target is encouraged or even possible (at normal speech rates, of course). Thus, ceritus paribus, a unimodal discontinuous methodology, while clearly an on-line task, nevertheless allows its own demand characteristics to confound results that it provides on this particular theoretical question. (See, e.g., Swinney, Nicol, Love, & Hald, 1997, for more details and comparisons on such tasks). Of course, the ultimate appropriateness of a particular task depends on the question one is asking and the level of sentence processing one is studying. The moral of this example is simple: each methodology brings demand characteristics

which must be carefully considered with regard to the process being examined. What is requisite in any examination of language processes is obviously to find the best match of research methodology to the question under investigation. However, the field is a long way from having any coherent categorization of such methodologies and such questions. Hence, developing these must become a key agenda for the study of language (and the brain) in the next century if progress on either is to be made.

Finally, let us return to a larger perspective on this problem. Inherent in the quest to understand how each behavioral methodology interacts with/ reflects language processing is the possibility that each different task actually engages a different, legitimate ''mode'' of language processing. That is, since language is inherently a goal-driven cognitive process, the mode or way in which processing takes place may be highly influenced by the goal given to the subject (where goal is defined by the task requirements of each particular method). And, since each methodology brings different task demands (goals) to the comprehension process, it may be that developing an understanding of each method's sensitivity to language processes is equivalent to developing an inventory of the parameters which place us in one or another language processing mode. Thus, the issue of detailing the nature of methodological task interactions with mental processes can be seen as potentially detailing the various ways in which we can (and do) process language. However, detailing these ways is just yet another fundamental issue which needs to be considered in the new millennium.

REFERENCES

Swinney, D., Nicol, J., Love, T., & Hald, L. (in press). Methodological issues in the on-line study of language processing. In R. Schwartz (Ed.), *Childhood language disorders.* New York: Erlbaum.