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Understanding the Relationship between Comprehension and Production

Janice M. Keenan
University of Denver

Brian MacWhinney
University of Denver, macw@cmu.edu

PSYCHOLINGUISTIC MODELS OF PRODUCTION

Edited by
Hans W. Dechert
and
Manfred Raupach

Gesamthochschule Kassel
Kassel, West Germany

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University of Denver

St. Augustine, in his *Confessions,* says that he learned language by noting how people spoke about different objects and by then trying to accustom his mouth to matching those sounds. Such has been the common folk wisdom on the relationship between comprehension and production: comprehension is viewed as the primary source of learning to produce language. As Ruder and Finch (this volume) clearly illustrate, however, the recent literature in developmental psycholinguistics shows how clever researchers can make something that has seemed to the general public quite straightforward now appear to be both complicated and wrong.

There are three ways in which this reversal of the common folk wisdom has been achieved. One way is to imply that production does not depend upon comprehension through claims such as that with which Ruder and Finch began their paper, namely the statement, "He doesn't know what he is talking about." If we examine those cases in which this statement might be applied, we typically find that a term such as "foresight" has been covertly substituted for the term "comprehension." Thus, it is not the case that the utterance has not been understood by its speaker; rather the speaker has failed to appreciate the consequences or implications of what was said. Does this mean, then, that there are no cases in which we can say "He doesn't understand what he is saying" and not be talking about foresight? Perhaps the statement could be applied to an aphasic victim with a lesion in Heschl's Gyms—the auditory cortex. But, if a normal person had on earmuffs, thereby approximating the state of this type of aphasic, we would simply say "He cannot hear what he is saying" rather than "He doesn't understand what he is saying."

A second way in which the folk wisdom has been subverted is by the pro-

liferation of attempts to demonstrate the primacy of production over comprehension—attempts which only succeed by disabling normal comprehension. Thus, studies like those of Chapman and Miller (1975) and Chapman (1978) achieve their effect, at least in part, by depriving the subject of the normal contextual support for comprehension. They succeed in showing that comprehension without contextual support may be inferior to production. In such studies the removal of contextual support is viewed as a way of measuring pure comprehension. Unfortunately, the unnaturalness of the resultant task may lead to underestimates of competence, and, as a result, these findings may tell us little about the normal relations between comprehension and production.

The third way of reversing the folk wisdom also involves demonstration of the primacy of production over comprehension. But these demonstrations involve a type of experimental manipulation that is just the opposite of that mentioned above. Instead of making the comprehension task abnormally difficult, the production task is made abnormally easy. An example of this is Rice's (1980) study. By making the production task simpler, she demonstrated that production can precede, or exceed, comprehension. In the extreme case, production is reduced to mere imitation and comprehension is elevated to a series of elaborate metacog-nitive judgments and predictions.

The point of this discussion has been to underscore our basic agreement with Ruder and Finch's analysis of the methodological problems involved in studying primacy relations between comprehension and production. As these examples have demonstrated, one can support any hypothesis regarding the relation of comprehension and production simply by either redefining the terms or by manipulating the requirements of the task. Clearly, what is needed at this point is a framework within which to view these various manipulations.

Ruder and Finch argue that comprehension and production are separate processes which are nonetheless intimately related in both language learning and in everyday use. In truth, it is hard to imagine, given what we now know about comprehension and production, how anyone could disagree with their conclusion. For all practical purposes it can be taken as an 'established fact that comprehension and production are separate processes which are nonetheless intimately related. The problem that faces the field is not verifying this proposition. Rather, the problem is specifying, in even the sketchiest terms, what the nature of the relationship is and how the two interrelate in actual behaviors.

One way to proceed in this endeavor is to break down production and comprehension into their component processes. Such an analysis will allow us to see the structural similarities between the two and thus will permit detailed specifications of their relatedness. It also has the additional benefit of providing a framework in which to view the cognitive requirements of the various task manipulations used to study language development.

In the remainder of this paper we will attempt to outline one possible analysis of the component processes in comprehension and production; and we will show

how this framework can be used to distinguish between various types of comprehension and production tasks or behaviors. Although this framework seems to be consistent with everything that we know about comprehension and production, our goal is not to argue for the particulars of this account. Rather, we present it only as an attempt to illustrate the type of discussion that is now needed in this area.

A FRAMEWORK FOR COMPREHENSION AND PRODUCTION

Space limitations require us to limit our discussion of this framework to the simplest case—the acquisition of lexical items. Our comments in this regard are an elaboration of some proposals first published in MacWhinney (1978).

We will use the terms *reception* and *expression* to refer to what many authors call comprehension and production. Our preference for these terms is based on the fact that "production" is often used to refer only to articulatory processes, whereas "expression" refers to the entire chain of processing from the formation of a communicative intention to the generation of articulatory movements. Similarly, "comprehension" is often used to refer only to post-auditory processing, whereas "reception" refers to both audition, parsing, and deeper comprehension.

Within both expression and reception, we can talk about three basic stages or processes in lexical acquisition. These three stages are: a) functional acquisition, b) formal acquisition, and c) mapping acquisition. We will examine these three types of learning first for reception and then for expression.

Reception

We assume that there are three processes involved in receptive acquisition: (a) the acquisition of a receptive function, that is, a concept; (b) the acquisition of an auditory form, and (c) the acquisition of a mapping from the form to the function. The first step in lexical acquisition is the receptive acquisition of a function. Many of the child's receptive functions or concepts arise directly from interactions with the material world. Thus, children develop the idea of a "tree" by seeing trees. Other concepts arise from children's interactions with their caretakers and playmates in the context of games and rituals (Wittgenstein, 1958). Parallel with the acquisition of a receptive function is the acquisition of a form. Form acquisition occurs while the child listens to speech. Thus, the child that hears the sound /dawg/ repeatedly will acquire it as a new form. During listening, forms (in this case, the sound of words) may be stored with varying strength. Forms that have been heard repeatedly and clearly will be the strongest. Forms that have been heard only indistinctly or only on occasion will be weaker. Most forms will be so weak that they will be lost between hearings. Note that knowledge regarding the shape of a form does not require knowledge about the meaning of the form. Thus, it is reasonable to talk about the learning of the forms of words as the acquisition of a set of unknowns.

In the third type of receptive acquisition, the unknown is identified. This occurs by developing an association that relates the form to a meaning. For example, a child may map /dawg/ onto the meaning "four-legged, furry creature. " In some cases a form may be present for some time before the corresponding function is acquired. More often a function is present and the child is waiting to match it to a form. When a salient form occurs in the context of the occurrence of the function, it will be acquired, and mapping of the form onto a function will follow directly.

Expression

Expressive acquisition is also assumed to involve three processes: a) acquisition of an expressive function, b) acquisition of an expressive form, and c) acquisition of a mapping from the function to the expressive form. At each stage expression can rely on prior developments in reception. However, receptive abilities alone are not enough to ensure expressive competence.

The first process in expressive lexical acquisition is the formulation of an intention to communicate. The intention may be to label something, to request some action, to engage in social interaction, or to convey information. Before the child tries to express an intention, the communicative function is acquired, at least to some degree, through reception. However, there are many things in this world that we recognize but seldom wish to talk about. Such functions are present receptively without being present expressively.

The second type of expressive acquisition involves the acquisition of an expressive form. Thus, once the child has formulated an intention to say something, such as the intention to say that something is a member of the "furry and four-legged" class, it may turn out that the child has no formal way of expressing this function. Acquisition of expressive forms often derives from imitation. But in order to imitate, the child must have a way of taking auditory forms and converting them to articulatory forms. As the child phonology literature clearly shows (Ferguson, Peizer & Weeks, 1973), this is not an automatic process. Rather, the child must devise an articulatory program in each new case. Once this program is devised, it may then be acquired as a new unit.

The third type of expressive acquisition involves forming an association between a meaning (and/or an intention) and an expressive form. For example, given the meaning "furry, four-legged creature," an intention to communicate, and the expressive form /dawg/, the child learns to get from the meaning to the form. Note that this type of learning involves acquisition of a pathway that goes in a direction that is opposite to that learned in reception. Note, too, that both the form and the function must be available before the child can control the mapping.

The Relation Between Reception and Expression
Given this brief sketch of the components of reception and expression, we are now in a position to go beyond the vague statement that production and com-

prehension are separate but related processes. We can now say how they are related. Reception and expression are related in that a) both involve the acquisition of functions or meanings, b) both involve the acquisition of forms, and c) both involve the acquisition of mappings between forms and meanings. Because they involve different forms and different mappings, however, the cognitive and physiological requirements of the two will clearly differ (Benedict, 1979; Huttenlocher, 1974).

We can also use this framework to specify how expression is dependent on reception in acquisition. In most cases the child first acquires a receptive form and then uses this form as the basis for the creation of an expressive form. However, in certain rare cases, a child may have expressive use of a word without appearing to understand it (Benedict, 1979; Huttenlocher, 1974). To see how this can occur, recall that there are three processes involved in expression acquisition: (a) acquisition of communicative intentions, (b) acquisition of expressive forms, and (c) acquisition of mappings from meanings to forms. Of these three, only the first two are dependent on reception. Communicative intentions are the expressive counterparts of concepts that emerge first in receptive processing. Similarly, expressive forms are compiled on the basis of the corresponding receptive forms. However, the mapping of a communicative intention onto an expressive form does not depend on reception.

Since not all of the expressive processes are dependent on reception, the child may have different expressive and receptive vocabularies. This is because even though acquisition of expressive forms presupposes receptive forms, acquisition of expressive mappings does not presuppose complete receptive mappings. Thus, a child can have expressive, but not receptive, use of a form whenever the child has developed an expressive, but not a receptive, mapping. This could occur, for example, when a child hears a form and learns to develop an expressive form from this receptive form, but never develops a usable mapping of the receptive form onto a meaning. Then the child is in a situation where there is an intention to communicate a meaning but no mapping from this meaning onto an expressive form. Because the child also has an expressive form available that is not tied down to a meaning, this form can be used to develop a mapping from the intended meaning onto this form. As a result, the child can show expressive use of a form without properly understanding it. Note, however, that because the expressive mapping is developed independent of reception, it is possible (even likely) that in these instances the child's use of the form may not coincide with adult usage of the form.

The proposed framework can also be used to account for the differences among types of lexical learning behaviors or tasks. Table 1 summarizes six different results of the application of the component processes of reception and expression. For each level of behavior the processes are listed in the order in which they must occur. Furthermore, the six levels of behavior are themselves listed in the order in which they could be observed if somehow we could tap into

Table 1.   Six Levels of Lexical Acquisition

	Level	Component Processes
1.	perceptual learning	receptive function acquisition
2.	discrimination learning; identification	receptive function acquisition receptive form acquisition
3.	echoic imitation	receptive form acquisition expressive form acquisition
4.	lexical comprehension	receptive functions acquisition receptive form acquisition receptive mapping
5.	comprehending imitation	receptive function acquisition receptive form acquisition expressive form acquisition
6.	lexical production	receptive function acquisition receptive form acquisition expressive function acquisition expressive form acquisition expressive mapping

lexical acquisition at each step along the path of development of a given lexical form.

The first level is essentially nonlinguistic. It involves the acquisition of a perceptual concept—some cluster of perceptions that has become stabilized in memory.

The second level involves nothing more than the acquisition of an auditory form. Of course, it is difficult to measure such acquisition directly, so experimenters usually teach the child to attach some overt, nonlinguistic response to the newly acquired form. In other words, the child is given discrimination training. An example of this is the receptive training Guess (1969) used to teach mentally retarded adolescents to respond to the plural.

In Guess's (1969) study there was also a group which received training in the production of plurals. That group seems to have been operating on Level 3, echoic imitation. They picked up the sound of the plural and learned to transfer it into the corresponding expressive form.

Guess (1969) found that his receptive training did not facilitate expressive use and that, furthermore, his expressive training did not lead to an improvement in receptive processing. Our analysis allows us to see why both types of generalization failed to occur. Referring to Table 1, we can see that Level 3 relies on a process, expressive form acquisition, that is not involved in Level 2. Thus, it is no surprise that Level 2 training did not result in Level 3 performance. In

contrast, one would expect Level 3 training to facilitate Level 2 performance. But, recall that Level 2 performance depends on discrimination training. Thus, the expressive training group failed to show reception because they had not been trained to respond to the plural as a stimulus.

In the normal process of language acquisition children seem to spend little time on these three levels. Rather, they move quickly to Level 4, where they take receptive forms and map them onto underlying meanings. Comprehending imitation (Level 5) seems to be an intermediate step between acquisition of lexical comprehension (Level 4) and acquisition of lexical production (Level 6). In comprehending imitation the child begins to acquire an expressive form. This level is followed, often quite imperceptibly, by the acquisition of full productive competence (Level 6), which includes the control of the mapping from meaning to expressive form.

As previously noted, this analysis of types of lexical acquisition has been offered only as an illustration of how we might better be able to understand the relation between production and comprehension and the relation between various types of production and comprehension tasks. Hopefully this type of approach will help to move us away from the definitional issues in this area and toward the investigation of the relations between comprehension and production.

REFERENCES

Benedict, H. (1979). Early lexical development: Comprehension and production. *Journal of Child Language, 6,* 183-200. Chapman, R. (1978). Comprehension strategies in children. In J.F. Kavanagh & W. Strange (Eds.),
Speech and language in the laboratory, school, and clinic (pp. 308-317) Cambridge, Mass: M.I.T. Press. Chapman, R., & Miller, J. (1975). Word order in early two- and three-word utterances: Does
production precede comprehension? *Journal of Speech and Hearing Research, 18,* 355-371.
Ferguson, C., Peizer, D., & Weeks, T. (1973). Model and replica phonological grammar of a child's first words. *Lingua, 31,* 35-65. Guess, D. (1969). A functional analysis of receptive language and productive speech: Acquisition of
the plural morpheme. *Journal of Applied Behavioral Analysis, 2.* 55-64. Huttenlocher, J. (1974). The origins of language comprehension. In R. Solso (Ed.). *Theories in cognitive psychology: The Loyola Symposium* (pp. 331-368). Potomac, Md.: Lawrence Erlbaum. MacWhinney, B. (1978). The acquisition of morphophonology. *Monographs of ihe Society for
Research in Child Development, 43,* Nos. 1-2. Rice, M. (1980). *Cognition to language: Categories, word meanings and training.* Baltimore:
University Park Press. Wittgenstein, L. (1958). *Philosophical investigations.* New York: MacMillan.

Lexical Representation Production Range Comprehension Range Production Block Colour Block. These keywords were added by machine and not by the authors. This process is experimental and the keywords may be updated as the learning algorithm improves. This is a preview of subscription content, log in to check access. Campbell R.N., Macdonald T.B., Dockrell J.E. (1982) The Relationship between Comprehension and Production and Its Ontogenesis. In: Lowenthal F., Vandamme F., Cordier J. (eds) Language and Language Acquisition. Springer, Boston, MA. Using think-aloud protocols to identify relationships between reading strategies and successful or unsuccessful L2 reading, Hosenfeld (1977) found that successful L2 readers at the junior high level kept the meaning of the passage in mind, skipped words that they believe to be unimportant to the meaning of the sentence or text, read in "broad phrases," and used context to determine. At the end of the semester a comparison was made between students' grammar-only scores, reading comprehension-only scores and overall exam scores. Final course grades, which involved a host of factors such as attendance, participation, oral skills, quizzes, homework, compositions, and complete exam scores were not considered. Findings. Sentence production, the comprehension of simple and complex sentences, and the parsing of sentences containing grammatical violations differ with respect to the recruitment of these functional components. 20.3.1 Sentence production compared with word production. 20.3.2. Production of syntactically more versus less demanding sentences. 20.3.3 Comparison of sentence comprehension and production activation patterns. 20.4 Within- and between-modality syntactic repetition effects.