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## Review Article

# The Psycholinguistics of the Output Hypothesis

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In this article I attempt to elucidate the psycholinguistic mechanics of Swain's "output hypothesis." Taking the information processing approach as a starting point and relating that to Levelt's model of language production and Anderson's learning theory, I argue that output serves an important role in second language acquisition, in particular because it generates highly specific input the cognitive system needs to build up a coherent set of knowledge. Output also plays a direct role in enhancing fluency by turning declarative knowledge into procedural knowledge. Output can also play an indirect role in the acquisition of declarative knowledge by triggering input that the learner can use for the generation of new declarative knowledge. On the basis of an analysis of think-aloud protocols, I hypothesize that the locus of the effect of output is in the transition of declarative to procedural knowledge.

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A number of publications have proposed the "output hypothesis" as an important extension of theories that consider input as the most important aspect of foreign/second language acquisition (SLA) (Pica, Holliday, Lewis, & Morgenthaler, 1989; Swain, 1985). Although the output hypothesis is appealing, and although experienced language teachers (and learners) will immediately recognize its validity, researchers have not treated in much detail the psycholinguistic mechanics of the role of output in acquisition. This paper is a first attempt to analyze a number of examples presented as evidence for output as learning in terms of processing. The emphasis is on word knowledge in a broad sense: that is, including the syntactic features that are part of a lexical item. I will discuss output data within the framework of the language production model developed by Levelt (1989) in an adapted version aimed at bilingual processing (de Bot, 1992; de Bot & Schreuder, 1993). This article aims not so much to test the output hypothesis against other hypotheses put forward in the SLA literature, but rather to clarify how input and output play a role in a model of SLA in which the information-processing approach is implemented in a psycholinguistic production model.

The structure of this paper is as follows. First, I present a psycholinguistic perspective on what it means to know a word, then discuss various functions of output in SLA. In the next part, I present two psychological models in the information processing tradition, Levelt's (1993) language production model and Anderson's (1982) ACT\* learning theory. I attempt to explain the various functions of output in terms of these models.

### *What Is Lexical Knowledge?*

There are a number of different approaches for defining what constitutes mastery of a word. Nation (1990) presented a list of aspects that a learner has to acquire about a specific word, including different aspects of meaning, associations, collocations, grammatical patterns in which a word can appear, frequency of

use, and orthography. Nation's list is a complete list of all the aspects that make up the knowledge of a word.

Another approach is to start from the information the language-processing system needs in order to function: What types of information must be available for the system to be able to perceive and produce language? A growing body of psycholinguistic research has treated how lexical knowledge functions as part of the language-processing system, and how we can deduce from that what information the learner has to acquire in order to be able to use language (cf. various papers in a special issue of *Cognition* on Lexical Access in Language Production, 1993, and in Schreuder & Weltens, 1993). In the present article I discuss lexical knowledge and lexical skills in terms of these kinds of processing models. I take as a starting point and discuss lexical knowledge in terms of the models.

This approach clearly has consequences for what we mean by "acquisition." The SLA research literature is not always clear on how acquisition is defined (cf. R. Ellis 1994, p. 15). It can refer to the acquisition of new linguistic features but also to changes in the processing of existing knowledge. The criteria set for acquisition depend on the theoretical framework used. As I shall describe later, a clear demarcation between new and existing knowledge is difficult to make in the model presented here. It conceives of acquisition as gradual growth of knowledge structures and an increase of the ease with which those structures can be used in processing. This implies that acquisition also can be the acquisition of incomplete rules or wrong word meanings: Acquisition is defined not by an external criterion, but largely by the extension of existing knowledge.

One aspect that I will not deal with is the distinction between "implicit" and "explicit" learning of lexical knowledge and skills. A full discussion of that issue is beyond the scope of the present article. N. C. Ellis (1994) provides an excellent review of work on this distinction.



*Input and Output*

The input/output controversy has a long history in applied linguistics. Swain's (1985, 1995; Swain & Lapkin, 1995) claims for a more prominent role for output in SLA are basically a reaction to Krashen's (1982, 1985) monitor theory in which comprehensible input plays a central role. On the basis of her research on immersion students who, despite receiving considerable comprehensible input, do not seem to acquire native-like productive skills, Swain has concluded that input alone is not enough:

The argument, then, is that immersion students do not demonstrate native-speaker productive competence, *not* because their comprehensible input is limited but because their comprehensible output is limited. It is limited in two ways. First, the students are simply not given—especially in the later grades—adequate opportunities to use the target language in the classroom context. Second, they are not being “pushed” in their output. (Swain 1985, p. 249)

In recent publications, Swain (1995) and Swain and Lapkin (1995) have discussed four functions of output in SLA. Its first function is to make learners aware of gaps in their knowledge, “noticing.” Noticing gaps “may trigger cognitive processes which might generate linguistic knowledge that is new for the learner, or that consolidates their existing knowledge” (Swain, 1995, p. 126). The second function is to serve language learning through *hypothesis testing*, and the third function is *metalinguistic* in nature: Output serves to control and internalize linguistic knowledge. The fourth function is to *enhance fluency* through practice.

*Previous Research on the Output Hypothesis*

A number of studies have aimed to evaluate the output hypothesis empirically. Pica et al. (1989) had pairs of native (NSs) and nonnative (NNSs) speakers interact in different tasks. The aim of the study was to describe how NNSs reacted when the NSs indicated that they had difficulty understanding NNSs in tasks that differed in the amount and type of information needed. The

results showed that different tasks and the linguistic demands associated with them play a role in the amount and type of “pushed output.” In other words, various tasks forced the NNSs to modify their output. It is not clear, however, to what extent actual learning took place. The modifications in the output may have resulted from an allocation of attentional resources that allowed the speaker to concentrate on a specific (sometimes form-related) aspect of the language. In addition, Pica et al. (1989) concluded that:

although NS confirmation requests were not as conducive to modification of output as NS clarification requests, we would not want to imply that they have less of a role to play in SLA. Because, by definition, confirmation requests provide a model to NNS of what the NS believes that NNS are trying to say, they may prove to be more important than clarification requests in other aspects of SLA, for example serving as a source of target language input for the learner. (p. 84)

This suggests that they view output as an important instrument to elicit specific input from the NSs.

Another study evaluating the output hypothesis is that by Nobuyoshi & Ellis (1993). In this small-scale study, they compared 3 experimental participants with 3 control participants. In the experimental condition, “focused meaning negotiation,” the participants received a clarification request every time they made a past tense error. In the control condition, “unfocused meaning negotiation,” they received a clarification request only when there was a genuine communication problem. In a second session one week later, both groups experienced only unfocused meaning negotiation. The results showed that 2 experimental participants improved their accuracy in the use of the past tense and maintained this improvement in the second session. The data from this study are more important because the improvements in the second testing session occurred in a situation in which the focus of the clarification requests was *not* on form, so here the allocation of attentional resources is less likely to be the explanation for the

findings. This study seems to support the output hypothesis in the sense that "pushed output" focused on a specific linguistic aspect led to sustained improvement. On the other hand, the size of the sample is too small to give this study much weight.

Swain & Lapkin (1995) reported on a study in which they looked at adolescent learners' awareness of gaps in their linguistic performance and the way in which the learners dealt with those gaps. In this study, a number of Grade 8 students of French in an immersion setting had to write an article on ecological problems. They were not allowed to use a dictionary and did not get any support from the teacher. The researcher sat with the students and asked them to think aloud when their behavior suggested that there was a problem, for example, when there was a pause or correction of text. From the transcripts the researcher selected so-called "language related episodes" and analyzed them in depth in order to find out what cognitive processes were generated by the output problems. The authors defined "language related episodes" as:

any segment of the protocol in which a learner either spoke about a language problem he/she encountered while writing and solved it either correctly or incorrectly, or simply solved it (again, either correctly or incorrectly) without having explicitly identified it as a problem. (p. 378)

The study's outcomes show that the learners did indeed become aware of the gaps and applied various strategies to overcome the problems. Some of the learners' evaluations appear to have been influenced by whether an utterance sounded right or not and whether it made sense or not. Their evaluations led to different types of reformulations that reveal different ways of handling the problem. To what extent actual learning or acquisition took place is not clear. On one hand, the authors pointed out that "it will take further research to trace the effect of these cognitive processes on learning" (p. 383), but on the other they later stated that "what goes on between the first output and the second, we are suggesting, is part of the process of second language learning" (p. 386).

In his discussion of the output hypothesis, R. Ellis (1994, p.

284) concluded there is still little hard evidence to support it. Nobuyoshi and Ellis (1993) suggested that output may lead to better control of features that had already been acquired, but “it is not clear whether ‘pushed output’ can result in the acquisition of *new* linguistic features” (R. Ellis, 1994, p. 284). It will not be easy to arrive at hard supportive evidence for the output hypothesis if the research does not focus on specific linguistic aspects, as in the Nobuyoshi and Ellis study. At the same time, this seems to go against one of the crucial aspects of output, which in the examples presented by Swain and her colleagues is inherently part of interaction and co-construction. In research on output in interaction, the focus on “pushed output” of specific aspects advocated by Nobuyoshi and Ellis is difficult to achieve.

The three studies discussed above can be interpreted as support for the output hypothesis. However, from these studies it has not become clear through what psycholinguistic processes output might play a role in acquisition. To validate the output hypothesis in processing terms requires a language-processing model that can account for learners’ output and a learning theory that is compatible with the processing model. The production model developed by Levelt (1989, 1993) is a suitable candidate. It is the most comprehensive model available, it has a firm empirical basis, and it has been applied successfully for modeling both monolingual and bilingual speech production (de Bot, 1992; Grosjean, 1995; Poulishse & Bongaerts, 1994).

### *Levelt’s Production Model*

Levelt (1989, 1993) assumed that lexical processing is just another form of information processing generally. Information-processing theory aims at modeling and quantifying the information people use in various cognitive processes. This view sees the brain as a system capable of processing information in a manner defined not only by the properties of its subcomponents, such as short-term and long-term memory, but also by its peripheral systems like the vocal tract or the visual system. Over the years,



the metaphorical part of the theory has grown into what is conventionally called "cognitive science," but the mathematics that went with it originally is no longer an integral part of the theory. Information processing as a metaphor lies at the heart of most current psycholinguistic theories of language processing that aim to model the flow of information in processes of language production and perception.

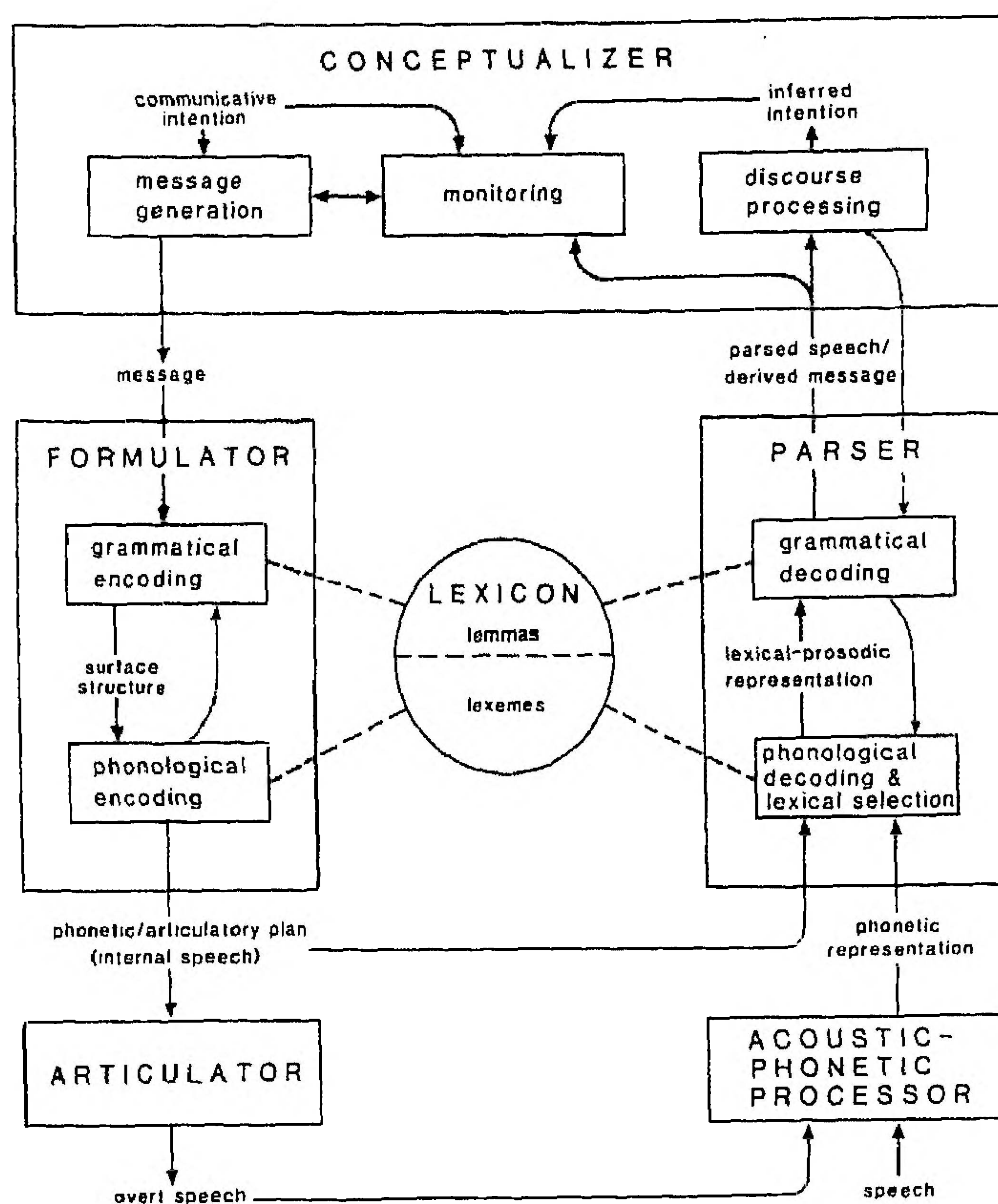


Figure 1. Levelt's (1993) production model. From *Linguistic disorders and pathologies: An international handbook* (p. 2), by G. Blanken, J. Dittmann, H. Grimm, J. Marshall, and C. Wallesch (Eds.), 1993, Berlin: de Gruyter. Copyright 1993 by de Gruyter. Reprinted with permission.

To understand what is happening here in terms of a processing model, some information about such a model may be useful. Here I give a brief sketch of the Levelt (1993) model (see Figure 1). The backbone of the human language production (and perception) system is formed by the relations among three distinct levels of representation: the conceptual level, the lemma level, and the word form level. In production, the conceptualizer (Levelt's term) formats the communicative intentions in such a way that the formulator can handle them.

The conceptualizer's outputs are so-called "preverbal messages": In other words, messages that contain all the information necessary to convert meaning into language but that are not themselves linguistic. The formulator converts the preverbal message into a speech plan (phonetic plan) by selecting the right words/lexical units and applying grammatical and phonological rules.

Lexical items consist of two parts, the lemma and the morpho-phonological form or lexeme. The lemma represents the lexical entry's meaning and syntax; the lexeme represents morphological and phonological properties. In production, the formulator activates lexical items by matching the meaning part of the lemma with the semantic information in the preverbal message. The selection of the lemmas and the relevant syntactic information leads to the formation of the surface structure. While the surface structure is being formed, the formulator activates and encodes the morpho-phonological information belonging to the lemma. The phonological encoding provides the input for the articulator in the form of a phonetic plan. In this article, I assume that concepts, lemmas, and word forms are central to various forms of language use: productive and receptive, written and spoken. Obviously, there are differences between modalities, in particular with respect to time and memory constraints.

Here I will limit discussion of the Levelt (1989, 1993) model to the lexical part. As I mentioned earlier, three levels are particularly relevant. At the conceptual level, all information about a concept is stored. This includes, for instance, that a

"horse" has four legs, that it can jump and pull carts, but also how it smells and how its neighing sounds. At the lemma level, the semantic information needed for a match with the conceptual and the syntactic information needed to arrive at a surface structure of the sentence are both stored. The lemma can be said to link meaning and form. The morphophonological information is stored at the lexeme level. There are separate stores for concepts, lemmas, and lexemes.

*Lexical Items: "Tuer" versus "Mourir"*

To show how learners' lexical knowledge can be described in terms of the production model, I will discuss Example 1 (from Swain & Lapkin, 1995) in some detail. Example 1 reads as follows:

[S17 has written an article about how phosphates released into lakes and oceans cause plants in them to grow quickly to such an enormous size that they will kill all the fish. She struggles in the following think-aloud episode with how to say "kill all the fish".]

... *et mort* [and dies]. I don't know. I don't know because *mour . . . mourir les poissons* [to die the fish], it's like *mourir* is something that you do. It's not something that someone does to you. So it's more like they're being murdered and not dying. So, uhm, *et tue toutes les poissons* [and kills all the fish], or something like that.

(Swain & Lapkin, 1995, p. 378)

In their discussion of this example, Swain and Lapkin suggested two possible processes elucidated by this verbal report: Either the learner applies generalized knowledge in a new context or

she is struggling consciously for the first time with the concept as she senses the difference in meaning between the two verbs. . . . If the latter then what she would seem to be doing is working out, on-line, a sophisticated linguistic rule based on a difference she senses in the meaning of the two verbs. (pp. 378–379)

In Example 1 the learner intends to say something that includes the semantic elements *cause* and *die*. These intentions



*Table 1*  
*Lemma Tuer*

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Conceptual specification: CAUSE (X ("DIE" Y))
Conceptual arguments: (X,Y)
Syntactic category: V
Grammatical functions: (SUBJ, DO)
Lexical pointer: 245
Diacritic parameters: tense, aspect, mood, person, number, pitch accent

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are part of the preverbal message, and the formulator has to match these semantic characteristics with a lemma. The lemma looked for is part of the lexical item *tuer* and contains the information in Table 1 (following the lemma format in Levelt, 1989, p. 191). The conceptual specification indicated that an entity X causes an entity Y to die. This is of course a simplified representation of the full specification needed to identify a given lexical item. The syntactic category indicates that the lexical item is a verb and the grammatical functions indicate that the entities X and Y will be subject and direct object. The lexical pointer is an address in the store of lexemes. This address contains several word forms, all inflections of *tuer*, such as, *tuer*, *tué*, *tuerons*. Which form is selected depends on the diacritic parameters in the lemma.

Other candidates share semantic features with this item. One such candidate is the lexical item *mourir*. This lemma contains the information shown in Table 2. The formulator tries to match a chunk from the preverbal message with a lemma

*Table 2*  
*Lemma Mourir*

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Conceptual specification: X ("DIE")
Conceptual arguments: (X)
Syntactic category: V
Grammatical functions: (SUBJ)
Lexical pointer: 687
Diacritic parameters: tense, aspect, mood, person, number, pitch accent

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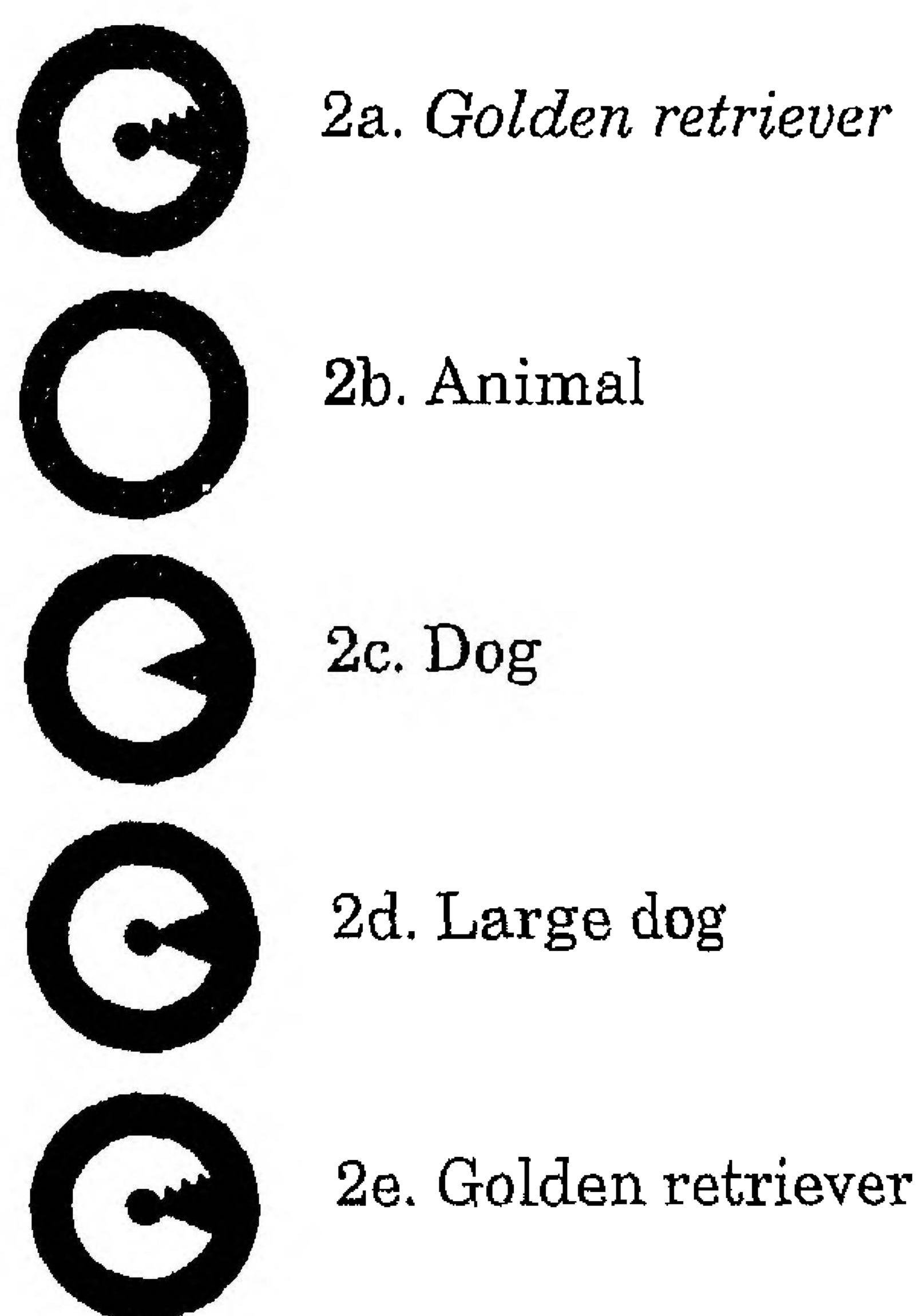


Figure 2. The selection of forms using "sieves."

containing the semantic characteristics *cause* and *die* and, accordingly, containing the argument structure (XY). The task for the formulator is to come up with the best match. How this matching takes place, and what criteria decide when a match is good enough, is unclear. The following metaphor may approximate what happens: The lexicon (more precisely: the collection of lemmas) is like a container with items of different shapes. If we want to select an item with a specific form, we can use a sieve with exactly that form, but it may be more efficient to make some sort of preselection. Figure 2 presents the selection process: 2a is the form to be selected, and 2b, 2c, and 2d are three preselecting sieves, that is, all forms sharing certain characteristics pass through those sieves. In this case, 2e is the final sieve for the form to be selected. The selection of items takes place by applying a series of sieves that have a specific form.

For the selection of lexical items, a similar process takes place: The formulator tries to match parts of the preverbal message with the meaning characteristics of lemmas and the

selection will be increasingly specific. The shapes of the sieves can be compared with meaning components; the selection of the name of a specific type of dog can go from *animal* to *canine* to *Golden Retriever*. The communicative setting defines how specific a lexical item has to be; in some situations it can suffice to label an entity as *animal* or *nonhuman*, whereas another setting requires a specific reference.

There is a structure within the store of lemmas, based on frequency of use and recency of access (among other things), which leads to differences in accessibility of items. More frequent items and items that have been used recently will be more readily available. For most lemmas, this series of sieves will lead to the selection of the right item. This selection of items proceeds at a very high rate: In normal speech production 5 items a second is not unusual. There is thus considerable pressure on the system to deliver the items rapidly. In some cases, no item will pass through the last sieve, which means that no perfect match is possible. For example, English has no single lexical item that expresses *killing someone with the aid of a stereo amplifier* (or an equivalent of the Dutch verb *ijsberen*, which means *walking up and down while thinking*). If there is no real match, there are two possibilities: Either one of the items that passed through the previous sieve will be selected because it is the next best match for this item, or a message is passed on to the conceptualizer pointing out that this chunking of the preverbal message cannot be handled with existing lexical items and that therefore the preverbal message has to be revised. This happens in the following example:

*Peut-être ils sont trop*, (Maybe they are too) uhm, lazy, lazy, lazy, lazy, uhm, *trop*. I'm thinking of lazy. Ils... no. I don't know how to write lazy and I'll never be able to figure out so I have to change the structure of the sentence so I can write something else instead of lazy.

(Swain & Lapkin, 1995, p. 382)

This is a particularly interesting example because it shows that after a given number of trials the system decides that it will not be able to find the target item, and feeds this information back to

the conceptualizer, who then has to come up with a different phrasing in which the French word for *lazy* does not appear.

Following the selection of a lexical item through the lemma, two things happen in parallel: First, various categorical procedures begin that will lead to the development of a basic syntactic structure—the argument structure, activation of an S-structure, selection of candidates for various syntactic roles, and the development of V-, N-, A- or P-phrases. Second, the lexical pointer selects a word form from the collection of lexemes. The nature of the relation between lemma and lexeme is not quite clear. In principle, there is a one-to-one relation between the two—that is, the lexical pointer refers to a unique address in the word form store. However, there is some evidence that the selection of a given lemma will not always lead to the selection of the right word form. This becomes apparent in the “tip-of-the-tongue” phenomenon, where speakers cannot find the right word form although they know that they know it. Research on this phenomenon reveals that speakers retrieve the information on word forms by using different aspects of form; in particular, the initial sound and the number of syllables of the word to be found are more easily available than the rest of the form information (see Jones & Langford, 1987, for a more extensive discussion). A recent study by Meyer and Bock (1992) showed that when participants were presented with a definition of a word followed by a cue word that was related either in meaning or in sound, both types of cues helped rather than hindered lexical retrieval. This seems to suggest that the retrieval of a word is a two-step process: First the lemma must be activated, and then the lexeme.

The word form that has been selected will now be integrated into the syntactic structure of the sentence, and the ensuing surface structure will go both to the articulator and an internal feedback loop that feeds into the conceptualizer. This monitoring only works as an external feedback loop; it cannot influence the construction process within the formulator. As a consequence, most error corrections are not corrections of specific errors but simply retries of the same utterance.



Let us now return to the example we started with. This participant's preverbal message contains a chunk with the conceptual information *cause* and *die*; she tries to match this with a lemma. The first run leads to the selection of *mourir*, apparently the best choice available. In the think-aloud protocol, she describes her evaluation of this outcome. This description reveals that she noticed a mismatch between the information in the preverbal message (*cause* + *die*) and the item selected (*die*), which in the feedback loop is translated back into conceptual terms to allow for a comparison in the monitor. The description shows that the participant noticed a mismatch in terms of the conceptual argument structure and accordingly in the conceptual specification.

### *The Dime in the Piggy Bank Model*

With respect to the output hypothesis, the crucial question is whether this kind of talking to oneself in any sense reveals learning. I will argue that lexical access is a completely autonomous and automatic process not amenable to external manipulation. Following the basic logic of the model, which works in terms of "if-then" operations (*if* the following operations have been carried out, *then* move to the next step, or *if* a sufficient match has been found, *then* select this item), no external operations can influence the selection process. In other words: You cannot talk yourself into finding the right word. An analogy may help to clarify this point. A possible model of lexical access is the "Dime in the Piggy Bank" model. There is a dime in the piggy bank, and you want to get it out now. First you hold the bank upside down and hope the dime will fall out, which in most cases will happen. Sometimes it will not come out. You can shake the piggy, hold it at a different angle, poke into it with a Swiss army knife, but all the actions hardly ever have any effect. After all that, you happen to turn the piggy upside down again, and out falls the dime. Why it did not come out the first time remains a mystery forever.

What seems to be going on with S17's processing is the



following: She selected a lexical item and noticed that it was not fully correct. Then, asked to talk about this monitoring activity, after a while she came up with the right word. There is no evidence in what she said that the verbalization of the monitoring process was a significant part of this "improvement." Talking about the argument structure merely gave her more time to try and try again to find the right word. At "So, uhm" the dime comes out: She finds the right word. The most likely explanation is that the think-aloud activity took her attention away from the (wrong) word that kept popping up, because it was activated recently. Some experimental research supports this interpretation. Experiments using the picture-word interference task, in which people have to name a picture presented along with a word semantically and/or orthographically related to the target word, show that semantically related words lead to longer naming latencies but orthographically related words lead to shorter naming latencies (La Heij, 1988). The semantically related word apparently activates a closely related lexical item that competes with the target item. In other words: Giving additional semantic information does not necessarily lead to easier access, and may even lead to access problems. The data from Meyer and Bock (1992) mentioned earlier suggest that form priming may have some effect on retrieval, but there is no evidence that talking to oneself ("I know this word begins with an s.") can be regarded as form priming in that sense.

Additional support for the position taken here comes from a study by Ammerlaan (1996), who looked at Dutch migrants in Australia who had not used their first language for 10 years or more. These "dormant" bilinguals had to name pictures (presented on a computer screen) in Dutch. The informants had great difficulty in accessing the words from the language they had not used for so long. The transcriptions of their attempts to arrive at the names of the pictures reveal that they used all sorts of strategies to gain time, but their talking did not seem to bring them closer to the word form for which they were looking. In the following example the informant was presented with a picture of a peanut (Dutch: *pinda*):

Pinda/Peanut: "... er ... peanut ... er *noten* erm are nuts, but peanoten, no, I don't know ... we used to buy them at the market, *de markt*, *op de markt*, and we used to buy those peanut, but I can't think, and take them home. One of the things I remembered as a child ... and we used to crack them at home, a little treat we had ..."

(Ammerlaan, 1996, p. 239)

This example shows that, despite a considerable amount of semantic and episodic information, the word form still could not be found, although there can be no doubt that in the past this word had been used frequently.

A recent study, by Paribakht and Wesche (personal communication, March 1994) of the University of Ottawa collected introspective data from adult ESL students with a variety of backgrounds. The students had to read a passage in English and summarize it. They also had to indicate what lexical problems they had encountered in that passage. The participants showed signs of the Dime in the Piggy Bank phenomenon, which is essentially a special version of the tip-of-the-tongue phenomenon: In the former a word form is looking for a lemma, whereas in the latter a lemma is looking for a word form. One person could not find the meaning of a word and tried to gain time:

I was repeating because I wasn't sure the meaning of the word *bleak*, so I keep repeating, repeating, to see if, to see if it sounded familiar because it's a word that sounds familiar. So I kept repeating. (Paribakht & Wesche, personal communication, March 1994)

In other words, this student knew that, given time, he could come up with the right meaning. By repeating, he hoped the word form would "find" its appropriate lemma.

Both word (form) finding difficulties in production and word (meaning) finding problems in perception are caused by problems in the lemma/word form connection. In principle, these problems do not really differ from L1 to L2, but problems with finding word meanings seem to occur more frequently in L2 than in L1.

*Learning: The Acquisition of Declarative  
and Procedural Knowledge*

To find the locus of learning through output requires discussing learning in terms of a theory that fits with the information-processing approach on which the Levelt (1989, 1993) model is based. Within the framework of processing described above, I define language acquisition as the acquisition of declarative and procedural knowledge. Here I follow the information-processing approach to skill acquisition proposed by Anderson (1982). (See also Towell, Hawkins, & Bazergui, 1996, for a discussion on the development of fluency using the Levelt and Anderson frameworks.) Following Hulstijn's (1990) description of this approach, one can distinguish between controlled information processing and automatic information processing. Learning implies the development from controlled processing to automatic processing. The acquisition of cognitive skills has two stages, a declarative stage and a procedural stage. In the declarative stage, learners acquire isolated facts and rules that can be applied in specific cognitive tasks. Through frequent use, these facts and rules get formalized and become procedures. Declarative-stage processing is slow and more or less open to conscious manipulation. However, procedural-stage processing is fast and beyond conscious control. Proceduralization takes place with increasingly larger units of information, leading to automatic processing of these units. Procedures do not develop in a linear fashion, but undergo constant tuning and restructuring.

Distribution of attention plays an important role in skill acquisition. In controlled processing and in the declarative stage, much attention is allotted to fairly simple, lower-level processing. When knowledge becomes more automatic and proceduralized, much less attention is spent on lower-level skills, and more attention goes to higher-level skills. For example, an incipient language learner will pay much attention to articulation, but a more advanced learner uses higher-level procedures and pays more attention to pragmatic aspects.



Various elements of a language to be learned may be in different stages: It is not the whole language as a system that goes from the declarative stage into the procedural stage. Tuning and restructuring take place on the basis of a mismatch between declarative and procedural knowledge in (various parts of) the system and input. As Hulstijn (1990, p. 33) pointed out, first language acquisition is basically coordination of comprehension and production: On the basis of input, the child develops a system of rules that is adapted constantly. Production lags behind comprehension, and the development of productive skills is based on a mismatch between what is said and the internal norm, or, to use Hulstijn's words: "The impetus for such language change (the fact that the children's first language acquisition does not halt) is provided by their detection of the mismatch between what they can understand and what they can say themselves" (p. 33).

A full treatment of Anderson's (1982) model is beyond the scope of this article. For the discussion of learning on the basis of output, Anderson's main points are the development from controlled processing to automatic processing, the distinction between declarative knowledge and procedural knowledge, and the role of attention in skill acquisition.

### *Learning and Output*

On the basis of what it means to know a word in production and perception, one can describe what types of knowledge the learner must acquire. In production one can distinguish the following steps: the conceptual framing of a communicative intention in a preverbal message, the matching of chunks of this preverbal message with lemmas in the lexicon, the activation of grammatical procedures, the activation of word forms and the formation of a surface structure. The next steps in production, which deal with the generation of a phonetic plan and the execution of articulation, I will not discuss here. When dealing with language learners who have acquired their first language to a considerable extent at this age, one can assume that in principle



the production system is available and that the generation of communicative intentions, which precedes language independently, poses no problems. This means that the learning will have to do with the remaining steps in the process.

Table 2 presented the information in the lemma. The information in the lemma is of a declarative nature, but its function is to trigger various sorts of procedural knowledge in the system. This means that the learner has to acquire the declarative knowledge, or link existing knowledge to it (e.g., that "action"-type lemmas will generally be verbs), and acquire the procedures on which knowledge will work. It is very unlikely that an L2-learner will acquire all procedures completely from scratch. Conceivably, speakers have a stock of procedures at their disposal that may not be language-specific. For example, the procedure for the placement of adjectives in NPs is to a large extent similar for English, German, and Dutch; however, the rules for adverbial placement are similar for German and Dutch, but different for English. In other words, speakers of more than one language have an extensive set of procedures at their disposal. Depending on the language they are using, they apply a subset of these procedures in language production. This does not differ much from how lexical items are organized in a bi- or multilingual speaker (see de Bot & Schreuder, 1993, for a discussion).

One of the main learning tasks, in particular when learning a cognate language, is to find out what procedures apply in the language to be learned. Parts of the information in the lemma may be learned fairly easily by analogy: The number and types of grammatical function are limited for most pairs of Indo-European languages. An English child learning French does not learn anything completely new when finding out that a particular verb has two grammatical functions: SUBJ and DO, because English has many transitive verbs as well. For learning less cognate languages, in particular ergative languages, this is not the case, of course.

Some L1 rules can be used in L2 as they are; others may need to be adapted; some L2 rules are so different from anything in L1

that they have to be learned from scratch. Both in the adaptation of existing rules and in the acquisition of new rules the learner must acquire new declarative knowledge. For example, acquisition of the French subjunctive by speakers of Dutch implies both the acquisition of the inflectional paradigm (which starts as declarative knowledge in the morphosyntactical system) and the acquisition of diacritic parameters for certain verbs and function words. In the course of time, with use, the slow processing on the basis of declarative knowledge turns into fast and automatic procedures. How quickly this transition takes place depends on various factors: amount of difference from the L1 (or existing L2) procedures, frequency of use, type of evidence in the input, and maybe amount and quality of output.

To return to the main question: To what extent and how does output play a role in acquisition? Output as such does not play a role in the acquisition of completely new declarative knowledge, because learners can only acquire this type of knowledge by using external input. Thus, the *locus of the effect of output must be in the transition of declarative to procedural knowledge*. Specific information in the lemma activates certain procedures, and the system does not get error messages about the result of this connection; hence the strength of this connection increases. When this connection is made repeatedly, the activity becomes automated, and therefore more rapid and more precise. The control mechanism for this connection is formed by the speaker's receptive knowledge about the use of specific rules and elements. If what is produced and what is correct do not match according to the internal norm, negative feedback will hamper the development of the connection. This is in fact how one of the roles of output, noticing, works.

A crucial point is whether making the right connection on one's own is more effective for learning than hearing this connection being made in the input. I assume that actively making this particular trace in memory is more effective than merely perceiving it. The explanation probably lies in the amount of attention invested: Attention can be viewed as a limited set of mental

resources that have to be shared by various processing activities. Selective attention is important in learning. Probably, focused attention to specific production processes stimulates the development of connections in memory. In language production by NSs, most attention goes to higher processes, such as the coordination of intentions; lower, automatic processes on the morphosyntactic and phonological/articulatory level receive hardly any attention. If the communicative intention and the form and content of the message do not match, the speaker will, depending on the communicative situation, allocate attentional resources to the source of the mismatch. If there is a form problem, the speaker can pay attention temporarily to form, for example, to morphology.

Returning to the lexical problem evidenced by Swain and Lapkin's (1995) S17: Is there any learning because there is output? I argued above that the comments made by S17 on the argument structure of the intended lexical item as such do not reveal any learning, except possibly in terms of articulating the difference between *kill* and *die*. Following the line of argument set out above, the finding of the right lexical item may involve learning: The participant made a connection between a lemma and a matching word form. Because she made this connection, and because no error messages on the connection occurred, the connection was strengthened, and will be made more easily and/or more quickly next time.

Finally, to what extent can the system itself generate new knowledge independent of input? As pointed out earlier, this depends on the definition of *acquisition*. When new words are formed through the application of existing rules or the combination of morphemes previously acquired, this can be interpreted as acquisition. Also, these newly formed elements can move from a declarative phase to a procedural phase.

### *A Reassessment of the Functions of Output*

1. *Noticing*. According to Swain & Lapkin (1995), "one function of output in second language learning might be to force the learner to move from the semantic processing prevalent in



comprehension to the syntactic processing needed for production" (p. 375). Although it is not clear how there can be comprehension without syntactic analysis, clearly in production learners are "on their own." They cannot rely on external cues and general nonlinguistic knowledge in the same way they do in comprehension. To produce, they need to be more active: They need to create communicative intentions and express them in linguistic forms; in doing so, they discover what they actually can and cannot do. Noticing a problem is not solving it, but the awareness of a problem may lead to more attention to relevant information in the input, given incentives to solve the problem. In most of the communicative tasks discussed by Swain (1995), the learners had good reasons to solve the problems encountered (e.g., students had to work in pairs to reconstruct a piece of text). Thus, noticing can lead to learning; it may help the learner make use of relevant information in the input; or it may stimulate the learner to fill gaps in other ways (e.g., by looking in a dictionary).

2. *Hypothesis testing*. There is little doubt that output serves to test hypotheses. The production model discussed here distinguishes between internal speech and external speech: The phonetic plan generated by the formulator is fed back into the speech-comprehension system to monitor the internal speech. Research using verbal reports has shown that learners generate internal speech and evaluate it internally before articulating it. The speech-comprehension system serves to monitor internal speech with respect to both form and content. Receptive knowledge is more stable and reliable than productive knowledge. In this sense, internal speech serves to test hypotheses against internal standards; on this basis, improved patterns of language use will develop. Output clearly serves to enhance productive knowledge and procedures to the level of the receptive knowledge. The external speech also may play a role in this type of hypothesis testing. If the internal feedback loops function appropriately, the external speech will present the best product available. Clearly, the feedback loop will not filter out all the errors it could, because it lacks time for corrections and retries. Assuming that for a given



sentence the external speech passes (i.e., it contains no errors according to the internal standards), the learner may still be aware that the utterances contain various dubious elements. (Not inconceivably, language learners label linguistic elements for “uncertainty” ranging from “this is probably wrong, but let’s try it” to “I am absolutely sure that this is correct.”) Two reasons may lie behind the use of “uncertain” linguistic means: There are no other means available to express this communicative intention, and/or the learner wants to try out whether it works. On the basis of the reactions to the message, the learner can estimate the appropriateness of the means. Depending on the situation, the feedback may be form- or meaning-related. Again, output functions to get specific input to adapt existing knowledge.

3. *Talking about language: The metalinguistic function.* The metalinguistic function involves using output to talk about language. In their work, Swain and her colleagues (Swain, 1995; Swain & Lapkin, 1995) have developed various classroom activities in which (pairs of) students have to work together to solve “form-based” problems in the target language. Through discussion, the students become more aware of the problem and try to solve it together. For this function, the elicitation of relevant input seems to be the mechanism through which learning can take place. Because they share the same (lack of) knowledge, learners working in pairs can perhaps understand the core of each other’s specific problems.

4. *Enhancing fluency.* I attempted to show how output enhances fluency. As will be clear from the description of the model used, enhancing fluency is one of the most crucial cognitive activities in learning. This means much more than just increased speed of delivery. Fluency serves as an index of automaticity of processing. Fluency on one level allows attentional resources to be spent on higher-level processes.

### *Summary and Implications*

This article treats the output hypothesis from a psycho-

linguistic perspective. I conclude that output serves an important role in SLA, in particular because it generates highly specific input that the language-processing system needs to build up a coherent set of knowledge. Output also plays a direct role in enhancing fluency by turning declarative knowledge into procedural knowledge. Output also can play an indirect role in the acquisition of declarative knowledge by triggering input that the learner can use for the generation of new declarative knowledge.

The output hypothesis in its present form is an important improvement over studies that have looked solely at *quantity* of output as the main factor. Looking at output can explain a lot about how learners find out the subtleties of the target language. Contrary to Krashen's (1994) interpretation, which seems to have missed the essence of the comprehensible output hypothesis completely, it is not quantity of output that counts. What matters is the *quality* of information made available through output.

A final word on paradigms. In her discussion of the functions of output, Swain (1995) proposed a Vygotskian perspective on language learning:

According to Vygotsky, cognitive processes arise from the interaction that occurs between individuals. That is, cognitive development, including presumably language development, originates on the interpsychological plane. Through a process of appropriation, what originated in the social sphere comes to be represented intrapsychologically, that is, within the individual. (p. 135)

This perspective differs somewhat from the information-processing perspective central to the discussion here. Notions from these two paradigms do not fit together well. From the information-processing viewpoint, the idea of interpsychological learning smacks of unfounded assumptions on the transmission of information (not unlike the early Phlogiston theory on the transmission of heat; see Grant, 1981, p. 109, for a discussion of that theory). But co-construction, rather than transmission, of information is taking place. From a Vygotskian perspective, the information-processing approach presents a mechanistic and re-

ductionist view on mental processes, missing crucial aspects—in particular that the exchange of information is essentially interaction-based.

Which perspective one holds true probably depends more on belief and personal preferences than on anything empirically testable. Trying to falsify hypotheses from one paradigm in terms of the other paradigm is a futile exercise. However, as I have tried to show, trying to understand a phenomenon like SLA by looking at it from different perspectives may enrich the field.

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