

ATTENTION

Richard Schmidt

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INTRODUCTION

The essential claim of this chapter is that the concept of attention is necessary in order to understand virtually every aspect of second language acquisition, including the development of interlanguages over time, variation within interlanguage at particular points in time, the development of second language fluency, the role of individual differences such as motivation, aptitude and learning strategies in second language learning, and the ways in which interaction, negotiation for meaning, and all forms of instruction contribute to language learning.

The theoretical issues dealt with in this chapter are organized around the basic assumptions, definitions, and metaphors concerning attention in psychology and include the idea of attention as a limited capacity, the notion of selective attention, and the role of attention in action control, access to awareness, and learning. It turns out that, like most psychological concepts initially based on common experience, attention is not a unitary phenomenon, but refers to a variety of mechanisms. These include alertness, orientation, preconscious registration (detection without awareness), selection (detection with awareness within selective attention), facilitation, and inhibition. This does not diminish the centrality of attention, in its several manifestations, for learning. Although recent evidence, discussed towards the end of this chapter, indicates the possibility of some unattended learning, this appears limited in scope and relevance for SLA. There is no

doubt that attended learning is far superior, and for all practical purposes, attention is necessary for all aspects of second language learning.

A secondary goal of this chapter is to provide some of the details of the role of attention as that fits within a broader cognitive approach to understanding second language acquisition, one that relies on the mental processes of language learners as the basic explanation of learning. I am particularly concerned with those mental processes that are conscious, under the working hypothesis that SLA is largely driven by what learners pay attention to and notice in target language input and what they understand the significance of noticed input to be. This stands in opposition to what Jerome Bruner (1992) has called the “magical realist” view, that unconscious processes do everything¹.

A full understanding of the ways in which awareness may shape SLA is beyond the scope of this chapter. Specifically, the issue of explicit and implicit learning and related questions concerning the role of explicit and implicit knowledge in SLA are not discussed here at any length. Both implicit and explicit learning surely exist, and they probably interact. Implicit learning (learning without awareness) is shown by numerous demonstrations that the result of allocating attention to input results in more learning than can be reported verbally by learners. Knowledge of the grammar of one’s first language is an obvious case. Native speakers of French “know” the rules for using the subjunctive, even if they know none of them explicitly. In experimental studies, it has also been

¹ This chapter is a revised version of presentations at PacSLRF (Aoyama Gakuin University, Tokyo, March, 1998) and SLRF ‘97 (Michigan State University, East Lansing, October, 1997), under the titles “The centrality of attention in SLA” and “There is no learning without attention,” respectively. The SLRF presentation was part of a point-counterpoint plenary with Jacqueline Schachter of the University of Oregon, who presented the view that multiple types of evidence for unconscious learning of various kinds converge on the notion that unconscious adult learning can and does take place in some, though presumably not all, areas of language. My own view is that conscious and unconscious processes probably interact in all domains of language, but that there is little evidence for learning without attention (one reading of “unconscious”) in any of them.

shown that people can learn to control complex systems without recourse to an explicit mental model of how the system works (Berry, 1994). Various theories have been proposed to account for this common phenomenon. In SLA, those most discussed at the present time are the UG account, which argues for unconscious deductive reasoning from innate principles (Gregg, this volume), and the connectionist account, in which automatic, implicit learning results from the strengthening and inhibition of connections in an associative network, a simple, “dumb” process that leads to a complex and intelligent result (Elman, Bates, Johnson, Karmiloff-Smith, Parisi, & Plunkett, 1996; MacWhinney, this volume). On both accounts, the learning is unconscious.

Explicit learning (learning with awareness) is also common. Probably most readers have learned a language recently enough to remember some of the experience or have learned some other cognitively demanding skill and can verify that learners commonly form (conscious) hypotheses about the target of their learning and modify those hypotheses as they encounter more information. What these two kinds of learning, implicit and explicit, have to do with each other continues to be a topic of great debate within SLA and elsewhere. In SLA the question has frequently been posed in terms of whether or not “learned” knowledge can become “acquired” or whether the learner’s conscious hypotheses can become internalized (Krashen, 1981; R. Ellis, 1993). Another, possibly more productive way to pose the question is in terms of learning processes (rather than types of knowledge), to ask whether bottom-up, data driven processing and top-down, conceptually driven processing guided by goals and expectations (including beliefs and expectations concerning the target language grammar) interact, to which the answer is probably yes, they do (N. Ellis, 1994a, 1996a, 1996b, this volume; Carr &

Curran, 1994; Mathews, Buss, Stanley, Blanchard-Fields, Cho, & Druhan, 1989; Robinson, 1995).

Since the concerns dealt with in this chapter concern the role of attention in SLA, it might be desirable to simply exclude all issues of awareness (Anderson, 1995). Unfortunately, it is probably impossible to separate attention and awareness completely, because of the common assumption that attention and awareness are two sides of the same coin (Carr & Curran, 1994; James, 1890; Posner, 1994), the emphasis in psychology on attention as the mechanism that controls access to awareness (discussed later in this chapter), and the reliance, in many experimental studies, on verbal reports as a method of assessing the allocation of attention. The solution adopted to this problem in this chapter is to limit the discussion of attention and its subjective correlate of “noticing” to awareness at a very low level of abstraction. “Noticing” is therefore used here in a restricted sense, as a technical term equivalent to “apperception” (Gass, 1988), to Tomlin and Villa’s (1994) “detection within selective attention,” and to Robinson’s (1995) “detection plus rehearsal in short term memory.” My intention is to separate “noticing” from “metalinguistic awareness” as clearly as possible, by assuming that the objects of attention and noticing are elements of the surface structure of utterances in the input, instances of language, rather than any abstract rules or principles of which such instances may be exemplars. Although statements about learners “noticing [i.e., becoming aware of] the structural regularities of a language” are perfectly fine in ordinary language, these imply comparisons across instances and metalinguistic reflection (thinking about what

has been attended and noticed, forming hypotheses, and so forth), much more than is implied by the restricted sense of noticing used here².

ATTENTION IN CURRENT ACCOUNTS OF SLA

Even a cursory review of the SLA literature indicates that the construct of attention appears necessary for understanding nearly every aspect of second and foreign language learning.

Understanding development

Some accounts of L2 development emphasize the importance of attention much more than others. If one is concerned only with linguistic competence and subscribes to a strong innateness position, that development is the mere triggering of innate knowledge (which is not only unconscious but inaccessible in principle to consciousness), then the role of input is minimized and the role of attention to input even more so. Perhaps the only role for attention is that, presumably, at least the crucial evidence that triggers changes in the unconscious system must be attended (Schmidt, 1990). Connectionist models of learning, which are based on the processing of input and do not distinguish between competence and performance, also have little to say about attention, since input and output units are usually simply assumed to be attended. (Most connectionist accounts are silent on this issue; for one that is explicit, see Cohen, Dunbar, & McClelland, 1990).

The role of attention is emphasized most in cognitive accounts of second language development, especially those that are strongly psycholinguistic in approach (Bialystok, 1994; Carr & Curran, 1994; N. Ellis, 1994b, 1994c, 1996a; R. Ellis, 1996; Gass, 1988, 1997a; Hatch, 1983; Pienemann, 1989; Pienemann & Johnston, 1987; Robinson, 1995;

² As Truscott (forthcoming) has pointed out, for some in SLA, rules are considered to be the targets of noticing (R. Ellis, 1993; Fotos, 1994).

Skehan, 1998; Swain, 1993, 1995; VanPatten, 1990, 1994, 1996; Wolfe-Quintero, 1992), within which attention to input is seen as essential for storage and a necessary precursor to hypothesis formation and testing. Common to these approaches is the idea that L2 learners process target language input in ways that are determined by general cognitive factors including perceptual salience, frequency, the continuity of elements, and other factors that determine whether or not attention is drawn to them (Slobin, 1973, 1985; Towell & Hawkins, 1994). It has also been pointed out that attention is what allows speakers to become aware of a mismatch or gap between what they can produce and what they need to produce, as well as between what they produce and what proficient target language speakers produce (R. Ellis, 1994; Gass, 1988, 1997a; Schmidt & Frota, 1986; Swain, 1993, 1995, 1998).

Most discussions concerning the role of attention in second language development focus exclusively on morphology and syntax, although a few have dealt with lexical learning (N. Ellis, 1994b) and pragmatic development (Bialystok, 1993; Schmidt, 1993b). Peters (1998) proposes that in every domain of language learning (phonology, grammar, semantics, pragmatics, vocabulary, discourse structuring), learners must attend to and notice any source of variation that matters, whatever makes a difference in meaning. For example, in syntax, one may say in English both “I turned the covers down” and “I turned down the covers,” but there is no difference in meaning that depends on the position of the direct object. Native speakers do not attend to this difference, and non-native speakers do not have to attend to it either, at least for comprehension. However, if an utterance contains a pronoun, then there is a difference: “I turned it down” is possible, but “I turned down it” is possible only in the sense of “I turned down the road,” while “I turned the

road down” makes sense only with the semantic reading of a road being offered but rejected as a gift. In this case, Peters argues that learners do have to notice the difference in ordering and be aware that it matters, mapping forms with their appropriate meanings. Moreover, since beginning learners are cognitively overloaded, they cannot pay attention to all meaningful differences at once. If they have not learned what is simple, they cannot learn what is complex, but as simpler processing routines are over-learned, they have more capacity to attend to details, eventually being able to attend to whatever native speakers pay attention to. In the multidimensional model of Pienemann and Johnston (1987), developmental features and natural orders are related to the learner’s gradually expanding processing space and the freeing of attentional capacity. For example, the crucial point for accurate production of third person singular –S is that the learner must have enough processing space available to generate a third person marker and keep it active in working memory until the appropriate moment arrives for attaching it to a verb.

VanPatten (1994) has argued that attention is both necessary and sufficient for learning L2 structure:

Bob Smith is a learner of Spanish, a language that actively distinguishes between subjunctive and indicative mood ... He begins to notice subjunctive forms in others’ speech. He attends to it. Soon, he begins to use it in his own speech, perhaps in reduced contexts, but nonetheless he is beginning to use it. If you ask him for a rule, he might make one up. But in actuality, he doesn’t have a rule. All he knows is that he has begun to attend to the subjunctive and the context in which it occurs and it has somehow begun to enter his linguistic system... Bob did not need to come up with a conscious rule; he only needed to pay attention. (p. 34)

Others who emphasize the importance of attention do not claim that attention is necessary for all learning. Carr and Curran (1994) claim that focused attention is required for some types of structural learning, but restrict this to cases where complicated

or ambiguous structures are the object of learning. Gass (1997a) argues against the principle that all second language learning requires attention (attributing some learning to UG), but cautions that her arguments are not intended to weaken the claim that attention is important, merely to show that attention and awareness are not the only factors (p. 16).

Understanding variation

Mellow (1996) has argued that, when non-automatized knowledge is target-like but automatized knowledge is not, tasks for which attentional resources are abundant will result in more accurate language use than tasks for which attentional resources are limited. For example, redundant grammatical elements that have not been automatized are likely to be omitted in tasks that make high demands on attention such as comprehension tasks, but will be supplied more consistently in tasks such as writing, which does not make as high demands on attention. Variability can also be induced by task constraints and instructions. Hulstijn and Hulstijn (1984) showed that performance on two Dutch word-order rules in a story retelling task improved when the subjects' focus of attention was experimentally manipulated towards grammatical correctness. From a different perspective, Tarone (1996) has argued that language learners should not be viewed solely as decontextualized information processors, emphasizing that social context (including interactional pressures) is what causes a speaker to pay more or less attention to one or another linguistic form. However, the information-processing account and the social variationist account agree that variations in attention underlie variations in use.

Understanding fluency

Attention is a key concept in accounts of the development of second language fluency that are related to the psychological concept of automaticity (de Keyser, this volume; Schmidt, 1992). Models that contrast controlled with automatic processing posit a transition from an early stage in which attention is necessary and a later stage (after practice) in which attentional resources are no longer needed and can be devoted to higher level goals (McLaughlin, Rossman, & McLeod, 1983; Shiffrin & Schneider, 1977). According to Logan's instance theory (1988; Logan, Taylor, & Etherton, 1996), a competitor to the standard information processing view, the transition to fluency is not the result of developing automatic routines that do not require attention, but rather the replacement of slower algorithmic or rule-based procedures by faster memory-based processing. However, this theory is also based on crucial assumptions about attention: encoding into memory is an obligatory consequence of attention (representations in memory are not complete and accurate snapshots, but only encode what subjects pay attention to), and retrieval is an obligatory consequence of attention at the time of retrieval. Similarly, chunking theories of fluency assume a role for attention; chunking is a mechanism that applies automatically, but only to attended input (N. Ellis, 1996a, this volume; Servan-Schreiber & Anderson, 1986). Other models of fluency emphasize executive control and skilled selective attention. Bialystok has argued that the basis of fluency is the ability to focus attention on relevant parts of a problem to arrive at a solution, an ability that develops as the result of age, experience, practice, and bilingualism (Bialystok, 1994; Bialystok & Mitterer, 1987).

Understanding individual differences

Attention is a useful construct for understanding individual differences in SLA. As Tremblay and Gardner (1995) have pointed out with respect to motivation, a statement that some aspect of motivation leads to higher proficiency or better performance does not answer the question of why such a relationship exists. Models of motivation and learning can be improved by the identification of mediators that explain why one variable has an effect on another. In a revised version of Gardner's well-known socio-educational model, Tremblay and Gardner propose that three "motivational behaviors" --effort, persistence, and attention-- mediate between distant factors, including language attitudes and motivation, and achievement. Tremblay and Gardner found support for a LISREL structural equation model linking these variables in a study of achievement in French courses. In addition, three studies to date (MacIntyre & Noels, 1996; Oxford & Nyikos, 1989; Schmidt, Jacques, Kassabgy, & Boraie, 1997) have found strong links between motivation and learning strategies, particularly cognitive and metacognitive strategies. These strategies are either strategies for focusing attention on some aspect of the target language or for sustaining attention while doing something else in addition --inferencing, looking for patterns, monitoring (paying attention to one's output and to the process of learning itself), and other types of active conscious processing (O'Malley, Chamot, & Walker, 1987; Oxford, 1990).

At least one aptitude factor, short term or working memory capacity (Baddeley, 1986; Cowan, 1996; N. Ellis, 1996a, this volume; Harrington & Sawyer, 1992), is closely related to attention. Robinson (1995) has suggested that my concept of "noticing" can be redefined as detection plus rehearsal in short term memory. Baddeley, Papagno, and

Vallar (1988) have reported that such rehearsal is necessary for learning unfamiliar verbal material, although not necessary for forming associations between meaningful items that are already known. In the model of Baddeley (1986), there are three components of working memory: a “central executive,” explicitly related to attention and responsible for controlling the flow of information into working memory; a “visuospatial sketchpad,” a passive storage buffer for visual and spatial information; and an “articulatory loop,” storing rich, detailed, and temporarily held information about the surface properties of language and allowing the relatively effortless recycling of the items currently in memory (Cowan, 1996). Another model relating attention to aptitude is that of Skehan (1998), who suggests that the ability to notice what is in input is one of three factors in foreign language aptitude (the others are language analytic ability and the ability to retrieve chunks from memory to support fluent speech production).

Understanding the role of instruction

Sharwood Smith (1995) points out that input salience can be internally derived (when input becomes noticeable to the learner because of internal cognitive changes and processes) or externally derived (when input becomes more noticeable because the manner of exposure is changed). One major role of explicit instruction is that, by changing expectations, it helps focus attention on forms and meanings in the input, a prerequisite for subsequent processing (de Graaff, 1997; N. Ellis, 1993; R. Ellis, 1994; Hulstijn & de Graaff, 1994; Long, 1988; Schmidt, 1990; Schmidt & Frota, 1986; Sharwood Smith, 1993, 1994; Tomlin & Villa, 1994; Terrell, 1991; VanPatten, 1994). It can be argued that task requirements, task instructions, and input enhancement techniques

affect what is attended to and noticed in on-line processing, thereby causing their effects (Doughty, 1991, this volume; Doughty & Williams, 1998; Skehan, 1996, 1998).

Similar characteristics of informal instruction, ranging from immersion contexts to natural interaction with native speakers of a language, have also been widely commented upon (Pica, 1994, 1997). Long (1983, 1992, 1996) has argued that interactional modifications such as clarification requests and recasts are more consistently present than are input modifications (e.g. linguistic simplification) in interaction between native and nonnative speakers and that the nature of interactional modifications as attention-focusing devices is what makes them likely to be helpful for acquisition. Gass and Varonis (1994) have proposed that interaction serves to focus learners' attention on form in instances where there is perceived difficulty in communicating, "raising to awareness that area of a learner's grammar that deviates (either productively or receptively) from native speaker usage." Swain (1985, 1993; Swain & Lapkin, 1995) has proposed that one reason learners in immersion contexts exhibit weaknesses in grammatical accuracy even after receiving years of comprehensible input is that they are not called upon to produce much, arguing that "producing the target language may be the trigger that forces the learner to pay attention to the means of expression needed in order to successfully convey his or her own intent" (1985, p. 249).

If all these accounts are correct, attention is a crucial concept for SLA. The allocation of attention is the pivotal point at which learner-internal factors (including aptitude, motivation, current L2 knowledge, and processing ability) and learner-external factors (including the complexity and distributional characteristics of input, discursal and interactional context, instructional treatment, and task characteristics) come together.

What then happens within attentional space largely determines the course of language development, including the growth of knowledge (the establishment of new representations), fluency (access to that knowledge), and variation.

However, it could be argued that attention in these accounts is merely a *deus ex machina* that does not actually explain anything. At the least, one must wonder whether a unitary concept of attention based on ordinary experience or folk psychology can be the explanation of so many varied phenomena. To gain a better understanding of what attention is and how it works, it is necessary to turn to psychology, where attention has been a major focus of theory and empirical research for over a century, and to examine some of the assumptions, definitions, metaphors, theoretical disputes, and empirical findings from that field.

ATTENTION IN PSYCHOLOGY: BASIC ASSUMPTIONS

In psychology, the basic assumptions concerning attention have been that it is limited, that it is selective, that it is partially subject to voluntary control, that attention controls access to consciousness, and that attention is essential for action control and for learning. All of these basic points were raised early on. The classic work on attention is that of William James (1890), who noted that “Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness, are of its essence. It implies withdrawal from some things in order to deal more effectively with others” (p. 403). The nature and mechanisms of attention turned out not to be so self-evident, however, and the topic continues to be discussed within an enormous literature, most of which is experimentally based.

Attention is limited

The classic view in psychology is that limited capacity is the primary characteristic of attention (Broadbent, 1958; Kahneman, 1973), and this view has been taken on by many in SLA (McLaughlin, Rossman, & McLeod, 1983; VanPatten, 1994). Within this general view, some have stressed that there are two general human information processing systems. Such accounts contrast effortful, attention-demanding (“controlled”) processes with capacity-free (“automatic”) processes (Shiffrin & Schneider, 1977). Another variant of the basic notion of capacity limitations in attention is that of Wickens (1980, 1984), who proposed multiple, specific resource pools for processing stages, brain hemispheres, and modalities (visual, auditory, vocal, manual). This model accounts for the fact that attention-demanding activities can be carried out at the same time more easily if they call upon different modalities than if they draw upon the same modality. In other words, there is some flexibility to capacity limitations, though each resource pool is assumed to have limited capacity.

Since the 1960’s, when computers with limited memory systems began to come into widespread use, the primary metaphor for the limited capacity notion of attention has been memory (CPU). Another influential variant of the limited capacity metaphor for attention was influenced by psychoanalysis; Kihlstrom (1984) proposed that “effort” (analogous to Freud’s libido) was the limited resource.

Attention is selective

In the classical account of attention, the common view is that a second characteristic of attention, that it is selective, is a corollary of limited capacity. Because there is a limited supply of attention and because any activity that draws upon it will interfere with other

activities requiring it, attention must be strategically allocated. The basic metaphor here is economic (Shaw & Shaw, 1978). When resources are limited, a cost-benefit analysis determines the focus of attention. VanPatten has drawn upon this metaphor in SLA, arguing that what is important in most SLA contexts is the meaning of messages. Limited attentional resources are directed first at those elements that carry message meaning, primarily lexicon, and only later, when the cost comes down, towards communicatively redundant formal features of language (VanPatten, 1990, 1994, 1996; Lee, Cadierno, Glass, & VanPatten, 1997).

In the selective attention literature, the most enduring controversy has been whether selection happens early or late in processing. One influential early view held that attending to one message eliminated perception of another (Broadbent, 1958). The metaphor here is that of a filter, gate, or bottle-neck. Later findings showing that individuals process highly meaningful words outside an attended channel (for example, in dichotic listening studies, in which different messages are played to the two ears) led some researchers to make the strong assumption that all information in the input stream is perceptually processed and that selection happens late (Deutsch & Deutsch, 1963).

Whether or not early selection occurs is still controversial (LaBerge, 1995), but more recent work in psychology has moved away from this issue and from the notion of selection as a corollary of limited capacity, identifying selection itself as the basic function of attention and emphasizing that selection may have other functions in addition to the allocation of scarce resources. Treisman (1992) argues that visual attention serves to integrate the features that belong to the same visual object, that is, to coalesce the properties of an object into a coherent perceptual representation (see also Shapiro, Arnell,

and Raymond, 1997). Within the language acquisition field, Bialystok (1994) has also emphasized the importance of selection (“control” in her framework) rather than limited capacity as the primary characteristic of attention.

Attention is subject to voluntary control

LaBerge (1995) emphasizes the importance of preparatory attention, which includes such things as being ready to step on the gas when a traffic light turns green or waiting to applaud at the exact moment the last sound of a musical performance ends. The benefits of preparatory attention include accuracy in perceptual judgment and categorization, as well as accuracy and speed in performing actions. Preparatory attention has not been discussed directly within SLA, but is relevant to studies of planning, comparing the complexity, accuracy, and fluency of learner language under conditions in which learners do or do not have time to plan before performing (Crookes, 1989; R. Ellis, 1987; Foster & Skehan, 1996; Ortega, forthcoming). More generally, with or without time to plan, we have some freedom to pay attention to one stimulus (or some feature of a complex stimulus) over another. A great deal of language teaching practice is founded on the premise that learners can attend to different aspects of the target language and that one of the important functions of teaching is to help focus learners’ attention. Hulstijn and Hulstijn (1984) have suggested that certain tasks can be repeated, with the teacher telling them each time to pay attention to different features, such as grammar, pronunciation, rate of speech, completeness of information, and so on.

The idea that we can control the focus of attention is an ancient one, often equated with the soul or will. In the 19th century, Wundt and James were the most prominent proponents of this view of attention (Neumann, 1996), while recognizing as well that

there is also a passive, involuntary form of attention. For example, one attends to a loud noise, whether one wants to or not. In the well-known Stroop effect, the printed name of a color word like “red” or “green” tends to interfere with the ability to name the color ink in which the word is printed, e.g. “brown,” when the word “red” is printed in brown ink (Dalrymple-Alford & Budayr, 1966). Involuntary attention is data driven, elicited bottom-up. Voluntary attention is top-down in the sense that attention is directed to outside events by inner intentions.

Attention controls access to consciousness

To quote William James again, “My experience is what I agree to attend to” (1890, p. 403). The idea that one of the roles of attention is to control access to consciousness is an old one (Baars, 1988: 301-324; Shapiro, Arnell & Raymond, 1997). Ever since Aristotle described the phenomenon of selective attention, consciousness (awareness) has been identified with the phenomena of selective access. Neumann (1996) provides an excellent historical account of these views. Descartes assumed that selectivity occurred at a specific place, the pineal gland, between the mechanical brain processes shared with all animals and higher mental processes that are unique to humans. Neumann points out that the idea that attention and awareness are essentially two sides of the same coin also played a prominent role in most 19th century theorizing in psychology. For Wundt, the focus of consciousness was determined by the direction of attention, what he called apperception³. Theodore Ziehen argued against Wundt’s concept of apperception, but also identified attention with access to awareness. In Ziehen’s model, attentional selection

³ Gass (1988, 1997a) refers to apperception as the first stage of second language input processing, defining it as “to perceive in terms of past perceptions” (1988, p. 200) and relating it to selective attention. Her use of “apperception” is equivalent to my use of “noticing” in this chapter.

was based on competition. Sensations and latent (nonconscious) ideas compete for access to consciousness (a very contemporary view). Only the most strongly activated ideas and their associated sensations actually enter consciousness; those that do not remain unconscious and have no effect at all. A modern version of these ideas is that of Marcel (1983), who identifies focal attention as the mechanism that establishes the boundary between an early processing stage that produces nonconscious representations of all stimuli and a higher state of phenomenal experience which consists of the imposition of a particular interpretation. Neisser's (1967) model of attention was similar, in the sense that he viewed the essential function of focal attention as a constructive, synthetic activity that makes stimuli available for further analysis. Baars (1988, 1996) also views attention as the mechanism responsible for access to awareness, distinguishing between autonomous, specialized processors that operate out of awareness and consciousness as a global workspace that broadcasts currently active information to any processor that can make use of it.

In reviewing two independent research traditions used in psychology to investigate attention, one rooted in filter theory and largely investigated through dichotic listening studies, the other based on paradigms from visual information processing, Neumann (1990, 1996) identified the following assumptions in common:

- Selection is the mechanism that moves information from one stage of processing to a subsequent stage;
- The locus of selection is situated between the unlimited-capacity and the limited-capacity portions of the information processing system;

- Selected stimuli are represented in conscious awareness, and unselected stimuli are not so represented.

The predominant metaphor of this view of selection as access to consciousness is that of the spotlight or zoom lens (Baars, 1996; Eriksen & St. James, 1986; Posner & Peterson, 1990). Various SLA theorists have also stressed the role of attention as the process that brings things into awareness. Bialystok has proposed a model of the development of L2 proficiency built around two cognitive processing components, called analysis and control. Analysis is the process by which internal, formal representations are constructed. Relatively unanalyzed representations (e.g. formulaic chunks useful for conversational purposes) gradually evolve into more analyzed representations which are required to support higher literacy skills. Control refers to access to these representations, the basis of fluency. For Bialystok (1994), awareness (consciousness) is the result of an interaction between analysis and control; the process of focusing attention onto internal representations “gives rise to the subjective feeling of awareness that has been called consciousness” (p. 165).

Attention is essential for the control of action

The essential contrast here is between novice behavior, for which controlled processing is required, and expert behavior, which can be carried out either automatically (without attention) or mostly automatically with only a controlled assist at critical decision points (Reason, 1984). Schneider & Detweiler (1988) have proposed a model in which automatization is viewed as a gradual, continuous transition through five identifiable phrases: fully controlled processing, context-maintained controlled comparison, goal-

state-maintained controlled comparison, controlled assist of automatic processing, and fully automatic processing.

Attention is essential for learning

The orthodox position in psychology is that there is little if any learning without attention (Baars, 1988, 1996; Carlson & Dulany, 1985; Fisk & Schneider, 1984; Kihlstrom, 1984; Logan, 1988; Nissen & Bullemer, 1987; Posner, 1992; Shiffrin & Schneider, 1977; Velmans, 1991). This claim is often related to models of memory. It is argued that unattended stimuli persist in immediate short-term memory for only a few seconds at best, and attention is the necessary and sufficient condition for long-term memory storage to occur. In SLA as well, the claim has been made frequently that attention is necessary for input to become available for further mental processing (Carr & Curran, 1994; Gass, 1988; van Lier, 1991, 1994; VanPatten, 1994; Schmidt, 1995).

ATTENTIONAL MECHANISMS

Metaphors for attention (attention as an economic resource, pipeline, gate, computer, spotlight, or executive) are useful and often drive research programs, but recent approaches to the study of attention have attempted to move beyond such metaphors to identify mechanisms that may be more explanatory. In a widely read article in SLA, Tomlin and Villa (1994) have drawn upon the work of Posner (1994; Posner & Peterson, 1990) to identify three mechanisms or subsystems of attention (each with identifiable neurological correlates): alertness, orientation, and detection.

Alertness vs. orientation

In Posner's account of attention, orienting refers to committing attentional resources to sensory stimuli. In earlier accounts (Pavlov, 1927), orienting was traditionally studied as

a reflexive response (e.g. attending involuntarily to a loud noise), and Posner comments that the orienting system responds to involuntarily processed stimuli during early visual processing, but for Posner the essential characteristic of orienting is the alignment process itself (attributed to the posterior cortex), not whether such alignment is voluntary or involuntary. Orientation can therefore be modulated by a second attentional subsystem, the alertness or executive attentional system (in the mid-frontal lobe), which maintains a state of vigilance to increase the rate at which high priority information is detected. Attending, in the sense of orienting, “is therefore jointly determined by environmental events and current goals and concerns” (Posner, 1994: 620).

Tomlin & Villa argue that both orientation and alertness are important in SLA. Alertness is related to motivation, interest in the L2, and classroom readiness to learn. Orientation is related to such instructional techniques as input-flooding and VanPatten’s notion of attention to form: “that is, the learner may bias attentional resources to linguistic form, increasing the likelihood of detecting formal distinctions but perhaps at the cost of failing to detect other components of input utterances” (Tomlin & Villa, 1994, 199). The notion of focus on form as presented by Doughty (this volume) also relates more directly to orientation than to either alertness or detection.

Detection: non-conscious registration vs. conscious perception

For Tomlin & Villa, both orientation and alertness enhance the likelihood of detection, but it is detection itself, the cognitive registration of stimuli (mapped to an anterior attention network that includes the anterior cingulate gyrus and nearby motor areas), that is the necessary and sufficient condition for further processing and learning. Tomlin and Villa stress that, in their view, detection is not equivalent to awareness. It is therefore

necessary to distinguish between detection without awareness (for which “registration” seems a non-controversial choice of labels) and detection within focal attention accompanied by awareness (conscious perception or noticing).

Making this distinction, unfortunately, immediately raises some thorny methodological issues:

- How can we know whether some stimulus (or a feature of it) has been attended?
- How can we know whether some stimulus (or a feature of it) has been noticed?
- How can we know whether some stimulus (or a feature of it) has been registered, even if not attended or noticed?

Evidence that some part of target language input has or has not been attended and noticed is sometimes available from learner productions (in either naturalistic or classroom settings), as in the following exchange, reported by VanPatten (1990):

Interviewer: Cómo están ellos? (How are they?)

Subject: Son contento. (They are happy.)

Interviewer: Y ellos, cómo están? (And them, how are they?)

Subject: Son contento también. (They are happy too.)

VanPatten argues that the learner in the above example was so intent on meaning that features in the input that were not crucial to meaning (verb choice between *ser* and *estar*) were neither attended nor noticed. It is impossible to tell whether verbs in the input might have been unconsciously detected.

Learner reports, for example in diary studies, provide another source of information about what learners pay attention to and notice. Schmidt & Frota (1986) reported the results of a diary study in which there were so many instances of L2 use

matching the learner's reports of what had been noticed when interacting with native speakers that the study was taken to support the hypothesis that there is no language learning without attention and noticing. On the other hand, Warden, Lapkin, Swain, and Hart (1995) found no particular relationship between the quantity and quality of linguistic observations recorded by high school students of French in their journals during a summer exchange program and their progress as reflected in test scores. This might be because some learners found their language observations more worthy of report than did others, but as Tomlin and Villa point out, the essential weakness of diary studies is that their temporal granularity is too coarse: "Diary studies encompass spans of time as large as several weeks, but the cognitive processing of L2 input takes place in relatively brief spans of time, seconds or even parts of seconds" (1994, p. 185). Once again, such studies cannot shed any light on what might have been detected without being noticed, since making diary entries requires not only noticing but reflexive self-awareness (awareness that one has noticed).

Leow (1997) has used data from think-aloud protocols produced by learners of Spanish while completing a problem-solving task (an L2 crossword puzzle) to gather finer-grained data and to distinguish between two levels of awareness illustrated below by two responses to the same item (the stem changing verb *mintieron*): simple noticing (registration with awareness, indicated by a report or repetition) and noticing with metalinguistic awareness:

Simple noticing:

"...the opposite of *no*, so it is supposed to be *sí*, so 11 across is gonna be *mintieron* (fills in *mintieron*)"

Noticing with metalinguistic awareness:

“... now let’s see where is number 17 down? oh *se durmieron, con* a with a *u...repetir, ellos repitieron*? I think it has a stem change, 25 down *ir*, yes!...four down would be *tu*, so *durmió* (writes in *durmió*) done cool, I like this. Number 5 *ellos* of *pedir*, that asked, *pidieron* and it’s good ... nine is gonna be *sí* again *mintieron* and obviously I spelled number 11 wrong so I can fix that (changes *mentieron* to *mintieron*)”

This technique appears to have been successful in distinguishing between two levels of awareness (those who showed higher levels of awareness learned more than those whose protocols showed that they merely attended and noticed), but once again it is difficult to see how such techniques could show that subjects did not attend or notice something, since verbal reports (even when concurrent) cannot be assumed to include everything that is noticed.

Jourdenais, Ota, Stauffer, Boyson, and Doughty (1995) have also used think-aloud protocols to see whether learners in a focus-on-form instructional treatment (target items were textually enhanced) would notice and learn more than subjects in a comparison group. Enhancement participants did notice more target forms and did produce more target features in production, but the methodology cannot identify all examples of target features that were noticed, or any that were not noticed but non-consciously registered. In computer-assisted learning contexts, instructional treatments can be designed to focus learners’ attention on crucial aspects of input, and the success of such efforts can be assessed not only through learners’ reports of what they notice (Chapelle, 1998) but also with programs that track the interface between user and

program, for example by recording mouse clicks and eye movements (Crosby, 1998). However, while such records can provide additional information about orientation, detection still remains invisible.

Nevertheless, it is possible to operationalize the distinction between non-conscious registration and conscious noticing within focal attention in some experimental settings. Merikle and Cheesman (1987) have introduced a distinction between the objective and subjective thresholds of perception. The clearest evidence that something has exceeded the subjective threshold and been consciously perceived or noticed is a concurrent verbal report, since nothing can be verbally reported other than the current contents of awareness. After the fact recall is also good evidence that something was noticed, but only if prior knowledge and guessing can be controlled. For example, if beginning students of Spanish are presented with a series of Spanish utterances containing unfamiliar verb forms, are forced to recall (immediately afterwards) the forms that occurred in each utterance, and can do so, that is good evidence that they did notice them. However, many have argued that it is unreasonable to assume that failure to provide a verbal report (whether concurrent or retroactive) signals the absence of noticing. Learners of Spanish may well notice the forms that are presented, fleetingly, without processing them sufficiently to be able to retrieve them from memory. Failure to achieve above-chance performance in a forced-choice recognition test is a much better indication that the subjective threshold of perception has not been exceeded and noticing did not take place. If subjects, such as these students of Spanish, cannot identify (with better than chance accuracy) which forms occurred in input when forced to choose between alternatives, that would be much stronger evidence for the absence of noticing

than their inability to produce them. If it could then be shown, using more indirect measures that tap the objective threshold of perception, that these subjects did, nevertheless, register those forms, then we would have a strong case for pre-attentive, unconscious detection.

One widely accepted indirect measure of registration is priming, the facilitation of responses to a stimulus by the prior presentation of the same or a related stimulus. Marcel (1983) showed that subliminally presented words that subjects could not consciously see could prime semantic associates. Eich (1984) reported dichotic listening experiments in which pairs of words were both presented to the unattended ear, one of which was ambiguous (e.g. “fair” or “fare”) while the other biased its less common interpretation (e.g., “taxi”). Recognition of both members of the pair was poor (indicating that the subjective threshold of perception was not exceeded), but in a spelling test subjects were biased in the direction of the disambiguated meaning (indicating that the objective threshold of perception had been reached). However, these studies used well-known native language words and are not inconsistent with the claim that novel material (such as foreign language input) cannot be unconsciously registered (MacKay, 1990). Before turning to some recent evidence that unfamiliar information might also be processed without exceeding the subjective threshold of perception, it is necessary to discuss two additional mechanisms of attention.

Facilitation vs. inhibition

The theories discussed so far have assumed that attention directly facilitates or enhances processing (LaBerge, 1995). Automatic processing is assumed up to some level.

Attention then enables selected information to receive further processing (Neill, Valdes,

& Terry, 1995), and ignored stimuli are not processed further (Van der Heijden, 1981). However, there is an alternative. The mechanism of attention might inhibit the processing of irrelevant information, so that processing of relevant information simply proceeds without interference.

The inhibition construct played an important role in early psychological theories (Harnishfeger, 1995). Luria (1961) for example, demonstrated a developmental sequence of action control via verbal regulation. Very young children are not able to guide their own behavior by inhibiting irrelevant behavior either through external or internal speech. Later, toddlers become capable of using external verbal commands to direct their behavior, yet they continue to be unable to regulate their behavior with their own verbal instructions (internal or aloud). However, until recently most psychological models paid little attention to inhibition. Inhibition was ignored by behaviorists and not seen as particularly useful in information processing models of cognition (Harnishfeger, 1995).

Selective attention probably cannot be exclusively an inhibition mechanism, because outside of laboratory experiments there are just too many things that would have to be inhibited. However, resistance to interference from potentially attention-capturing processes is clearly important in understanding many real-life phenomena, such as school children who cannot keep their attention on class, adults with obsessive-compulsive disorder (who cannot inhibit the intrusion of unwelcome thoughts), and older adults with Alzheimer's disease (Kane, Hasher, Stolzhus, Zacks, & Connelly, 1994). Considerable evidence has accumulated in support of the suppression position in general (Tipper, 1985; Tipper & Baylis, 1987; Tipper & Cranston, 1985), and research on inhibitory processes is probably the most active and theoretically interesting work within attention theory at the

present time. The reasons for this probably include the growing preference among cognitive psychologists for the brain metaphor rather than the computer metaphor, the impact of studies relating the frontal cortex to resistance and interference, and connectionist models in which simple processing units send both excitatory and inhibitory signals to each other (Bjorklund & Harnishfeger, 1995; Dempster, 1995; Posner, 1994).

Evidence for facilitation and inhibition effects comes from positive and negative priming, respectively (Neill, Valdes, & Terry, 1995). Suppose that a subject must attend and respond to one source of information, while ignoring another, and must later unexpectedly respond to the previously ignored information or to entirely new information. According to facilitation theories, the effects of the ignored information dissipate over time, but if those effects have not yet dissipated completely, then processing of the previously ignored information should show an advantage over completely new information (positive priming). However, if the processing of ignored information is inhibited when processing attended information, subsequent processing of the ignored information must overcome that inhibition. Inhibited information should be more difficult to process than new information (negative priming).

Negative priming has been demonstrated in a great variety of selective-attention tasks. For example, research on lexical ambiguity has focused heavily on the question of whether sentence context is able to constrain processing only to the meaning that is appropriate in the context, or whether multiple meanings become activated in all contexts. Data supporting the latter view (temporary non-conscious activation of multiple meanings) are frequently cited as evidence for the modularity of lexical processing.

However, Simpson and Kang (1994) and Yee (1991) report recent studies that are concerned with the fate of meanings after the processing of an ambiguous word has run its course, reporting several studies showing that one meaning of an ambiguous word is suppressed following the selection of the other for a response.

CAN THERE BE LEARNING WITHOUT ATTENTION?

It is necessary to deconstruct this question somewhat in order to find the essential issues, since different variants of the question may well have different answers. For example, Gass (1997a) has countered the claim that “attention to input is a necessary condition for any learning at all” (Schmidt, 1993b: 35) with the observation that some learning does not even depend on input. Gass cites studies showing that ESL learners who are instructed on one type of relative clause perform well not only on that type but also on other types of relative clauses that are higher up in the universal relative clause accessibility hierarchy (Gass, 1982; Eckman, Bell, & Nelson, 1988). Gass points out that input on those structures was not available to the learners in the study, and asks, “If no input existed, how could attention to input be a necessary condition for all aspects of learning?” (p. 16).

Gass is certainly correct in pointing out that not all aspects of second learning depend on input. Leaving aside the issue of whether innate universals guide SLA and, if so, how, the L1 is a source in addition to target language input that can assist learners and that clearly influences interlanguage development (Zobl & Liceras, 1994). It is equally clear that successful second language learning goes beyond what is present in input. However, it seems to me that this argument misses the main point of the argument

concerning attention, which is not “Can there be learning that is not based on input?,” but rather “Can there be learning based on unattended input as well as attended input?”

Even restricting the question to whether or not it is necessary to attend to input in order for it to become intake, however, further clarification of the question is necessary. For example, one might paraphrase the question as “Is it necessary to pay attention, deliberately, to some aspect of second language input in order to learn it?,” with a focus on intentionality, alertness, and voluntary orienting to specific stimuli. Because we know that attention can be involuntarily attracted to stimuli, it cannot be claimed that learners must intentionally focus their attention on each particular aspect of L2 input in order to learn it. Even if it is true that in order to learn anything one must attend to it, that does not entail that it is necessary to have either the intention to attend or the intention to learn. On the other hand, we know that preparatory attention and voluntary orienting vastly improve encoding (LaBerge, 1995; Cowan, 1995) and since many features of L2 input are likely to be infrequent, non-salient, and communicatively redundant, intentionally focused attention may be a practical (though not theoretical) necessity for successful language learning. Language learners who take a totally passive approach to learning, waiting patiently and depending on involuntary attentional processes to trigger automatic noticing, are likely to be slow and unsuccessful learners. As Hulstijn (this volume) points out, most vocabulary is learned from context, but relying on reading and listening alone for vocabulary learning is very inefficient. We also know that learners are not free to allocate their attention wherever they wish. VanPatten (1990) has carried out experiments showing that learners have great difficulty in attending to both form and content simultaneously, although they need to do both in order to map form and meaning.

Another way to paraphrase the question is to ask whether all aspects of L2 input must be attended in order to learn them, or whether some kind of global attention to input is sufficient (Truscott, forthcoming). For example, is it sufficient for attention to be focused on meaning, with message form picked up without any attention to it (Paradis, 1994), or is Gass (1997a) correct in arguing that apperceived input that is processed only semantically (for example, with the help of non-linguistic cues, isolated lexical items, and contextual expectations) and receives no syntactic processing will not lead to development of syntax? It has been suggested that aspects of language may differ in their attentional requirements; perhaps learning lexicon and morphology require attention and awareness in ways that learning syntax does not (VanPatten, 1994; Schwartz, 1993). Based on a review of vocabulary learning studies by amnesics, Ellis (1994b) concludes that attention (but not awareness) is necessary and sufficient for learning the perceptual aspects of novel word forms, while learning word meanings requires both attention and explicit awareness.

The psychological literature provides much less help in resolving this question than some others concerning attention, because relatively few studies have assessed the effects of focusing attention on different features of stimulus sets (as opposed to dividing or sharing attention between two sources of stimuli). The few studies that address this issue suggest that stimulus attributes are filtered by attention and only those that are relevant to the experimental task and receive attention are represented in stored instances (Logan, Taylor, & Etherton, 1996). This is sufficient grounds to motivate an attentionally determined encoding specificity hypothesis for SLA, but insufficient to settle the issue,

which clearly requires research within SLA itself, focused on different domains of language.

The question of whether global attention to L2 input might be sufficient is also reflected in the sentiment expressed by many SLA researchers that many features of language could not possibly be attended to, because they are too subtle and abstract (Sharwood Smith, Internet posting to PSYCHE-B@listserve.uh.edu, 11/3/97). If these features of language are taken to be those that modern linguistic theory makes explicit -- such as abstract principles of government, constraints on movement, and the like-- then this must surely be true, since many of these are unrecognizable in any conscious way simply by attending to input. On the other hand, assuming that abstract grammars of the type described by linguists are what L2 learners acquire (itself not an uncontroversial assumption), it may well be necessary for learners to attend to the evidence for these principles, including the presence of morphological material, the order of elements, and the ways in which specific utterances map onto meanings. That is, the issue may be resolved in terms of the distinction made at the beginning of this chapter between attention to the surface structure of utterances as distinct from an understanding of abstract rules or principles.

Another way to resolve this issue is suggested by Sharwood Smith's (1994) distinction between competence, held to be elusive, intuitive, and essentially subconscious, and the on-line production and reception processes of actual language performance. Sharwood Smith gives as an example the position of a verb in a sentence. As far as competence is concerned, there is no rule as such for positioning a verb. Its position falls out from some general principles of universal grammar which prevent it

from going anywhere but its one position. However, language processing takes place in real time, so a verb (whose position in the structure of a sentence may not be governed by a rule) must be positioned appropriately (by a rule or routine) in real time utterances generated by a language processor. In order to establish such routines, attention must be allocated to the order of elements (sequences) in both input-processing and in production.

Probably the most interesting variant of the question of whether attention is necessary for learning in all cases concerns detection in Tomlin and Villa's sense and the distinction that can be made between nonconscious registration and conscious perception, "noticing," or --in Tomlin and Villa's terms "detection within selective attention."

Tomlin and Villa's claim that detection is necessary for learning but that detection need not result in awareness is somewhat anticlimactic, since it is self-evidently true that some aspect of language that is not registered in any sense will not lead to learning. The most interesting question, and the hardest to answer conclusively, is whether selection accompanied by awareness is necessary, or whether pre-consciously detected information is sufficient for learning.

There is evidence for the cognitive registration of stimuli without focal attention or awareness, both from subliminal perception studies and from studies using measures of implicit memory to establish the registration of unattended information (Schmidt, 1990, 1993a, 1994a, 1994b, 1995). These studies clearly show cognitive activation (for about a tenth of a second) of previously well-learned information present in long term memory. However, the vast majority of these studies do not show learning of anything new. On the basis of this distinction, I have proposed a strong version of the "noticing

hypothesis,” a claim that while there is subliminal perception, there is no subliminal learning.

Several types of studies have the potential to falsify this claim, but each entails methodological difficulties. The most straight-forward would be to demonstrate the existence of subliminal learning directly, either by showing positive priming of unattended and unnoticed novel stimuli or by showing learning in dual task studies in which central processing capacity is exhausted by a primary task. Unfortunately, in positive priming studies one can never really be sure that subjects did not allocate any attention or have at least fleeting awareness of what they could not later report (DeSchepper and Treisman, 1996; Merikle & Daneman, forthcoming). Similarly, in dual task experiments one cannot be sure that no attention is devoted to the secondary task, and in experiments using this paradigm, selective attention procedures vary considerably in the extent to which they permit subjects to divide attention between two information sources rather than focusing exclusively on one (Greenwald, 1992).

Schachter, Rounds, Wright, and Smith (1996) have reported learning of complex WH-questions by ESL learners in a nonattentional condition, based on a paradigm used by Curran and Keele (1993) in psychology, although “nonattentional” is a very misleading label when applied to these experiments. Subjects in this condition were required to read the target structure sentences out loud while performing on-line a substitution of an earlier seen word for its synonym in the target sentence. Since reading aloud requires attention to the sequence of words and since Schachter et al. define the learning task as one of serial learning, it is very difficult to accept the claim that this was truly a nonattentional condition. If not (and both Schachter et al. and Curran and Keele

comment that their use of “nonattentional” does not mean that no attention at all is devoted towards the secondary task) then the results are consistent with the idea that performance under conditions of divided attention results in some learning (though less than in single task learning), as long as the competing task does not completely deplete attentional resources. The general point is that both positive priming and dual task learning are likely to be contaminated by conscious processes (Loftus & Klinger, 1992).

As a way out of this bind, Jacoby, Lindsay, and Toth (1992) have argued that the way to demonstrate true nonattentional learning is to use the logic of opposition, to arrange experiments in which unconscious processes oppose the aims of conscious processes. DeSchepper and Treisman (1996) have recently used this logic to produce what may be the most solid demonstration to date of unattended learning, using an experimental paradigm devised by Rock and Gutman (1981). Rock and Gutman presented two overlapped nonsense shapes and asked subjects to attend to one of them (e.g. the green one, not the red one) and rate it for aesthetic quality. After a series of trials, they gave participants a surprise recognition test, found that recognition was at chance, and concluded that attention is needed to form new representations of shape. DeSchepper and Treisman’s innovation was to add an implicit memory measure (response time) to the paradigm and to restructure the experimental procedure based on an inhibition mechanism model of attention. After a series of trials in which subjects attended to green shapes (ignoring red ones) and matched them to other shapes, target and distracter were reversed, i.e. a shape that previously appeared in red (distracter) now appeared in green (target). DeSchepper and Treisman report that previously ignored shapes were subsequently responded to more slowly than control shapes (never before

exposed). This can only be accounted for by assuming that representations of these unattended novel shapes were formed in memory.

One could perhaps argue that the “unattended” shapes in experiments like these are in fact attended and briefly noticed before being suppressed, that inhibition is by definition an attentional mechanism, or that learning in this case is an example of unconscious detection (without alertness, orienting, or awareness), which is itself a form of attention. However, it would be unwise to make such arguments, for this would raise the very serious question of whether the hypothesis that attention is necessary for all learning could ever be falsified, even in principle. It seems wise to conclude, therefore, that there can be representation and storage in memory of unattended novel stimuli, something frequently claimed but not convincingly demonstrated in the past.

The DeSchepper and Treisman experiment counts even more heavily against the strong form of the noticing hypothesis, that there is no learning whatsoever from input that is not noticed, because stimuli that were shown in a previous experiment (Rock & Gutman, 1981) not to have exceed the subjective threshold of perception were shown in this experiment to have exceeded the objective threshold and to have led to learning. This is an important study, therefore, although there are some limitations to these findings that make it questionable how relevant such learning could be for SLA. The effect has been found so far only with visual perception and only when ignored stimuli compete directly and strongly for attention, which is probably not generally the case with second language input. There was no build up of memory strength with multiple presentations in the distracter role, making it unlikely that preconsciously established traces gradually build in strength until they are finally noticed. Not all subjects showed negative priming,

suggesting strategy differences, but for those subjects who did demonstrate negative priming, a single act of attention was sufficient to change from inhibition to facilitation, which is necessary if knowledge is to be available for use. This study did not assess subject awareness, but other priming studies have, and the general finding is that unaware subjects show negative priming of ignored stimuli, while aware subjects show facilitation (Driver & Baylis, 1993; Hasher, Stolfus, Zacks, & Rympa, 1991; Neill & Valdes, 1992). Similar effects have been found in other studies contrasting conscious and unconscious perception (Merikle & Daneman, forthcoming). Unconsciously perceived stimuli can influence affective reactions; when the same stimuli are consciously perceived, these reactions are neutralized. Unconsciously perceived stimuli lead to automatic reactions; consciously perceived stimuli allow subjects to modify their reactions.

However interesting the finding of storage of nonconsciously stored novel information is theoretically, therefore, it appears to be of little potential benefit for language learning. Kellogg and Dare (1989), who argue that both attended and unattended encoding are possible, emphasize that this “does not imply that unattended encoding has any practical value ... [since] the degree of elaboration resulting from unattended encoding appears to be too limited to have any substantive influence on human cognition or behavior” (p. 412). In fact, if we are less able to access previously ignored information than completely new information, we might have an explanation, not for development in language learning, but for non-learning through habituation of the self-instruction to ignore something.

CONCLUSIONS

Like most psychological constructs based initially on common experience, attention does not refer to a single mechanism but to a variety of mechanisms or subsystems, including alertness, orientation, detection within selective attention, facilitation, and inhibition⁴. What these have in common (and do not share with the mechanisms of unattended, preconscious processing) is the function of controlling information processing and behavior when existing skills and routines are inadequate (Neumann, 1996). Learning in the sense of establishing new or modified knowledge, memory, skills, and routines is therefore largely, and perhaps exclusively, a side effect of attended processing.

The question of whether *all* learning from input requires attention to that input remains problematic, and conceptual issues and methodological problems have combined to make a definitive answer illusive, even after a century of psychological experimentation. If the issue is seen as one of intention or the voluntary orientation of attention onto stimuli, the answer seems to be that intention is not a general requirement. However, because goals and motivation are such important determinants of the focus on attention (Baars, 1986), paying deliberate attention to less salient or redundant aspects of L2 input may be a practical necessity. Since task demands are an equally important determinant of attentional focus, instructional practices that focus learners' attention on

⁴ This is probably not an exhaustive list. Posner, Walker, Freidrich, & Rafal (1987) have suggested that the orientation subsystem itself has three mechanisms: disengaging from one stimulus, shifting to a new one, and re-engaging with the new stimulus. Tom Scovel (personal communication) has alerted me to a study by Casey, Gordon, Mannheim, & Rumsey (1993) that accounts for the attentional strengths and weaknesses of autistic savants in terms of these mechanisms. Autistics do not have a problem noticing new stimuli but do have deficient orienting abilities, specifically in disengaging, which gives them their savant ability to perform elaborate calculations.

things that they are less likely to attend to or notice on their own also have a solid justification.

There may be some cases where intentionally focused attention is a requirement. One type of case is when the target language requires that sources of information be attended that are not attended in the L1. An example from phonology would be lexical tone in Vietnamese, which not only requires that six new categories of phonological representation be established, but also requires that learners attend to an aspect of speech that non-tonal languages do not make use of. The other type of case arises when information that is automatically processed in the L1 (without reaching awareness) must be suppressed or treated differently in the L2. Flege (1991) and Valdman (1976) have argued that the learning task is harder in the long run for sounds that are similar in the L1 and L2 than for those that are different. Adult L2 learners are eventually more successful in producing new than similar sounds because they are able to establish phonetic categories for new phones, whereas similar sounds are perceived as equivalent to L1 sounds and therefore escape further attention. It is difficult both to detect and to produce the subphonemic details of L2 categories because automatic processing is fast and difficult to modify. To do so requires the inhibition of well established routines so that new ones can be established. The examples given here have been from phonology, but there are parallel cases in all domains of language where it is necessary to attend to new kinds of information or to suppress the automatic processing of other information, both of which require selective attention or control (Bialystok, 1994).

The important issue of whether there can be any learning (as opposed to activation of known information) on the basis of unattended, subliminal processing

remains recalcitrant. Some recent evidence that appears to falsify the claim that attention is necessary for any learning whatsoever has been presented in this chapter. However, many psychologists have expressed the opinion that this dispute will never be settled conclusively, because zero-point questions are not answerable (Baars, 1986; Merikle & Daneman, forthcoming). Baars argues that the important question is not whether there can be any learning without attention and conscious involvement (unanswerable) but rather whether more attention results in more learning. There does not appear to be any evidence at all against the weaker (but much more easily falsifiable) claim that people learn about the things they attend to and do not learn much about the things they do not attend to (Logan, Taylor, & Etherton, 1996).

If the focus of inquiry is on what specifically in L2 input must be attended, there is a conflict between the encoding specificity hypothesis and the global attention hypothesis. The former claims that only those stimulus attributes that are attended in processing are encoded (Logan, Taylor, & Etherton, 1996). The latter derives from the belief that some aspects of L2 input are so subtle and abstract that they cannot possibly be attended to. The solution proposed in this chapter is that attention must be directed to whatever evidence is relevant for a particular learning domain, i.e. that attention must be specifically focused and not just global. Nothing is free. In order to acquire phonology, one must attend to the sounds of target language input, especially those that are contrastive in the target language, and if one's goal is to sound like a native speaker, one must attend to sub-phonemic details as well. In order to acquire vocabulary one must attend to both word form (pronunciation, spelling) and to whatever clues are available in input that can lead to identification of meaning. In order to acquire pragmatics, one must

attend to both the linguistic form of utterances and the relevant social and contextual features with which they are associated. In order to acquire morphology (both derivational and inflectional), one must attend to both the forms of morphemes and their meanings, and in order to acquire syntax one must attend to the order of words and the meanings they are associated with (Schmidt, 1990, 1993b, 1995).

What is noticed or apperceived is not the raw data of the input (the phonetic stream of speech) to which attention is directed, but input as interpreted by existing schemata (Gass, 1988; N. Ellis, this volume). Learners do not notice such aspects of the phonetic stream as voice onset time or vowel frequencies directly, but perceive these phonetic features only as filtered by an existing phonological system (L1-based in the earliest stages, modified as learning progresses) which is itself implicit. The fact that such features are subliminally detected (without orientation or awareness) is important, but so is the principle that non-conscious registration applies to well learned rather than new information. Syntactic categories may also be nonconsciously activated once they are well established. MacKay (1990) has reported that highly familiar meanings and syntactic categories of words (in the L1) receive unconscious processing (as shown by priming of semantic and syntactic associates) without entering awareness; however, comprehending what is new requires conscious processing.

While what learners notice (in the restricted sense in which I have been using this term) is not the raw data of input, it is still relatively concrete, utterances (and parts of utterances) that may be exemplars of higher level categories and principles of the linguistic system, but not the principles or the system itself. Noticing is therefore the first step in language building, not the end of the process. In syntax, Bley-Vroman (1997) has

argued that in SLA (unlike L1 acquisition), learners do not reset parameters based on abstract features but accumulate constructions or patterns, and noticing is the interface between the input and the developing set of such constructions. For example, although inversion and the positioning of adverbs in German are seen in the UG perspective to be linked, different learners may notice different things in the input: one learner may notice that adverbs can occur pre-sententially but not notice that there is inversion in such cases, while a different learner may notice the inversion along with the preposed adverbial. However, this use of noticing already goes somewhat beyond the restricted sense in which I have been using the term here, because the only obligatory consequence of attention to input is that learners become aware of sounds, words (recognizable sequences of sounds associated with meanings) and sequences of words. These words are examples of lexical categories such as noun, adverb, and so on, but the input does not come labeled that way. Going beyond purely formulaic use so that one is able to use such constructions productively requires that utterances be syntactically analyzed or parsed (Gass, 1988; Gregg, this volume) and that the learner eventually comes to “know” (implicitly) that individual words are exemplars of lexical categories. The way in which learners acquire knowledge lexical categories, constructions, and rules is a central issue in SLA, but it is being viewed here as a question related to the contrast between implicit and explicit learning, rather than to the contrast between attended vs. unattended input⁵.

⁵ There are at least five ways in which lexical categories and constructions could be established in a second language. They may be innate or transferred from the L1 (not learned from L2 input in either case). Alternatively, they may be learned from input based on an implicit, associative, inductive learning mechanism (N. Ellis, this volume). Or they may be learned explicitly, either through instruction or through active, conscious hypothesis testing. Bley-Vroman (1997) proposes that only the L1 and categories “evidently present” in the input can be the source of such construction. What is evidently present or obvious from input clearly needs to be independently defined. For derivational and inflectional morphology, Bybee (1985) has argued that morphemes whose meanings are centrally related to the meanings of the stems to which they are attached are more obvious and will be acquired earlier than

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morphemes whose meanings are only peripherally related to that of the stem. For verbs --which deal mainly with events (actions, processes, and states)-- the most important semantic distinctions are (in order): aspect, tense, mood, number, and person, and they are predicted to be acquired in that order. Cognitive linguistics constitutes a more general attempt to relate linguistic and cognitive categories and discuss the relationships of these to attention (see N. Ellis, this volume, for discussion).

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