

Attention, Awareness, and Noticing in SLA: A Methodological Review

Jieun Irene Ahn

Second Language Studies Program

Michigan State University

ahnjieun@msu.edu

Introduction

Schmidt's Noticing Hypothesis (1990, 1994, 1995, 2001), which proposes that the process of noticing enables the conversion of input to intake, has been hugely influential and is now "regarded as a mainstream SLA construct" (Yoshioka, Frota, & Bergsleithner, 2013, p. 7). Early studies on noticing mainly involved the issue of whether attention or awareness—and what types—were necessary for L2 learning (Gass, 1997; Leow, 1997, 2000; Robinson, 1995; Schmidt, 1990; Tomlin & Vila, 1994). However, researchers have begun to note that it is important to ascertain how to operationalize and measure noticing for empirical testing (Philp, 2012). Given that L2 learners' internal cognitive activities are neither directly measurable nor observable, the difficulty we face in measuring noticing is not surprising. Moreover, "the terms *noticing*, *attention*, and *awareness* have lacked in precision" (Gass, Behney, & Plonsky, 2013, p. 266) across studies, resulting in inconsistencies in the measures of noticing.

To gain access to learners' cognitive processes of noticing, online/concurrent measures (e.g., think-alouds, underlining) and off-line/non-concurrent measures (e.g., post-task questionnaires, pretest-posttest,

stimulated recall) have been widely used in SLA. Additionally, eye-tracking has arisen recently as a more sophisticated methodology to measure the construct of noticing, shedding a new light on the issue. Because each measure has its own advantages and disadvantages, it is likely that the selection of a measure will inevitably influence the research results to a great extent. To better understand the relationship between noticing and SLA, it is paramount that "we have an adequate measure of what learners notice and when" (Smith, 2012, p. 53). In this regard, I would like to explore the roles of attention, awareness, and noticing in SLA from a methodological point of view, especially by examining what measurements have been used to gauge these psycholinguistic elements of noticing in various research contexts.

Critical Review of the Research Theoretical Debate on the Noticing Hypothesis

In response to Krashen (1981)'s claim that only subconscious processes can guarantee successful L2 acquisition, Schmidt (1990) originally proposed the importance of the conscious mode of learning, evaluating noticing as a necessary

and sufficient condition for L2 learning. According to his hypothesis, learners should have awareness at the point of learning, and their focal attention will lead to the input of new linguistic features in the memory system for further processing (Schmidt, 1995). After a decade, Schmidt came to view noticing as a facilitator of L2 development (Schmidt, 2001) and emphasized the role of attention in adult SLA. In this vein, the roles of attention and awareness during the early stage of language processing were highly underscored in the Noticing Hypothesis. With regard to this theoretical model, two controversial issues have been raised that are tightly linked to the measurement problem. First, the level of awareness is difficult to specify when admitting the fact that awareness cannot always be verbalized. From Schmidt's perspective, for learning to occur, attention and a low level of awareness (i.e., noticing), "conscious registration of the concurrence of some event" (Schmidt, 1995, p. 29) are necessary, but high level awareness (i.e., understanding), "recognition of a general principle, rule, or pattern" (Schmidt, 1995, p. 29), is not required. However, as Truscott and Sharwood Smith (2011) suggested, it seems that noticing and understanding are almost impossible to "operationalize in any nonarbitrary way" (p. 37). Second, Schmidt (1995) viewed the two psychological constructs—attention and awareness—as isomorphic. What is neglected in this claim is that "attention and awareness can be dissociated" (Williams, 2013, p. 51). If we treat attention and awareness at the identical level, we come to face conceptual as well as methodological challenges since attention is

a continuous variable whereas awareness is a dichotomous variable in research design. This discrepancy can then bring about a "mapping problem" (Godfroid, Boers, & Housen, 2013, p. 485). Researchers, therefore, should discern what type of measurement they will employ to measure what construct underlying noticing.

Furthermore, two more theoretical positions should be kept in mind to attain a better understanding of the notion of noticing. Inspired by Schmidt's seminal work on noticing, two more models regarding attention and awareness (Robinson, 1995; Tomlin & Vila, 1994) were subsequently proposed in the mid 1990's. First, Tomlin and Vila (1994) suggested a more fine-grained analysis of attention. According to their model, there are three components of attention with corresponding neurological correlates: a) alertness (readiness to address incoming stimuli), b) orientation (direction of attentional resources to stimuli), and c) detection (selective cognitive registration of stimuli). It is argued that only detection is essential for further processing and learning whereas the other two elements can, at best, promote detection, but neither is a necessary condition. Crucially, Tomlin and Vila (1994), unlike Schmidt (1990), highlighted the role of detection rather than awareness and believed that awareness did not play an important role in L2 learning. Second, Robinson (1995), who built on Cowan's (1988) model of memory and attention, defined noticing as "detection plus rehearsal in short-term memory, prior to encoding in long-term memory" (p. 296). That is, Robinson incorporated both detection

(Tomlin & Villa, 1994) and awareness (Schmidt, 1990) in his account of noticing, expanding its relationship with working memory. All the theoretical issues mentioned above are open to further experimentation with more valid measures, leaving many intriguing questions unanswered.

Empirical Research on Attention

Attention is generally understood as a “necessary and sufficient condition of long-term storage” (Schmidt, 2001, p. 16) in the field of SLA. Before the 1980s, there was little concern about whether learners virtually paid attention to the target items inputted during L2 learning; it was assumed that learners’ attention would be elicited through instruction or exposure, just as the researchers intended. Resting on this premise, researchers employed the pretest-experimental condition-posttest design with a belief that their experimental conditions would make learners attend to the target forms from the L2 data, naturally resulting in the conversion of input to intake (Leow, 2013a). However, this was a mere assumption that could not be substantiated without empirical testing.

Underlining, a “less intrusive task” (Godfroid et al., 2013, p. 487) than other measures of noticing such as think-alouds, has been an option for researchers to measure learners’ attention in relation to noticing (Izumi & Bigelow, 2000; Uggen, 2012). Learners are asked to underline “the word, words, or parts of the words that are particularly necessary for subsequent production” during a reading task (Izumi & Bigelow, 2000, p. 250). The rationale behind

this is that readers normally underline the parts in a text that they actually attend to. Based on this idea, Izumi and Bigelow (2000) linked attention and awareness by arguing that underlining could not help accompanying a certain amount of awareness of the importance of the underlined parts. Uggen (2012), in a conceptual replication of Izumi and Bigelow (2000), focused on probing into the noticing function of output with an attempt to triangulate two different types of measures of noticing: underlining and stimulated recall. Their study aimed to investigate whether output would serve as a trigger of noticing in a subsequent input during input-output-input sequences with a pretest-posttest design. The target structures were the past and present hypothetical conditionals in English. Noticing was measured by means of multiple measures, underlining of the target structures and stimulated recall in an attempt at the methodological triangulation of data sources. After taking pretests, the participants participated in an output activity (i.e., writing an essay) and an input activity (i.e., reading and underlining a model essay) and were asked to write an essay on the same topic given in the previous output activity; these activities were followed by a stimulated recall interview and posttests. The experimental condition was the elicitation of the target structure in the first writing activity. Overall, the results showed the effect of output in promoting noticing, and the complexity and saliency of the target structure were likely to play a role in the success or failure of participants’ noticing. Methodologically, I believe that this study is

highly promising in terms of using multiple measures of noticing. To be specific, underlining was an online index of attention whereas stimulated recall was an off-line measure of awareness. Therefore, by adopting both online and off-line measures for each construct, this study could offer a more balanced picture of the cognitive processes of noticing.

Recently, eye tracking has spurred renewed interests in the measurement of noticing. Whereas underlining “indicates the locus of attention, but it never quantifies attention” (Godfroid et al., 2013, p. 488), eye movement data can provide more accurate information on where and how much attention is being paid. Godfroid et al. (2013) conducted an eye-tracking study that measured the learners’ focal attention on new vocabulary while reading and its relationship to subsequent learning outcomes. Critically, the authors made a distinction between the two constructs of noticing, attention and awareness. It was the first attempt in the field to empirically disentangle attention and awareness. The focus of the study was noticing as attention, which was gauged by an increase in eye-fixation times on target words. Four experimental conditions were created: a) existing word (control condition), b) pseudo-word, c) pseudo-word + existing word, and d) existing word + pseudo-word, and the eye-fixation durations on the lexical targets embedded in English text were compared for the different condition. An incidental acquisition of the target items, pseudo-words, was measured by means of an unannounced vocabulary posttest. The results revealed that the learners’ eye

fixations were longer on the novel pseudo-words than on the existing words, and the amount of allocated attention was positively related to the learning gains evidenced on the unannounced post-test. This suggested great potential for eye tracking as a measure of noticing processes in SLA.

Smith (2012) also proposed eye tracking as a measure of noticing recasts in the context of synchronous computer-mediated communication (SCMC). Specifically, he aimed to test whether participants’ eye-gaze data and stimulated recall data, both employed as measures of noticing, would be compatible, and he further investigated the relationship between noticing events and learning outcomes. In terms of measuring noticing events, along with the eye movement data Smith used heat maps to measure the relative length of eye gaze. He concluded that both measures seemed to be “favorable predictors of noticing” (p. 71), and in terms of the linguistic targets, the semantic and syntactic targets were more easily noticed than were the morphological targets in the recasts. Although these results highlight the value of eye tracking as a measure of noticing, some methodological questions remain. Smith (2012) employed heat maps, a visual representation of eye-tracking data. According to Holmqvist et al. (2011), heat maps may be beneficial in that they can offer a general and intuitive overview of the data that is very easy to understand at a glance. However, at the same time, the simplicity of the data presentation also possibly takes a toll on the precise interpretation of the data, thus requiring researchers to be cautious when employing

these attentional maps. Based on Holmqvist and colleagues' guideline, a number of problems can be detected from Smith's (2012) heat map analyses. First, the most critical drawback of using heat maps is that they do not offer "any method for systematic and statistical comparison between conditions" (p. 239) because they merely show the relative eye-gaze duration. In other words, the nature of heat maps is quite "exploratory" (p. 239), and they cannot provide temporal information on eye movement, such as regression duration, "the duration of the fixations when the reader returns to the lookzone" (Simard & Foucambert, 2013, p. 213), which might tempt researchers to rush into a conclusion that favors their own predictions. Second, as Godfroid et al. (2013) accurately noted, the heat map analyses in Smith (2012) could not control the confounding effects of "word length, word frequency, and predictability, among other factors" (p. 490). This might have yielded considerable confounding effects as well. As we can infer from the analyses shown in Smith (2012), currently the utmost need in the field is for our own specific guidelines for using eye-tracking methodology to conduct research focusing on L2 phenomena (Spinner, Gass, & Behney, 2013). Because little guidance is available, the use of eye tracking is often at risk of misleading researchers into making unreliable interpretations of their results

Empirical Research on Awareness

The Noticing Hypothesis (Schmidt, 1990, 1995, 2001) brought about an imperative question regarding the role of awareness in L2 learning. Since the 2000s,

the role of awareness in L2 learning has received much attention and has yielded contradictory findings. Some have maintained that learning without awareness—implicit learning—is possible (e.g., Leung & Williams, 2012; Williams, 2005), whereas others have been pessimistic (e.g., Hama & Leow, 2010; Leow, 1997, 2000). These contradictory findings can be much better understood if one notices that the studies relied on different methodologies to measure awareness. That is, depending on whether online or off-line measures were used, the results differed from each other. Williams (2005), for example, used a post-task interview, one of the non-concurrent/off-line measures, as a measure of awareness to explore the possibility of implicit learning. Four artificial determiners were created as target forms: *gi*, *ro*, *ul*, and *ne*. *Gi* and *ro* were used with objects that were "near" and *ul* while *ne* were used with objects that were "far" and this mapping was explicitly described to participants. At the same time, determiners also represented animacy in that *gi* and *ul* were used with "animate" objects, whereas *ro* and *ne* were used with "inanimate" objects. However, the important aspect of the study is that participants were not informed about this mapping rule of animacy. Next, during a training phase, participants were asked to listen to a sentence and indicate whether the novel word meant "near" or "far" by pressing a key. They then repeated the sentences aloud and were required to create mental images of the general situations. In the testing phase, participants completed the written test, for which they had to choose the most appropriate determiner for a given

noun in the sentence. After participants completed the first session of the test, the post-task interview was conducted. Participants were asked what criteria they had used to answer the questions on the test. The participants who did not mention “living or non-living”, “moves or does-not-move” were regarded as unaware. The results showed above-chance generalization ability in the unaware group, which provided evidence for the implicit learning of form-meaning mapping. However, I believe that the generalizability of the findings is likely somewhat limited because of the specificity of the participants—most of them were “undergraduate and graduate students at the University of Cambridge” (p. 278), and thirty-four percent of them “were studying language-related disciplines” (p. 279). We cannot exclude the possibility that their intelligence and language aptitude were much higher than average, which could have generated a confounding effect in the experiment.

Interestingly, Hama and Leow (2010), a replication of Williams (2005), found different results for learning without awareness. What should be noted is that there were several methodological changes in their study from that of Williams (2005). Most importantly, in their study, awareness was measured both retrospectively and concurrently. That is, the learners engaged in a think-aloud protocol during a training phase as well as in a post-task interview after the training phase. Moreover, the test contained four options rather than two, and both receptive and productive knowledge were measured. The online verbal protocol data obtained from the think-alouds was

advantageous because it was “still fresh in working memory” (p. 471) and provided “accessibility to the construct of awareness at the stage of encoding” (p. 477). As a result, unlike Williams (2005), they found that “unaware learners, at the stage of encoding, did not appear to demonstrate any significant animacy bias” (p. 482). It is undeniable that their study showed considerable advances in research design; nonetheless, they could not avoid the reactivity issue of think-aloud protocols. The concern was whether thinking aloud itself could affect learners’ cognitive processes, and the answer to this question seems to still be inconclusive (Bowles, 2010). A solution to this problem would be to combine a within- and a between-subject design in an experiment to control for potential reactive effect (See, Godfroid & Schmidtke, 2013; Godfroid & Spino, 2013).

Evaluation of the current status of the topic

There is no perfect methodology for measuring noticing. It seems that researchers are in agreement inasmuch as they do not believe that either online or off-line measures can absolutely gauge learners’ cognitive processes. It is a matter of two sides of the same coin. Instead of arguing that one measure is the best fit, they have begun to address the need to triangulate measures of noticing. It seems that Leow (2013b) exactly described the current state of the topic:

Perhaps employing concurrently *both* eye-tracking measures and think aloud protocols simultaneously while controlling for reactivity would appear

at this point in time to be the more appropriate methodological procedure to minimally establish the process of attention (via eye-tracking) and (levels of) awareness (via think alouds). In this way, the internal validity of the study is promoted, and the strengths and limitations of the two procedures are addressed while investigating the process of noticing at exactly the stage at which it is occurring, namely, the input-to-intake stage (p. 19).

As Leow suggested, a combination of techniques would help us to gain a more complete and thorough picture of noticing. A good example of this claim would be Godfroid and Schmidtke's (2013) study. They triangulated measures of attention and awareness, eye-tracking technology, and verbal reports, and multiple data revealed that attention and awareness are closely associated, lending support to Schmidt's Noticing Hypothesis (1990, 1995, 2001). Such methodological improvement is expected to increase the reliability and the validity of the obtained findings.

Suggestions for Future Research

On the basis of this critical review of the previous research, I would like to emphasize triangulating measures of noticing for future research to compensate for each measure's drawbacks. Moreover, I would like to mention possible agendas for further research on noticing. First, little research in this area has focused on non-Roman languages, such as Chinese, Korean, or Japanese. Most studies related to noticing have investigated English, Spanish, Italian, German and French, and it is somewhat

obvious that attention to non-Roman languages as second languages has been relatively scant in the mainstream SLA research. When evaluating the role of noticing, the target language itself may play a role to some extent, possibly owing to the considerable differences between the Roman and non-Roman alphabets. For example, cross-language transfer of orthographic processing skills is likely to elicit different reading patterns or viewing behaviors in bilingual processing. Thus, encouraging the expansion of the learner population within various contexts is needed to enhance the validity of studies on noticing and to ascertain the robustness of previous findings on the role of attention, awareness, and noticing.

Second, there is room for further investigation of the diverse variables that could affect noticing. For example, the characteristics of the target structures, saliency, difficulty, and redundancy (Uggen, 2012), may influence noticing. Also, future research is encouraged to include learners' proficiency as a variable as well.

Third, another avenue worth pursuing in future research on noticing is to take into account a broad array of individual-difference factors, both cognitive and affective, for the research design. In-depth research into how individual differences affect noticing in diverse learning conditions will create a strong bond between SLA research and L2 classrooms and will provide pedagogical advantages with respect to the implementation of learner-centered, tailor-made instruction.

References

- Bowles, M. (2010). *The think-aloud controversy in second language research*. New York: Routledge.
- Egi, T. (2007). Interpreting recasts as linguistic evidence: The role of linguistic target, length, and degree of change. *Studies in Second Language Acquisition*, 29(4), 511-538.
- Gass, S. M. (1997). *Input, interaction, and the second language learner*. Mahwah N.J.: Lawrence Erlbaum Associates.
- Godfroid, A., Boers, F., & Housen, A. (2013). An eye for words: Gauging the role of attention in incidental L2 vocabulary acquisition by means of eye-tracking. *Studies in Second Language Acquisition*, 35(3), 483-517.
- Godfroid, A., & Schmidke, J. (2013). What do eye movements tell us about awareness? A triangulation of eye-movement data, verbal reports, and vocabulary learning scores. In J.M. Bergsleithner, S. N. Frota, & J. K. Yoshioka (Eds.), *Noticing and second language acquisition: Studies in honor of Richard Schmidt* (pp. 183-205). Honolulu: University of Hawai'i, National Foreign Language Resource Center.
- Godfroid, A., & Spino, L. (2013). Timing is of the essence: Disentangling the roles of attention and awareness in L2 vocabulary learning. Paper presented at the American Association for Applied Linguistics Conference, Dallas, TX.
- Hama, M., & Leow, R. P. (2010). Learning without awareness revisited. *Studies in Second Language Acquisition*, 32(3), 165-191.
- Holmqvist, K., Nyström, M., Anderson, R., Dewhurst, R., Jarodzka, H., & van de Weijer, J. (2011). *Eye tracking – A comprehensive guide to methods and measures*. Oxford: Oxford University Press.
- Izumi, S., & Bigelow, M. (2000). Does output promote noticing in second language acquisition? *TESOL Quarterly*, 34(2), 239-278.
- Krashen, S. D. (1981). *Second language acquisition and second language learning*. Oxford: Pergamon.
- Leow, R. P. (1997). Attention, awareness, and foreign language behavior. *Language Learning*, 47(3), 467-506.
- Leow, R. P. (2000). Attention, awareness, and foreign language behavior: Aware vs. unaware learners. *Studies in Second Language Acquisition*, 22(4), 557-584.
- Leow, R. P. (2013a). Attention in SLA. In P. Robinson (Ed.), *The Routledge encyclopedia of second language acquisition* (pp. 41-45). New York: Routledge.
- Leow, R. P. (2013b). Schmidt's noticing hypothesis: more than two decades after. In J.M. Bergsleithner, S. N. Frota, & J. K. Yoshioka (Eds.), *Noticing and second language acquisition: Studies in honor of Richard Schmidt* (pp. 11-23). Honolulu: University of Hawai'i, National Foreign Language Resource Center.
- Leung, J. H. C., & Williams, J. N. Constraints on implicit learning of grammatical form-meaning connections. *Language Learning*, 62(2), 634-662.
- Philp, J. (2012). Noticing hypothesis. In P.

- Robinson (Ed.), *The Routledge encyclopedia of second language acquisition* (pp. 464-467). New York: Routledge.
- Robinson, P. (2003). Attention and memory during SLA. In C. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 631-678). Oxford: Blackwell.
- Robinson, P., Mackey, A., Gass, S., & Schmidt, R. (2012). Attention and awareness in second language acquisition. In S. Gass & A. Mackey (Eds.), *Routledge handbook of second language acquisition* (pp. 247-267). New York: Routledge.
- Simard, D., & Foucambert, D. (2013). Observing noticing while reading in L2. In J.M. Bergsleithner, S. N. Frota, & J. K. Yoshioka (Eds.), *Noticing and second language acquisition: Studies in honor of Richard Schmidt* (pp. 207-226). Honolulu: University of Hawai'i, National Foreign Language Resource Center.
- Schmidt, R. (1990). The role of consciousness in second language learning. *Applied Linguistics*, 11, 129-158.
- Schmidt, R. (1995). Consciousness and foreign language learning: A tutorial on attention and awareness in learning. In R. Schmidt (Ed.), *Attention and awareness in foreign language learning* (pp. 1-63). Honolulu, HI: University of Hawai'i, National Foreign Language Resource Center.
- Schmidt, R. (2001). Attention. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 3-32). New York: Cambridge University Press.
- MSU Working Papers in SLS 2014, Vol. 5 *Attention, Awareness, and Noticing in SLA*
- Smith, B. (2012). Eye tracking as a measure of noticing: A study of explicit recasts in SCMC. *Language Learning & Technology*, 16(3), 53-81.
- Spinner, P., Gass, S. M., & Behney, J. (2013). Ecological validity in eye-tracking. *Studies in Second Language Acquisition*, 35(2), 389-415.
- Tomlin, R. S., & Villa, V. (1994). Attention in cognitive science and second language acquisition. *Studies in Second Language Acquisition*, 16(2), 183-203.
- Truscott, J., & Sharwood Smith, M. (2011). Input, intake, and consciousness: The quest of a theoretical foundation. *Studies in Second Language Acquisition*, 33(4), 497-528.
- Uggen, M. S. (2012). Reinvestigating the noticing function of output. *Language learning*, 62(2), 506-540.
- Williams, J. N. (2005). Learning without awareness. *Studies in Second Language Acquisition*, 27(2), 269-304.
- Williams, J. N. (2013). Attention, attention, and noticing in language processing and learning. In J. M. Bergsleithner, S. N. Frota, & J. K. Yoshioka (Eds.), *Noticing and second language acquisition: Studies in honor of Richard Schmidt* (pp. 39-57). Honolulu: University of Hawai'i, National Foreign Language Resource Center.
- Yoshika, J. K., Frota, S. N., & Bergsleithner, J. M. (2013). In J.M. Bergsleithner, S. N. Frota, & J. K. Yoshioka (Eds.), *Noticing and second language acquisition: Studies in honor of Richard Schmidt* (pp. 1-9). Honolulu: University of Hawai'i, National Foreign Language Resource Center.

Center.