

Research Timeline

The role of (un)awareness in SLA

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The construct ‘awareness’ is undoubtedly one of the more difficult constructs to operationalize and measure in both second language acquisition (SLA) and non-SLA fields of research. Indeed, the multi-faceted nature of awareness is clearly exemplified in concepts that include perception, detection, and noticing, and also in type of learning or learning conditions (implicit, explicit, incidental, subliminal), type of consciousness (autooetic, noetic, anoetic), and type of awareness (language, phenomenal, meta-cognitive, situational). Given this broad perspective, this article provides, from a psycholinguistic perspective, a timeline on the research that addresses the role of awareness or lack thereof in second/foreign language (L2) learning.

An early focus on the potential role of awareness in L2 learning can be found implicitly embedded in the two dominant theoretical approaches (and their pedagogical spinoffs) to language learning in the sixties: The behaviorist/empiricist (e.g., Skinner 1957, where there was no role for learner internal processes versus the rationalist/mentalistic/nativist perspective of language learning (cf. Chomsky 1957, who underscored the innateness of learning that led to a role for learner internal processes). However, research on the role of awareness in the L2 learning process in the SLA field was arguably boosted by Krashen’s (1981) Monitor Model (see timeline). The Monitor Model raised the issue of the role the construct ‘awareness’ (then termed ‘consciousness’) plays in the L2 learning/acquisition process, and distinguished between *learning* (with consciousness) and *acquiring* (without consciousness). Notable was a strict relationship between the learning/acquisition PROCESS (*how* L2 data were processed, that is, with or without awareness) and the learned/acquired PRODUCT (type of knowledge attained after the learning PROCESS). This theoretical postulation subsequently led to early research in the eighties that subsumed the role of awareness within a pedagogical approach that addressed the effect of type of instruction (explicit/deductive versus implicit/inductive) (e.g., Shaffer 1989; Scott 1989) on subsequent performance.

In addition to Krashen’s Monitor Model, the first half of the nineties witnessed three early theoretical underpinnings premised, in addition to the role of attention, on the role of

awareness during the early stages of the learning process (Schmidt 1990*; Robinson 1995a*) or lack thereof (Tomlin & Villa 1994*). These theoretical underpinnings, in addition to challenging Krashen's Monitor Model, led to research probing the construct 'awareness' as an independent variable in research designs. Several studies began to empirically address awareness as either taking place concurrently (as a PROCESS), albeit from different methodological perspectives, or as performance or type of resultant knowledge (implicit or explicit) gleaned after the experimental exposure (as a PRODUCT). Definitions of awareness as a PROCESS can be found, for example, in Tomlin & Villa's (1994)* restricted definition as 'a particular state of mind in which an individual has undergone a specific subjective experience of some cognitive content or external stimulus' (p. 193). Consequently, early studies addressing awareness as a PROCESS employed concurrent data elicitation procedures (online verbal reports or think aloud protocols) while other studies employed non-concurrent/retrospective questionnaires or recalls.

More recent studies have also begun to employ other concurrent procedures, including retrospective stimulated recall procedure and eye-tracking. Studies addressing awareness as a PRODUCT employed several non-concurrent test batteries and measures (e.g., grammaticality judgment tasks, timed oral and written tests, offline verbal reports, subjective measures such as confident ratings, source attributions) to address the type of resultant knowledge (implicit or explicit) achieved after some kind of experimental exposure (incidental, implicit, explicit). The strict relationship between the PROCESS and PRODUCT of learning/acquisition postulated by Krashen appears to have played some role in the data interpretation of many of these studies. More specifically, type of knowledge reported after some type of learning condition was viewed as evidence of the role awareness played during the L2 learning process. In addition, following Reber's (1967)* seminal study on implicit learning of artificial grammar in the field of cognitive psychology, several awareness studies began to employ semi-artificial language data instead of naturally occurring languages, raising doubts as to their applicability to naturally occurring languages.

Currently, while the beneficial role of awareness (operationalized and measured both concurrently as a PROCESS and non-concurrently as a PRODUCT) in L2 learning has been well established, there remains controversy as to whether such a role is important. This is reflected in a methodological debate about whether the non-concurrent operationalization and measurement of the construct 'awareness' were indeed referring to the same construct, that is, whether the PRODUCT accurately reflects the PROCESS.

Research is still needed on the role of awareness in the L2 learning process. Current research has yet to establish whether the construct 'awareness' is a dichotomy (aware vs. unaware) or occurs on a continuum (Leow 2000*; Hulstijn 2015). Similarly, the potential co-occurrence of both implicit and explicit learning and knowledge during the L2 learning process remains to be empirically investigated (R. Ellis 2005*; N. C. Ellis 2015). To address these theoretical gaps, future research in SLA may need to first situate this construct appropriately within an SLA theoretical framework that typically comprises several stages along the learning process: input > intake > internal system > output (Gass 1997; VanPatten 2007; Leow 2015*). Addressing phases before internalization of L2 data comprises the stage of CONSTRUCTION, where L2 learners encode and/or decode incoming L2 data (PROCESS) while addressing the

* denotes that the full reference is in the timeline itself.

phase after the internal system comprises the stage of RECONSTRUCTION where L2 learners report or demonstrate what they have learned (PRODUCT).

To address the dichotomy issue, Leow (2015a*) proposed applying the same descriptors of very low levels of processing associated with implicit knowledge to implicit learning. Any behavioral performance that deviates from such descriptors may be coded as an indication that the threshold of awareness has been crossed at the CONSTRUCTION stage. To address the potential interactive role played by both implicit and explicit learning and knowledge during the CONSTRUCTION stage, concurrent data need to be coded to allow a more sensitive operationalization of the construct when levels of awareness are considered. Similarly, at RECONSTRUCTION, measures need to be designed to gather data on whether L2 learners do possess lower levels of target grammatical rules that fail to attain the level of partial or full metalinguistic verbalization, as coded by offline verbal reports. This procedure may address the important appropriateness of categorizing participants to (a) aware or unaware status or (b) accessing implicit or explicit knowledge.

The aim of this timeline is to provide only a representative sample of the key theoretical underpinnings and studies that have addressed the construct ‘awareness’, viewed from both a PROCESS and PRODUCT perspective, in L2 learning over the last three decades. The articles included in this timeline cover the following five recurring themes and each publication is classified according to the most relevant theme(s).

- A: Theoretical
- B: Empirical
- C: Methodological
- D: Process
- E: Product

Acknowledgements

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YEAR	REFERENCES	ANNOTATION	THEME
1967	Reber, A. S. (1967). Implicit learning of artificial grammars. <i>Journal of Verbal Learning and Verbal Behavior</i> 6, 317–327.	Reber , from the field of cognitive psychology, is widely referenced as being the first to use the term <i>implicit learning</i> , defined as a <i>process</i> during which participants acquire knowledge without intention and without becoming aware of the acquired knowledge. In his seminal study, the author exposed participants to an artificial finite-state grammar through a memorization procedure. Implicit learning was operationalized as participants' ability to verbalize underlying rules and was measured non-concurrently/offline as a <i>product</i> . He reported participants' ability to implicitly learn grammatical letter sequences better than randomized sequences (for SLA studies that have followed a relatively similar operationalization with semi-artificial data, see ROBINSON 1995a; WILLIAMS 2004, 2005; ROBINSON 2005, 2010; LEUNG & WILLIAMS 2011, 2012; REBUSCHAT & WILLIAMS 2012; GREY ET AL. 2014; HAMRICK & REBUSCHAT 2014; REBUSCHAT 2015; REBUSCHAT ET AL. 2015; ROGERS, REVESZ & REBUSCHAT 2016).	B E
1981	Krashen, S. D. (1981). <i>Second language acquisition and second language learning</i> . Oxford: Pergamon Press.	Krashen's Monitor Model was the first theoretical postulation in relation to the role of consciousness in SLA. In his model, the author argued for a non-interface division between the constructs of <i>acquisition</i> (an unconscious process that results in acquired/implicit knowledge) and <i>learning</i> (a conscious process involving awareness that results in learned/explicit knowledge). Krashen's postulations, together with REBER's (1967) definition of implicit learning and its operationalization, provided the impetus for several SLA studies addressing implicit learning and type of learning conditions (implicit, explicit, and incidental) (see ROBINSON 1995a, 2005; REBUSCHAT & WILLIAMS 2012; GREY ET AL. 2014; HAMRICK & REBUSCHAT 2014; REBUSCHAT ET AL. 2015; ROGERS ET AL. 2016).	A

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1981	Sharwood Smith, M. (1981). Consciousness-raising and the second language learner. <i>Applied Linguistics</i> 2, 159–168.	One early reference to consciousness in SLA was Sharwood Smith's argument that implicit knowledge had to be made explicit in order for the L2 learner to improve linguistic skills, which he described as 'consciousness raising' (subsequently changed to input enhancement in Sharwood Smith 1991). ¹	A
1990	Schmidt, R. (1990). The role of consciousness in second language learning. <i>Applied Linguistics</i> 11, 129–158.	Schmidt's seminal article was the first in SLA to centralize both the roles of attention and awareness in the early processing stage (input to intake) of learning an L2. Schmidt's Noticing Hypothesis postulated that attention controls access to awareness and is responsible for the subjective experience of <i>noticing</i> , which allows input to be converted to intake. Schmidt proposed three levels of awareness: perception, noticing, and understanding. The Noticing Hypothesis became arguably the most influential theoretical underpinning of many strands of SLA research premised on the role of attention and/or awareness in L2 development. Several studies have provided empirical support for the benefits of awareness in L2 development (see LEOW 1997; ROSA & O'NEILL 1999; LEOW 2000; ROSA & LEOW 2004; SACHS & SUH 2007; GODFROID & SCHMIDTKE 2013). See also Schmidt's edited book (SCHMIDT 1995) and BERGSLEITHNER ET AL. (2013) for an edited book in honor of Schmidt's contribution to the field of SLA.	A
1994	Ellis, N. C. (ed.). (1994). <i>Implicit and explicit learning of languages</i> . London: Academic Press.	Ellis's edited book was the first to address the roles of implicit learning, conscious hypothesis testing, and explicit instruction in SLA, drawing upon evidence from field studies of classroom SLA and laboratory experiments investigating the acquisition of artificial grammars.	A

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1994	Tomlin, R. S. & V. Villa (1994). Attention in cognitive science and second language acquisition. <i>Studies in Second Language Acquisition</i> 16, 183–203.	Tomlin & Villa proposed a model of input processing in SLA from a cognitive science perspective that addresses the early processing stage (input to intake) of learning an L2. Using brain-based attentional data primarily gathered to treat pathologies linked to attentional disorders, they offered a fine-grained analysis of attention that comprises the attentional functions of alertness, orientation, and detection (defined as the cognitive registration of stimuli). While detection is the level at which intake takes place and most related to awareness, they claim that none of the three attentional functions may require awareness to operate (see LEOW 1998 for empirical support for Tomlin & Villa's fine-grained analysis of attention). For further discussion on the authors' model, see ROBINSON (1995b) and SIMARD & WONG (2001) and the latter for a critique of LEOW's (1998) study.	A
1995	Robinson, P. (1995a). Aptitude, awareness and the fundamental similarity of implicit and explicit second language learning. In R. Schmidt (ed.), <i>Attention and awareness in foreign language learning</i> . Honolulu: University of Hawai'i, National Foreign Language Resource Center, 303–359.	Robinson (1995a) was one of the early studies to address empirically SCHMIDT's (1990) Noticing Hypothesis. Specifically, Robinson investigated the claims of REBER (1967) and KRASHEN (1981) that implicit, unaware learning does not show differences in aptitude between individuals, in contrast to explicit, aware learning, which does show such differences. Awareness was operationalized retrospectively (non-concurrent) as participants' responses to questions on a questionnaire administered after exposure. He reported positive benefits for a higher level of awareness (understanding) on performance on a grammaticality judgment task. Several current studies have extended his investigation of type of learning conditions in relation to the role of awareness (see ROBINSON 2005; REBUSCHAT & WILLIAMS 2012; GREY ET AL. 2014; HAMRICK & REBUSCHAT 2014; REBUSCHAT ET AL. 2015; ROGERS ET AL. 2016).	B D E

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1995	Robinson, P. (1995b). Review article: Attention, memory and the ‘noticing’ hypothesis. <i>Language Learning</i> 45, 283–331.	Robinson proposed a model of the relationship between attention and memory that is complementary to SCHMIDT’S (1990) Noticing Hypothesis. At the input-to-intake stage, Robinson postulated two different kinds of processing strategies: data-driven (bottom-up) and conceptually-driven (top-down), both of which require awareness. He also proposed that the attentional demands of pedagogical tasks and individual differences in memory and attentional capacity both affect the extent of noticing, thereby directly influencing SLA. Crucially, Robinson argued that TOMLIN & VILLA’S (1994) concept of <i>detection</i> occurred temporally before SCHMIDT’S (1990) <i>noticing</i> within the learning process. Robinson (2003) ³ revised his model by presenting a hierarchical understanding of short-term and long-term memory together with the notion that learners’ cognitive capacity was unlimited.	A
1995	Schmidt, R. W. (ed.), <i>Attention and awareness in foreign language learning and teaching</i> . Honolulu: University of Hawai’i, National Foreign Language Resource Center.	Schmidt’s edited book, the first of its kind in SLA, specifically addressed the role of attention and awareness in learning and the theoretical and practical controversies that each construct has sparked. This book also included one early attempt to include think aloud protocols (conflated with other non-concurrent assessment measures) to operationalize the concept of noticing (Alanen 1995). ²	A B C D E
1997	Leow, R. P. (1997). Attention, awareness, and foreign language behavior. <i>Language Learning</i> 47, 467–506. (Updated in <i>Language Learning</i> 51, 113–155.)	Leow’s study was the first to employ a hybrid design to include a concurrent procedure (online think aloud protocols) to operationalize and measure the construct of awareness as a <i>process</i> in SLA. The assessment tasks were a four-option multiple-choice and a controlled written production task. Results revealed three levels of awareness (at the level of noticing, reporting, and understanding), positive effects of awareness on L2 development, and higher levels of awareness correlating with higher levels of performances. These findings were replicated in several subsequent studies employing a similar hybrid design to address different linguistic (see ROSA & O’NEILL 1999; ROSA & LEOW 2004; SACHS & SUH 2007) and lexical (GODFROID & SCHMIDTKE 2013) items in the L2 input.	B D

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1998	Han, Y. & R. Ellis (1998). Implicit knowledge, explicit knowledge and general language proficiency. <i>Language Teaching Research</i> 2, 1–23.	Han & Ellis investigated ways of measuring implicit and explicit L2 knowledge, specifically as such measures relate to measures of general language proficiency. The study employed scores (knowledge of verb complementation in English) obtained from a timed oral production test, a timed grammaticality judgment test, a delayed grammaticality judgment test, and an interview designed to tap metalingual knowledge. A factor analysis revealed a two-factor solution, which the authors took to represent a division between implicit knowledge and explicit knowledge. Importantly, implicit knowledge was understood to emerge in the presence of time constraints; explicit knowledge emerged in the absence of such constraints. For a follow-up of this study, see ELLIS 2005 and for subsequent validation studies, see ELLIS ET AL.'s (2009) edited book, BOWLES (2011), GUTIERREZ (2012), and ZHANG (2015).	B C E
1998	Leow, R. P. (1998). Toward operationalizing the process of attention in second language acquisition: Evidence for Tomlin and Villa's (1994) fine-grained analysis of attention. <i>Applied Psycholinguistics</i> 19, 133–159.	Leow tested TOMLIN & VILLA's (1994) model by addressing the role of the three attentional functions (alertness, orientation, detection) in L2 development. Assessment tasks were a four-option multiple-choice and a controlled written production task and the design was a pretest – immediate posttest – delayed posttest (five weeks later) – delayed posttest (two months after exposure). The results appeared to provide strong support for Tomlin & Villa's fine-grained analysis of attention although Leow pointed out that whether awareness was crucial for intake at the level of detection was not addressed (see SIMARD & WONG 2001 for a critique of this study).	B C D

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1999	Rosa, E. & M. D. O'Neill (1999). Explicitness, intake, and the issue of awareness. <i>Studies in Second Language Acquisition</i> 21, 511–556.	Rosa & O'Neill extended LEOW's (1997) study by addressing a different linguistic item and language level. The assessment task was a recognition test. The design was pretest-posttest and awareness was operationalized via online verbal reports. Results revealed that a higher level of awareness led to superior intake when compared to a lower level. See ROSA & LEOW (2004) for an extension of this study.	B D
2000	Gass, S. M. & A. Mackey (2000). <i>Stimulated recall methodology in second language research</i> . New York: Routledge.	Gass & Mackey offered an overview of the stimulated recall procedure, another retrospective (non-concurrent) procedure employed in SLA to access participants' reflections on their cognitive or mental processes during an oral interaction (or task) in which they had previously participated. If learners provided any mention of the targeted item or the corrective nature of the feedback, it was assumed that this was evidence of perception, noticing, or awareness (see GODFROID & SCHMIDTKE 2013 for an example of retrospective recalls to operationalize the construct 'awareness').	C
2000	Leow, R. P. (2000). A study of the role of awareness in foreign language behavior: Aware versus unaware learners. <i>Studies in Second Language Acquisition</i> 22, 557–584.	Leow extended LEOW (1997) and was the first empirical effort to operationalize and measure the construct of unawareness as a <i>process</i> via concurrent verbal reports. While no relationship between unawareness and further processing of target forms was found in this study, aware learners performed significantly better than unaware learners. Only items introduced in the experimental phase were investigated. Leow raised the question of whether the construct 'awareness' should be viewed as a dichotomy or as occurring on a continuum. See HAMA & LEOW (2010) and FARETTA-STUTENBERG & MORGAN-SHORT (2011) who reported similar findings and WILLIAMS (2004, 2005), LEUNG & WILLIAMS (2011, 2012), and CHAN & LEUNG (2014) who reported contrary findings.	B D

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2001	Simard, D. & W. Wong (2001). Alertness, orientation, and detection: The conceptualization of attentional functions in SLA. <i>Studies in Second Language Acquisition</i> 23, 103–124.	Simard & Wong critiqued both TOMLIN & VILLA's (1994) model of input processing in SLA and the research design employed in LEOW (1998) to provide empirical support for the model's roles of attentional functions during early L2 input processing. They underscored the mismatch between the original neuroscience source and data TOMLIN & VILLA relied on to support their model's postulations and cognitive processes employed in language learning. In addition, Simard & Wong pointed out the methodologically challenging task of creating a research design capable of separating the three attentional functions in relation to L2 learning.	A C
2004	Rosa, E. M. & R. P. Leow (2004). Awareness, different learning conditions, and second language development. <i>Applied Psycholinguistics</i> 25, 269–292.	Rosa & Leow , employing the same hybrid design in LEOW (1997, 2000) and ROSA & O'NEILL (1999), extended these studies by addressing degrees of explicitness. The design was pretest-posttest-delayed and results revealed that higher levels of awareness led to statistically higher levels of performances on both recognition and production assessment tasks.	B D
2004	Truscott, J. & M. A. Sharwood Smith (2004). Acquisition by processing: A modular approach to language development. <i>Bilingualism: Language and Cognition</i> 7, 1–20.	Truscott & Sharwood Smith proposed their modular framework, Modular Online Growth and Use of Language (MOGUL), which is an interdisciplinary, processing-oriented framework of L2 development. Learners were said to become aware of mental representations, of which there are two types: perceptual and affective. These representations were identified to have especially high activation levels, which is the key to awareness. In their updated model (Truscott & Sharwood Smith 2011), ⁴ the authors proposed different levels of processing in relation to awareness.	A

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2004	Williams, J. N. (2004). Implicit learning of form-meaning connections. In B. VanPatten et al. (eds.), <i>Form-meaning connections in second language acquisition</i> . Mahwah, NJ: Erlbaum, 203–218.	Following REBER's (1967) methodology, Williams employed both old and new exemplars of a semi-artificial language (four novel determiners, <i>gi, ro, ul, ne</i> that also carried animacy features) to address the role of awareness, operationalized and measured as a <i>product</i> via offline verbal reports requesting the underlying rule of the target embedded features. The assessment task to measure learning was a two-option multiple-choice task and the statistical analysis was chance performance. Results indicated that participants did not perform above chance on new items.	B E
2005	Ellis, R. (2005). Measuring implicit and explicit knowledge of a second language: A psychometric study. <i>Studies in Second Language Acquisition</i> 27, 141–172.	Ellis , building on HAN & ELLIS (1998), tackled the lack of valid measures of implicit and explicit knowledge in L2 learning by attempting to establish operational definitions of the two constructs and test them through a psychometric study of a battery of tests to independently measure them. The tests examined 17 English structures, and included an oral imitation test with grammatical and ungrammatical sentences; an oral narration test; a timed and an untimed grammaticality judgment test (GJT); and a metalinguistic knowledge test. A principal component factor analysis was shown to produce two clear factors that were interpreted as corresponding to implicit and explicit knowledge. Empirical support for the validity of these tests was given in several studies reported in ELLIS ET AL.'s (2009) book, BOWLES (2011), GUTIERREZ (2012), GODFROID ET AL. (2015), and ZHANG (2015).	B E
2005	Hulstijn, J. H. (2005). Theoretical and empirical issues in the study of implicit and explicit second language learning. <i>Studies in Second Language Acquisition</i> 27, 129–140.	Hulstijn's introduction to this seminal volume, following up on REBER (1967), KRASHEN (1981), and ELLIS (1994), offered a thorough review of definitions related to concepts and types of learning, of how to better operationalize and assess implicit and explicit learning processes in controlled studies, and of how to incorporate individual differences into evaluative measures. Ultimately, the author pleaded for consensus on many of the definitions surrounding the concepts of awareness, attention, and implicit and explicit learning within the field of SLA, contingent on more refined development of theory of L2 acquisition as well as comprehensive empirical testing in support of theoretical claims. Highly cited articles from this volume include ELLIS (2005), ROBINSON (2005), and WILLIAMS (2005).	A B E

YEAR	REFERENCES	ANNOTATION	THEME
2005	Robinson, P. (2005). Cognitive abilities, chunk-strength and frequency effects in implicit artificial grammar and incidental second language learning: Replications of Reber, Walkenfield & Hernstadt (1991) and Knowlton & Squire (1996) and their relevance for SLA. <i>Studies in Second Language Acquisition</i> 27, 235–268.	Robinson sought to address whether, in relation to their content and population generalizability, empirical findings from studies in cognitive psychology related to unaware, unintentional learning of complex rule-systems were replicable in SLA settings. The author replicated studies of both implicit artificial grammar (AG) learning and explicit series-solution learning, and included Samoan, a novel L2 language for comparative purposes. While replicating some previous findings, the author reported little evidence for content generalizability between AG and incidental Samoan learning in relation to cognitive abilities, underscoring the need for further replication of non-SLA studies to better understand how basic cognitive processes are used in language-specific settings.	B E
2005	Williams, J. N. (2005). Learning without awareness. <i>Studies in Second Language Acquisition</i> 27, 269–304.	Williams is a methodological improvement of Experiment 2 in WILLIAMS (2004) in which, using the same research design, the author reported evidence of implicit learning of the embedded features. Studies following a similar methodology (LEUNG & WILLIAMS 2011, 2012; CHAN & LEUNG 2014; PACIOREK & WILLIAMS 2015) also reported similar findings.	B E
2007	DeKeyser, R. (2007). Skill acquisition theory. In B. VanPatten & J. Williams (eds.), <i>Theories in second language acquisition</i> . Mahwah, NJ: Lawrence Erlbaum, 97–113.	DeKeyser adopted the strong interface position, as opposed to KRASHEN's (1981) non-interface one, which neatly falls within cognitive psychology models of skill acquisition and theories of controlled and automatic processing, best represented by Anderson et al.'s (2004) ⁵ Adaptive Control of Thought Model. Learning is viewed as the gradual transformation of controlled performance to automatic performance, which is achieved via much practice. This process, called proceduralization or automaticity, is seen in the conversion of explicit (declarative) knowledge to implicit (procedural) knowledge.	A

YEAR	REFERENCES	ANNOTATION	THEME
2007	Sachs, R. & B-R. Suh (2007). Textually enhanced recasts, learner awareness, and L2 outcomes in synchronous computer-mediated interaction. In A. Mackey (ed.), <i>Conversational interaction in second-language acquisition: A series of empirical studies</i> . Oxford: Oxford University Press, 197–227.	Sachs & Suh , following LEOW (1997), addressed the roles of textual enhancement and levels of awareness in subsequent performances. The assessment tasks were a multiple-choice and a story-telling production task. Results indicated that a higher level of awareness led to superior L2 development when compared to a lower level. See Gurzynski-Weiss et al. (2016) ⁶ for a follow-up of this study.	B D
2009	Ellis, R., S. Loewen, C. J. Elder, R. Erlam, J. Philp & H. Reinders (eds.) (2009). <i>Implicit and explicit knowledge in second language learning, testing, and teaching</i> . Clevedon: Multilingual Matters.	Ellis et al. provided a comprehensive overview of several perspectives of explicit and knowledge of L2 morphosyntax. The book is divided into five parts in relation to definitions of type of knowledge from different fields of research (Part 1), tests creation (Part 2), the application of these tests of type of knowledge in relation to morphosyntactic complexity, general L2 proficiency, ultimate attainment, and teacher trainees' knowledge (Part 3), how different instructional approaches may lead to these two types of knowledge (Part 4), and a conclusion that summarizes the book together with its limitations and suggestions for future research (Part 5).	A B C E
2010	Hama, M. & R. P. Leow (2010). Learning without awareness revisited: Extending Williams (2005). <i>Studies in Second Language Acquisition</i> 32, 465–491.	Hama & Leow extended WILLIAMS (2005) by addressing several methodological issues of his research design that included operationalizing (un)awareness at both the construction (online verbal reports) and reconstruction (offline verbal reports) stages (see LEOW ET AL. 2011 for a fine-grained methodological perspective of awareness research). Results indicated no evidence of implicit learning. See FARETTA-STUTENBERG & MORGAN-SHORT (2011) for similar findings.	B D

YEAR	REFERENCES	ANNOTATION	THEME
2010	Robinson, P. (2010). Implicit artificial grammar and incidental natural second language learning: How comparable are they? <i>Language Learning</i> 60, 245–263.	Robinson summarized the results of a previous study (ROBINSON 2005) that compared learning of an AG, by experienced L2 learners, with their learning of a novel L2, Samoan. Based on the results, the author recommended using caution when making inferences from the use of artificial language data to naturally occurring languages.	B E
2011	Bowles, M. (2011). Measuring implicit and explicit linguistic knowledge: What can heritage language learners contribute? <i>Studies in Second Language Acquisition</i> 33, 247–271.	To address the validity of ELLIS's (2005) test battery measuring types of knowledge (implicit vs. explicit), Bowles not only adapted the tests for L2 learners of Spanish (intermediate level) but also included heritage language learners of Spanish. The author reported empirical support for both the original study's content and construct validities.	B E
2011	Faretta-Stutenberg, M. & K. Morgan-Short (2011). Learning without awareness reconsidered: A replication of Williams (2005). In G. Granena, J. Koeth, S. Lee-Ellis, A. Lukyanchenko, G. Prieto-Botana & E. Roades (eds.), <i>Selected proceedings of the 2010 Second Language Research Forum: Reconsidering SLA research, dimensions, and directions</i> . Somerville, MA: Cascadilla, 18–28.	Faretta-Stutenberg & Morgan-Short was a conceptual replication of WILLIAMS (2005) in which they employed, according to the researchers, a more fine-grained analysis of awareness level, classified as noticing, understanding, and no report (see ROSA & O'NEILL 1999; HAMA & LEOW 2010). The authors did not find evidence for learning without awareness, or of learning with awareness at the level of noticing, duplicating the overall findings reported by HAMA & LEOW (2010) that no empirical evidence was found to support the original study's claim of implicit learning.	B E

YEAR	REFERENCES	ANNOTATION	THEME
2011	Leow, R. P., E. Johnson & G. Zárate-Sández (2011). Getting a grip on the slippery concept of awareness: Toward a finer-grained methodological perspective. In C. Sanz & R. P. Leow (eds.), <i>Implicit and explicit conditions, processes and knowledge in SLA and bilingualism</i> . Washington, DC: Georgetown University Press, 61–72.	Leow et al. 's chapter focused on the methodological issues surrounding the investigation of the relationship between the role of awareness, or lack thereof, and learning in both SLA and non-SLA fields. The article presented a fine-grained methodological perspective of awareness research that includes the <i>what</i> (is being learned), the <i>where</i> (awareness is being investigated, concurrently or non-concurrently), and the <i>how</i> (experimental task, type, and location of measurement are employed to investigate awareness). They recommended that the construct of awareness should be investigated with regard to the stages (construction/concurrent vs. reconstruction/non-concurrent) of the L2 learning process. See LEOW (2015a, 2015b) for similar proposals.	C
2011	Leung, J. H. C. & J. N. Williams (2011). The implicit learning of mappings between forms and contextually derived meanings. <i>Studies in Second Language Acquisition</i> 33, 33–55.	Leung & Williams extended WILLIAMS (2005) by investigating the implicit learning of a mapping between thematic roles (adult vs. children) and his original set of novel determiners. Learning of the mapping between thematic roles and the set of novel determiners was measured by participants' performances on a reaction time test or the serial reaction time task, which is the standard paradigm for examining sequence learning in psychology. Like the original study, the authors also measured awareness via non-concurrent verbal reports and reported evidence of implicit learning.	B E
2011	Sanz, C. & R. P. Leow (eds.) (2011). <i>Implicit and explicit conditions, processes and knowledge in SLA and bilingualism</i> . Washington, DC: Georgetown University Press.	Sanz & Leow 's edited book covered a range of topics addressing implicit and explicit learning processes, conditions, and knowledge in SLA and bilingualism (see LEOW, JOHNSON & ZÁRATE-SÁNDEZ for methodological issues regarding the operationalization and measurement of the construct awareness).	A B C E

YEAR	REFERENCES	ANNOTATION	THEME
2012	Gutiérrez, X. (2012). Implicit knowledge, explicit knowledge, and achievement in second language (L2) Spanish. <i>The Canadian Journal of Applied Linguistics</i> 40, 20–41.	To test the validity of ELLIS's (2005) test battery for L2 learners, Gutiérrez employed three measures (timed and untimed grammatical judgment tests and metalinguistic knowledge) from the test battery adapted by BOWLES with L2 Spanish learners at two proficiency levels (third and fifth semesters). In addition, the author also addressed test validity in terms of the grammaticality of the test items. He concluded that the ungrammatical sentences in both GJTs and the metalinguistic knowledge test measured explicit knowledge while the grammatical sentences in the timed and untimed grammatical judgment tests measured implicit knowledge.	B E
2012	Leung, J. H. C. & J. N. Williams (2012). Constraints on implicit learning of grammatical form-meaning connections. <i>Language Learning</i> 62, 634–662.	Leung & Williams extended their research design in LEUNG & WILLIAMS (2011) by addressing animacy and the relative size of two objects over two experiments. They reported support for implicit learning of animacy but not in relation to size.	B E
2012	Rebuschat, P. & J. N. Williams (2012). Implicit and explicit knowledge in second language acquisition. <i>Applied Psycholinguistics</i> 33, 829–856.	Rebuschat & Williams , following REBER (1967), KRASHEN (1981), and ROBINSON (1995a), reported the results of two experiments with semi-artificial data that investigated whether L2 implicit knowledge can occur in an incidental (as opposed to intentional) learning condition. Assessment tasks were grammaticality judgments, subjective measures of awareness (see REBUSCHAT (2013) for a full description of these measures), and offline verbal reports. Results indicated that incidental exposure to L2 syntax can result in unconscious knowledge, which the authors took to suggest that at least some of the learning in the experiment was implicit. This study measured awareness as a <i>product</i> (type of knowledge) within an incidental learning condition. Several subsequent incidental learning condition studies employing a non-concurrent measure of awareness in their research designs include GREY ET AL. (2014); HAMRICK & REBUSCHAT (2014); REBUSCHAT ET AL. (2015); ROGERS ET AL. (2016).	B E

YEAR	REFERENCES	ANNOTATION	THEME
2013	Bergsleithner, J. M., S. N. Frota & J. Y. Yoshioka (eds.) (2013). <i>Noticing and second language acquisition: Studies in honor of Richard Schmidt</i> . Honolulu: University of Hawai'i, National Foreign Language Resource Center.	This collection of studies honored Richard Schmidt's important contribution to the SLA field, especially in the attentional and awareness strands of research due to his Noticing Hypothesis (SCHMIDT 1990). Part 1 situates the Noticing Hypothesis in SLA from a theoretical, methodological, empirical, and pedagogical perspective. Part 2 is a series of empirical studies addressing the observation and enhancement of noticing while Part 3 extends the methodological approach to the concurrent procedure of eye-tracking. Part 4 is a mixture of chapters covering the use of subjective measures, the role of individual differences, and approaches to noticing and awareness (cognitive neuroscientific and sociocultural).	A B C D E
2013	Godfroid, A. & J. Schmidtke (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.), <i>Noticing and second language acquisition: Studies in honor of Richard Schmidt</i> . Honolulu: University of Hawai'i, National Foreign Language Resource Center, 183–205.	Godfroid & Schmidtke made use of eye-tracking technology to investigate SCHMIDT's (1990) Noticing Hypothesis and the conscious registration of linguistic surface elements. The study triangulated measures of attention in the form of eye-movement recordings and of awareness via offline verbal reports (see ROBINSON 1995a) in order to elucidate the differential contributions of the two mechanisms to receptive vocabulary learning. In interpreting their findings, the authors distinguished lower-level noetic awareness from higher-level auto-noetic awareness and confirmed the distinct contributions of each type through regression analysis.	B D
2013	Leow, R. P. & M. Hama (2013). Implicit learning in SLA and the issue of internal validity: A response to Leung and Williams's 'The implicit learning of mappings between forms and contextually derived meanings'. <i>Studies in Second Language Acquisition</i> 35, 545–557.	Leow & Hama provided a detailed critique of LEUNG & WILLIAMS's (2011) research design (modeled on the WILLIAMS (2005) design) in relation to the study's internal validity due to (a) the offline operationalization and measurement of the construct of unawareness, (b) the provision of implicit feedback during the treatment phase, and (c) the exposure to ten or less of the training items during the post-exposure phase. The authors proposed a list of criteria to be considered in studies investigating implicit learning as a <i>process</i> in SLA in order to improve the internal validity of studies.	C

YEAR	REFERENCES	ANNOTATION	THEME
2013	Rebuschat, P. (2013). Measuring implicit and explicit knowledge in second language research. <i>Language Learning</i> 63, 595–626.	Rebuschat reviewed three types of measures widely used in psychological research to assess the conscious or unconscious status of linguistic knowledge: retrospective verbal reports, direct and indirect tests, and subjective measures (confidence levels and source attributions). His goal was to present the measures to the SLA field to encourage their usage in the study of implicit L2 learning. The article provided thorough descriptions of representative studies for each measure, discussions of their limitations, as well as how best to apply each measure for L2 research (for studies that have employed some of these measures, see REBUSCHAT & WILLIAMS (2012); HAMRICK & REBUSCHAT (2014); REBUSCHAT ET AL. (2015); ROGERS ET AL. (2016).	C
2014	Chan, R. K. W. & J. H. C. Leung (2014). Implicit learning of L2 word stress regularities. <i>Second Language Research</i> 30, 463–484.	Extending the target items and awareness measure (retrospective verbal reports) in WILLIAMS (2005), Chan & Leung addressed the issue of implicit learning in phonology while including an objective measure of awareness employed in cognitive psychology, namely, the process dissociation procedure assumed to ‘disentangle the contribution of explicit and implicit processes to task performance’ (p. 469). Chan & Leung reported that L2 word stress regularities can be learned implicitly.	B D
2014	Grey, S., J. N. Williams & P. Rebuschat (2014). Incidental exposure and L3 learning of morphosyntax. <i>Studies in Second Language Acquisition</i> 36, 611–645.	Grey et al. extended REBUSCHAT & WILLIAMS (2012) by addressing the incidental learning of L3 morphosyntax (word order and case marking). Assessment tasks were an acceptability judgment and picture matching tasks administered immediately after exposure and two weeks later. The authors reported that learning of L3 structures can take place following incidental exposure; that such learning is durable and undergoes improvement; and that development of reportable rule knowledge may also play an important role.	B E

YEAR	REFERENCES	ANNOTATION	THEME
2014	Hamrick, P. & P. Rebuschat (2014). Frequency effects, learning conditions, and the development of implicit and explicit lexical knowledge. In J. Connor-Linton & L. Amoroso (eds.), <i>Measured language: Quantitative approaches to acquisition, assessment, processing, and variation</i> . Washington, DC: Georgetown University Press, 125–139.	Hamrick & Rebuschat also extended REBUSCHAT & WILLIAMS (2012) by investigating an interaction between frequency, awareness (internal), and learning conditions (external) in adult lexical development of semi-artificial data. The authors reported overall complex interactions between frequency, learning conditions, and awareness.	B E
2015	Andringa, S. & P. Rebuschat (2015). New directions in the study of implicit and explicit learning. <i>Studies in Second Language Acquisition</i> 37, 185–196.	This volume probed deeper into recent developments in research on L2 learning both as a <i>process</i> and as a <i>product</i> in relation to a redefinition of what comprises implicit and explicit learning with more focus on the concept of statistical learning, the role of awareness, measurement, the implicit-explicit interface, and individual differences.	A B C D E
2015	Godfroid, A., L. Shawn Loewen, S. Jung, J-H. Park, S. Gass & R. Ellis (2015). Timed and untimed grammaticality judgments measure distinct types of knowledge. <i>Studies in Second Language Acquisition</i> 37, 269–297.	Godfroid et al. employed eye-tracking procedure to probe deeper into the test-related variables (i.e., time pressure and item grammaticality) associated with ELLIS (2005) GJTs that formed part of his test battery. The authors reported that these two measures addressed different constructs that might correspond to type of knowledge, thereby appearing to provide empirical support to ELLIS's use of these GJTs to measure type of knowledge.	B E

YEAR	REFERENCES	ANNOTATION	THEME
2015	Leow, R. P. (2015a) <i>Explicit learning in the L2 classroom: A student-centered approach</i> . New York: Routledge.	Leow focused on the issue of explicit learning in the L2 classroom from a learner-centered perspective. The book reported on the theoretical, methodological, and empirical approaches to SLA research on the constructs of attention and awareness, with a special focus on <i>how</i> L2 learners process L2 data. Leow recommended situating the constructs <i>learning</i> and <i>awareness</i> within an SLA theoretical framework in an effort to address these constructs at different stages of the learning process. In his own model of the L2 learning process in Instructed SLA, Leow posited that the role of awareness at different stages of the L2 learning process may be dependent upon the role played by depth of processing or <i>how</i> the L2 data are processed by the learner.	A C D
2015	Leow, R. P. (2015b). Implicit learning in SLA: Of processes and products. In P. Rebuschat (ed.), <i>Implicit and explicit learning of languages</i> . Amsterdam: John Benjamins, 47–67.	Leow addressed the role of learning without awareness in SLA by disambiguating the different perspectives of unawareness and learning based on their operationalizations and measurements and addressing several methodological issues derived from the research designs of studies purporting to investigate the role of awareness or lack thereof in language learning. Following LEOW (2015a) and LEOW ET AL. (2011), he strongly recommended addressing the role of awareness within a theoretical framework in SLA in which learning can be viewed as both a <i>process</i> and a <i>product</i> dependent upon the stage of operationalization and measurement of this construct along the L2 learning process.	C
2015	Leow, R. P., L. Cerezo & M. Baralt (eds.) (2015). <i>A psycholinguistic approach to technology and language learning</i> . Berlin: De Gruyter Mouton.	Leow et al. 's edited psycholinguistic-based book addressed current and prospective uses of technology in L2 learning from a unique four-prong approach (theoretical, methodological, empirical, and pedagogical). Several chapters addressed the role of (levels of) awareness in relation to L2 reader comprehension, depth of processing, type of recast and type of linguistic item, and L1 awareness.	A B C D

YEAR	REFERENCES	ANNOTATION	THEME
2015	Paciorek, A. & J. N. Williams (2015). Implicit learning of semantic preferences of verbs. <i>Studies in Second Language Acquisition</i> 37, 359–382.	Following LEUNG & WILLIAMS's (2011) research design, Paciorek & Williams targeted the domain of verb meaning and, more specifically, semantic preferences regarding novel verbs, for example, the preference for a novel verb to take abstract objects. Like previous studies employing a similar design and non-concurrent verbal report to operationalize and measure awareness at the level of understanding, the authors reported strong evidence for semantic implicit learning in language.	B E
2015	Rebuschat, P. (ed.) (2015). <i>Implicit and explicit learning of languages</i> . Amsterdam: John Benjamins.	Following up on REBER's (1967) coined term of 'implicit learning,' Rebuschat edited a book that covers, across a range of research fields, theoretical perspectives, methodology, and practical applications of the unconscious cognitive process as a fundamental piece of human cognition. Divided into three parts, the book provided ten chapters that offer a range of theoretical perspectives on issues related to the study of implicit and explicit learning.	A B C D E
2015	Rebuschat, P., P. Hamrick, R. Sachs, K. Riestenberg & N. Ziegler (2015). Triangulating measures of awareness: A contribution to the debate on learning without awareness. <i>Studies in Second Language Acquisition</i> 37, 299–334.	This study by Rebuschat et al. , addressing the conflicting findings and different methodological designs of WILLIAMS (2005) and HAMA & LEOW (2010), employed both concurrent (think aloud protocols) and non-concurrent (confidence ratings and source attributions) measures of awareness to triangulate measures of awareness from both a <i>process</i> and <i>product</i> perspective. They raised the question of whether both implicit and explicit learning and knowledge co-occur.	B C D E
2015	Zhang, R. (2015). Measuring university-level L2 learners' implicit and explicit linguistic knowledge. <i>Studies in Second Language Acquisition</i> 37, 457–486.	Zhang sought to validate ELLIS's (2005) test battery designed to measure type of knowledge by employing these tests with Chinese university-level learners of English. Like previous studies (e.g., BOWLES 2011, GUTIERREZ 2012, GODFROID ET AL. 2015), the author reported support for the construct validity of ELLIS's test battery.	B E

YEAR	REFERENCES	ANNOTATION	THEME
2016	Leow, R. P., S. Grey, S. Marijuan & C. Moorman (2016). Concurrent data elicitation procedures, processes, and the early stages of L2 learning: A critical overview. <i>Second Language Research</i> 30, 111–127.	Leow et al. provided a critical review of three concurrent data elicitation procedures commonly used in SLA research to probe cognitive processes employed by L2 learners in the early stages of the learning process: think aloud protocols, eye-tracking, and reaction time. Each procedure's strengths and limitations were discussed and suggestions provided to maximize their usage, especially through triangulation.	C
2016	Rogers, J., A. Révész & P. Rebuschat (2016). Implicit and explicit knowledge of inflectional morphology. <i>Applied Linguistics</i> 37, 781–812.	Rogers et al. expanded ROBINSON (2005) and GREY ET AL. (2014) by investigating the extent to which incidental learning conditions could promote the acquisition of L2 case marking and whether any knowledge acquired after incidental exposure was implicit or explicit in nature. A GJT was utilized to assess learning while subjective measures of awareness and retrospective verbal reports (see REBUSCHAT 2013) were used to measure whether the acquired knowledge was conscious or not. The results of the experiment indicated that participants could rapidly develop knowledge of L2 inflectional morphology under incidental learning conditions in the absence of verbalizable rule knowledge.	B E

Note: Authors' names are shown in small capitals when the study referred to appears in this timeline.

¹Sharwood Smith, M. (1991). Speaking to many minds: On the relevance of different types of language information for the L2 learner. *Second Language Research* 7, 118–132.

²Alanen, R. (1995). Input enhancement and rule presentation in second language acquisition. In R. W. Schmidt (ed.), *Attention and awareness in foreign language learning*. Honolulu: University of Hawai'i, National Foreign Language Resource Center, 259–302.

³Robinson, P. (2003). Attention and memory during SLA. In C. Doughty & M. H. Long (eds.), *The handbook of second language acquisition*. Oxford: Blackwell, 631–678.

⁴Truscott, J. & M. Sharwood Smith (2011). Input, intake, and consciousness: The quest for a theoretical foundation. *Studies in Second Language Acquisition* 33, 497–528.

⁵Anderson, J. R., D. Bothell, M. D. Byrne, S. Douglass, C. Lebiere & Y. Qin (2004). An integrated theory of the mind. *Psychological Review* 111, 1036–1060.

⁶Gurzynski-Weiss, L, M. Al Khalil, M. Baralt & R. P. Leow (2016). Levels of awareness in relation to type of recast and type of linguistic item in computer-mediated communication: A concurrent investigation. In R. P. Leow, L. Cerezo & M. Baralt (eds.), *A psycholinguistic approach to technology and language learning*. Berlin: De Gruyter Mouton, 151–170.