Language Teaching (2025), 1–20
doi:10.1017/S026144482500059X

CAMBRIDGE UNIVERSITY PRESS

RESEARCH TIMELINE

Research timeline: Automatization in second language learning

Yuichi Suzuki[1], Ryo Maie[2] and Bronson Hui[3]

[1]Waseda University, Shinjuku, Tokyo, Japan; [2]Tohoku University, Sendai, Miyagi, Japan and [3]University of Maryland, College Park, Maryland, USA
Corresponding author: Yuichi Suzuki; Email: yszk@waseda.jp

(Received 16 September 2024; accepted 26 April 2025)

Abstract
Automatization is the learning process by which controlled, effortful second language (L2) processing becomes automatic, fast, and effortless through practice – a critical transition for L2 development. Achieving automaticity allows learners to progress from laborious language use to fluent, real-time communication by freeing limited cognitive resources. This research timeline synthesizes four decades of laboratory and classroom research on automatization, bridging cognitive learning theories with pedagogical practice. We trace five key research strands: (1) cognitive mechanisms, including the explicit-implicit knowledge interface; (2) skill development trajectories across phonological, lexical, morphosyntax, and pragmatics domains; (3) instructional approaches promoting automatization of knowledge and skills through deliberate and systematic practice; (4) methodological advances in measuring automaticity (e.g., reaction time, coefficient of variation, neural measures); and (5) individual differences in long-term memory systems (declarative and procedural memory). This timeline offers a comprehensive perspective on how automatization research has significantly advanced our understanding of L2 learning.

Keywords: automaticity; automatization; second language acquisition; skill acquisition

1. Introduction

Automatization is the learning process through which controlled (conscious, effortful, and slow) language processing gradually becomes automatic (unconscious, effortless, and fast) through practice. This development plays a pivotal role in second language (L2) learning and teaching, as learners progress from effortful language use to fluent use across all language skills. For example, while a beginner L2 learner needs to consciously think about word order and verb conjugations when forming basic sentences in speaking and writing, an advanced learner can seamlessly integrate these elements and produce them during real-time communication. Similarly, in comprehension tasks, while beginners often need to mentally translate each word and analyze grammatical structures in text, advanced learners can directly access meaning without conscious linguistic analysis.

Automaticity refers to the state achieved through automatization where learners can effortlessly perform language tasks with high accuracy and speed. This advanced state of language development marks a crucial transition: from laborious, cognitively demanding usage (e.g., characterized by slow, halting retrieval of linguistic knowledge) to smooth, efficient communication in real-life situations. The process of automatization bridges cognitive theory of learning and pedagogical practice in unique ways: theories explain how repeated L2 practice leads to automatization, while language teaching methods provide systematic opportunities for practice using L2 needed to achieve automaticity. This

reciprocal relationship between theory and practice has made automatization a central focus in both second language acquisition (SLA) research and language education (for reviews, see DeKeyser, 2001; Segalowitz, 2003; Segalowitz & Hulstijn, 2005; Suzuki, 2023). In the remainder of this introductory section, we provide a concise review of L2 automatization research from both theoretical and practical perspectives.

2. Theoretical foundations

Automatization has been a recurring concept over several decades in language teaching and learning. The emergence of automatization as a research topic in SLA can be traced back to the 1980s. Following the rise of the Monitor Model (e.g., Krashen, 1985), the information processing approach was introduced as a complementary or alternative cognitive theory in SLA (e.g., McLaughlin et al., 1983). Drawing on findings from cognitive psychology, L2 learning was seen as the acquisition of complex skills that draw on automatic and controlled processes (Shiffrin & Schneider, 1977). As successful L2 use hinges on the coordination of linguistic skills in an integrated manner, automatization compensates for a learner's limited attentional capacity by freeing up cognitive resources; for instance, by automatizing lower-level skills such as lexical retrieval for speaking (e.g., Levelt, 1978) and word recognition for reading skills (e.g., McLeod & McLaughlin, 1986).

Information processing theory laid the groundwork for exploring the learner's transition from controlled processing, a slow and effortful stage, to automatic processing, characterized by its speed, effortlessness, and minimal requirement for conscious attention. Building on these cognitive principles, researchers examined to what extent learning theories (e.g., Anderson et al., 2004; Logan, 1988), originally developed for general cognitive skills, could be applied to SLA. Since the 1990s, empirical studies have tested key theoretical assumptions of skill acquisition theory (e.g., DeKeyser, 1997*; Robinson, 1997*), revealing that L2 skill learning can be accounted for by learning principles governing the acquisition of other general skills such as music, sports, algebra, chess, computer programming, and flying an aircraft (see Tenison & Anderson, 2016, for a neuroimaging study).

Underlying mechanisms of automatization have been debated over decades in the fields of cognitive psychology and SLA research. A seminal study by Norman Segalowitz and his colleagues proposed a fine distinction between simple speed-up and genuine automatization in L2 processing (Segalowitz & Segalowitz, 1993*[1]). Consider how L2 learners process grammar when forming sentences: they might first translate from L1, then reorder words to match L2 structure, and finally apply grammar rules. A mere speed-up means executing these same steps faster (e.g., reducing time from 900 to 500 milliseconds), analogous to a student solving multiplication problems by performing addition steps more rapidly (e.g., calculating 5×4 as $4 + 4 + 4 + 4 + 4$) and a beginning typist locating keys more quickly while still looking at the keyboard. In contrast, genuine automatization represents a fundamental restructuring of these processes. Just as students progress from counting-based calculation to instant recognition of multiplication facts ($5 \times 4 = 20$) and typists develop fluid movements without looking at keys, L2 learners develop the ability to directly access target language structures without relying on L1 translation.

While extended practice triggers both speed-up and restructuring, Norman Segalowitz argued that only restructuring leads to true automaticity (Segalowitz & Segalowitz, 1993). To measure this distinction, he proposed using the coefficient of variation (CV) – calculated by dividing the standard deviation of response times (RT) of an individual by their own mean RT. Coefficient of variation provides insights into processing variability, with lower CV values indicating more stable and consistent processing thought to characterize automatic performance. Higher CV values suggest more variable processing typically associated with controlled, non-automatic processing.

Since then, the utility and validity of CV as a measure of automatization, alongside with RT, has been subjected to intensive empirical investigations. Several limitations have been raised: CV

measurements assume accurate knowledge representation and may not capture development when new content is being learned simultaneously (Hulstijn et al., 2009*). Hence, CV may be only useful in investigating automatization in controlled laboratory settings where participants without prior knowledge are trained to learn a finite set of materials (e.g., words), and it may not be useful in real learning situations where learners simultaneously develop both (new, declarative) knowledge (e.g., accuracy) and efficient skills to retrieve existing knowledge.

With the methodological caveats of using CV in mind, automaticity can be captured more broadly, at least for practical purposes (e.g., using it as a predictor of proficiency), through a combination of several indices, such as speed, stability, ballistic (unstoppable) processing, resistance to interference, levels of consciousness, and so on (DeKeyser, 2001; Segalowitz, 2003). Some research revealed that RT (processing speed) predicted L2 proficiency more strongly than CV (processing stability) (e.g., Suzuki & Sunada, 2018*), whereas other research found the opposite pattern (e.g., Zhang & Yang, 2023). This discrepancy may reflect different stages of L2 development: it appears that RT is a stronger predictor in earlier stages when learners are still developing rudimentary processing speed, while CV becomes more influential in advanced stages when processing stability becomes more crucial after declarative knowledge is established.

Building on these theoretical and methodological developments, researchers have expanded their toolkit for measuring automaticity. Recent methodological syntheses have revealed numerous experimental tasks, instruments, and objective measures to capture different aspects of fluent comprehension and production (sub)skills and knowledge (Suzuki & Elgort, 2023; S. Suzuki & Révész, 2023). By employing various psycholinguistic tasks yielding different measures (e.g., accuracy, RT, CV, neural responses), researchers have delved deeper into the cognitive mechanisms underlying language acquisition and usage, offering a more nuanced understanding of how automaticity develops in the context of SLA. This approach has not only provided valuable insights into learners' progression towards fluency but has also helped in understanding the outcomes of L2 practice aimed at facilitating automatization.

3. Automatization and knowledge and skills

In tandem with the growing interest in information processing theory during the 1980s and 1990s, there was burgeoning exploration into the realm of explicit and implicit learning. Explicit learning refers to conscious learning processes, whereas implicit learning concerns incidental learning without awareness (DeKeyser, 2003; Ellis, 1994; Rebuschat, 2015). This demarcation of learning processes can be considered as an extension of the distinction Krashen (1985) made between acquisition and learning.[2]

One approach to understanding the roles of explicit and implicit learning in SLA is skill acquisition theory (e.g., DeKeyser, 2020; Suzuki, 2023). Since "skill" is central to both this theory and the automatization research reviewed thus far, it is essential to clarify the distinction between skill and knowledge in L2 learning. While knowledge refers to the mental representations of language forms and rules, a skill represents the learner's ability to draw upon linguistic knowledge (stored in memory) to perform various linguistic tasks such as listening, reading, speaking, and writing (DeKeyser, 2017). In the technical terminology of skill acquisition theory, these components are formalized as declarative and procedural knowledge. Declarative knowledge reflects one's conceptual understanding of facts and rules, while procedural knowledge represents the ability to use these rules in performance. Within the framework of skill acquisition theory, procedural knowledge corresponds directly to the definition of skill described above – the ability to perform linguistic tasks by drawing upon knowledge stored in memory. For instance, L2 learners typically begin with declarative knowledge (such as understanding grammar rules) and, through practice, develop procedural knowledge (the ability to use these rules in speech). This progression from declarative to procedural knowledge forms the foundation of automatization, and researchers have extensively studied how initial declarative knowledge

influences both proceduralization and eventual automatization of language skills (e.g., McManus & Marsden, 2019*; Sato & McDonough, 2019*).

The distinction between declarative and procedural knowledge in skill acquisition theory often aligns with the explicit-implicit learning dichotomy in SLA research. Based on the historical evolution of SLA research commencing from the Monitor Model, the learning stages of declarative-procedural-automatization are typically associated with explicit, rather than implicit, learning and knowledge (e.g., DeKeyser, 2020). Therefore, the end product of automatization is often called automatized explicit knowledge – linguistic knowledge that can be deployed quickly albeit with some level of conscious access and mental effort (Suzuki, 2017). While both automatized explicit knowledge and implicit knowledge enable rapid processing, they differ fundamentally in terms of awareness: automatized explicit knowledge, which typically develops through explicit learning of grammar rules followed by extensive practice (e.g., consciously accessing subject-verb agreement rules during speaking until the rules can be applied effortlessly), remains conscious and accessible even when highly practiced, whereas implicit knowledge, which typically develops through extensive exposure to input (e.g., developing intuition about article usage through extensive reading), is characterized as capacity to use linguistic rules without awareness. However, these two types of knowledge are functionally equivalent in everyday language use (DeKeyser, 2003; Suzuki, 2017), as both support fluent communication. Indeed, recent neuroimaging research indicates that L2 speakers dynamically recruit both automatized explicit and implicit knowledge in complementary ways for accurate and fluent speech (Suzuki et al., 2023).

Furthermore, from a neurocognitive perspective, recent research has also demonstrated that individual differences in long-term memory – specifically declarative and procedural memory – are implicated in automatization (Buffington & Morgan-Short, 2019; Skehan, 2019). Learners with greater capacities in these memory systems typically advance more rapidly from effortful to fluent language production. A key question is how specific types of long-term memory differentially influence various stages of L2 learning across linguistic domains (e.g., syntax, lexis, phonology) and among diverse learner populations.

Fluency is another construct often associated with automatization (Tavakoli, 2019). As a multifaceted concept extensively studied in SLA research, fluency encompasses multiple dimensions. Segalowitz (2010, 2016) proposes three dimensions of fluency: perceived, utterance, and cognitive. Perceived fluency relates to subjective assessments of speech, while utterance fluency involves measurable speech characteristics such as speed, breakdown (pausing), and self-repair. Cognitive fluency, a cornerstone of fluent language use, entails the efficient integration of cognitive processes for producing fluent speech and is closely linked to automaticity in language processing. This cognitive dimension underpins utterance fluency and supports the efficient production of fluent utterances.

4. Practical applications and developments

The study of automatization has not only advanced our theoretical understanding of L2 acquisition but also influenced language teaching methodologies. This influence is particularly evident in foreign language contexts, where learners have limited exposure to the target language outside the classroom. In such settings, educators must carefully adapt their pedagogical strategies to support the protracted and gradual process of automatization.

The evolution of automatization research in SLA has paralleled significant shifts in language teaching approaches. The field of language teaching witnessed the emergence of communicative language teaching (CLT) as a response to earlier methods such as audiolingualism. During the same period, information processing theory gained prominence in L2 learning research during the 1980s and 1990s. While CLT successfully prioritized authentic language use in the classroom, it initially underestimated the importance of systematic practice in developing automaticity. Recognizing this limitation, Gatbonton and Segalowitz (Gatbonton & Segalowitz, 1988, 2005) proposed a framework

that integrated automaticity development within the CLT approach. Their methodology emphasizes the mastery of naturally occurring utterances in communicative situations (e.g., idiomatic expressions, functional language for requesting, questioning, and describing) rather than focusing on abstract structures. This approach provides learners with abundant opportunities for meaningful repetition and practice, thereby fostering automaticity without resorting to the mechanical nature of traditional drills.

The turn of the century marked a shift towards a more nuanced understanding of deliberate and systematic practice and its role in automatization in L2 learning (DeKeyser, 2007; Jones, 2018; Lyster & Sato, 2013; Suzuki, 2023). This period coincided with a significant expansion in L2 practice research, including influential studies informed by cognitive psychology, as documented in a recent synthesis by Maie and Godfroid (2023) which revealed the exponential growth of such studies in the twenty-first century. DeKeyser and his colleagues emphasized that mere exposure to language is insufficient for automatization; rather, the concept of deliberate and systematic practice, involving focused, goal-directed activities, is integral to the automatization of language skills (Suzuki et al., 2019). Such goal-directed activities can be simple real-world tasks that incorporate repetition combined with increasing complexity. The judicious sequencing of these tasks leads learners to repeatedly use the same structures and phrases, providing high-quality practice without the disadvantages of drills. In this sense, the concept of automatization is not incompatible at all with more contemporary teaching methodologies such as task-based language teaching (TBLT).

Recently, task repetition research in fluency development within TBLT has incorporated the concept of automaticity (Bygate, 2018). This approach recognizes the tight link between fluency and automaticity development, emphasizing the importance of repeated engagement in communicative tasks for transitioning from controlled to automatic processing of lexico-grammatical structures (e.g., De Jong & Tillman, 2018). Understanding how language teaching approaches, such as TBLT, can promote automatization across various L2 skills is crucial for effective language teaching (DeKeyser, 2018; Lambert, 2023).

In summary, this introduction has traced the evolution of automatization research in SLA over the past four decades. From its roots in information processing theory to the current prominence of skill acquisition theory, our understanding of automatization has grown increasingly sophisticated. This progression reflects advancements in cognitive psychology, shaping our understanding of how practice, repetition, and cognitive processing contribute to the automatization of L2 skills. Key developments include:

1. The transition from the earlier Monitor Model to cognitive approaches in SLA.
2. The exploration of explicit and implicit learning processes in relation to automaticity.
3. The refinement of concepts such as fluency and its nature in relation to L2 skill development.
4. The development of methodologies to measure and assess automaticity in L2 processing.
5. The integration of automatization principles into language teaching methodologies such as CLT and TBLT.

This evolving understanding has significant implications for both research and practice in SLA. As we continue to refine our understanding of automatization in L2 learning, this research trajectory promises to yield further insights that will enhance our ability to foster successful language acquisition in diverse learning contexts.

The purpose of this timeline is to review major empirical research on automatization in L2 learning conducted over the last 40 years and to illustrate how the field has come to better understand its mechanisms and implications for language teaching. Due to space limitations, this timeline focuses on selected pivotal studies published in English as book chapters and as articles in leading academic journals. The criteria for selection included the citation frequency and contribution of novel insights that have significantly shaped subsequent research in the field. Additionally, we sometimes prioritize

the relevance to language teaching and learning over the technicality often involved in psycholinguistic research for the interests of readers of *Language Teaching*. This curated approach ensures that the timeline reflects key developments and turning points in the understanding of automatization in L2 learning.

We highlight and categorize the main themes in the following ways throughout the timeline:

A. Research focus
   1. Mechanism (testing theory of automatization)
   2. Skill development (investigating how automatization relates to proficiency development)
   3. Pedagogy (intervention for promoting automatization)
   4. Method (methodological refinement of research on automatization)
   5. Individual difference (investigating individual differences factors in automatization)

B. Contexts
   1. Lab
   2. Classroom

C. Study design
   1. Observational (no control group)
   2. Experimental

D. Linguistic domains
   1. Phonology (PHO)
   2. Lexis (LEX)
   3. Morphosyntax (MSYN)
   4. Pragmatics (PRAG)

E. Outcome measurements
   1. Accuracy (ACC)
   2. Fluency (FLU)
   3. Response time (RT)
   4. Coefficient of variance (CV)
   5. Eye-tracking (EYE)
   6. Event-related potential (ERP)
   7. Functional magnetic resonance imaging (fMRI)

Notes

1. *Indicates that the full reference for this work can be found in the subsequent timeline.

2. Acquisition and learning are used interchangeably in the remainder of this article; explicit and implicit learning are used to distinguish the learning with and without awareness.

References

Anderson, J. R., Bothell, D., Byrne, M. D., Douglass, S., Lebiere, C., & Qin, Y. (2004). An integrated theory of the mind. *Psychological Review*, *111*(4), 1036–1060. https://doi.org/10.1037/0033-295X.111.4.1036

Buffington, J., & Morgan-Short, K. (2019). Declarative and procedural memory as individual differences in second language aptitude. In Z. Wen, P. Skehan, A. Biedroń, S. Li, & R. L. Sparks (Eds.), *Language aptitude: Advancing theory, testing, research and practice* (pp. 215–237). Routledge.

Bygate, M. (2018). *Learning language through task repetition*. John Benjamins Publishing Company.

De Jong, N., & Tillman, P. C. (2018). Grammatical structures and oral fluency in immediate task repetition: Trigrams across repeated performances. In M. Bygate (Ed.), *Language learning through task repetition* (pp. 43–73). John Benjamins Publishing Company.

DeKeyser, R. M. (1997). Beyond explicit rule learning: Automatizing second language morphosyntax. *Studies in Second Language Acquisition*, *19*(2), 195–221. https://doi.org/10.1017/S0272263197002040

DeKeyser, R. M. (2001). Automaticity and automatization. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 125–151). Cambridge University Press.

DeKeyser, R. M. (2003). Implicit and explicit learning. In C. J. Doughty, & H. M. Long (Eds.), *The handbook of second language acquisition* (pp. 312–348). Blackwell Publishers.
DeKeyser, R. M. (2007). *Practice in a second language: Perspectives from applied linguistics and cognitive psychology*. Cambridge University Press.
DeKeyser, R. M. (2017). Knowledge and skill in ISLA. In S. Loewen, and M. Sato (Eds.), *The Routledge handbook of instructed second language acquisition* (pp. 15–32). Routledge.
DeKeyser, R. M. (2018). Task repetition for language learning: A perspective from skill acquisition theory. In M. Bygate (Ed.), *Learning language through task repetition* (pp. 27–42). John Benjamins Publishing Company.
DeKeyser, R. M. (2020). Skill acquisition theory. In B. VanPatten, G. D. Keating, & S. Wulff (Eds.), *Theories in second language acquisition: An introduction* (3rd ed., pp. 83–104). Routledge.
Ellis, N. (1994). *Implicit and explicit learning of languages*. Academic Press.
Gatbonton, E., & Segalowitz, N. S. (1988). Creative automatization: Principles for promoting fluency within a communicative framework. *TESOL Quarterly*, *22*(3), 473–492. https://doi.org/10.3138/cmlr.61.3.325
Gatbonton, E., & Segalowitz, N. S. (2005). Rethinking communicative language teaching: A focus on access to fluency. *Canadian Modern Language Review*, *61*(3), 325–353. https://doi.org/10.3138/cmlr.61.3.325
Hulstijn, J. H., Van Gelderen, A., & Schoonen, R. (2009). Automatization in second language acquisition: What does the coefficient of variation tell us? *Applied Psycholinguistics*, *30*(4), 555–582. https://doi.org/10.1017/S0142716409990014
Jones, C. (2018). *Practice in second language learning*. Cambridge University Press.
Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. Longman.
Lambert, C. (2023). Integrating systematic practice into task-based language teaching. In Y. Suzuki (Ed.), *Practice and automatization in second language research: Perspectives from skill acquisition theory and cognitive psychology* (pp. 144–159). Routledge.
Levelt, W. J. M. (1978). Skill theory and language teaching. *Studies in Second Language Acquisition*, *1*(1), 53–70. https://doi.org/10.1017/S0272263100000711
Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review*, *95*(4), 492–527. https://doi.org/10.1037/0033-295X.95.4.492
Lyster, R., & Sato, M. (2013). Skill acquisition theory and the role of practice in L2 development. In M. G. Mayo (Ed.), *Contemporary approaches to second language acquisition* (pp. 71–92). John Benjamins Publishing Company.
Maie, R., & Godfroid, A. (2023). A synthesis of L2 practice research: What is "practice" and how has it been investigated? In Y. Suzuki (Ed.), *Practice and automatization in second language research: Perspectives from skill acquisition theory and cognitive psychology* (pp. 181–205). Cambridge University Press.
McLaughlin, B., Rossman, T., & McLeod, B. (1983). Second language learning: An information-processing perspective. *Language Learning*, 33(2), 135–158. https://doi.org/10.1111/j.1467-1770.1983.tb00532.x
McLeod, B., & McLaughlin, B. (1986). Restructuring or automaticity? Reading in a second language. *Language Learning*, *36*(2), 109–123. https://doi.org/10.1111/j.1467-1770.1986.tb00374.x
McManus, K., & Marsden, E. (2019). Signatures of automaticity during practice: Explicit instruction about L1 processing routines can improve L2 grammatical processing. *Applied Psycholinguistics*, *40*(1), 205–234. https://doi.org/10.1017/S0142716418000553
Rebuschat, P. (2015). *Implicit and explicit learning of languages*. John Benjamins Publishing Company.
Robinson, P. (1997). Generalizability and automaticity of second language learning under implicit, incidental, enhanced, and instructed conditions. *Studies in Second Language Acquisition*, *19*(2), 223–247. https://doi.org/10.1017/S0272263197002052
Sato, M., & McDonough, K. (2019). Practice is important but how about its quality? Contextualized practice in the classroom. *Studies in Second Language Acquisition*, *41*(5), 999–1026. https://doi.org/10.1017/S0272263119000159
Segalowitz, N. S. (2003). Automaticity and second languages. In C. J. Doughty, & H. M. Long (Eds.), *The handbook of second language acquisition* (pp. 382–408). Blackwell Publishers.
Segalowitz, N. S. (2010). *Cognitive bases of second language fluency*. Taylor & Francis.
Segalowitz, N. S. (2016). Second language fluency and its underlying cognitive and social determinants. *International review of applied linguistics in language teaching*, *54*(2), 79–95. https://doi.org/10.1515/iral-2016-9991
Segalowitz, N. S., & Hulstijn, J. (2005). Automaticity in bilingualism and second language learning. In J. F. Kroll, & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 371–388). Oxford University Press.
Segalowitz, N. S., & Segalowitz, S. J. (1993). Skilled performance, practice, and the differentiation of speed-up from automatization effects: Evidence from second language word recognition. *Applied Psycholinguistics*, *14*(3), 369–385. https://doi.org/10.1017/S0142716400010845
Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review*, *84*(2), 127–190. https://doi.org/10.1037/0033-295X.84.2.127
Skehan, P. (2019). Language aptitude implicates language and cognitive skills. In Z. E. Wen, P. Skehan, A. Biedroń, S. Li, & R. L. Sparks (Eds.), *Language aptitude: Advancing theory, testing, research and practice* (pp. 56–77). Routledge.

Suzuki, S., & Révész, A. (2023). Measuring speaking and writing fluency: A methodological synthesis focusing on automaticity. In Y. Suzuki (Ed.), *Practice and automatization in second language research: Perspectives from skill acquisition theory and cognitive psychology* (pp. 235–264). Routledge.

Suzuki, Y. (2017). Validity of new measures of implicit knowledge: Distinguishing implicit knowledge from automatized explicit knowledge. *Applied Psycholinguistics*, *38*(5), 1229–1261. https://doi.org/10.1017/S014271641700011X

Suzuki, Y. (2023). *Practice and Automatization in Second Language Research: Perspectives from Skill Acquisition Theory and Cognitive Psychology*. Routledge.

Suzuki, Y., & Elgort, I. (2023). Measuring automaticity in a second language: A methodological synthesis of experimental tasks over three decades (1990–2021). In Y. Suzuki (Ed.), *Practice and automatization in second language research: Perspectives from skill acquisition theory and cognitive psychology* (pp. 206–234). Routledge.

Suzuki, Y., Jeong, H., Cui, H., Okamoto, K., Kawashima, R., & Sugiura, M. (2023). fMRI reveals the dynamic interface between explicit and implicit knowledge recruited during elicited imitation task. *Research methods in applied linguistics*, *2*(2), 100051. https://doi.org/10.1016/j.rmal.2023.100051

Suzuki, Y., Nakata, T., & DeKeyser, R. M. (2019). Optimizing second language practice in the classroom: Perspectives from cognitive psychology. *Modern Language Journal*, *103*(3), 551–561. https://doi.org/10.1111/modl.12582

Suzuki, Y., & Sunada, M. (2018). Automatization in second language sentence processing: Relationship between elicited imitation and maze tasks. *Bilingualism: Language and Cognition*, *21*(1), 32–46. https://doi.org/10.1017/S1366728916000857

Tavakoli, P. (2019). Automaticity, fluency and second language task performance. In Z. E. Wen, and M. J. Ahmadian (Eds.), *Researching L2 task performance and pedagogy* (pp. 39–52). John Benjamins Publishing Company.

Tenison, C., & Anderson, J. R. (2016). Modeling the distinct phases of skill acquisition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*(5), 749–767. https://doi.org/10.1037/xlm0000204

Zhang, X., & Yang, X. (2023). Using sentence processing speed and automaticity to predict L2 performance in the productive and receptive tasks. *International Review of Applied Linguistics in Language Teaching*. https://doi.org/10.1515/iral-2023-0183

Year	References	Annotations	Theme
1982	Bialystok, E. (1982). On the relationship between knowing and using linguistic forms. *Applied Linguistics, 3*(3), 181–206. https://doi.org/10.1093/applin/III.3.181	**Bialystok** originally proposed a framework to distinguish between representation and use of linguistic knowledge as two different dimensions of language proficiency. Representation can be either analyzed or unanalyzed, while use can be controlled or automatic. This two-dimensional model provided a rapprochement of the previously contrasted dichotomy of explicit/implicit knowledge (or learning/acquisition) and controlled/automatic processing. This article described two experiments in which learners were tested in linguistic tasks that imposed varying demands for analyzed or automatic information to investigate the role of those two factors on proficiency.	Mechanism Observational Lab MSYN ACC
1986	McLeod, B., & McLaughlin, B. (1986). Restructuring or automaticity? Reading in a second language. *Language Learning, 36*(2), 109–123. https://doi.org/10.1111/j.1467-1770.1986.tb00374.x	**McLeod and Mclaughlin** conceptualized automatization and restructuring as distinct yet complementary processes. They defined automatization as a continuous process of transitioning from controlled to automatic processing, and restructuring as a discontinuous process of organizing disparate performance routines into an integrated whole or replacing the routines with more efficient ones. Their study demonstrated that differences in the reading process of native and non-native speakers stem from whether one's reading process has undergone restructuring, thus highlighting, for the first time in L2 research, that language learning involves not only continuous but also discontinuous changes in language skills.	Mechanism Observational Lab MSYN ACC
1993	Robinson, P. J., & Ha, M. A. (1993). Instance theory and second language rule learning under explicit conditions. *Studies in Second Language Acquisition, 15*(4), 413–438. https://doi.org/10.1017/S0272263100012365	**Robinson and Ha** tested whether Logan's (1988) instance theory of automatization is generalizable to L2 learning. The theory claims that learners store memory of processing episodes as an instance, and the accumulation of instances drives the shift from initially algorithm-based performance to direct retrieval from memory, causing automatization. Researchers manipulated the frequency of exemplar sentences of the target structure in English and examined whether learners learn to process more frequent sentences faster. Evidence for the generalization of the claim was not conclusive, but the study was the first to test predictions from the cognitive-psychological model in L2 contexts.	Mechanism Experimental Lab MSYN ACC, RT
1993	Segalowitz, N. S., & Segalowitz, S. J. (1993). Skilled performance, practice, and the differentiation of speed-up from automatization effects: Evidence from second language word recognition. *Applied Psycholinguistics, 14*(3), 369–385. https://doi.org/10.1017/S0142716400010845	**Segalowitz and Segalowitz** contended that automatization is caused not only by a gradual speedup in performance, but results from the restructuring of existing performance routines. They introduced the initial thesis in L2 research, questioning whether automatization entails quantitative changes (gradual enhancement of the same process) or qualitative changes (restructuring). Coefficient of variance was proposed as an index to quantify the degree of restructuring in RT data. They introduced a novel perspective by synthesizing the concepts of controlled/automatic processing with restructuring, which were previously considered distinct by MCLEOD & MCLAUGHLIN[a] (1986).	Mechanism Observational Lab LEX RT, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
1997	DeKeyser, R. M. (1997). Beyond explicit rule learning: Automatizing second language morphosyntax. *Studies in Second Language Acquisition, 19*(2), 195–221. https://doi.org/10.1017/S0272263197002040	**DeKeyser** investigated whether L2 morphosyntax automatization exhibits patterns similar to cognitive skill acquisition in domains like maths and chess. The research focused on two key aspects: (a) the power-law of practice and (b) skill specificity. Using an artificial language called Autopractan, participants underwent training over 11 weeks, including instruction, testing, and extensive practice in both comprehension and production. Results showed that both error rates and RTs exhibited a dramatic decrease between the first two sessions, followed by gradually diminishing improvements across subsequent sessions, demonstrating the power law of practice. Notably, learning proved highly skill-specific, with participants performing better in the practiced modality (comprehension or production) than in the reverse. This study provides evidence that L2 morphosyntax development follows similar patterns to other cognitive skills when practiced over an extended period.	Mechanism Experimental Lab MSYN ACC, RT
1997	Robinson, P. (1997). Generalizability and automaticity of second language learning under implicit, incidental, enhanced, and instructed conditions. *Studies in Second Language Acquisition, 19*(2), 223–247. https://doi.org/10.1017/S0272263197002052	Following up on ROBINSON & HA (1993), Robinson investigated the generalizability of the instance theory to L2 learning under different learning conditions, with conscious attention paid to linguistic forms (enhanced and instructed conditions) or no conscious attention elicited (implicit and incidental conditions). As with the previous study, evidence for the applicability of the theory was limited in L2 learning (especially when performance speed was concerned), but the author found that participants acquired more accurate knowledge of the target structure under focus on form conditions (enhanced and instructed conditions).	Mechanism Experimental Lab MSYN ACC, RT
2004	Snellings, P., Van Gelderen, A., & De Glopper, K. (2004). The effect of enhanced lexical retrieval on second language writing: A classroom experiment. *Applied Psycholinguistics, 25*(2), 175–200. https://doi.org/10.1017/S0142716404001092	**Snellings** and colleagues investigated whether intensive training on retrieving necessary words for writing can improve accuracy and speed of lexical retrieval and eventually free up cognitive resources for more macro-level processes in writing such as planning, organizing, and reviewing. The training comprised four types of exercises that enhance collocation knowledge, form-meaning mapping of lexical items, synonym choice, and translation skills. Results showed that increased accuracy and speed in lexical retrieval transferred to writing as learners used the trained words more often. However, it did not have an impact on the overall writing quality.	Pedagogy Experimental Classroom LEX ACC, RT
2004	Jiang, N. (2004). Morphological insensitivity in second language processing. *Applied Psycholinguistics, 25*(4), 603–634. https://doi.org/10.1017/S0142716404001298	**Jiang** investigated whether morphological knowledge is integrated into L2 learners' automatic competence. In a self-paced reading task, where participants pressed a button to read sentences one word at a time, reading times were measured at critical points in grammatical and ungrammatical sentences. Automatic knowledge integration would be indicated by slower reading times at points of ungrammatical forms, as demonstrated by native speakers. Results showed that advanced L2 readers displayed no reading time differences for number agreement violations (e.g., "cabinet was" vs. *"cabinets was") but did show slower reading times for other grammatical errors like pronoun-be disagreement. This pattern suggests that their knowledge of number morphology is not integrated into their automatic L2 competence, despite their high proficiency level.	Mechanism Observational Lab MSYN RT

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2004	Phillips, N. A., Segalowitz, N. S., O'Brien, I., & Yamasaki, N. (2004). Semantic priming in a first and second language: Evidence from reaction time variability and event-related brain potentials. *Journal of Neurolinguistics, 17*(2–3), 237–262. https://doi.org/10.1016/S0911–6044(03)00055–1	This multi-experiment study explored the relationship between L2 proficiency and the automaticity of semantic priming in animacy judgment tasks, measuring processing efficiency through the CV. Participants performed animacy judgments in both their L1 and L2. Results showed that while participants were more efficient in L1 processing than in L2 processing (as indicated by lower CV values), more proficient bilinguals showed higher processing automaticity. In the following experiment, researchers found a similar pattern of results when using a neuronal measure of processing efficiency (i.e., N400), showing that automaticity constitutes an aspect of proficiency and that CV and N400 may tap into the same (or at least similar) cognitive process.	Skill Development Observational Lab LEX RT, CV, ERP
2005	Segalowitz, N., & Frenkiel-Fishman, S. (2005). Attention control and ability level in a complex cognitive skill: Attention shifting and second-language proficiency. *Memory and Cognition, 33*(4), 644–653. https://doi.org/10.3758/BF03195331	As PHILLIPS et al. (2004) showed processing efficiency can be an aspect of proficiency, this study further explored to what extent efficiency in attentional control skills in L2 is related to proficiency. Participants completed an animacy judgment task to measure proficiency (RT [lexical processing speed] and CV [lexical processing efficiency]) and an attention-shifting task to assess attentional control skills (measured through shift costs in RTs). To account for L1 influence, participants also performed equivalent tasks in their native language. The results revealed that attentional control skills explained over a third of the variance in L2 proficiency, highlighting a strong connection between these two variables.	Skill Development Observational Lab LEX ACC, RT, CV
2005	Fukkink, R. G., Hulstijn, J. A. N., & Simis, A. (2005). Does training in second-language word recognition skills affect reading comprehension? An experimental study. *Modern Language Journal, 89*(1), 54–75. https://doi.org/10.1111/j.0026–7902.2005.00265.x	The study had a similar objective as that of SNELLINGS ET AL. (2004) and investigated whether intensive training on lexical access to improve accuracy and speed as well as automaticity of word recognition would lead to improvement in reading comprehension. Learners in the study underwent training that aimed to accelerate and automatize their lexical retrieval speed. Results showed that the training overall led to increased automaticity in word recognition, but this improvement in the subprocess did not transfer to the macro-level of reading comprehension.	Pedagogy Experimental Classroom LEX ACC, RT, CV
2008	Gorsuch, G., & Taguchi, E. (2008). Repeated reading for developing reading fluency and reading comprehension: The case of EFL learners in Vietnam. *System, 36*(2), 253–278. https://doi.org/10.1016/j.system.2007.09.009	The study was similar to FUKKINK et al. (2005) in that researchers investigated whether lexical retrieval as a subprocess (of reading) can contribute to the overall reading fluency. Participants in the study were trained through repeated reading, a method in which they repeatedly read simplified texts to automatize word recognition. Results showed that when the target is reading fluency (rather than reading comprehension, as in FUKKINK et al, 2005), increased automaticity in word recognition can lead to enhanced fluency in reading.	Pedagogy Experimental Classroom LEX, FLU RT

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2008	Akamatsu, N. (2008). The effects of training on automatization of word recognition in English as a foreign language. *Applied Psycholinguistics, 29*(2), 175–193. https://doi.org/10.1017/S0142716408080089	**Akamatsu** investigated how training influences the automaticity of word recognition. Japanese learners of English were trained on 150 words for seven weeks to quickly and accurately identify word boundaries. Lexical decisions showed an improvement in both accuracy and speed. Interestingly, changes in CV depended on word frequency in that the expected decrease was only observed for low-frequency words. The researcher suggested that this type of training led to a qualitative change in the processing of low-frequency words, possibly reflecting automatization.	Pedagogy Lab Experimental LEX ACC, RT, CV
2009	Hulstijn, J. H., Van Gelderen, A., & Schoonen, R. (2009). Automatization in second language acquisition: What does the coefficient of variation tell us? *Applied Psycholinguistics, 30*(4), 555–582. https://doi.org/10.1017/S0142716409990014	In this paper, the researchers reported two studies. The first one is a longitudinal investigation spanning two years. Participants were English learners in the Netherlands completing four processing tasks (receptive, productive, lexical, and syntactic), affording RT and CV data. In the second study, the authors reported additional analyses carried out on the data reported by FUKKINK et al. (2005). The authors were unable to observe evidence for automatization in either study, as manifested in a decrease in CV as proficiency developed. The researchers argued that it is almost impossible to distinguish knowledge accumulation and skill acquisition in real-life situations.	Mechanism Lab Observational LEX, MSYN RT, CV
2009	Ferman, S., Olshtain, E., Schechtman, E., & Karni, A. (2009). The acquisition of a linguistic skill by adults: Procedural and declarative memory interact in the learning of an artificial morphological rule. *Journal of Neurolinguistics, 22*(4), 384–412. https://doi.org/10.1016/j.jneuroling.2008.12.002	The study investigated automatization of an artificial morphological rule based on intensive training. The rule involved phonological transformations of verbs based on a semantic category (i.e., animacy). Researchers found that while learners eventually automatized their rule application, the phonological and semantic aspects of the rule underwent different developmental patterns when the rule was applied to new items. Specifically, the phonological aspects could be generalized without declarative knowledge, whereas generalization of the semantic aspects depended on successful declarative learning, which was also found critical in driving proceduralization. The study shows that different aspects of language may undergo different automatization processes.	Mechanism Experimental Lab MSYN ACC, RT
2011	Rodgers, D. M. (2011). The automatization of verbal morphology in instructed second language acquisition. *International Review of Applied Linguistics in Language Teaching (IRAL), 49*(4), 25–295. https://doi.org/10.1515/iral.2011.016	The study examined whether L2 proficiency development corresponds to enhanced automaticity. Learners of Italian at three proficiency levels (Beginner, Intermediate, and Advanced) were compared on how they perform on comprehension and production tasks in terms of accuracy, RT, and CV. Results showed that while higher proficiency was associated with greater accuracy and speed of performance for both comprehension and production, evidence on higher automaticity (or restructuring) measured by CV was found only for comprehension, highlighting different degrees of automatization for the two skills.	Skill Development Observational Lab MSYN ACC, RT, CV
2011	Elgort, I. (2011). Deliberate learning and vocabulary acquisition in a second language. *Language Learning, 61*(2), 367–413. https://doi.org/10.1111/j.1467–9922.2010.00613.x	In line with AKAMATSU (2008), **Elgort** investigated deliberate training effects on the degree of automaticity in lexical knowledge. English learners studied 48 target pseudowords both in the lab and at home for one week, before completing three lexical decision tasks in the priming paradigm. The author reported significant form, repetition, and semantic priming effects, suggesting the development of representational and functional aspects of lexical knowledge of the pseudowords. Additionally, the author calculated CV values from the RT data collected from the repetition and semantic priming procedures and found a lower CV value for the target pseudowords than for nonwords and low-frequency L2 words, indicating that the pseudowords were processed more automatically by the participants as a result of the deliberate learning sessions before the testing experiments.	Pedagogy Lab Experimental LEX RT, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2012	Khatib, M., & Nikouee, M. (2012). Planned focus on form: Automatization of procedural knowledge. *RELC Journal, 43*(2), 187–201. https://doi.org/10.1177/0033688212450497	The authors investigated how well English learners with L1 Persian can automatize the present perfect tense after practice. The study involved 20 intermediate students who were divided into experimental and comparison groups. The experimental group received rule explanations, mechanical practice, meaningful practice, and planned communicative practice, while the comparison group did not receive planned communicative practice. The results from oral and written tests showed that the experimental group outperformed the comparison group in terms of reduced errors and RT. This effect was sustained after two weeks. These findings suggest that incorporating planned communicative practice into grammar instruction may be beneficial for learners.	Pedagogy Lab Experimental MSYN ACC, RT
2012	Sato, M., & Lyster, R. (2012). Peer interaction and corrective feedback for accuracy and fluency development: Monitoring, practice, and proceduralization. *Studies in Second Language Acquisition, 34*(4), 591–626. https://doi.org/10.1017/S0272263112000356	This study investigated how giving peer corrective feedback during interaction impacts L2 development. Over a semester, Japanese university students participated in peer interactions, with two groups learning to give specific types of corrective feedback and one group engaging only in peer-interaction activities. Compared to a control group, the two feedback groups improved in both accuracy and fluency. Overall, repeated peer-interaction practice promoted fluency, and providing corrective feedback helped learners monitor their own and their peers' language, leading to proceduralization of speaking skills.	Pedagogy Classroom Experimental MSYN ACC, FLU
2014	Ferman, S., & Karni, A. (2014). Explicit versus implicit instruction: Which is preferable for learning an artificial morphological rule in children? *Folia Phoniatrica et Logopaedica, 66*(1–2), 77–87. https://doi.org/10.1159/000363135	The authors investigated whether implicit or explicit instruction could facilitate the learning of an artificial morphophonological rule for eight-year-olds. The researchers taught morphological rules that were based on Hebrew grammar with or without explicit explanation. The results suggested that the participants in the implicit group were unable to induce the rules and generalize them to novel items. In contrast, explicit explanations improved learning especially during the initial stages. Generalization of the rules was also observed, with a small cost for speed. The authors concluded that rule explanation can play a key role in enabling rule generalization and facilitating proceduralization.	Pedagogy Lab Experimental MSYN RT, ACC
2014	Kahng, J. (2014). Exploring utterance and cognitive fluency of L1 and L2 English speakers: Temporal measures and stimulated recall. *Language Learning, 64*(4), 809–854. https://doi.org/10.1111/lang.12084	In this study, **Kahng** compared what it means to be fluent in one's L1 and L2 speech. Analysis of temporal measures (e.g., speed, length of run) suggested major differences between the L1 and L2 speakers. Silent pause rate within a clause was particularly prominent for L2 speakers, indicating processing difficulties in production. The authors also held a stimulated recall session in which participants verbalized their issues during production. For instance, learners with lower proficiency tended to think about declarative knowledge about specific rules (e.g., how to use correct tense-aspect features and make a sentence using comparatives), indicating the challenges of syntactic and morphophonological encoding that is not automatized for real-time speech process.	Mechanism Lab Observational FLU

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2014	Li, S., & Taguchi, N. (2014). The effects of practice modality on pragmatic development in L2 Chinese. *Modern Language Journal, 98*(3), 794–812. https://doi.org/10.1111/modl.12123	The authors examined how different types of practice (input-based vs. output-based) influence the development of accuracy and speed in comprehending and producing a pragmatic feature in Chinese (request making). Intermediate L2 Chinese learners practiced request forms over four days in comprehension or production. Findings suggest that the input-based group improved more in comprehension accuracy and speed, while the output-based group showed greater gains in production speed. This skill-specific development pattern confirms prior findings by DEKEYSER (1997), suggesting that practice of pragmatic skills leads to developmental patterns comparable to those seen in other areas of cognitive skill development.	Mechanism Experimental Lab PRAG ACC, RT
2015	Lim, H., & Godfroid, A. (2015). Automatization in second language sentence processing: A partial, conceptual replication of Hulstijn, van Gelderen, and Schoonen's 2009 study. *Applied Psycholinguistics, 36*(5), 1247–1282. https://doi.org/10.1017/S0142716414000137	The authors conducted a partial replication study of HULSTIJN ET AL. (2009) with English learners and native speakers, who completed one lexical (semantic classification) and two sentence (verification and construction) processing tasks, all in the visual modality. The RT data were recorded for the computation of CV. Results suggested that CV values generally decreased from intermediate to advanced learners, and to native speakers, consistent with the theorization of CV. This study was the first to report a downward CV trend for sentence processing, contrary to the findings of the earlier study by HULSTIJN ET AL. (2009). It is also one of the first to use CV as a between-participants measure of automaticity.	Mechanism Lab Experimental LEX, MSYN RT, CV
2017	Leonard, K. R., & Shea, C. E. (2017). L2 speaking development during study abroad: Fluency, accuracy, complexity, and underlying cognitive factors. *Modern Language Journal, 101*(1), 179–193. https://doi.org/10.1111/modl.12382	In this longitudinal study, **Leonard and Shea** tracked 39 L2 learners in a Spanish-speaking country for three months. They administered lexical and grammatical knowledge and processing tests and used their scores as predictors of complexity, accuracy, and fluency gains in the learners' speaking skills. Their findings revealed that prior levels of lexical knowledge (vocabulary size) and lexical processing speed (RT) predicted gains in accuracy and lexical/syntactic complexity during the study abroad program. However, none of the prior knowledge and processing speed measures predicted fluency change, which differs from SEGALOWITZ & FREED's (2004) findings, likely because the learners had frequent contact and opportunities to use the L2 during the three-month sojourn.	Skill Development LabObservation LEX RT, CV
2017	Li, M., & DeKeyser, R. M. (2017). Perception practice, production practice, and musical ability in L2 mandarin tone-word learning. *Studies in Second Language Acquisition, 39*(4), 593–620. https://doi.org/10.1017/S0272263116000358	**Li and DeKeyser** compared the effects of perception and production practice on learning Mandarin tone words by English speakers. Results showed that each group performed significantly better on the skill they practiced, with performance much worse when tested on the opposite skill. This provides further evidence for skill-specific development through extended practice, aligning with previous findings on morphosyntactic rule learning (DEKEYSER, 1997) and pragmatics learning (LI & TAGUCHI, 2014). This study also found that musical ability correlated positively with perception and production accuracy. The authors conclude that practice in both receptive and productive skills is crucial for developing high L2 proficiency.	Mechanism Experimental Lab PHO ACC, RT

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2017	Suzuki, Y., & DeKeyser, R. M. (2017). The interface of explicit and implicit knowledge in a second language: Insights from individual differences in cognitive aptitudes. *Language Learning, 67*(4), 747–790. https://doi.org/10.1111/lang.12241	**Suzuki and DeKeyser** used their new test battery of implicit and automatized explicit knowledge to investigate the interface between explicit and implicit knowledge. Advanced L2 speakers of Japanese living in Japan performed three implicit knowledge tests (eye-tracking while listening, self-paced reading, and word-monitoring tasks) and three automatized explicit knowledge tests (e.g., a time-pressured grammaticality judgment task) as well as explicit and implicit aptitude tests. The findings from structural equation modelling indicate automatized explicit knowledge, fostered by drawing on explicit learning aptitude, influences the acquisition of implicit knowledge. This supports a strong interface between explicit and implicit knowledge and suggests that automatization, through solid declarative and procedural learning, can eventually lead to implicit knowledge.	Mechanism Lab Observational MSYN ACC, RT, EYE
2017	Dao, P., Iwashita, N., & Gatbonton, E. (2017). Learner attention to form in ACCESS task-based interaction. *Language Teaching Research, 21*(4), 454–479. https://doi.org/10.1177/1362168816651462	**Dao, Iwashita, and Gatbonton** reported a classroom study in which learners completed communicative tasks designed within the framework of task-based language teaching, with an additional focus on automatization, called Automatization in Communicative Contexts of Essential Speech Sequences (ACCESS). Three main principles guided the design of the task in this approach: genuinely communicative, inherently repetitive, and functionally formulaic. Interaction data from Chinese learners of English in Canada were analyzed as evidence for focus on form in language-related episodes. A large number of these episodes were identified and represented correct resolutions during the interaction. While automatization was not measured directly in this classroom study, the findings suggest that learners' attention was successfully drawn to the target grammar structures through ACCESS task-based interaction, providing a foundation for enhancing fluency and accuracy.	Pedagogy Classroom Observational LEX, MSYN ACC
2018	Suzuki, Y. (2018). The role of procedural learning ability in automatization of L2 morphology under different learning schedules: An exploratory study. *Studies in Second Language Acquisition, 40*(4), 923–937. https://doi.org/10.1017/S0272263117000249	**Suzuki** investigated the effects of learning schedules (three-day vs. seven-day intervals) and procedural learning ability on automatization of L2 morphology. Participants learned a miniature language and were assessed on oral production tests, measuring processing speed (RT) and stability (CV). Both groups showed faster RT, but the three-day group demonstrated slightly greater advantage in a CV-related measure. Procedural learning ability correlated with faster RT only in the three-day group. Findings suggest shorter spacing between practice sessions may facilitate automatization more than longer spacing. Procedural learning ability contributes to early automatization (speedup) but not later stages (restructuring).	Individual Difference Lab Experimental MSYN RT, CV
2018	Suzuki, Y., & Sunada, M. (2018). Automatization in second language sentence processing: Relationship between elicited imitation and maze tasks. *Bilingualism: Language and Cognition, 21*(1), 32–46. https://doi.org/10.1017/S1366728916000857	Building on previous work on methodological issues of capturing automatization (LIM & GODFROID, 2015), **Suzuki and Sunada** explored the effectiveness of RT (processing speed) and CV (processing stability) in predicting English-as-a-foreign-language learners' speaking proficiency in Japan. They measured syntactic processing speed and stability using a maze task. The results revealed that RT, not CV, was the sole significant predictor of speaking proficiency, assessed by an elicited imitation task. Although a subgroup of learners with previous immersion experience in an English-speaking country showed some signs of automatization, RT remained a better predictor of L2 oral proficiency than CV, regardless of immersion experience. These findings suggest that CV may have limited practical value in predicting L2 proficiency, consistent with the conclusion by HULSTIJN ET AL. (2009) but inconsistent with that of LIM AND GODFROID (2015).	Method Lab Observational MSYN RT, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2018	Solovyeva, K., & DeKeyser, R. (2018). Response time variability signatures of novel word learning. *Studies in Second Language Acquisition, 40*(1), 225–239. https://doi.org/10.1017/S0272263117000043	**Solovyeva and DeKeyser** presented data to challenge the accepted prediction that CV always decreases as proficiency develops. Seventy-three native English speakers learned Swahili-English word pairs through a paired-associate learning task. Before and after treatment, participants responded to both real English words and target nonwords in two lexical decision tasks using a priming paradigm (with Swahili primes). The authors analyzed both RT and CV in these repeated measurements and found that, during the initial stage of form-meaning mapping, CV increased, suggesting that the establishment of novel representations temporarily disrupted processing stability. This result provided evidence for an initial increase in CV on the word learning journey.	Mechanism Lab Experimental LEX CV
2019	Sato, M., & McDonough, K. (2019). Practice is important but how about its quality? Contextualized practice in the classroom. *Studies in Second Language Acquisition, 41*(5), 999–1026. https://doi.org/10.1017/S0272263119000159	**Sato and McDonough** investigated the role of declarative knowledge in oral fluency development underpinned by procedural knowledge of wh-questions through communicative grammar practice activities in an English-as-a-foreign language classroom. Over five weekly sessions, learners engaged in tasks that elicited wh-questions. Analyses revealed that prior declarative knowledge, assessed by a paper-and-pencil test, facilitated accurate and faster use of the target structure only in the initial stages of fluency development, as evidenced by higher speech rates and shorter pauses. This demonstrates that systematic oral practice, combined with some prior declarative knowledge, plays a role in incipient stages of automatization of oral communicative skills.	Pedagogy Classroom Observational MSYN ACC, FLU
2019	McManus, K., & Marsden, E. (2019). Signatures of automaticity during practice: Explicit instruction about L1 processing routines can improve L2 grammatical processing. *Applied Psycholinguistics, 40*(1), 205–234. https://doi.org/10.1017/S0142716418000553	**McManus and Marsden** investigated how explicit L1 grammar rule explanation alongside L2 rule explanation influences sentence interpretation. English learners of French were divided into groups: one receiving only L2 metalinguistic explanations and practice, another receiving L2 explanations plus L1 grammar explanations and practice, and a third receiving L2 explanations and practice in both languages but without L1 explanations. Only the group that received both L1 and L2 rule explanations improved in accuracy and speed. Analysis of CV suggested that automatization occurred during later practice sessions. Taken together, the authors concluded that providing explicit rule explanations about both L1 and L2 grammar can significantly boost learning.	Pedagogy Lab Experimental Morphosyntax ACC, RT, CV
2020	Pili-Moss, D., Brill-Schuetz, K., Faretta-Stutenberg, M., & Morgan-Short, K. (2020). Contributions of declarative and procedural memory to accuracy and automatization during second language practice. *Bilingualism: Language and Cognition, 23*(3), 639–651. https://doi.org/10.1017/S1366728919000543	**Pili-Moss** and colleagues investigated the role of declarative and procedural learning ability in predicting accuracy and processing stability (indexed by CV) during practice of an artificial language. Participants practiced comprehension and production of the target language over four sessions. Results showed that declarative learning ability positively predicted accuracy, while procedural learning ability predicted CV reduction for learners with higher declarative memory. Building on SUZUKI (2018), who found a relationship between CV and procedural learning ability, this study provides further insights into the role of long-term memory abilities in automatization through L2 practice.	Individual Difference Lab Observational MSYN ACC, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2020	Hui, B. (2020). Processing variability in intentional and incidental word learning: An extension of Solovyeva and DeKeyser (2018). *Studies in Second Language Acquisition, 42*(2), 237–357. https://doi.org/10.1017/S0272263119000603	Following up SOLOVYEVA & DEKEYSER (2018), the researcher conducted this study to more closely examine the trajectory of CV as a proficiency measure. Thirty-five native English speakers learned 16 Swahili-English word pairs and performed 10 blocks of animacy judgements with feedback. The author reported an inverted-U shape development in CV where an increase was initially observed, replicating the results of SOLOVYEVA & DEKEYSER, followed by a turnaround, in line with the prediction by skill acquisition theory. However, the author did not find a similar pattern for reading times from an eye-tracking experiment where vocabulary was learned through reading.	Method Lab Experimental LEX ACC, RT, CV, EYE
2020	Nakata, T., & Elgort, I. (2020). Effects of spacing on contextual vocabulary learning: Spacing facilitates the acquisition of explicit, but not tacit, vocabulary knowledge. *Second Language Research, 37*(2), 233–260. https://doi.org/10.1177/0267658320927764	**Nakata and Elgort** investigated the extent to which spacing would facilitate the acquisition of tacit, automatic semantic lexical knowledge through reading. Japanese learners of English encountered 48 target vocabulary items under spaced and massed conditions. In line with ELGORT (2011), they used a lexical decision task in a priming paradigm as a lexical outcome measure. Although there was an advantage for the spaced condition on the meaning recognition and recall tests, the two learning conditions produced a similar level of semantic priming. The authors concluded that spacing did not have an effect on tacit vocabulary knowledge in the context of learning from reading.	Pedagogy Lab Experimental LEX ACC, RT
2021	Hui, B., & Godfroid, A. (2021). Testing the role of processing speed and automaticity in second language listening. *Applied Psycholinguistics, 42*(5), 1089–1115. https://doi.org/10.1017/S0142716420000193	**Hui and Godfroid** extended the work by FUKKINK ET AL. (2005) to test the predictive validity of the speed and automaticity of lexical, syntactic, and propositional processing in terms of listening comprehension. Forty-four Chinese learners of English performed a speeded Yes-No vocabulary test and two sentence processing tasks adapted from LIM & GODFROID (2015), as well as a listening comprehension assessment. The authors used the accuracy, RT (speed), and CV (automaticity) measures from the processing tasks to predict listening comprehension. Results showed that lexical processing speed, not syntactic processing and not automaticity, was more strongly related to L2 listening comprehension. The authors concluded that successful L2 listening depends on both accurate and efficient lexical processing skills.	Skill Development Observational Lab LEX ACC, RT, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2022	Suzuki, Y., & Hanzawa, K. (2021). Massed task repetition is a double-edged sword for fluency development: An EFL classroom study. *Studies in Second Language Acquisition, 44*(2), 536–561. https://doi.org/10.1017/S0272263121000358	To investigate the optimal timing of task repetition for oral fluency development, **Suzuki and Hanzawa** conducted a classroom experiment in English-as-a-foreign-language classes. Class 1 narrated the same cartoon story six times in one class (massed practice), Class 2 narrated three times at the beginning and at the end of a class (short-spaced practice), and Class 3 narrated three times as a part of two classes one week apart (long-spaced practice). Findings indicate that massed practice reduced breakdown fluency the most but led to a slower articulation rate and more verbatim repetition. While SUZUKI (2018) showed some advantage in shorter-spaced practice for grammar learning, the current finding suggests that optimal timing may differ for speaking practice through narrative tasks.	Pedagogy Classroom Experimental FLU
2022	Maie, R., & Godfroid, A. (2022). Controlled and automatic processing in the acceptability judgment task: An eye-tracking study. *Language Learning, 72*(1), 158–197. https://doi.org/10.1111/lang.12474	Imposing time pressure on grammaticality judgments has been thought to provide a measure of automatized language use by restricting reliance on controlled processing. **Maie and Godfroid** used eye-tracking to investigate how time pressure affected different components of reading in timed and untimed grammaticality judgment tasks. Additionally, researchers examined how learners' automaticity in lexical processing may moderate the effect as some are faster readers than others. Results showed that time pressure not only limited controlled processing but also automatic processing and that learners with slower lexical processing were more severely affected, highlighting that time pressure may not function as theoretically predicted by researchers.	Method Lab Observational MSYN CV, EYE
2023	Jeong, H., & DeKeyser, R. (2023). Development of automaticity in processing L2 collocations: The roles of L1 collocational knowledge and practice condition. *Studies in Second Language Acquisition, 45*(4), 930–954. https://doi.org/10.1017/S0272263122000547	**Jeong and DeKeyser** investigated the development of automaticity in L2 collocation processing. Participants completed fill-in-the-blank exercises over three practice sessions, with the target collocations presented in either identical or varied sentence contexts. The results showed that both learning contexts led to faster RT and lower CV over time, indicating the development of automaticity. L1 collocational knowledge facilitated processing speed only in the early learning stages. Although potential differences between the practice conditions were observed, no significant differences were found. The findings suggest that repeated practice is crucial for developing automaticity in L2 collocation processing, with L1 influence being more prominent in early stages.	Pedagogy Lab Experimental LEX ACC, RT, CV
2023	Albarqi, G., & Tavakoli, P. (2023). The effects of proficiency level and dual-task condition on L2 self-monitoring behavior. *Studies in Second Language Acquisition, 45*(1), 212–233. https://doi.org/10.1017/S0272263122000146	**Albarqi and Tavakoli** examined the impact of L2 proficiency and dual-task conditions on self-monitoring, which reflects automaticity in speech processing. L1 Arabic learners of L2 English narrated picture stories in single- and dual-task conditions. As proficiency increased, learners produced fewer disfluencies and corrected more errors, suggesting automatization enabled more effective monitoring. The demanding dual-task only increased repetitions, likely because the high resource-demands of L2 speech limit further impacts on monitoring before automatization develops. The findings indicate automatization of speech production underlies efficient self-monitoring skills.	Skill Development Lab Experimental FLU

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2023	Suzuki, Y., Jeong, H., Cui, H., Okamoto, K., Kawashima, R., & Sugiura, M. (2023). An fMRI validation study of the word-monitoring task as a measure of implicit knowledge: Exploring the role of explicit and implicit aptitudes in behavioral and neural processing. *Studies in Second Language Acquisition, 45*(1), 109–136. https://doi.org/10.1017/S0272263122000043	Extending previous validation research on implicit knowledge test, **Suzuki and colleagues** investigated neural processing in advanced L2 and L1 speakers of Japanese using a word-monitoring task in an MRI scanner. L1 and L2 speakers recruited different neural circuits associated with procedural memory: premotor cortex (L1) and left caudate (L2). L2 speakers showed weaker premotor cortex activation than L1 speakers but its activity was correlated with left caudate activation, which suggests their procedural knowledge was under development and less automatized. Explicit language aptitude predicted word-monitoring task performance in L2 speakers. This study provides evidence that supports the findings of an earlier behavioral study by SUZUKI & DEKEYSER (2017) who elucidated the nature of automatized L2 knowledge.	Method Lab Observational MSYN RT, fMRI
2023	Saito, K., Uchihara, T., Takizawa, K., & Suzukida, Y. (2023). Individual differences in L2 listening proficiency revisited: Roles of form, meaning, and use aspects of phonological vocabulary knowledge. *Studies in Second Language Acquisition.* Advance online publication. https://doi.org/10.1017/S027226312300044X	**Saito and his colleagues** propose that automatization is a critical aspect of phonological vocabulary knowledge for successful L2 listening comprehension. They defined and operationalized automatization as the ability to retrieve phonological lexical knowledge in relation to surrounding words as part of automatized lexical chunks. The authors developed a lexicosemantic judgment task to measure automatized phonological vocabulary knowledge. Their analyses revealed that automatized vocabulary knowledge played a central role in L2 listening proficiency, accounting for 55.3% of the explained variance. The findings highlight the importance of focusing on automatization to help L2 learners attain the lexical knowledge required for successful listening skills.	Skill Development Lab Observational LEX ACC, CV
2024	Hanzawa, K., & Suzuki, Y. (2023). Does automaticity in lexical and grammatical processing predict utterance fluency development? A six-month longitudinal study in Japanese EFL context. *Journal of Second Language Studies, 6*(2), 290–318. https://doi.org/10.1075/jsls.22007.han	To extend our understanding of the role of automaticity in oral fluency development in classroom settings (cf., SEGALOWITZ & FREED, 2004; LEONARD & SHEA, 2017), **Hanzawa and Suzuki** tracked oral fluency development of English-as-a-foreign-language (EFL) learners in Japan over six months. Their RT and CV analyses using lexical and grammar tasks indicate high-frequency words were already automatized at Time 1. Faster RT and smaller CV at Time 1 significantly predicted oral fluency gains that presumably reflect proceduralization in speaking skills. This highlights the importance of syntactic processing speed and automaticity in oral fluency development in an EFL context.	Skill Development Lab Observational LEX, MSYN ACC, RT, CV

(*Continued*)

(*Continued.*)

Year	References	Annotations	Theme
2025	Foryś-Nogala, M., Broniś, O., & Janczarska, A. (2025). The interplay of learners' cognitive abilities in the learning and automatization of miniature language grammar: What matters beyond general IQ? *Studies in Second Language Acquisition*, 1–25. Advance online publication. https://doi.org/10.1017/S0272263125000117	**Foryś-Nogala, Broniś, and Janczarska** investigated cognitive predictors (working memory, IQ, language analytic ability [LAA]) of automatization through incidental grammar learning. Polish adults learned a miniature language (MiniItaliano) through comprehension-focused tasks. Explicit knowledge was tested via an untimed grammaticality judgment task (GJT), and automatized knowledge was measured via a timed auditory GJT. Results showed LAA significantly predicted performance on both timed and untimed tasks, beyond other cognitive measures. Additionally, untimed GJT scores related to reliance on self-discovered rules, while timed GJT performance was associated with general IQ and LAA. The findings highlight LAA as a language-specific, crucial ability for acquiring both explicit and automatized grammatical knowledge, potentially more so than general IQ, while working memory showed no unique contribution.	Individual Difference Lab Observational MSYN ACC
2025	Maie, R., & Godfroid, A. (2025). Testing the three-stage model of second language skill acquisition. *Studies in Second Language Acquisition*, 1–33. Advance online publication. https://doi.org/10.1017/S027226312500021X	**Maie and Godfroid** tested one of the fundamental assumptions in skill acquisition theory: the three-stage model (declarative, procedural, automatic) of L2 grammar learning. Participants learned a miniature language (Mini-Nihongo) via intentional learning with explicit instruction followed by comprehension practice. Their analysis using a hidden Markov model confirmed that learners progressed through three distinct stages. Furthermore, the transition to the procedural stage (stage 2) occurred after roughly 18 trials, strikingly similar to DEKEYSER's (1997) estimate. Reaching the final stage of automatization took an average of 165 additional trials. Furthermore, declarative ability predicted accuracy throughout, although its influence decreased in later stages, corroborating the pattern in PILI-MOSS ET AL. (2020). Procedural ability tended to predict performance speed (indicated by RT) later, supporting the shift from declarative to procedural stage.	Mechanism Lab Observational MSYN ACC, RT

[a]Authors' names are shown in small capitals when the study referred to appears in this timeline.

Yuichi Suzuki is Associate Professor at the Faculty of International Research and Education at Waseda University. He received his Ph.D. in Second Language Acquisition from University of Maryland College Park. He is interested in theory-practice interface in instructed SLA and involved in collaboration projects with public and private sectors to support secondary school teachers in Japan. He writes ELT textbooks and books on ISLA research and English education that serve the interests of practitioners, general audiences, and researchers.

Ryo Maie is Senior Assistant Professor in the Graduate School of International Cultural Studies at Tohoku University. He received his Ph.D. in Second Language Studies from Michigan State University. His research focuses on skill acquisition, automatization, language aptitudes, task-based language teaching, and applied statistics in L2 research.

Bronson Hui is Assistant Professor of Second Language Acquisition at the University of Maryland, College Park. He earned his doctorate from Michigan State University. He teaches and conducts research in areas such as instructed SLA, vocabulary learning and teaching, as well as quantitative research methods.

Cite this article: Suzuki, Y., Maie, R., & Hui, B. (2025). Research timeline: Automatization in second language learning. *Language Teaching*, 1–20. https://doi.org/10.1017/S026144482500059X