An investigation of the automaticity in parsing for Japanese EFL learners: Examining from psycholinguistic and neurophysiological perspectives

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論 文 要 旨

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論文題目（外国語の場合は日本語訳を併記すること）

An investigation of the automaticity in parsing for Japanese EFL learners: Examining from psycholinguistic and neurophysiological perspectives

（日本語訳　日本人英語学習者の初期統語解析における自動性の解明：心理言語学的・神経科学的検討）

論文要旨

The purpose of this dissertation is to investigate and reveal the mechanism of sentence processing for Japanese EFL (English as a Foreign Language) learners, especially focusing on the use of the explicit linguistic information, and the effects of proficiency on the automaticity in syntactic parsing.

Japanese EFL learners tend to be not good at reading English sentences. Although the difficulties of Japanese EFL learners in comprehending sentences are often discussed in pedagogical forums, they are rarely targeted in the psycholinguistic literature so far. Particularly in English, it is crucial to parse and understand the syntactic structure of the sentences correctly. During syntactic parsing, readers need to use the linguistic information of the sentence such as morphological, syntactic, semantic, and discourse information as the cue to construct the structure. But it is not clear what is easy or what is difficult for Japanese EFL learners to construct sentence structures and what becomes easier when their proficiency improves.

In the previous research, psycholinguistic experiments were conducted on native speakers of English from the perspective of their use of syntactic and semantic information in processing temporarily ambiguous sentences. Ferreira and Clifton (1986) insisted that native speakers of English use only syntactic information on parsing. Trueswell, Tanenhaus, and Garnsey (1994), on the other hand, concluded that native speakers of English use not only syntactic information but also semantic and other information on parsing. In addition, Just and Carpenter (1992) investigated the relation between linguistic information processing and individual difference of working memory capacity in sentence processing and revealed that the use of the linguistic information differed depending on readers' working memory capacity. In contrast, it is said that L2 learners including Japanese EFL learners rely more on lexical, semantic and pragmatic information and that the syntactic information is absent in their sentence processing (Shallow Structure Hypothesis: Clahsen & Felser, 2006). Moreover, in recent studies, neurophysiological methods that focus on brain activation gradually become more used for investigating the mechanism of language processing and the sensitivity to the linguistic information on syntactic parsing in both L1 and L2 speakers.

But little is known about how Japanese EFL learners build syntactic representations during sentence processing and how learners acquire and develop their methods of sentence processing including syntactic parsing. In this dissertation, the mechanism of syntactic parsing for Japanese EFL learners, especially focusing on the use and the process of linguistic information, and the effects of proficiency on the automaticity in syntactic parsing are investigated from both psycholinguistic and neurophysiological perspectives.

In Chapter 3, an eye-tracking experiment was conducted to investigate how Japanese EFL learners with intermediate proficiency process temporarily ambiguous sentences from the perspective of their use of semantic and morphosyntactic information. In Experiment 1, participants read sentences containing reduced relative clauses for which initial noun phrases were controlled by the information of animacy. In Experiment 2, participants read sentences containing main clause or reduced relative constructions for which initial verbs were morphologically controlled. The effects of the improvement of proficiency within the intermediate group and the increase of working memory capacity were also considered using the linear mixed-effects model. The results revealed that Japanese EFL learners can use the information of animacy to facilitate sentence processing as their proficiency improves. However, they do not always use the morphosyntactic information effectively for sentence processing and there were few effects of proficiency and working memory capacity for reading sentences containing reduced relative clauses. These results indicate that Japanese EFL learners rely on the semantic and other information for sentence processing and that the use of the syntactic information is absent, which is consistent with the Shallow Structure Hypothesis of L2 speakers (Clahsen & Felser, 2006).

In Chapter 4, the event-related potentials (ERP) experiment was conducted to investigate Japanese EFL learners' sensitivity to linguistic information, including (a) morphosyntactic information (regular/irregular verbs), (b) semantic information, and (c) phrase structural rules, during sentence processing. Learners with intermediate and lower proficiency participated in the experiment and the effects of proficiency on the sensitivity to the information were also examined. Participants read sentences including correct or incongruent information and judged whether the sentences were grammatically/semantically correct. The results revealed that the P600 magnitude for the morphosyntactic incongruent condition of the regular verbs was positively correlated with proficiency level, indicating that proficient learners became more sensitive to the morphosyntactic rules of regular verbs in later processing stages. However, learners were not sensitive to the morphosyntactic information of the irregular verbs and the phrase structural rules regardless of their proficiency; the ERP components that L1 speakers typically have were not detected. On the other hand, N400 was detected in the semantic incongruent condition even if learners' proficiency were relatively low. These results indicate that, in terms of automaticity, Japanese low-proficiency EFL learners are sensitive to semantic information but not morphosyntactic information or phrase structural rules.

In Chapter 5, the changes of the sensitivity to the syntactic information after the exposure to the correct information were investigated. Recent studies revealed that the

exposure to the linguistic information including sentence structure is effective to promote the sentence processing and language learning. The exposure tasks focusing on (a) morphosyntactic information (regular/irregular verbs) and (b) phrase structural rules were conducted to Japanese EFL learners with low proficiency. The effects of task type on exposure are also investigated, (1) silent reading task and (2) repetition task without looking. Then the ERP experiment was conducted in the same manner as Chapter 4. The experiment showed that P600 components were elicited against the morphosyntactic violations of the regular verbs and the phrase structural violations after participants completed the silent reading task. In contrast, P600 components were detected in the incongruent condition of the irregular verbs after participants completed the repetition task without looking. The results revealed that the learnability of the linguistic information is different between the morphosyntactic information of the verbs and the phrase structural rules for Japanese low-proficiency EFL learners.

Chapter 6 presents the general discussion about the results obtained from the experiments. Lastly, Chapter 7 concludes this dissertation with reviewing the residual problems and improvements for further studies.

論文審査の結果の要旨

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論文題目	An investigation of the automaticity in parsing for Japanese EFL learners: Examining from psycholinguistic and neurophysiological perspectives [日本人英語学習者の初期統語解析における自動性の解明：心理言語学的・神経科学的検討]
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要　　　旨

別紙のとおり。

1. 本論文の目的および考察対象

　本論文は、外国語学習者としての初・中級熟達度の日本人英語学習者を対象に、心理言語学的行動実験・神経科学的脳科学実験を通して、文レベルでの統語解析における言語情報の利用の様相と、熟達化・学習に伴う言語情報処理の自動化プロセスの解明を目指したものである。

2. 本論文の構成と内容

　Chapter 1. Introductionでは、言語処理における文理解プロセスにおいて、文の統語構造の構築が必要不可欠であるとの認識に立ち、形態・統語・意味などの言語情報に基づいて、心内でリアルタイムに統語構造を構築することの重要性が指摘される。

　Chapter 2. Literature Reviewでは、第一言語および第二言語（外国語）における統語解析時の言語情報の利用について、心理言語学的・神経科学的な面から詳細に先行研究が検討され、日本人英語学習者の文理解が意味情報に強く依存しているのに対して、統語情報の利用が自動化されていないことが指摘される。

　Chapter 3. The Use of Animacy and Morphosyntactic Information in Comprehending Temporarily Ambiguous Sentences: An Eye-Tracking Studyでは、中級熟達度の日本人英語学習者を対象に、文処理時の意味情報・動詞の形態統語情報の利用について熟達度・ワーキングメモリ容量別に眼球運動測定実験により検証した。その結果、学習者の意味情報処理の熟達度依存性と動詞の形態統語情報処理の非自動性が明らかになった。

　Chapter 4. Sensitivity to Linguistic Information during Sentence Processing: An Event-Related Potentials Studyは、初・中級熟達度の日本人英語学習者における、文中の言語情報（形態統語情報・意味情報・句構造規則）の違反に対する敏感さと、熟達度の上昇に伴う敏感さの変化を事象関連電位測定実験により検証したものである。実験の結果、学習者の規則動詞の形態統語違反に対する敏感さの熟達度依存性と、不規則動詞の形態統語違反・句構造規則違反の非敏感性が示された。

　Chapter 5. Exposure Effects on Sensitivity to Linguistic Information during Sentence Processing: An Event-Related Potentials Study では、初級熟達度の日本人英語学習者を対象に、統語情報（形態統語情報・句構造規則）への反復接触課題（黙読または音読）による情報の脳内処理機構の変化を事象関連電位測定実験により検証した。その結果、黙読課題が文法規則（規則動詞の形態統語情報・句構造規則）の学習を促進するのに対して、音読課題が語彙情報（不規則動詞の形態統語情報）の学習を促進することが明らかにされた。

　Chapter 6. General Discussion では、3つの実験結果に基づき総合考察が行われる。初・中級日本人英語学習者の統語解析は、母語話者のように自動的な統語情報処理が前提とはならず、意味情報に依存していることが指摘される。非自動的な統語情報処理の学習可能性については、大きな処理コストが要求されない黙読課題において文法規則が明示的に学習されるのに対して、ワーキングメモリ内の音韻ループが活性化される音読課題に語彙情報の記憶・学習効果があると結論づけている。

　Chapter 7. Conclusions and Further Studiesでは、本論文の結論および今後の課題について述べられている。

3. 本論文の独創性と意義

　本論文は、外国語習得途上の日本人英語学習者における、言語情報のリアルタイムでの処理と、熟達化に伴う処理プロセスの変化を心理言語学・神経科学の2つの観点から学際的に検討した点で新規であり、学習者の文処理メカニズムとその発達過程の解明に大きく貢献するものである。また、外国語学習者の反復接触による統語情報処理の潜在学習の可能性を神経科学的に調査した研究は過去に例がほとんどなく、外国語教育の授業実践にも示唆に富んだ論文と言える。

（研究業績）
　本論文の内容に関しては、以下の通り、学術論文として公刊されている。

1. 鳴海智之・横川博一 (2012).「日本人英語学習者の一時的構造曖昧文の理解における有生性・動詞の形態統語情報の利用に熟達度・ワーキングメモリ容量が及ぼす影響 －眼球運動測定実験による心理言語学的検討－」電子情報通信学会技術研究報告『信学技報』, 112巻, 339号, 89-94（査読なし）

2. 鳴海智之・長井千枝子・松本絵理子・林 良子・横川博一 (2013).「日本人英語学習者の文処理時における言語情報への敏感さに熟達度が与える影響－事象関連電位測定実験による神経脳科学的検討－」電子情報通信学会技術研究報告『信学技報』, 113巻, 174号, 13-18（査読なし）

3. 鳴海智之・横川博一 (2013). 「日本人英語学習者の言語情報への繰り返し接触が文処理に与える影響 －事象関連電位測定実験による検討－」電子情報通信学会技術研究報告『信学技報』, 113巻, 354号, 65-70（査読なし）

4. Narumi, T., & Yokokawa, H. (2013). Proficiency and Working Memory Effects on the Use of Animacy and Morphosyntactic Information in Comprehending Temporarily Ambiguous Sentences by Japanese EFL Learners: An Eye-tracking Study.ことばの科学会学会誌『ことばの科学研究』, 14号, 19-42.（査読有）

5. 鳴海智之（印刷中）「外国語の文処理プロセスにおいて形態統語・意味情報はいかに利用されるか－眼球運動・事象関連電位からの検討」横川博一ほか編『外国語運用能力はいかに自動化するか―言語情報処理の自動化プロセスを探る』松柏社，2014年3月刊行予定（分担執筆，査読無し）

　この他、学会・研究会発表8件（うち1件は英語での発表）、うち1件は国際学会で発表を行うなど精力的に学会発表を行っており、国内外のさまざまな分野の研究者との交流の中で精錬されてきたものである。このような学究活動の水準からも、本論文は博士論文としてふさわしい研究成果と言える。

　以上のことから、学位申請者の鳴海智之氏は博士（学術）の学位を得る資格があると認める。