Available online at:
https://dergipark.org.tr/eltrj/
International Association of Research in Foreign Language Education and Applied Linguistics
ELT Research Journal
2020, 9(1), 71-89
ISSN: 2146-9814

A Critical Review on The Components of Processability Theory: Identifying the Limitations

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Received: 2020-06-01 Accepted: 2020-06-22

Abstract

There has been a tendency among the second language acquisition/learning theorists to make generalization about the stages that learners go through in learning a second language (L2). Processability Theory, developed by Pienemann (1998), is one of those theories. It is argued in Processability Theory that learners can learn an L2 in an order that they are capable of at specific times. In other words, learners acquire/learn L2s in a predictable order, which is called '*developmental trajectory'*. This article reviews Processability Theory from a critical perspective and investigates the limitations of and ambiguities in the theory through examining previous studies. The issues discussed in this paper include the hierarchical order, hypothesis space, grammar and lexicon, operational definition of language processor and its connection to Neurolinguistics and working memory, overgeneralization of features to all languages, and lexical functional grammar. Based on the review of these issues, it is proposed that Processability Theory may need some modifications and amendments in near future, as there is a need for more empirical studies.

Keywords: Processability theory, processability hierarchy, second language acquisition, working memory, individual differences in language learning, lexical-functional grammar.

Introduction

The factors influencing the process of acquiring/learning a second language (L2), the effects of learners' first language (L1) on this process and the cognitive stages that learners

go through are just a few of the issues which arise while teaching an L2. The challenges faced while teaching an L2 have helped the linguists to enrich the field of second language acquisition (SLA). Throughout the history of SLA, dating back to more than 20 years ago (Gass, 1993), linguists have had different perspectives and priorities to dwell upon. While some of them have had a nativist viewpoint, considering innate capabilities of learners, some others have had an environmentalist viewpoint, emphasizing the social and psychological variables which play an important role in SLA (Escamilla & Grassi, 2000). A great deal of theories, hypotheses and models emerged within these nativist and environmentalist accounts such as the Natural Approach by Krashen (1985), the Output Hypotheses by Swain (1985, 1995, 2005), the Sociocultural Theory by Vygotsky (1978), the Complexity Theory by Larsen-Freeman (2015, 2018), and so on. However, in this review article, the Processability Theory by Pienemann was profoundly investigated by examining its components and identifying some of their limitations, as it is one of the least researched theories among the aforementioned ones.

Theoretical Background

Processability Theory is a theory in the field of SLA and it is proposed in this theory that learners go through some developmental stages in learning languages and learners' accumulation of knowledge is limited to the developmental phase that they are in (Pienemann & Lenzing, 2015). This theory is based on Levelt's (1989) model of language generation, which was inspired by Kempen and Hoenkamp's (1987) computational model. The key propositions underlying this view were reported by Pienemann (2011) as follow:

1. Processing components (such as the Formulator, the Grammatical Encoder and the lexicon) are relatively autonomous specialists which operate largely automatically.
2. Processing is incremental.
3. The output of the processor is linear, while it may not be mapped onto the underlying meaning in a linear way.
4. Grammatical processing has access to a grammatical memory store (p. 28).

The framework of Processability Theory is based on predicting learners' developmental trajectories, and there are certain categorizations of procedures and a time sequence between the developmental trajectories. Thus, learners need to follow each one in an order while producing a sentence. For example, noun procedures follow category procedures. The basic hypothesis behind this order is that the hierarchy is incremental, and it represents the time-course in terms of generation (Pienemann, 1998). Regarding the feature

unification, there is another hierarchy. Each entry in the mental lexicon should have certain values and these values should be unified (Pienemann, 1998). There is a certain hierarchy that starts with no exchange of grammatical information, then grammatical information within a phrase, and finally grammatical information within the sentence, which, in turn, determines the developmental trajectory.

It is also important to mention that Processability Theory is not language-specific, as it is believed that the transfer of grammatical information applied to all languages is considered as a universal framework that has the ability to foresee developmental trajectories for any second language (Pienemann & Lenzing, 2015). However, the examples that are provided for English morphology by Pienemenn and Lenzing (2015) demonstrate language-specific features. In other words, Processability Theory does not provide sufficient examples which can fit into any language or to make the theory universal rather than language specific. In addition, as a result of the specific structures of individual languages, their grammars are different, as it is also illustrated in the example of the difference between English and Italian (Pienemann & Lenzing, 2015). Thus, it is crucial to consider the differences between languages that are reflected in lexical-functional grammar (LFG) in different ways aimed at modeling psycholinguistic processes.

While comparing two languages, one should be attentive about whether the languages that are compared are comparable or similar in terms of grammatical functions. Even the translation of each language is specific to itself due to the lexis and discrete linguistic features, and this has been proved with the help of statistical machine translation (SMT) systems since the differences between pairs of languages make the translation quality remarkably distinctive among the SMT systems (Do, Utiyama, & Sumita, 2015). Therefore, grammars of individual languages are considerably different from each other and it is not possible to utilize processability hierarchy in all the languages in the same way as it is claimed. The examples provided by Pienemann (1998) and Pienemann and Lenzing (2015) are not beyond morphological examples which all show the language specific features. As a consequence, these language-specific examples, indeed, refute the claim that the procedures are universal and thus can be applicable to any language.

Furthermore, regarding the LFG, there are three independent levels of representation, which are argument, constituent, and functional structure (Pienemann & Lenzing, 2015). Argument structure refers to the agent and theme in a sentence, while the constituent structure is related to phrase structure of sentences. Last, the functional structure is formed by the grammatical functions in the sentence. On the other hand, lexical mapping, a component

of LFG, indicates the mapping processes from argument structure to functional structure. However, the variability between the agent and the theme constitutes a linearization problem (Pienemann, 1998; Pienemann & Lenzing, 2015). For instance, with passive structures, the linear mapping process is disrupted because of the discrepancy between argument (agent) and functional (subject-object) structures in the initial stages of acquisition/learning (i.e. *agent equals to subject*, which is called *unmarked alignment*). In the early stages, it is directly associated with subject; however, later on, it can be differentiated.

Considering these components of Processability Theory, it is hard to deny that Processability Theory is quite impressive in many aspects. However, some explanations that the theory offers may need further empirical support. Therefore, in this review paper, some of the problematic issues are identified, reviewed, and discussed in the light of empirical evidence from previous studies. However, it is also acknowledged that the lack of studies on Processability Theory may be one of the reasons why certain issues in this theory still need to be clarified.

Issues Related to the Basic Components of Processability Theory

The Hierarchical Problem

According to Pienemann and Lenzing (2015), the four basic constructs of Processability Theory are *the processability hierarchy*, *hypothesis space*, *transfer of grammatical information and feature unification (i.e., information matching)*, and *LFG*. The processability hierarchy explains how grammatical structures within a sentence interact with each other while an L2 learner processes information. The language processor checks the grammaticality of the sentences in terms of *subject-verb agreement* and *plurality*, for instance. For example, in *David works hard*, the language processor checks whether *David* is followed by *third person singular '-s'* or in a phrase such as *three dogs*, the language processor makes sure that *three* is followed by a plural noun. The reason why this component is named as the processability hierarchy is that it is assumed that learners follow a certain order while acquiring these grammatical structures such as acquiring noun structures, verb structures, sentence structures, and subordinate clause structures, respectively (Pienemann & Lenzing, 2015). The processability hierarchy or the processability stages proposed by Pienemann and Lenzing (2015) is as follows:

1. no procedure (e.g., producing a simple word such as 'yes')
2. category procedure (e.g., adding a past tense morpheme to a verb as in 'talk-**ed**')
3. noun phrase procedure (e.g., matching plurality as in '**two** kids')

4. verb phrase procedure (e.g., moving an adverb out of the verb phrase to the front of a sentence 'I went yesterday/yesterday I went')

5. sentence procedure (e.g., subject-verb agreement as in 'Peter sees a dog')

6. subordinate clause procedure (e.g., use of subjunctive in subordinate clauses triggered by information in a main clause as in 'The doctor insisted that the patient be quiet') (p.163)

In this theory, it is asserted that language learners do not have other options but to develop their target language along with this hierarchy. Claiming this actually restricts the variability of the output produced by learners. Pienemann and Lenzing (2015) claimed that if a learner is in Stage 3, for example, s/he can process solely phrases and cannot go beyond that stage. Making such a strong overgeneralization seems as if Processability Theory ignores a great number of learners who do not strictly follow this order due to individual differences. In order to prove the hierarchy claim, there is a need for a great number of longitudinal empirical studies. However, the number of studies, which are to be mentioned later in this review, is limited and is insufficient to designate such a claim.

Furthermore, even the proficient users of a language or native speakers can produce ungrammatical and incoherent sentences under stress and they might require assistance at times (Frawley, 1997). In other words, in addition to the fact that each native speaker is different from each other, it would be nothing but an overgeneralization to specify that learners experience the same procedures in the specific stage of the learning process. For example, learner adaptation is one of the concepts that might affect the process of language acquisition/learning. As a result of its dynamic nature, language acquisition/learning is affected by learner's capability to adapt to specific environment as well as the learner's individual differences (Thelen & Smith, 1994).

Additionally, proposing a hierarchy that has clear-cut boundaries disregards the other prominent factors in SLA. Each learner is unique, and it means that each learner has his/her way of processing knowledge and goes through distinct psycholinguistic stages. Furthermore, the fact that L1 influence also has a substantial role in acquisition additionally contradicts with the processability hypothesis. The similarities and differences between L1 and the target language may affect this hierarchy, and some learners may skip certain stages depending on their L1 (Khansir & Pakdel, 2019).

The processability hierarchy may easily be challenged by the nonlinearity of learning/acquisition phenomena. Language development cannot be regarded as unidirectional since the performance of the learners can regress or progress at any stage even under the

stable learning conditions (Larsen-Freeman, 1997). There are various components in language development, and each single component of the whole process of language learning is in interaction with each other and those components are constantly transforming, and they are dynamic (Cooper, 1999). However, Processability Theory discounts this dynamicity, variability, and non-linearity. As claimed by Larsen-Freeman (2015) and Hiver and Larsen-Freeman (2020), language learning comprises dynamic, complex, and emerging patterns. Regarding learners' interlanguage, it would be convenient to state that learners continuously adopt new patterns and change the existing ones in a nonlinear fashion. A learner may be at Stage 5 and may be good at sentence procedure according to the processability hierarchy; however, the same learner may move into a country where English is spoken as a native language and may learn new patterns, including new noun phrases (i.e., Stage 3), and still make mistakes. The same learner may jump back to earlier stages and have difficulty with category procedure (i.e., Stage 2) when faced with new words and structures as a result of languages' transformation through time and space. Hadidi Tamjid (2008) claimed, "language is a collection of static units but their use in actual speech involves an active process" (p. 11). Due to the active process and nonlinearity in language learning, it is not possible to confine learner output to a presumed order or hierarchy, not to even mention the learner variability.

Regarding empirical findings, there exist very few studies conducted in the field of SLA within the framework of Processability Theory. This makes it adverse to justify certain features of the theory; however, if the number of those studies increases, some of the points mentioned above could be supported by direct evidence. Alhawary (2003) investigated the acquisition of Arabic morphological features in accordance with the processability hierarchy in Processability Theory. Nine American learners of Arabic as a foreign language took part in the longitudinal study for an academic year. They were all university students who started to learn Arabic with no previous experience in the language. Alhawary (2003) examined the morphological features of noun-adjective agreement (Stage 3 in the study) and subject-verb agreement (Stage 4 in the study) such as masculinity/femininity and singularity/plurality. The participants were interviewed every two weeks, which equaled to ten interviews per participant a year. In order to elicit the target structures, various instruments such as picture description, picture differences, picture sequencing and video story telling were employed as well as informal interviews during the sessions. The results revealed that learners of Arabic acquired subject-verb agreement before noun-adjective agreement, which contradicted to the hierarchy of processability. Thus, Alhawary (2003) concluded that there might be factors affecting processing other than the ones predicted by Processability Theory.

In another longitudinal study, Zhang (2004) investigated the acquisition of the adjective marker *–de* in Chinese as a foreign language. Whether processing constraints in Processability Theory interacted with the categorization of Chinese adjectives and stative verbs was the question posed. In order to respond to the research question, Zhang recruited three volunteers who enrolled in a first-year Chinese course with zero proficiency at a university in Australia. The participants were native speakers of English in their late teens. Data were collected throughout an academic year. The first data collection was 5 weeks after the academic year started. However, the others were implemented every three weeks. Each session lasted about 15 to 50 minutes. The participants completed some tasks such as describing their dormitory and roleplaying. At the end of the tasks, participants had a talk with the interviewer. The sessions were recorded, and then, they were transcribed. In the analysis, the researcher identified and tagged attributive adjectives, the presence and absence of *–de* (ADJ) and Subject-Verb-Statives. The results revealed that *–de* (ADJ) appeared after Subject-Verb-Stative structure, which was in line with Processability Theory acquisition patterns. However, it was true for two of the three participants. Thus, again, generalizing these findings may lead one to wrong conclusions with regard to the hierarchical order in Processability Theory.

Furthermore, in a case study conducted by Iwasaki and Oliver (2018), two constructs of Processability Theory (i.e., Unmarked Alignment Hypothesis (UAH) and Lexical Mapping Hypothesis (LMH)) were investigated in terms of their applicability to learning Japanese as an L2 by a young learner whose native language is English. Specifically, they focused on the acquisition of passive voice, and it was claimed that the result was consistent with the previous studies. That is, the participant in the study acquired the passive voice later than active voice, and this result was given as an evidence for developmental trajectory. However, since there was only one participant, it is difficult to make generalization and support these two components of Processability Theory.

In another small-scale study, Sakai (2008) examined the validity of the theory by analyzing speech data in relation to the acquisition of interrogatives, word order and negation in English. This time, the participants of the study were seven Japanese undergraduate students learning English at a national university in Japan. They were volunteers who had studied English when they were at secondary and high school. Sakai conducted a one-hour session with each participant individually. The participants completed five communicative tasks involving picture description, picture identification, spotting the difference, storytelling, and an interview. The sessions were either video or audio recorded. Sakai and another rater

coded the recordings with respect to the presence of structures attributed to certain stages in Processability Theory such as Subject-Verb-Object (Stage 2) and Auxiliary-2nd (Stage 5). According to the analysis, participants of this study were in Stage 5 and Stage 6. In addition, the results indicated that Japanese learners of English followed the six stages of SLA proposed in Processability Theory. However, this study was a small-scale study with seven students, and only included high-level students. In addition, the session each participant was observed or whose data were obtained took an hour, which limits its generalizability and conclusiveness for Processability Theory.

Yamaguchi and Kawaguchi (2016) conducted a longitudinal study also in Japanese on the acquisition of relative clause structures and found opposing evidence regarding the stages in Processability Theory. In this study, the subject was a Japanese child who was 5 years old at the beginning of the study and they audio-recorded her language acquisition process for two years. According to Processability Theory, the acquisition of the relative clause structures should be at higher stages. However, Yamaguchi and Kawaguchi (2016) argued that some of these structures are acquired at the earlier stages of acquisition while learning English as a second language. They also found that she could produce infinitival relative clause structures at Stage 3, which may be considered as a counter evidence for Processability Theory.

In addition, Buyl and Housen (2015) conducted a study utilizing the framework of Processability Theory. Their primary focus in their study was developmental stages in receptive grammar acquisition. They found that the trajectory stages that 72 Francophone L2 learners in an immersion program followed was in line with Processability Theory's predictions. However, the study was not comprehensive enough as the grammatical structures that they focused on fall into Stage 2 and Stage 5 only. Additionally, it was a cross-sectional study; therefore, it provided limited amount of information. The study may be supporting Processability Theory within itself; however, there is no evidence on Stage 3 and Stage 4. Furthermore, since it was not longitudinal but cross-sectional (i.e., one-shot) design, it is hard to make generalization concerning Processability Theory.

Another study conducted by Spinner and Jung (2018) examined the procedural skills hypothesis of Processability Theory, which claims that learners at a certain stage should behave in a similar way to native speakers regarding the stage they acquired. Specifically, the research study focused on whether the ESL learners in the higher group based on the interview results can also be considered as Stage 5 in the self-paced reading task, which compared native speakers and learners regarding the reading time spent on ungrammatical

structures. The data collection was performed through a self-paced reading task and face-to-face interview. They divided the participants into three groups: low, mixed, and high. However, the results indicated that the learners using Stage 5 structures in an accurate way in the interview were not able to do so in the reading task. Like the previous studies, this study also fails to support Processability Theory. None of the groups spent as much time as native speakers did, which meant they were not able to notice ungrammatical structures.

In another cross-sectional study, Jansen (2008) investigated the acquisition of German word order to test the four predictions of Processability Theory. These predictions were sequential building up of speech processing resources, stages in acquisition, cumulative aspect of stages, and universal limitations on processing resources. Jansen (2008) collected data from 21 adult native speakers of English who were enrolled in different levels of German courses as a second language. The participants completed a conversational task. They individually came together with a German native speaker whom they had not met before. The task was getting to know one another. Each conversation lasted about 45 minutes. The data were recorded and transcribed. Then, subject, verb, and adjunct placement were analysed. The results conformed the predictions of Processability Theory; however, stages in acquisition were less clear and findings regarding universality of limitations were not in line with the studies in the literature.

Is it a Leeway or a Restricting Aspect?

Based on the second component of Processability Theory, named as hypothesis space, it is claimed that the stages proposed in the processability hierarchy permits some leeway. It is asserted that although learners cannot go beyond the boundary of the stage they are capable of, they can still have some leeway at every stage. Pienemann and Lenzing (2015) provided the following example for the hypothesis space. A learner produces questions such as '*Where he been? *Where has been? *Where he has been? *He has been where?" (p. 164). In each case, the learner either avoids using auxiliary or changes the word order and forms an ungrammatical question. It is claimed that different forms of the same usage (e.g., WH-questions) refer to the same learning problem and hypothesis space offers solutions to these problems. Specifically, Pienemann and Lenzing (2015) claimed the following:

> During L2 development, learners accumulate grammatical rules and their variants, allowing them to develop individual developmental trajectories while adhering to the overall developmental schedule. In this way, PT accounts for both universal stages of development and individual variation within stages. (p. 160)

However, this claim restricts learner variability mentioned in the previous section, and if this hypothesis were supposed to be correct, learners would not be able to produce correct statements sometimes and incorrect ones at other times. In addition, to a certain extent, it violates the hierarchy component since there are variations within stages in hypothesis space and it is also possible to have variations between the stages. Regardless of the proficiency level of learners, they may produce such ungrammatical utterances under different conditions such as high affective filter (Krashen, 1985) and high anxiety (Horwitz, 2010; Horwitz, Horwitz, & Cope, 1986). When these individual factors are taken into consideration, it can be observed that ungrammaticality cannot be limited within the stages proposed by processability hierarchy. It may also be inter-stages.

To exemplify, Bonilla (2015) investigated L2 Spanish morphology and syntax development based on the processability hierarchy. First, when the acquisition of syntax was being examined, no evidence was found corresponding to an independent Stage 4. Second, there was some evidence against Unmarked Alignment Hypothesis (UAH). That is, L2 Spanish learners usually omitted subject of the sentence and did not follow canonical word order assumed in Stage 2. Moreover, the participants confuted the location of subject-verb agreement in processability hierarchy. Last but not the least, Spanish Learner Language Oral Corpus (SPLLOC) was used to collect data in this study; however, one should accept that speaking is the skill which may develop later than other language skills; therefore, the data should be interpreted carefully. Thus, the results of the study do not thoroughly support the universal developmental stages offered by Processability Theory.

Furthermore, when L2 learners are observed, it is noticed that they do not have any problems with the placement of auxiliaries in questions such as *What is your name? What do you do? How old are you?* because they form these questions without any attempt to think about their structural formations. In addition, these formations may occur at the exceedingly early stages, probably due to exposure to such kind of input multiple times. In other words, automaticity (DeKeyser, 2015) or frequency of input (Swain & Lapkin, 2002) may move the learner, for example, to Stage 5 (i.e., sentence procedure or subject-verb agreement) from Stage 1 (i.e., no procedure). Mozayan (2015) exemplified this by calling them formulaic sentences and asked “If a learner, supposedly at stage 2, producing an utterance like “Where does he live?” which corresponds to Stage 5, to what extent does this falsify the theory.” (p. 5). It is possible that Processability Theory neither has an explanation for this, nor provides empirical studies that investigate data more than observations.

Part of the reason is that observing only learner's output or doing solely discourse analysis discounts the existence of formulaic expressions or frequency/automaticity issues. Gass and Mackey (2015) also pinpointed this gap. They stated,

> …whatever the data source, the important point is not to rely solely on the transcript of the interaction but to investigate the link between interaction and learning by whatever means possible. For this reason, research designs which employ pre-tests and post-tests (and ideally, delayed post-tests and possibly tailor-made post-tests as well) and/or designs that include introspective or retrospective protocols are of value. As research designs progress, clearer answers to the questions about interaction and learning can be obtained. (p. 194)

However, Pienemann and Lenzing (2015) did not pose empirical evidence through different studies or they did not support their claims by triangulating the data. Thus, examining the output departing from other learning components or factors would lead researchers to adopt misleading ideas.

Grammar and Lexicon

According to Processability Theory, every new lexical item needs to be categorized under certain features such as number, person, tense or aspect in learners' lexicon. As argued by Pienemann and Lenzing (2015), to form a grammatical sentence in terms of subject-verb agreement, for example, the number and person aspects should match. However, in order for this argument to be more valid and clear, there should be some further explanation regarding the learning environment or conditions. Pinemann and Lenzing (2015) did not offer much empirical evidence proving this.

Furthermore, every new lexical item's being categorized under the aforementioned features may be applicable to learning a foreign language in a formal or school context; however, it is questionable whether it is additionally applicable to learning the language in a non-standard way. For example, immigrants working in another country usually learn the language through exposure, without receiving any formal education. Thus, it cannot be argued that such learning patterns follow similar developmental trajectories to the learning patterns taking place in school context. Other learning patterns such as deductive or inductive or following bottom-up (implicit) or top-down (explicit) processes seem to be more credible determinants in this process.

Operational Definition of Language Processor and Its Connection to Neurolinguistics and Working Memory

According to Processability Theory, the language processor assists individuals to comprehend and use the target language gradually; and it is the tool or the cognitive devise that handles L2 (Pienemann & Lenzing, 2015). It enables tracking the developmental trajectories in learners' comprehension and production. However, the language processor is not operationally defined. What is known about this device is that the architecture of the language processor is compatible with LFG and both the processor and LFG are necessary for Processability Theory to address the developmental problem as well as the logical problem (Pienemann & Lenzing, 2015).

Today, neurolinguistic measures are considered as essential indicators which provide reliable indexes that can explain native-like processing (Roberts, González Alonso, Pliatsikas, & Rothman, 2016). In other words, it is not clear enough whether language processor refers to a kind of cognitive device that can be explained through neurolinguistics. If it does, it should be noted that Processability Theory does not mention anything about neurolinguistics. Even the word *processor* makes researchers think that language needs to be processed for acquisition, which reminds us of brain and processing information. Therefore, further explanation on the language processor is needed, and a clear operational definition of the processor could have been provided for a more solid base for the theory.

Furthermore, the architecture of the language processor also accounts for language processing constraint by individual differences such as word access and working memory. Working memory is a term which was adapted from cognitive psychology referring to the ability of retaining and manipulating a limited and small amount of information to implement a specific task (Baddeley, 2015). It can be defined as a type of memory that changes the new and old information and integrates these into each other (Xu, 2016). Since language acquisition is a process through which the learner modifies and builds on the previous knowledge, working memory may affect this process.

However, Processability Theory does not provide any specific examples to demonstrate to what extent working memory is substantial in language acquisition/learning. According to Indrarathne and Kormos (2017), learners with the ability to hold and update verbal input longer than the others in their working memory are more competent in processing information. In this sense, Processability Theory does not explain how a learner with a better working memory differs from the one who cannot use his or her working memory as effectively as the former. Therefore, the theory fails to explain how working memory affects the performance of the learner.

Lexical-Functional Grammar (LFG)

According to Processability Theory, LFG "has three independent and parallel levels of representation" (Pienemann & Lenzing, 2015, p. 166). These three components are argument structure, constituent structure, and functional structure. The argument structure refers to the doer and the receiver of the action, which are named as *agent* and *theme* in LFG. Constituent structure defines the lexical chunks in sentences in terms of their functions such as noun phrase or verb phrase. Last, functional structure simply refers to grammatical functions of lexical items in a sentence, namely, subject or object.

It seems that LFG explains the concepts that (which) are already well known by means of using different terminologies. In addition, it t also embraces several components, including lexical mapping (Bresnan, 2001), unmarked alignment, the TOPIC hypothesis, and the initial L2 grammatical system, which are not going to be denoted in detail in this paper, but the crucial question is whether there is a need to transform this already complex system into a more complex phenomenon by creating fancy terminologies. There is an effort to illustrate the process of language acquisition through some formulations such as processability hypothesis or LFG; however, one should question the validity and generalizability of these arguments, especially when these are not supported by empirical studies. Thus, even if LFG may be legit, it is suggested in the current paper that Pienemann and Lenzing (2015) should provide more support for their claims especially with some studies which draw their data from multiple sources.

For instance, Eguchi and Sugiura (2015) also questioned how applicable Processability Theory is in terms of its arguments related to syntactic and morphological development in a cross-sectional study. Fourteen Japanese young adolescent ESL learners participated in this one-shot study. They concluded that Processability Theory was applicable to some extent; however, they recommended that Processability Theory should be modified, as there were developmental discrepancies in terms of the development of syntax and morphology. Furthermore, the findings of the study conducted by Dyson (2009) showed similar results. It was claimed that the findings of the study could be accounted as evidence as well as counterevidence for Processability Theory. It was suggested that the issues related to syntax and morphology be revised. Therefore, more research studies are needed.

Evidence Supporting the Processability Theory

Despite the issues mentioned earlier which are mostly related to clarifications of some concepts as well as methodological issues of the empirical studies, Processability Theory still

holds some validity. The limitations of certain studies with the processability framework were examined recently; however, there are a few studies that uphold the theory.

For instance, Côté (2020) investigated the predictions of Processability Theory on gender agreement, specifically in noun phrase (NP), verb phrase (VP) and relative clause (CP). As noted in the study reports, nouns are either feminine or masculine in French; therefore, "adjectives and determiners must agree in gender with the noun they modify" (p. 2). In order to observe gender agreement in three different stages, Côté worked with 45 native speakers of English, who were intermediate level French students at the time. The task of the study was spotting the difference. The participants completed the task individually with Côté. That is, Côté and a participant looked at a computer screen that demonstrated a series of illustrations. The participant was provided with a list of adjectives they could use. First, Côté described the picture sentence by sentence. Target structures (NP, VP, CP) were deliberately used in the descriptions to stimulate participants to use them. If the participant thought that the sentence matched the picture, s/he repeated it. If not, the participant described the picture using adjectives assigned previously. These sessions were audio-recorded to be transcribed and analysed afterwards. The analysis indicated that learners produced noun-adjective agreement correctly in NPs the most and in CPs the least, while VPs were in between. The results were in accordance with Processability Theory hypothesis, which upholds processability hierarchy among phrases. However, the data were focused on accuracy, not emergence although Processability Theory relies on emergence of structures. In addition, the data were first elicited by the researcher; thus, it may be comprising some bias; in other words, the learner output was elicited not naturally but with the help of the researcher.

In another study, Håkansson and Norrby (2010) investigated grammar, pragmatics, and lexicon with respect to the effect of the environment on L2 Swedish acquisition. They implemented a longitudinal comparative study encapsulating two different experiment groups of intermediate learners of Swedish, and one control group formed by native speakers of Swedish. One group regarding learners of Swedish consisted of university students who learn Swedish in Sweden. The other group learning Swedish was of university students in Australia. Native speakers were selected among university students in Sweden. All groups could speak English. Håkansson and Norrby (2010) compared the development of grammar in learners residing in Sweden and Australia with regard to Processability Theory. They examined the data to explore whether these cohorts experience the same developmental stages in different environments. Data were collected in three discrete two-week time periods over eight months. The participants were expected to write free compositions on a childhood

memory, their first toy, and their lives in ten years. Furthermore, they translated a low-level text from English to Swedish. The text was specifically designed for the experiment. That is, it was first prepared in Swedish to provide "obligatory contexts for NP agreement, predicative agreement, subject-verb inversion, and subordinate clause word order" (Håkansson & Norrby, 2010, p. 635). Then a native speaker of English translated the text into English. In addition to translation and composition tasks, participants performed a communicative task and an interview. The data were analyzed in terms of Stage 2 (plural and tense markings), Stage 3 (noun phrase agreement), Stage 4 (subject-verb inversion and predicative agreement) and Stage 5 (subordinate clause word order). The results indicated that groups followed the predictions of Processability Theory concerning the development of morphosyntax although their developments differed in time periods.

Conclusion

Processability Theory is considerably impressive in terms of its explanations of learners' comprehending linguistic structures in the process of language acquisition/learning. It is comprehensive enough considering certain languages separately examined, including English, Italian, Japanese, and Chinese. However, some issues mentioned earlier could be reconsidered in the theory to convert this theory into a more comprehensive one. There should be more concrete examples and explanations to support the arguments such as the hierarchy claim and language processor definition. The lack of longitudinal empirical studies also contributes to this ambiguity. Conducting more studies within Processability Theory framework would strengthen the theory.

In addition, according to the processability hierarchy, there is a predictable development as mentioned earlier, and this is against the nature of second language acquisition/learning because this would mean that there cannot be any differences among the second language learners. This is the opposite of what Larsen-Freeman (1997) claimed in Chaos/Complexity Theory, which is a more recent and widely accepted theory compared to Processability Theory (Hiver & Larsen-Freeman, 2020).

Furthermore, encouraging the notion that the theory is applicable to all languages makes the linguists question the validity of the theory since the examples were drawn only from several languages. Even in those languages, only limited range of grammatical features are exemplified, and these must be revisited through more empirical studies. In doing this, individual differences must be considered owing to languages' being non-linear and dynamic. However, language acquisition/learning is viewed as a linear process in Processability Theory.

In this review article, Processability Theory along with its components was examined from a critical point of view. After analysing its components in detail and reviewing the existing studies that were conducted within the framework of Processability Theory, it could be concluded that the claims mentioned earlier were over-stated by the theorists. Therefore, it is crucial to conduct further longitudinal studies and revise the theory by considering the previous and prospective findings.

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