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Contributions of cognitive theory to the problem of automatization of grammatical structures in teaching foreign language

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Unlike traditional methods, the communicative approaches draw on implicit and incidental ways of learning and contextualised exercises of grammar which improve language performance in terms of fluency and communicative competence. However, the discursive plan implies the use of high-level units of knowledge and the automatization of low-level knowledge is not ensured. Although learners' production achieves success in terms of communicative skills, their competence in terms of accuracy is usually unsatisfactory. The benefits of explicit grammar teaching are another issue that concerns teachers and that needs more evidence. Therefore, a need exists to study which approach supports the automatization of low-level information, in a short class time (30-40 min). The first purpose of this study is to better understand the cognitive processes that lead to the automatization of forms, the second purpose is to know whether explicit grammar teaching promotes the automatization of forms. When first reviewing the literature on cognitive psychology and automatization, the focus was limited to how automaticity is brought about. Next, the main assumptions of Adaptative Control of Though (ACT*) and Instance Theories are presented. The reviewed research results confirmed the effectiveness of the explicit teaching of rules and the importance of practice and attention in the language learning process. In the conclusion, there are some recommendations that may be useful for language teachers.

Key words: Automatization, explicit grammar, focus on form, cognitive process.

INTRODUCTION

In the field of foreign language education, grammar instruction has always been a central subject, as one cannot learn a foreign language (L2) without acquiring its linguistic system. However, learning an L2 involves the use of linguistic forms in order to communicate specifically.

In the history of language teaching, each methodology has given more or less importance to the teaching of grammar. ''Among the major issues raised by classroom SLA researchers is the controversial question of whether and how to include "grammar" in L2 instruction'' (Doughty and Williams, 1998, p. 1). Grammatical competence is

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one linguistic component, like lexicon, syntax and pronunciation. It is defined as "the ability to understand and express meaning by producing and recognising well-formed phrases and sentences (…)" (CEFR, 2001, p. 113). Clearly, expressing and understanding the meaning of any communication involves the use of grammatical phrases. Therefore, unlike some previous methodologies, in communicative language teaching, the study of grammatical structures is not an objective in itself, but rather is seen as a tool facilitating their use in interaction. The learner, as a "social agent" (CEFR, 2001, p.9), aims to develop his capacity to perform tasks that are not only linguistic, but also cultural, interactional, pragmatic and discursive. From the action-oriented perspective, the focus of a lesson is usually on meaningful communication about the lesson's topic and sometimes it can be on the language itself. At the same time, a student's success is not measured by the correct use of grammatical structures, but rather by their ability to perform a task in the L2. Since from an action-oriented point of view, the forms are at the service of the effective use of the L2 (the communicative competence), it remains to be known, for a language teacher, whether it is better to build his/her course on the forms or on the senses that they convey. In this regard, the CEFR leaves the choice to whoever designs the language course. Languages are based on an organisation of form and an organisation of meaning. The two kinds of organisation cut across each other in a largely arbitrary fashion. ''A description based on the organisation of the forms of expression atomises meaning, and that based on the organisation of meaning atomises form. Which is to be preferred by the user will depend on the purpose for which the description is produced. What is clear is that a language learner has to acquire both forms and meanings'' (CEFR, 2001, p.116).

Regarding the way in which the formal structures of the language are inserted into the course, the teacher has the choice between implicit or explicit grammar teachings. Implicit grammar is defined as "an approach which avoids any explanation or verbalization of regularities and grammar rules" (Puren et al., 1998, p. 199) (our translation). Besse and Porquier (1991, p. 86) emphasize that "implicit grammar is in fact an unspoken inductive teaching of a particular grammatical description of the target language, and that it therefore relates more to learning than to acquisition" (our translation). In other words, the implicit method does not resort to any metalinguistic explanation. On the other hand, according to the method of explicit grammar teaching, the teacher goes through the clarification of the rules and uses a certain amount of grammatical terminology. Where possible, teachers should make it clear which grammar theory they consider when determining the content of their course (CEFR, 2001, p.114). They should therefore consider several factors such as the teaching/learning objectives, the teaching methodologies adopted, their own teaching experiences, the environment in which teaching/learning takes place, institutional limits and expectations, the time devoted to teaching/learning, the expectations, the needs, the academic and cultural habits of the learners, and individual factors such as the cognitive abilities, age and competency level of the learners.

It is obvious that learning a L2 as an adult is a different process from learning a mother tongue (L1) as a child. The latter first learns to communicate in his L1 before the period of school, and then it is at school that he/she learns the rules of its operation in an explicit way. However, when it comes to learning a L2, this situation is often reversed. The development of an internalized grammar, which takes place in natural learning settings, finds its place in guided learning activities as a means of ensuring mastery of linguistic forms. In a language class, the teacher will mainly seek to make the language a medium of communication rather than an object to be studied and, for that, he will endeavour to make operations automatic and almost unconscious as soon as they are understood, and even before (Defays and Deltour, 2003, p.207). In natural communicative interactions, the learner is exposed to a large amount of input, as well as a wide variety of vocabulary and structures, and those around him use the language effectively (Lightbown and Spada, 1999, p.93). Therefore, a L2 learner is invited to internalize the grammatical rules after very little contact with the L2.

According to Vigner (2004), grammar teaching has two dimensions: on the one hand, language in its formal dimension (sentence / text), and on the other in its usage dimension (utterance/speech). In this sense, he accentuates "the discrepancy between teaching practices, which start from the enunciative approach, and commercial grammar books, which only provide descriptions of the language. Even grammatical metalanguage appears traditional, although the latest linguistic theories consider the utterance and the communicative approach to be central." L2 Learners should deal with both the meaning and the use of the new forms they discover, since the communicative syllabus offers several speech acts per unit of work (Hilton, 2019, p.31). The discursive context is therefore so large that the learner has difficulties in automatizing the smallest units of the language in term of pronunciation, recognising words and syntactic rules. In current language textbooks, which consider the principles of the action-oriented approach, the grammar is often presented implicitly and is always contextualized while the explicit rules are presented in the part of the textbooks reserved for explanations of grammatical specifications. Stembah (2014, p.65) researched the opinions of six French teachers about the place of grammar in French textbooks. She pointed out the considerable lack of grammatical and training exercises, so that the learner does not have the opportunity to develop certain automatisms which could help him/her

spontaneously produce correct statements without consciously referring to the corresponding grammar rules.

The well-known problem of the automatization of the grammatical system of an L2 illustrates one of the learning difficulties when the contact time with the language is very limited. The presentation of grammar rules in the language classroom can provide declarative knowledge about how the language works, but this declarative knowledge does not necessarily lead to new plans for action (procedural and automatic skills) in a situation of communicative interaction (oral or written) (Hilton, 2019, p.26) In the school context, even when the grammatical rules are explicitly studied and practiced, the available time of the course is too limited for the learner to acquire related skills. A large number of studies which have investigated the effects of explicit and implicit learning reveal that explicit second language instruction is superior to the implicit approach. As Norris and Ortega (2000, p. 500) reported, “on average, instruction that incorporates explicit (including deductive and inductive) techniques leads to more substantial effects than implicit instruction”. Other researchers also argued that approaches which integrate the development of explicit knowledge promote a faster and more efficient L2 learning process (Ellis, 2011; Hulstijn, 2002; Norris and Ortega, 2000; Spada and Tomita, 2010).

Several pieces of evidence prove that many learners are capable of mastering a wide range of explicit grammar rules. In their study, Green and Hecht (1992), for example, asked to the participants to explain grammatical errors to the students of English. The results showed that 85% of participants were able to produce clear explanations. The results of the study carried out by Macrory and Stone (2000) with British comprehensive school students showed that explicit instruction allowed a fairly good understanding of the perfect tense in French “(e.g., they understood its function, they knew that some verbs used *avoir* and some *être*, they were familiar with the forms required by different pronouns, and they were aware of the need for a final accent on the past participle).” DeKeyser studied the automatization of explicitly learned rules of morphosyntax in an artificial language. The results support the model of skill acquisition and show that the practice of grammar rules in one skill (production or comprehension) leads to improvement in the practiced skill (DeKeyser, 2003).

Research in the field of foreign language teaching mostly aims to measure the effect of a certain teaching method or technique. However, it does not consider sufficiently the characteristics of the learning process. In recent years, in cognitive psychology many studies have been conducted and theories have been developed aiming to explain the learning process. Interdisciplinary knowledge transfer is essential in order to adequately benefit from these data. According to Huong (2010, p.138), it is necessary to combine the efforts of cognitive psychology, linguistics and pedagogy in this field: psychology tries to identify the nature of the operations carried out by the learner, linguistics establishes the descriptions that are essential to the development of exercises, and the purpose of the pedagogy is to build the most favourable procedures for setting up this interaction. Therefore, there is a need for a theoretical study that summarizes and synthesizes these data in order to integrate it into the field of foreign language teaching. The purpose of this study is to help teachers choose more appropriate teaching methods and techniques by presenting information explaining the cognitive process of automatization.

Therefore, this research will address the following questions:

a. Is it possible to learn and automatize implicitly the rules of grammar, in a limited class time? Or could explicit teaching of these rules optimize learning time?

b. What is the contribution of the cognitive approach to the automatization of L2 grammar rules?

METHOD

This study aims to highlight the automatization process of L2 grammatical forms. For this purpose, we preferred a narrative review format. The literature review is ordered by thematic research. First, the key terms of the issue were identified: automatization, knowledge processing, explicit learning, declarative knowledge and procedural knowledge. These key terms were then researched in databases and websites such as Google Scholar, academia edu, ERIC. New sources were also acquired by consulting the library and examining the references of relevant books and articles. In the second stage, those articles that were not directly related to the scope of the research were eliminated. In third stage, two new and well-established theories with their strong and weak points were presented: Adaptative Control of Thought (ACT*) and Instance Theory. Finally, the information presented was synthesized, taking into account the perspective of foreign language teaching at every stage. When we shift from a traditional way of presenting language grammar to an adoption of a purely communicative approach, which draws on implicit and incidental ways of learning, the language performance of the learners improves to a great extent in terms of fluency and communicative needs, yet learners’ accuracy of language use suffers. In light of previous research findings, analytic syllabuses provide a platform for integrating a focus on language form, which is generally “considered a necessary component of any language teaching paradigm, if native-like proficiency is the goal of instruction” (Révész, 2007, p.25). The focus on form approach consists of inserting explicit knowledge of linguistic forms when it is necessary in a course whose main objective is to communicate and understand the meaning of the utterances. Skehan (1998) claims that learners chances of focusing on form should be maximized through attentional manipulation of task variables in the context of meaningful language use.

Automaticity

According to DeKeyser (1997, p.197), automaticity which is the result (product) of the automatization process, has been one of the topics that has attracted many researchers in the cognitive literature of the last 20 years. Substantial progress has been made, although

researchers do not agree about the exact nature of capacity limitations and the role of attention, about the relationship between automaticity and implicit knowledge, and about how automaticity is brought about. Different researchers employ the term automaticity in different senses. In one sense, it refers to handling utterances quickly and fluently without undue groping, hesitation, or pauses. The greater the automaticity the faster the recognition and production of grammatically correct and communicatively appropriate utterances (Gotbonton and Segalowitz, 1988). In a more psychological sense, automaticity refers to the operation of those mechanisms underlying performance that function quickly, without interference from other on-going cognitive processes, and that draw relatively little or no attention resources away from other concurrent processing activities. Processes become automatic in this sense as a result of a great deal of practice (Schneider and Fisk, 1982; Shiffrin and Schneider, 1977; Gotbonton and Segalowitz, 1988). Automaticity in L2 enables a learner to control utterances with little effort and to devote attention resources to other aspects of speaking such as "matching the timing, tone and rhythm of his utterances to his conversational purpose" or "constructing a larger piece of discourse by expanding on or combining ready-made constructions" (Pawley and Syder, 1983, p.208). Moreover, an advanced level of automaticity seems to lead to near-native performance (DeKeyser, 2001; Hulstijn, 2002). Even though the operations of automatization need to be enlightened by empirical research, DeKeyser (2003) argues that “research in cognitive psychology as well as in second language acquisition suggests that automaticity is best achieved by repeated creative use of the language rules taught in a context of authentic communication.”

He proposes a two-phase automatization process. In the first phase, the main activity intends to create in the learners a need to repeat target utterances while transferring authentic messages. The second phase, the follow-up activity, aims to provide more controlled but still communication-based exercises focusing on the target sentences already elicited in the main activity. According to Gatbonton and Segalowitz (1988) the task-based approach allows structured repetition and creative transfer of knowledge items with extensive practice without making use of traditional pattern drills and exercises. “The reason why such large units (communicative drills) of activity are essential for skill acquisition in the sense of automatization is that an important feature of an automated plan is its potential to be called by higher-level plans.”

Some data from cognitive theory

According to cognitivists, the learner processes information using a mental mechanism. He learns, integrates, and reuses the knowledge that is built gradually. During the realization of this mechanism, several factors (memory, attention, intention and interaction) come into play to facilitate learning. Cognitive scientists can guide pedagogues in strengthening theoretical bases as well as methodological proposals. They provide important information on:

a. Human memory for language: declarative and non-declarative knowledge, and the specificities of memory in a foreign or second language;
b. The communicative and interactional use of language: automatic and caring processes in the co-construction of meaning;
c. The acquisition of knowledge and skills allowing this dynamic use of language: the reality of explicit and implicit learning (Hilton, 2019) (our translation).

Learning a foreign language is not a simple, mechanical process, due to its multidimensional nature. The learner mobilizes the various knowledge, skills and representations at his disposal in order to appropriate a given L2. From the cognitivist perspective, three types of knowledge are involved declarative, procedural and conditional/strategic. The first type refers to knowledge that can be formulated verbally to provide proof of its acquisition, for example a date, a theorem, or a law. It answers the question "what?” The second manifests itself through the performances it achieves, for example, playing a musical instrument, driving a car, or tying a tie. It corresponds to the answer to the question "how?" The last type makes it possible to use other two types according to the objectives set and the elements of the situation of communication. It answers the questions "when?" and “why?" (Defays and Deltour, 2003, p.164).

In the literature, there is a great deal of research on how declarative knowledge turns into a skill (procedural knowledge) and different theories aimed to explain the automatization process. We will now explain the most widely recognized model: Adaptative Control of Thought (ACT*).

Adaptativ control of thought (ACT*)

Anderson’s Adaptive Control of Thought (ACT*) model (cf., esp.Anderson, 1987) is the most widely accepted theory on how automaticity is brought about. According to this model, knowledge typically starts out as explicit (declarative) information, “knowledge that,” which is turned into specialized procedural rules, and “knowledge how,” for very specific behaviours through analogy with a series of examples and with the help of very general behavioural rules. It is then fine-tuned over time as a function of cost-effectiveness (probability of being correct and cost in terms of mental resources). The result of this last process is a gradual drop-off in reaction time and error rate (DeKeyser, 1997). This transformation of declarative knowledge to procedural knowledge is called proceduralization. Forms produced as a result of controlled processing at the beginning become automatic as a result of practice and repetition. Later, these automatized forms are stored in the long-term memory and can be recalled when the learner needs them, and this automatized knowledge does not require much attention control. Thus, automatic processes can simultaneously continue to operate and activate complex sets of cognitive skills. To summarize, according to this approach, learning takes place as a result of many repetitions, which causes the conversion of controlled processing to automatic processing. Simple sub-skills and routines need to become automatic before dealing with more complex skills (Mitchell and Myles, 2004, 101). The automatization of controlled processing requires constant restructuring of the linguistic system throughout the foreign language learning process. Anderson (2005) argues that although procedural knowledge governs the performance of fluency, declarative and procedural knowledge can coexist. According to Schneider (1977, cited in Mitchell and Myles, 2004, p.100), after several repetitions, the forms produced at the beginning by a controlled process, become automatic as learning involves a shift from controlled processing to automatic processing in foreign language learning. When this shift from controlled processing to automatic processing through practice occurs, controlled processes are released to process higher levels of processing.

Instance theory of automaticity

The researchers identified some properties in order to define automaticity. Some lists are longer than others, in this study we will consider the list of four properties cited by Logan (1997): speed, effortlessness, autonomy, and lack of conscious/awareness. Speed is one of the most important characteristics of automaticity because an increase in speed provides a decrease in reaction time. An effortless performance apparently is realised easily because it is not

subject to attention limitations. The ability to do another task while performing an automatic one is the second criterion of an effortless performance. Automatic processing is autonomous, in that it begins and continues on to completion without intention. Automatic processing is not available to consciousness while non-automatic processing is, because attention is the mechanism of consciousness and only those things that are attended are available to consciousness (Posner and Snyder, 1975; Logan, 1988). Our performance is automatic, fast and effortless, when memory retrieval is faster than algorithmic performance and involves fewer steps. For example, if we are well-practiced, we type and read words without much awareness of the processing involved in doing so. There is evidence (reviewed above; also see Logan, 1985) that all of the properties of automatic processing change more or less continuously with practice, and it may be that different properties change at different rates. If autonomy develops before effortlessness, then it may be easy to find cases of effortful autonomous processes, like those observed by Paap and Ogden (1981), Regan (1981), and Kahneman and Henik (1981) (Logan, 1997, p.128).

The instance theory explains automaticity as a memory phenomenon rather than a resource limitation. A novice performs a task with a general algorithm, after several repetitions, he/she gains experience and learns specific solutions to specific problems. He/she retrieves these solutions when he/she encounters the same problems again. After several trials, the learner's performance is automatic when it is based on single-step direct-access retrieval of past solutions from memory instead of an algorithm (Logan, 1988). Instance theory assumes that automaticity is memory-based processing and automatization is a shift from algorithmic processing to memory retrieval. Logan assumes that retrieval involves a race between the different traces in memory, such that the first trace to finish governs performance. Thus, when you are asked to produce the sum of 2 + 2, all of the different traces that represent 2 + 2 = 4 get retrieved, and you are able to respond as soon as the first one finishes (Logan, 1997).

According to Logan, *episodic memory* (the same type of memory used in daily life) is used in automatization. He argued that each experience with a task lays down a separate memory trace or instance representation that can be retrieved when the task repeats itself. The number of instances in memory grows with the number of practice trials, building up a task-relevant knowledge base (Logan, 1997). The instance theory makes three main assumptions: obligatory encoding, obligatory retrieval and instance representation. Obligatory encoding says that attention to an object or event is sufficient to cause it to be encoded into memory. This assumption provides a learning mechanism. Attention to objects and events in the course of performing a task causes a task-relevant knowledge base to be built up in the memory. According to Logan, it seems that the intention to learn has no effect on learning, except that it guarantees attention to the things to be learned. "Learning and storing seem to be a side effect of attending" (Logan, 1997). "Obligatory retrieval, which says that attention to an object or event is sufficient to cause things that were associated with it in the past to be retrieved from memory, and instance representation, which says that each trace of past objects and events is encoded, stored, and retrieved separately, even if the object or event has been experienced before (Logan, 1988)".

RESULTS AND DISCUSSION

Memory based theories assume that automatic performance is based on retrieval of representations of past solutions from memory. The central questions that pose these theories are "what" gets into" those representations during learning and what is "taken out" of them during automatic performance. According to Logan et al. (1996), "the distinction between encoding and retrieval is important in understanding the acquisition and expression of automaticity. Automatic performance emphasized speed and so may not be sensitive to things that are retrieved slowly". The longitudinal and fine-grained study of DeKeyser (1997) supported the model of skill acquisition and showed that a large amount of practice of grammar rules in comprehension and production leads to improvement in the practiced skill, that is to say, the results have presented evidence of the skill specificity of the learning process. In summary, processing is considered as automatic when it relies on the retrieval of stored instances which will occur in a consistent environment. It seems that practice (repetition) is important since it allows learners to increase the number of representations as well as the speed of retrieval. Another important key concept is "consistency" because it ensures that retrieved instances will be useful. We can give a positive response to the first research question addressed in the introduction: Could explicit teaching of grammar rules optimize learning time? The research results show that explicit teaching of the language rules enhances their learning. Yet the time allowed to the explicit teaching, the use of metalanguage, and the type of grammatical descriptions depends on various factors related to the teaching settings. The type of exercises used to practice the forms is also important. The rules are learned faster and better if they are repeated in communicative tasks. An intensive use of complex metalanguage tires the student's mind and can be an unnecessary cognitive burden. The second question that was addressed is: What is the contribution of the cognitive approach to the automatization of L2 grammar rules? In order to find an answer to this question, we first explained two basic theories explaining what automatism is and how it is brought about. According to Anderson's ACT* theory, learning involves a shift from controlled processing to automatic processing in a foreign language. Initially, the forms are produced by a controlled process, after much practice, this declarative knowledge will become fully proceduralized and at the end of the process, the skill will become automatic. This theory considers automaticity in terms of processing resources and assumes that automatic processing requires little or no attention. On the other hand, recent theories, such Logan's Instance theory, consider automaticity as a memory phenomenon rather than a resource limitation. A learner's performance is based at the beginning on a general algorithm. After practice, it will become automatic when it is based on single-step direct-access retrieval of past solutions. Instance theory provides us a more details on the automatization process.

These two theories explain the automatization process differently, but what they have in common is that automatization requires a lot of repetition.

CONCLUSION AND RECOMMENDATIONS

Three important conclusions can be drawn from research on automaticity. First, the clearest conclusion is that practice is essential to achieve automatization of a skill. However, by “repetition” we do not mean the repetition of grammar rules such as in traditional grammar exercises. We rather mean the practice of them in communicative tasks. Second, a consistent environment is necessary for practice to be effective, because automatic processing will occur only after practice in a consistent environment. Third, the role of attention in learning is major since a task-relevant knowledge base will be built up in memory through attention to an object or event. We think that this sentence of Logan (1997) should always be remembered by students and teachers: “Learning and storing seem to be a side effect of attending.” In order to be effective, analytical approaches, such Task-Based Language Teaching, need to be supplemented by some type of grammar instruction. This instruction can be implicit, explicit, inductive or deductive. The task-based approach allows structured repetition and the creative transfer of knowledge items with extensive practice without making use of traditional pattern drills and exercises. Communicative drills allow learners to use large units of communication; while repeating lower-level information, the learner practices using declarative knowledge which becomes at the end automatic. Focus on form is an approach which aims simply to use these forms in communicative activities. What is important in this regard is to emphasize the relationship between form and meaning and to show that forms are mediators for communicating and conveying meanings. Automaticity refers to fluency as well as the accuracy of the production of learners. The research results provide evidence about how automaticity is brought about, about the capacity limitations and the role of attention. However, the issue of automatization of grammar rules through practice in productive and receptive skills needs to be supported by empirical studies. The relation between the grammar activities and their long-term consequences needs to be discovered. Future research could examine the effect of practice time on the automatization of grammatical forms. The relation between automatization and grammar teaching types needs to be examined in detail: explicit-inductive vs. explicit-deductive and implicit-inductive vs. implicit-deductive. Additionally, which grammar categories (articles, adjectives-subject agreement, plural forms, etc.) are best learned explicitly or implicitly should be investigated. Moreover, the role of learners’ learning styles in automatization could be investigated to clarify which learners profit best from the explicit teaching. Finally, learners’ characteristics such as motivation level and predisposition to self-learning can affect their achievement and therefore, the automatization process. On the other hand, the effect of different variables such types of teaching materials and learning activities on attention and perception need to be investigated. In summary, attention and practice seem to be key terms in the language learning process.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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