Research Paper

Designing an instrument to measure explicit and implicit learning processes

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Abstract: In this research paper, the researcher's intention was to design an instrument that is able to measure learning under two different conditions: explicit and implicit learning. Exploring explicit and implicit learning is gaining more and more attention nowadays in the field of second language acquisition (SLA). Quantitative method was used in this study to investigate which learning mechanism proves to be more efficient in the selected sample. The present study involved Hungarian technical school, secondary school, and university students from Budapest ($N = 40$) who participated in completing an Artificial Grammar Learning (AGL) task. The most important finding of the present research endeavour is that implicit learning has proven to be more effective than explicit learning in the case of the selected participants and this was a statistically significant finding. The pedagogical implication of this study is that the effectiveness of implicit learning should be reconsidered by EFL teachers in Hungary.

Keywords: explicit learning, implicit learning, consciousness, awareness, quantitative method

1. Introduction

The question of which learning mechanisms are involved in the language learning process is one of the most intriguing facets of SLA that researchers are constantly trying to find an answer to (e.g., DeKeyser, 2005). Since this question seems to be a long-lasting issue that causes controversy amongst SLA researchers, it is certainly worthwhile to investigate the processes that are taking place when learning a language. While reviewing the relevant literature, two main processes have been found that a learner can apply or experience when learning a foreign language, specifically, explicit and implicit learning. These appear to be different in terms of the level of consciousness involved (Reber, 1993).

The aim of this research is, therefore, to investigate the interplay of explicit and implicit learning and to design a test which measures these learning mechanisms. According to DeKeyser (2005), it is rather challenging to find an instrument that measures conscious and unconscious learning in a proper way, that is why there is less research concerning the pure measurement of explicit/implicit learning. To address this research niche, one research question has been formulated. Quantitative methodology was employed in the attempt to find answer to the research question and bridge the research gap.

2. Review of literature

First, the theoretical background to explicit and implicit learning processes and cognate terms – incidental and intentional learning – shall be presented. Second, possible measurement methods are going to be provided for explicit/implicit learning.

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In the fields of language pedagogy, cognitive neuroscience, cognitive psychology, and psycholinguistics, explicit and implicit learning mechanisms are widely researched concepts (Ellis, 2009a, 2009b). Amongst researchers (e.g., Rebuschat, 2015), there appears to be a great disagreement over the distinction between explicit and implicit learning. Moreover, even the importance and the proper definitions of these two processes causes controversy amongst experts. Prominent researchers (e.g., Ellis) argued that it is essential to distinguish explicit/implicit learning and explicit/implicit knowledge since the former refers to the process, while the latter subsumes the actual product of the process. Similarly, Rebuschat emphasised that measuring the two conditions can happen either at the time of encoding, that is, during learning or at the time when learning finally becomes knowledge (i.e., the product of the learning process). Rebuschat also pointed out that the two types of knowledge are considered to elicit learning – explicit – on the one hand and acquisition – implicit – on the other as described in Krashen's Monitor Theory (1982).

Since there are several interpretations of these concepts, providing definitions that are most widely accepted by researchers is certainly important. The intention is to clarify the definitions of implicit and explicit learning and cognate terms: incidental and intentional learning. In order to see how the interrelated terms differ from each other, explicit learning shall be contrasted with intentional learning and implicit learning is differentiated from incidental learning. As it was mentioned above, two different ways of language acquisition can be observed to be taking place: one is a conscious (i.e., intentional or explicit) process, whereas the other is an unconscious (i.e., incidental or implicit) process according to Krashen (as cited in Hulstijn, 2015). Undoubtedly, language learners neither can be entirely aware of the whole process of how they acquired their semantic knowledge nor can recall implicitly acquired features by conscious processes (Reber, 1993). Thus, Krashen ascertained the underlying difference between the conscious process of language learning and the unconscious process of language acquisition, which can be distinguished by the degree of awareness these processes involve.

The definition of implicit learning is provided first since this term seems to cause heated debate amongst researchers in the field. This might be due to the fact that – as it is also shown by DeKeyser (2005) – consciousness and awareness on their own are rather difficult to define; moreover, the non-existence of these notions is even more challenging to explain. The term implicit learning was first coined by Reber (1993), who could prove in his experiment in the area of cognitive psychology that the participants processing certain stimuli can acquire knowledge implicitly, that is, without awareness (Leow, 2015). Reber explained that implicit learning is a process that happens outside of consciousness. He also pointed it out that the acquired implicit knowledge is completely unavailable to consciousness.

Hayes and Broadbent (as cited in DeKeyser, 2005), in attempt to narrow down Reber's definition of implicit learning, clarified that it involves acquiring a set of random items and information and that this process is highly passive. DeKeyser argued that implicit learning is inherently recognised to be different from intentionality because implicit learning entails much more than simply just the fact that it is non-intentional. Thus, DeKeyser claimed that the proper definition of implicit learning is as follows: "learning without awareness of what is being learned" (p. 242). Hulstijn (2005) added that implicit learning is "a learning process in which the learner is unaware of the statistical properties and the degree of regularity in the linguistic stimuli to which (s)he is exposed" (p. 30).

As it has been mentioned, the interpretation of explicit or conscious learning is rather clear-cut after discussing its opposite, implicit or unconscious learning. Long (2014) defined explicit learning in the following way: "Explicit learning is a conscious operation, in which the learner attends to aspects of a stimulus array in the search for underlying patterns or structure" (p. 49). VanPatten and Rothman (2015) also highlighted that this conscious learning process demands an extent of awareness and noticing – conscious attending to – a particular linguistic element or structure during input processing. Additionally, VanPatten and Rothman claimed that explicit learning usually requires an intention to learn a certain linguistic item. Roehr-Brackin (2015) argued that explicit knowledge – the outcome or product of explicit learning – is represented declaratively and explicit learning functions within the working memory.

In order to identify the most important difference between explicit and implicit learning, Ellis (as cited in Hulstijn, 2005) stated that the basis of determining which process is operationalised during learning can be ascertained by the presence or absence of consciousness. Subsequently, learners' awareness of the learned item indicates explicit learning, which entails conscious operations, whereas learners' unawareness of the acquired feature implicates implicit learning, which happens outside of consciousness, that is, unconsciously. Furthermore, according to Hulstijn (2015), explicit and implicit knowledge are stored in separate parts of the brain: the former is stored in the medial temporal lobe, specifically, in the hippocampus, whereas the latter is stored in the frontal areas of the cortex, in the basal ganglia and the cerebellum.

As it was mentioned above, an overview of the interrelated constructs of incidental and intentional learning are also going to be provided. Schmidt (as cited in Hulstijn, 2005) stated that incidental learning not only means non-intentional learning – namely, learning without the intention to learn – or learning one certain structure or element with the intention to learn some other linguistic element, but that it is an outcome of acquiring linguistic knowledge while the actual intention was to learn a formal feature. Hulstijn (2005) clarified the meaning of incidental learning with the example of extensive reading. He argued that learners are likely to enlarge their vocabularies incidentally while reading a book; for example, they are inclined to memorise certain context of new vocabulary items and word collocations, though their primary intention probably was to focus on the overall content and meaning.

The opposite of incidental learning is intentional learning, and Hulstijn (2005) demonstrated that the most appropriate interpretation of intentional learning is having the intention to learn one specific feature. Hulstijn gave an example for intentional learning, as well: after completing a vocabulary memorising task in the FLL classroom where students were informed previously that they are going to be assessed, it can be assumed that most probably their primary intention was to store the vocabulary items in their brain; thus, it can be claimed that their intention was to memorise the certain words.

After discussing the definitions of explicit/implicit learning and interrelated terms, a question might emerge regarding their connection. How can implicit learning be distinguished from incidental learning and how can a distinction be made between explicit and intentional learning? Paradis (as cited in Hulstijn, 2005) indicated that incidental and implicit learning can be differentiated by the fact that the former may be subsumed in the latter, but implicit learning expresses more than just being incidental if automaticity is taken into consideration, for instance. In order to make a distinction between implicit and incidental learning, Long (2014) emphasised that the former is happening without awareness, while the latter is taking place without intention. Accordingly, Hulstijn (2005) claimed that differentiating explicit learning from intentional learning lies in the observation that in the former, awareness is taking place during the encoding phase – learning –, whereas intentional learning requires the attempt and intention to transmit a new piece of information (i.e., an item, a structure, a feature, an element) to the memory system.

2.1 Measuring explicit and implicit learning

Although it is highly demanding to find the optimal instrument to measure explicit/implicit learning, several instruments have been designed to determine which learning had been taking place during the learning process (e.g., Robinson, 1997). Undoubtedly, an fMRI would be able to show the exact parts of the brain activated. As it has been mentioned earlier, the hippocampus is responsible for explicit learning, while the basal ganglia and the cerebellum are accountable for implicit learning (Hulstijn, 2015). However, the aim was to find an instrument that is more accessible.

Several researchers argued (e.g., Ellis, 2009b; DeKeyser, 2005) that it is rather challenging to find out which process was involved during learning since even an inconsiderable amount of deficiency in measuring of what has been learned can cause divergences in the outcome of the test and thus the results of the study (DeKeyser). Ellis mentioned that error correction tasks and blank-filling exercises are problematic because it cannot be ascertained with complete certitude that learners completed the task using exclusively one particular type of knowledge and not the other. He claimed

that spontaneous production tasks may be appropriate ways to measure the two kinds of knowledge. DeKeyser pointed out that time pressure is problematic because speeded tests for eliciting the use of implicit knowledge cannot simply guarantee the pure measurement of this knowledge; moreover, in untimed tests for eliciting the use of explicit knowledge, some learners may still draw on their implicit knowledge. Loewen (2009) also presented an instrument called timed/untimed grammaticality judgement test (GJT) and proved the validity of the test, while he stated that GJTs may not be pure measures of explicit/implicit knowledge. Despite this fact, he has shown that GJTs are the most accurate measurement methods of explicit and implicit knowledge.

As it has been mentioned before, consciousness and unconsciousness can be measured as processes during – or immediately after – learning and later their product, the result of these learning processes can be measured as well. This is the reason why an Artificial Grammar Learning (AGL) task is applied in this research instead of a GJT. According to the review of literature (e.g., Loewen, 2009), a GJT may be used if the intention is to measure explicit or implicit knowledge – the product – ; however, the purpose of this particular research was to gain insight into these conscious and unconscious learning processes at the time of encoding or immediately after the instructional learning process.

Robinson (1997) conducted a study in which he examined learners' aptitude with the Modern Language Aptitude Test (MLAT) and designed a method to gain data about learning under four conditions, namely, implicit condition, incidental condition, rule-search condition and instructed condition. Since the present research is rather similar to that of Robinson's, his idea is followed and an artificial grammar learning (AGL) task is employed. However, in the present research, explicit learning is not going to be decomposed to rule-search and instructed conditions because according to the review of literature, conscious learning subsumes these processes. Several researchers (Gass et al., 2003; Robinson, 1997; Rosa & O'Neill, 1999) after conducting a study in the field of second language acquisition (SLA), came to the conclusion that explicit instruction seems to be more effective than implicit instruction. However, the hypothesis with regard to this research is that implicit instruction is at least as effective as explicit instruction. The rationale for conducting a study involving a task eliciting explicit and implicit learning processes is based on the fact that there is little research regarding the relationship between the conscious and unconscious processes in the Hungarian context.

Research question

Based on previous literature on the topic, the proposed research question is the following:
Which learning process – explicit or implicit – seems to be more effective on a specific learning task in the case of the selected participants?

3. Methods

The review of literature of conscious/unconscious learning processes provided a rationale why the relationship between the two constructs is relevant to be studied. After establishing the research niche of this empirical research, this section of the paper is going to focus on the methods and procedures employed to conduct the research. With the objective to find the answer to the research question, quantitative method was applied in the present study in which explicit and implicit learning processes of the learners were measured with the help of an AGL task.

3.1 Participants

The participants of this research were selected through convenience sampling from five Hungarian schools (N = 40). The original sample included 42 individuals; however, as the results of two participants who have completed the first version of the AGL task were excluded due to piloting the instrument, the final analysis only included data after the pilot. There were altogether 16 males and

24 females aged 15-26 (M = 18.86). The rationale for selecting participants from five different institutes is that the intention was to see a wider range of the sample involving students with different backgrounds and learning contexts. The intention was to exclude possibilities of having very similar results. 17 students have been selected from a secondary school (11 males, 6 females, age ranged from 15 to 17), 15 students from a technical school (2 males, 13 females, age ranged from 17 to 22) and 8 students from three different universities (2 males, 6 females, age ranged from 22 to 26) to participate in the present study. The first language of the participants is Hungarian, and their second language is English. The students have been learning English for 7 and 19 years, their level of proficiency is approximately between A1 and C1, their overall performance in the FLL classroom in the form of grades ranged from 2 to 5.

3.2 Instrument

The Artificial Grammar Learning (AGL) task is based on an experimental task proposed by Field (2003). The idea is that designing a set of rules which specify the order in which letters of the alphabet can appear is a similar process to grammar, which also contains rules, for example, specifying the word order of an utterance. Therefore, a simple AGL task was designed: a letter has been chosen (i.e., "T") which was fix and appeared in every word or string of letters. After this, four letters have been chosen which could occur before it and four which could occur afterwards. This instrument was piloted with 2 participants.

As it is suggested by Field (2003), participants were divided into two groups: one group completed the task under the implicit learning condition and the other completed it under the explicit learning condition. Students learning under implicit condition were asked to only look at the strings of letters and try to memorise them, while the other group under explicit learning condition was asked to look for patterns or regularities in the strings of letters. 30 of the correct strings were shown to each group – increasing the number suggested by Field seemed to be important because showing them only 20 words did not allow too much possibility for learning to happen at a profound level. These nonsense words or strings of letters were presented to the test takers with the help of visual input. A projector was used to present the stimuli one by one – one word on one slide and at a time displayed for two seconds – to each group of test takers. Group A was under implicit learning condition; therefore, the instruction was only to look at the strings of words – observe them and try to memorise them –, group B was under explicit learning condition; therefore, the instruction was to find the regularities or patterns in the words.

Immediately afterwards the training, they were asked to complete a task, they were given a sheet of paper showing the remaining 30 items (20 correct strings and 10 incorrect strings). Considering the time constraint, it is important not to allow time for monitoring to happen in the implicit learning condition to ensure that the process is mainly unconscious. That is the reason why limited time was given to complete the task under the implicit condition and ample time to complete the task under explicit learning condition. Students were asked to circle the correct words.

In the pilot, both participants provided valuable and meaningful critical feedback in the form of verbal self-reports for developing this instrument as part of this research. After collecting data about their opinions on what could be the weaknesses of this assessment method, some aspects of this instruments were changed. After this piloting session, the tasks were tailored according to the perceived cognitive level of secondary school students. Furthermore, ambiguous terms were formed to be clear-cut in the instruction. Items that both participants found too easy or too difficult became excluded from the task. To make the whole task less challenging for secondary school students, it seemed straightforward to reduce the number of rules; thus, the original 8 rules were limited to 5 rules only. The letter "T" remained the fix and permanent member of each word and the rules have also been changed: "U" and "E" are permitted before "T", while "A", "I" and "K" are permitted after "T". Consequently, correct strings are as follows: ETAB, UTIB, RUTA, OUTK. In addition, the distribution of correct and incorrect strings in the test task was changed: now half was legal (15) and half was illegal (15).

In addition, the number of words to be learned in the training section was changed: irrespective of whether they did the task under the implicit or explicit condition, they had to find regularities in 40 words. This was an important factor in giving more opportunity for learning to happen – be it a conscious or an unconscious process. The last aspect that was changed in the AGL task is the time constraint, and now for both conditions 10 minutes were given to the candidates to complete the task because both participants claimed that the time pressure had a negative impact on them and they could not really focus due to the narrow time limit. Later it was proven that for the other 40 participants of the AGL task, the time constraint was not important because they have all completed the task within 7 minutes, both groups of students under implicit and explicit conditions. They stated that they intended to complete the task as rapidly as they could in order not to forget the previously learned words.

The new version of the instrument was piloted again to see if it is an efficient measurement of learning under the two conditions. The second piloting phase was conducted with 17 secondary school students, 1 technical school student and 2 university students. It lasted approximately 45 minutes along with the verbal self-reports collected from the learners. All the names presented here are pseudonyms. One student was asked to provide feedback immediately after the second piloting session, both considering task difficulty and if she managed to find the regularities. She has given an account of the following:

> When we were learning the words with the pictures shown, I realised that the letters "E","A" and "U" are frequently occurring in the example. And the letter "O" as well. Also, the letter "T" occurred in every single word, but in different positions: I remember seeing the letter "T" as the second letter, third and maybe fourth. Overall, this task was not too challenging. (Mónika)

One university student was also asked to provide information about how he was trying to solve the task. He said that he was trying to find regularities and patterns while studying and after presented with the task:

> I soon realised that the letter "T" appears in every word projected. I was trying to find the logic behind it. When I could start doing the task, the first impression was that I could have circled every single word because what I have recognised is that every word contains "T" and every word contains four letters only. Then, I tried to find what the words have in common: for example, I tried to distribute high and low vowels appearing in each word. If this did not prove to work, I tested other theories again and again. (Elemér)

The revised version of the AGL task was proven to be successful (see the Appendix). 15 students of the 20 agreed that it was not too difficult for them to complete. Some students under the explicit condition gave an account of finding at least 4 of the 5 regularities, while there were some who did not find any pattern at all. There were some students who took the test under the implicit condition who realised that the letter "T" is fix and were able to find regularities in some cases. In other cases, they mentioned that they were trying to find words similar to those we have learnt before. In the results and discussion section, the reported strategies they used to memorise and observe the words are going to be elaborated.

3.3 Data collection procedures

After designing the AGL task, it had gone through piloting with 2 participants. After this, data was collected about AGL task scores as completed by the 17 secondary school students, 1 technical school student and 2 university students. This was seen as the second phase of the piloting session. After this, 15 technical school students completed the AGL task. Later, data was collected about the AGL task score of 6 university students. Thus, 42 students completed the AGL task. It is important to mention that the scores of the first quantitative piloting session of the AGL task were disregarded in the calculations since the first version of the AGL task is quite different from the finalised version. As no modifications have been made on the task after its second piloting, the obtained data of the second piloting was kept for analysis.

During the AGL task pilot sessions – first phase with 2 participants and second phase with 20 participants –, self-reports were collected from the students on the task itself that is also analysed later. First, self-reports were collected in which they were asked about the difficulty of the task, understandability of the instructions and if they could detect the rules or regularities in the input. Following this, the revised version of the AGL task was completed by the 20 students, after which verbal self-reports were collected from the students and notes were taken to record their answers.

3.4 Data analysis

In order to analyse the assessment records statistically, the SPSS programme was applied. With the help of SPSS, the mean (*M*), mode (*Mo*), median (*Med*) values, variance (*Var*) and standard deviation (*SD*) of the scores were calculated, along with the minimum (*Min*) and maximum (*Max*) points reached on the AGL task. After this, addressing the determination of the cut scores, the cut point was calculated in a norm-referenced method: after calculating the average score of this sample, students who met the average score or scored above the average were categorised as high-scorers on the AGL task, while the low-scorer category included those students whose scores were below average.

The mean value of the total scores of the AGL task is 18, which is 60%. Thus, under both learning conditions, candidates scoring below 18 points were considered as low AGL task scorers, while students reaching at least 18 points (18 and above out of 30) were regarded as high AGL task scorers. As it has been already mentioned, it is important to clarify that the data of the pilot were discarded; as they have completed the first version of this task, it seemed to be reasonable to leave their score out from the final analysis.

4. Results and discussion

First, in this section, the analysed descriptive and inferential statistics of the AGL task are going to be depicted. All of the statistical data was calculated with the SPSS software. This paper shall start with discussing the descriptive statistics of the AGL task scores, see Table 2.

Table 2
Descriptive statistics of the AGL task scale under implicit and explicit learning conditions (N = 40)

Learning condition	*N*	*M*	*Med*	*Mo*	*SD*	*Var*	*Min*	*Max*
Implicit	20	19.10	19.00	21.00	2.24	5.04	14	22
Explicit	20	17.20	16.00	16.00	3.23	10.48	10	25

From this data, it can be seen that the arithmetic mean for learning under implicit condition is over 19, while the average for learning under explicit condition is 17.2. The independent samples *t*-test (see Table 3) showed that the mean for learning under implicit condition is significantly higher, $p = .037$ (two-tailed). Test takers under the implicit learning condition scored higher and showed less variance (*Var* = 5.04 and *SD* = 2.24), while students under the explicit learning condition scored lower on the task and showed more variance (*Var* = 10.48 and *SD* = 3.23). Paired samples *t*-test was also calculated to analyse task difficulty and the result of the calculation shows that there is a statistically significant difference between the mean values of the implicit learning task and the explicit learning task, $t(19) = -2.51$, $p = .021$ (two-tailed).

Table 3
Independent samples t-test comparing the two learning conditions

Learning condition	*N*	*M*	*SD*	*t*-value	*p**	*df*	Cohen's *d*
Implicit	20	19.10	2.24	-2.15	.037	38	.7
Explicit	20	17.20	3.23				

Note. *two-tailed significance

The hypothesis prior to the research; specifically, that implicit learning is at least as efficient as explicit learning, was proven to be correct on this AGL task, the relevant data being presented in Table 2 and 3. From the data, it can be observed that implicit learning is significantly more effective in the cases of the selected participants and this is the intended answer for the research question. This finding lends support to Schmidt's Noticing Hypothesis (Schmidt, 2010), who claimed that having learners' attention focused on the input enhances learning, even if no rules or regularities are detected or applied consciously. In addition, the effect size was calculated, d = .7, which is bigger than the medium effect size according to Cohen (1988).

Considering the mean and the standard deviation along with students' self-report, the interpretation is that in the case of the selected sample (N = 40), implicit learning can be at least as effective as explicit learning; moreover, it seems to result in more stable performance as standard deviation is smaller. From the maximum scores (Max = 22 under implicit condition and Max = 25 under explicit condition), which is only 73 and 83%, it is unambiguous that the test after its revision still remained rather challenging.

After this, one-way Analysis of Variance (ANOVA) was calculated focusing on the age and gender differences within the AGL task decomposing it to the two different learning conditions. Considering age and gender, there were no significant differences either under explicit or under implicit conditions, so an S-N-K post hoc test is not needed.

Regarding the self-reports of explicit-condition-students, it could be observed that either they were likely to recognise a considerable number of regularities – usually at least 4 out of the 5 in several cases –, or they could not discover any. When they were asked to explain their process of learning, they reported that they were trying to search for some patterns while exposed to the stimuli, and most of them reported that they realised that the letter "T" is fix and appears in every – correct – strings of letters. It must be noted that the fixed position of "T" was not considered to be a regularity because on its own it was not a pattern, but students had to detect the regularities of the positions of the surrounding letters as compared to the fix "T". Students under the explicit condition seemed to be focusing on finding the regularities in the input, which tells the researcher that most probably, the test is in fact measuring conscious processes.

Implicit-condition-students reported that they were trying to memorise the words by various interesting strategies: some claimed to hear an inner voice reading out aloud the words, which helped them memorise the words, some reported that they were using repetition techniques, others said that they were trying to write the input down in their imagination, and some also mentioned that they were trying to link the words to something funny or surprising to make it become fixed in their short term memory. In this case, few of the students realised that the "T" is fixed, and even fewer detected regularities. Despite this fact, they completed the task with higher scores as compared to the explicit-condition-students, which is a very interesting finding of this research. This tends to support Schmidt's Noticing Hypothesis (2010), as it has been already mentioned. Additionally, the fact that the implicit-condition-students did not recognise regularities in most cases supports the assumption that the test is measuring unconscious and conscious processes in an effective way.

5. Conclusion and pedagogical implications

To sum up the research findings, it can be claimed that based on the scores of the AGL task, implicit learning seems to be more effective than explicit learning. This finding probably lends support to Schmidt's Noticing Hypothesis (Schmidt, 2010), who argued that having learners' attention focused on the input enhances learning, even if no rules are detected or applied consciously. This finding has some important pedagogical implications in the development of SLA research. Since implicit learning has proven to be more effective in this particular task in this sample, it would be worthwhile to consider employing more implicit-focused instructions in language teaching. Although explicit learning seems to be efficient as well, teachers are encouraged not to ignore the usefulness of implicit learning either. Language teachers used to be preoccupied with putting more emphasis on rule-focused teaching which may not be the most beneficial way of teaching in every circumstance. The researcher argues that combining the two modalities would lead to more potential in the FLL classroom, thus finding and focusing on the advantages of both learning mechanisms is essential.

However, this research is not without limitations. The AGL task may not have been the best research instrument to simulate explicit and implicit learning conditions because students may or may not have recognised the regularities under the explicit learning condition, and students' learning may have become explicit from implicit once they detected the rules. Naturally, it must be admitted that the most precise technique to measure consciousness might have been an fMRI in order to see which part of the brain is activated under both conditions when studying the words. As an additional limitation, it must be noted that since there was only one kind of task to measure conscious and unconscious learning processes, the same person under both learning conditions could not be tested. It would be worthwhile to see the scores of the same students completing tasks under explicit and implicit learning conditions and to observe how well they perform in each case.

The effectiveness of implicit learning seems to be an important finding of this research, which can be relevant in the field of language pedagogy, therefore, researchers are encouraged to investigate the relationship of consciousness and language learning from various aspects. It would be worthwhile to conduct a longitudinal study to examine the progress of language learning focusing on the explicit or implicit mechanisms employed. Additionally, it is recommended to explore the connection between explicit and implicit learning on a larger sample. Besides the already mentioned ideas for further research, creating a task different from the AGL task to measure conscious and unconscious processes would be very useful, as having two tasks to measure implicit and explicit learning would mean that data about both explicit and implicit learning processes could be collected from the same participant.

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References

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Lawrence Erlbaum Associates Publishers.

DeKeyser, R. M. (2005). Implicit and explicit learning. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 241-267). Blackwell.

Ellis, R. (2009a). Implicit and explicit learning, knowledge and instruction. In R. Ellis, S. Loewen, C. Elder, R. Erlam, J. Philip & H. Reinders (Eds.), *Implicit and explicit knowledge in second language learning, testing and teaching* (pp. 3-25). Multilingual Matters.

Ellis, R. (2009b). Measuring implicit and explicit knowledge of a second language. In R. Ellis, S. Loewen, C. Elder, R. Erlam, J. Philip & H. Reinders (Eds.), *Implicit and explicit knowledge in second language learning, testing and teaching* (pp. 31-64). Multilingual Matters.

Field, J. (2003). *Psycholinguistics: A resource book for students.* Routledge.

Gass, S., Svetics, I., & Lemelin, S. (2003). Differential effects of attention. *Language Learning*, *53*, 495–543.

Hulstijn, J. H. (2015). Explaining phenomena of first and second language acquisition with the constructs of implicit and explicit learning: The virtues and pitfalls of a two-system view. In P. Rebuschat (Ed.), *Implicit and explicit learning of languages* (pp. 25-46). John Benjamins Publishing Company.

Hulstijn, J. H. (2005). Incidental and intentional learning. In C. J. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 268-291). Blackwell.

Krashen, S. (1982). *Principles and practice in second language acquisition.* Pergamon Press.

Leow, R. P. (2015). Implicit learning in SLA: Of processes and products. In P. Rebuschat (Ed.), *Implicit and explicit learning of languages* (pp. 47-67). John Benjamins Publishing Company.

Loewen, S. (2009). Grammaticality judgment tests and the measurement of implicit and explicit L2 knowledge. In R. Ellis, S. Loewen, C. Elder, R. Erlam, J. Philip & H. Reinders (Eds.), *Implicit and explicit knowledge in second language learning, testing and teaching* (pp. 94-112). Multilingual Matters.

Long, M. H. (2014). *Second language acquisition and task-based language teaching.* John Wiley & Sons, Ltd.

Reber, A. S. (1993). *Implicit learning and tacit knowledge: An essay on the cognitive unconscious.* Oxford University Press.

Robinson, P. (1997). Individual differences and the fundamental similarity of implicit and explicit adult second language learning. *Language Learning, 47*(1), 45-99. https://doi.org/10.1111/0023-8333.21997002

Robinson, P. (2002). Effects of individual differences in intelligence, aptitude and working memory on adult incidental SLA: A replication and extension of Reber, Walkenfield and Hernstadt (1991). In P. Robinson (Ed.), *Individual differences and instructed language learning* (pp. 211-266). John Benjamins Publishing Company.

Rosa, E., & O'Neill, M. D. (1999). Explicitness, intake, and the issue of awareness: Another piece to the puzzle. *Studies in Second Language Acquisition, 21*(4), 511-556. https://doi.org/10.1017/s0272263199004015

Roehr-Brackin, K. (2015). Explicit knowledge about language in L2 learning: A usage-based perspective. In P. Rebuschat (Ed.), *Implicit and explicit learning of languages* (pp. 117-138). John Benjamins Publishing Company.

Schmidt, R. (2010). Attention, awareness, and individual differences in language learning. In W. M. Chan, S. Chi, K. N. Cin, J. Istanto, M. Nagami, J. W. Sew, T. Suthiwan & I. Walker (Eds.), *Proceedings of CLaSIC* (pp. 721-737). Centre for Language Studies.

VanPatten, B., & Rothman, J. (2015). What does current generative theory have to say about the explicit-implicit debate? In P. Rebuschat (Ed.), *Implicit and explicit learning of languages* (pp. 117-138). John Benjamins Publishing Company.

Appendix

Artificial Grammar Learning (AGL) task – revised and finalised version

English translation from Hungarian

Group A – implicit learning condition

Please circle the correct strings of letters (words) based on what you have memorised.
You have 10 minutes to complete the task.

UTIM	ATUM	ETAP
RUTI	CUTA	ITEG
ATEB	META	KATU
ETAO	ATUP	OUTI
CATU	ITUG	SGTQ
OUTA	BETI	ETAB
OUTK	FATU	XDXP
ITUK	UTAO	RITU
PUTA	MITU	UTAZ
ETIR	ZATE	MITE

Group B – explicit learning condition

Please circle the correct strings of letters (words) based on the regularities or patterns that you have detected.
You have 10 minutes to complete the task.

UTIM	ATUM	ETAP
RUTI	CUTA	ITEG
ATEB	META	KATU
ETAO	ATUP	OUTI
CATU	ITUG	SGTQ
OUTA	BETI	ETAB
OUTK	FATU	XDXP
ITUK	UTAO	RITU
PUTA	MITU	UTAZ
ETIR	ZATE	MITE