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LEXICAL AND GRAMMATICAL STUDIES OF THE ELDERLY AND YOUNG ADULTS WHILST LEARNING FOREIGN LANGUAGES

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Background and aims: Our aim was to find out which aspects of a language can be successfully mastered by the elderly, compared to younger subjects, at the beginning of the language learning process.

Method: We used digitized cartoon drawings of animals performing different picturable actions in dyadic pairs. The animals and actions could be combined freely to create a large number of different scenes corresponding to independent clauses of the type "The dog hugs the lion". In the present experiment, young and elderly adult participants learned novel names for these animals and their actions, as well as two morphosyntactic rules (object marking vs. grammatical gender marking) embedded in the new language. Unsupervised implicit learning was accomplished by viewing scenes with accompanying sentences like "Garomi poh+a tunuke+r". Thus, both lexicon and grammar were learnt simultaneously. Vocabulary learning was examined by a picture-word matching task and grammatical learning was examined by a sentence-picture matching task and a grammatical judgment task and a short interview.

Results: Although young participants were more successful in each task, results indicate that effective word-learning mechanisms are retained even by the elderly. The performance of those elderly people, who learnt the simplified version of the language, was similar to the results of young adults in the recognition task. Learning of grammar proved to be more difficult than lexical learning for all groups.

Conclusion: Our results indicate that grammatical learning may start when vocabulary reaches a critical size. There are implicit learning mechanisms at work when we learn words in a foreign language. In acquiring grammar, incidental learning is not efficient, not even for young adults. Providing examples and concrete explanations are more useful, at least at the beginning of the language learning process.

Keywords: foreign language learning, lexical learning, grammatical learning, the elderly and young adults.

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Several studies have focused on foreign language learning, most of which have concerned the younger age group. Very few studies have concentrated on the elderly. Excepts are the works of de Bot and Makoni (2005) in this regard, who consider language and aging as part of lifelong development. In their interpretation this progress includes not only development, but also decline, biological, psychological and social dimensions change over time, but the effects of these changes differ among individuals.

Data show that in old age work performance only decreases in areas where rapid response to uncertain and varied stimuli is required, and in occupations involving high physical workloads. In other areas, knowledge and experience may offset cognitive impairment that occurs because of old age (for a review see Czigler 2000). During aging the size of nerve cells diminishes, the number of dendrites and synapses decreases and the degeneration of the myelin sheath can also be observed. Alterations vary throughout the brain, decline is more significant in the frontal region (Salat et al. 2005) and the association cortices also appear to be more sensitive to aging (Raz 2000). As a function of these alterations, information processing capacity is subject to change. The most affected cognitive functions are those related to frontal lobe function (West 1996). Thus, compared to young age groups the elderly usually perform more poorly in tasks involving working memory (Salthouse 1990), attention (Plude – Doussard – Roosevelt 1989, Salthouse – Miles 2002, Bialystok – Craik – Ruocco 2006), planning (Sorel – Pennequin 2008, Craik – Bialystok 2006), cognitive control (Bialystok – Craik – Ryan 2006), fluid intelligence (Bugg – Zook – Delosh – Davalos – Davis 2006) or inhibitory processes (Hasher – Zacks 1988, Hasher – Stoltzfus – Zacks – Rypma 1991).

Memory capacity, which has paramount importance in language learning, is one of the focal research topics concerning the decline of performance at old age. Experimental results prove that the elderly perform worse compared to young people in memory-related tasks. A quite definite performance degradation occurs when another task that also needs processing has to be done in parallel. However, performance may improve in the presence of promoting stimuli. Implicit memory is quite well preserved, but its functioning depends on the type of task used to measure it. Regarding motor activities performance is weaker, but it improves with exercise, as well as in the case of younger people (Baddeley 2010).

In regard to language learning and grammar learning in particular, it is important to emphasize age-related changes in the thinking process. In inferential tasks involving multiple premises performance deteriorates (this is associated with changes in memory capacity as well). However, if the solution is to be inferred from a small number of premises, there is no significant difference between the performances of younger and older age groups (Salthouse – Legg – Palmon – Mitchell 1990).

Most studies of age-related changes examine intelligence, however, these are not closely related to the language learning process. Yet, it is important to mention the theories that attempt to explain the changes observed in these studies. For example, according to the deceleration hypothesis, lower performance of the elderly in fluid intelligence tasks is primarily due to the deceleration of processing (Salthouse 1996). Wingfield, Kemtes, & Miller (2001) tested the processing speed of young and elderly participants, who had to listen to a story, which they had to recall later. Subjects were allowed to control the delivery rate of spoken prose. Results suggested that when the elderly had enough time to think (i.e. with reduced reading speed), they performed as well as the young age group. Another theory explaining the decrease in performance at old age focuses on inhibitory processes (Hasher – Zacks 1988). According to their concept, mental slowdown occurs because neural inhibition is slower and less effective, hence intensifying the interferences (let them be novel or retrieved from the memory) between information being processed.

Age-related performance decline is not inevitable, at least not in all areas (Czigler 2012). Basic skills (e.g. cycling), which we learn implicitly manifest quite a strong resistance to

decline with age, but the more complex skills (e.g. use of a foreign language) must be practiced, otherwise they fade. Research shows that the brain retains its plasticity to some extent even at old age (Greenwood 2007), thus, with training, the functional reorganization of neural networks involved in certain tasks can be achieved (Doidge 2010). As a result of practice, improvements were found in tasks involving working memory (Buschkuhl et al 2008) and episodic memory (Verhaeghe – Marco – Goossens 1992). However, in these experiments training only improved performance in practiced tasks, no actual transfer occurred (Li et al 2008).

Many skills, capabilities and environmental factors can serve as resources to hinder cognitive decline in old age: working memory and long-term memory capacity, attentional processing and its speed, education, learning, social and linguistic environment, and multilingualism (de Bot – Makoni 2005). Intellectual activity (be it crosswords, active learning or language learning) plays a causal role in the compensation of age-related deterioration in attention, learning and thinking (cognitive) processes (e.g. Baltes – Lang 1997, Compton – Bachman – Brad – Avet 2000). Compensatory efforts to counteract functional impairments were found to increase up to the age of 70 years, contributing to the experience of successful aging (Brandstädter – Rothermund 2003).

In this paper we want to emphasize those cognitive mechanisms which do not or only deteriorate slightly with aging. Our research aim was to find out, which aspects of a language can be mastered successfully in the case of the elderly at the beginning of the language learning process, compared to younger subjects. Our previous study has shown that young adults are successful and fast at learning words during the initial phase of foreign language learning, but grasping grammar is initially difficult, especially if a rule in the novel language is not of the same complexity as in the first language (Polonyi – Abari – Nagy – Sántha – Gnadtt, in press).

Implicit memory is more resistant to the negative aspects of aging than explicit memory. Learning and conscious recollection of new information are more problematic for the elderly (O'Hanlon – Wilcox – Kemper 2001). Hence, our first assumption is that the elderly perform better in language testing, than when asked in an interview to name novel words and formulate rules.

Learning when elderly is hindered by a decrease in interest, fear of change, lack of adaptability, and other personality factors; the deterioration of short-term memory and biological functions (sensory and motor organs) (Bajusz 2008). Accordingly, we hypothesize that the efficiency of learning the artificial language will exhibit differences between young and elderly subjects (the young performing better), while word-learning will be more effective than grammar learning in both groups. Based on the research results of Johnson and Newport (1989), Weber-Fox and Neville (1996) and Newport (2002), we can say that language learners achieve greater success in acquiring the lexicon, than grasping grammar and phonology. Our further hypothesis is that the elderly group will be as successful as the young group in learning words but their reaction time will be slower in various tasks.

According to several studies (Snowdon 1997, Snowdon et al 1996, Bialystok – Craik – Klein – Viswanathan 2004, Bialystok – Craik – Freedman 2007), negative changes due to aging could be delayed by language learning experience. Accordingly, in the present study, it is expected that those subjects who have a higher level of previous foreign language knowledge, will perform better in the artificial language learning situation as well.

Methods

Participants

Two groups participated in the study, an elderly group and a group consisting of young adults. 25 university students formed the young adult group (17 females, 8 males, mean age 19.32, age range 18-24, SD = 2.16). The elderly group was composed of 19 participants (14 females, 5 males, mean age 61 years, age range 56-67, SD = 3.6). Participants gave their written informed consent before engaging in the study. None of them reported having a neurological illness or reading difficulties and all had normal or corrected-to-normal vision.

The selection of the elderly participants was aided by objective psychological instruments [Mini-Mental State Examination (MMSE), and subtests of WAIS]. The Mini-Mental State Examination (Folstein, Folstein & Mchugh, 1975) is used by psychologists and physicians to identify dementia and its severity. The results of the group were: $M=28.4$, age range: 22-30, $SD=1.98$. Two subtests of Wechsler Adult Intelligence Scale (Wais-R, Wechsler, 1981) were administered: Digit Symbol ($M=37.5$, age range: 17-67, $SD=12.6$), and Vocabulary ($M=56.89$, age range: 37-76, $SD=10.35$).

All participants filled out a language background questionnaire tapping into their foreign language proficiency and the number of languages they speak. All participants were native speakers of Hungarian. All university students had learnt at least one foreign language at primary and secondary school. They knew a minimum of two (primarily English and German) and a maximum of three foreign languages ($M=2.2$; $SD=0.37$). The elderly knew 0-3 foreign languages ($M=1.68$; $SD=1.002$), the majority had learnt at least one foreign language at primary and secondary school. The languages most commonly spoken by the elderly participants were Russian, German and English. Participants were asked in the questionnaire to rate their speaking, writing, listening and reading comprehension skills in everyday contexts in the languages they knew by using a 6-point scale (1 = deficient, 6 = excellent). This yielded a summative score for each language. The results for the two groups were as follows: young adults: $M=32$, $SD=8.8$, the elderly: $M=14.473$, $SD=9.08$.

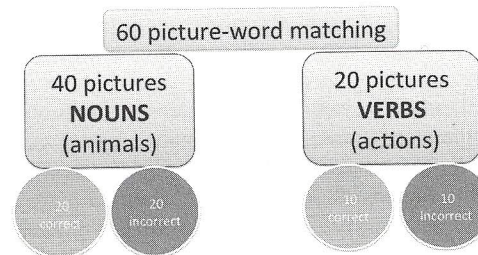
Tools

The study was realized using an artificial language (see also Polonyi 2012, short description in the Appendix). Participants were familiarized with the language in a training session followed by testing. During the training session images were displayed on the screen accompanied by an appropriate descriptive sentence. Participants observed the novel language and the pictures along with reading aloud the sentences below the images three times. The elderly group also listened to the audible version of the sentences once. The training session was followed by several tasks tapping into language learning. These tasks were as follows: a picture-word matching task, a picture-sentence matching task (young adults), grammaticality judgment tasks (elderly adults) and an interview.

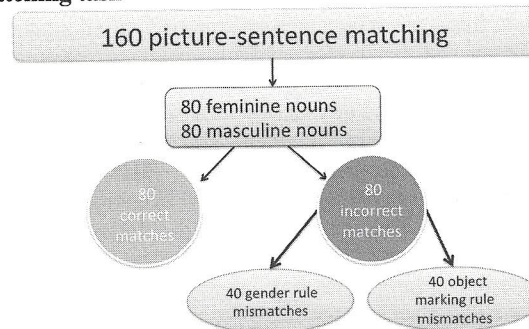
The construction of the test tasks for both test groups is described as follows:

The construction of testing tasks for the young group

Picture-word matching task

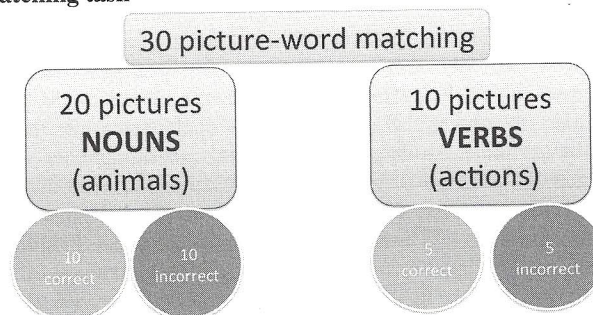


Picture-sentence matching task

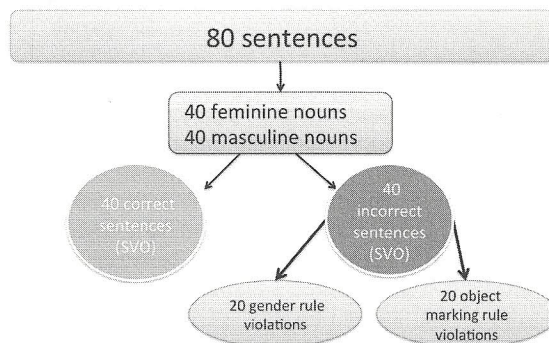


The construction of simplified testing tasks for the elderly group

Picture-word matching task



Grammaticality Judgment Task (sentences without pictures)



In the case of the picture-sentence matching task, half of the correctly matched sentences previously appeared in the training material, while the other half were unfamiliar to the participants. Feminine and masculine nouns were evenly represented. Each verb appeared four times in the sentences; nouns appeared four times as subjects and four times as objects.

In the case of the elderly group, we used a simplified version of the original tests. The rationale behind the simplification of the testing material is our finding derived from the pretesting phase, where we noticed that the results of the non-active elderly were scarcely interpretable. Instead of the picture-sentence task, we used a grammaticality judgment task (sentences without pictures). In the grammaticality judgment task every noun appeared two times as an object and two times as a subject, and every verb appeared four times (two-two times with feminine and masculine endings) (e.g. *pohi*, *poha*). Half of the correctly matched sentences previously appeared in the training material, while the rest were unfamiliar to participants. In half of the sentences nouns were feminine, in the other half they were masculine.

The testing tasks were supplemented by a short interview with the aims of finding out whether the participants noticed grammatical rules and if they were able to formulate them.

The results of the picture-sentence matching task (young adults) and grammaticality judgment tasks (the elderly) are referred to as "grammar learning" in the results section.

Procedure

Both training and testing were run on a computer using Inquisit software (Inquisit, version 3.0.6.0, Millisecond Software), which recorded the participants' reaction times in milliseconds (the time from the appearance of the stimuli to the pressing of the reaction time key) and the correctness of their responses. The participants were tested individually in a quiet room⁸.

The experiment consisted of three sessions run on three different days, reviewed hereafter:

Session 1

Session 1 commenced with a pre-training exercise in which participants were asked to carefully watch pictures on the screen of the computer appearing one after another and to

⁸We would like to thank Emese Babinszki and Zsuzsanna Gyöngy Eszenyei for their help in data collection.

label them in their mother tongue, Hungarian. If they committed an error, the experimenter corrected them and gave the correct label of the picture in Hungarian. The pre-training session was followed by three training sessions with the novel language. The elderly group also listened to the audible version of the novel language.

During the training session, all pictures were presented for 7 seconds along with the proper sentences or words describing them. Stimuli were preceded by a fixation point and followed by a 1.5 seconds pause. At this point, participants did not have to give a response to any of the stimuli presented, just observe the novel language, look at the pictures and read the sentences aloud. The duration of one training session was about 15 minutes. Session 1 also included filling out the informed consent form and the language background questionnaire. In the case of the elderly group the Mini-Mental State Examination and the subtests of WAIS were also administered.

Session 2

First, participants completed the testing tasks (picture-word matching, picture-sentence matching, grammaticality judgment task, respectively). In the case of the picture-word matching task we wanted to see whether the participants associated correctly the animal or action appearing on the screen with its equivalent in the novel language. There was a 2 seconds pause between different stimuli.

In the picture-sentence matching and grammaticality judgment tasks words in the sentences appeared in subject - verb - object (SVO) order, as in the sentences in the training material. In both tasks stimuli were preceded by a fixation point (appearing for 1 second), followed by a 2 seconds pause. In all of the tasks mentioned we included an upper limit of 10 seconds of waiting time for the answer. Testing tasks were followed by a single training session.

Session 3

This session consisted of solely testing. Picture-sentence matching or grammaticality judgment tasks were followed by picture-word matching. After completing the tasks, participants were interviewed by the experimenter about the rules of the novel language presented (short interview). Answers were captured using a voice recorder.

In our experimental design learning during the first day we met the criteria of implicit/incidental learning, as participants did not receive any explicit information about the language. All knowledge had to be extracted from the stimuli presented. On the other days however, principles of explicit learning must have prevailed (participants probably sought deliberately regularities in the language, as a consequence of the interview on the second day).

Results

Statistical tests were run on the percentage ratio of correct answers and reaction time (RT) data obtained on the two test days. In determining the average RT of subjects for each task, wrong answers and RT data more than 3 standard deviations away from the average individual RT were excluded from the processed database. Similarly, results with very extreme RTs were omitted from the proportion of correct responses. Two-way ANOVAs and Tukey's tests were used for data analysis.

The expansion of passive vocabulary in the picture-word matching task

The effects of two factors were examined in the statistical analysis of the correct responses: the group (young adults, the elderly) and test day (test 1, test 2) factors. In the picture-word

matching task, the effects of both factors were significant (group: $F(1, 84) = 56.67, p < 0.001$, test day: $F(1, 84) = 8.26, p = 0.005$). The interaction was also significant ($p = 0.01$) (see Figure 1). According to the Tukey's test results, the two groups differed from each other ($p < 0.001$). The average performance of the young group on the second test day was 90.39%, while the average performance of the elderly group was 61.81% (within this group there were two subjects who scored above 80% on both test days, one of whom scored very highly on the vocabulary test as well and whose average RT on the picture-word association task was low).

Each participants' d-prime scores (signal detection) were calculated for correct and incorrect matches (the average of young adults, $d' = 3$, and of the elderly group, $d' = 0.88$). There is no d-prime cutoff value for successful learning, but looking at the group averages it can be said that the young group did not respond randomly, thus learning occurred. For the elderly group the d-prime scores showed a 73% hit rate and a 47% false-alarm rate which can also be considered learning (Hit rate is the proportion of correct matches to which the participants correctly answered "yes", false-alarm rate is the ratio of incorrect matches to which the participants responded "yes"). When performance is impeccable the hit rate is equal to one, and the false-alarm rate is 0. If hit rate equals the false-alarm rate, it means that the subjects answered randomly. The greater the difference between the hit rate and the false-alarm rate, the more certainly we can conclude that subjects can distinguish correct matches from incorrect ones, that is, learning occurs).

The analysis of RT data showed a significant main effect of the test day factor ($F(1, 84) = 9.64, p < 0.03$), subjects' reaction times were higher on test 1, than on test 2. The main effect of the group factor was also significant ($F(1, 84) = 40.12, p < 0.001$), reaction times of the two groups differed, words and pictures were matched at a different pace (Figure 1). The interaction was not significant ($F(1, 84) = 0.06, p = 0.81$).

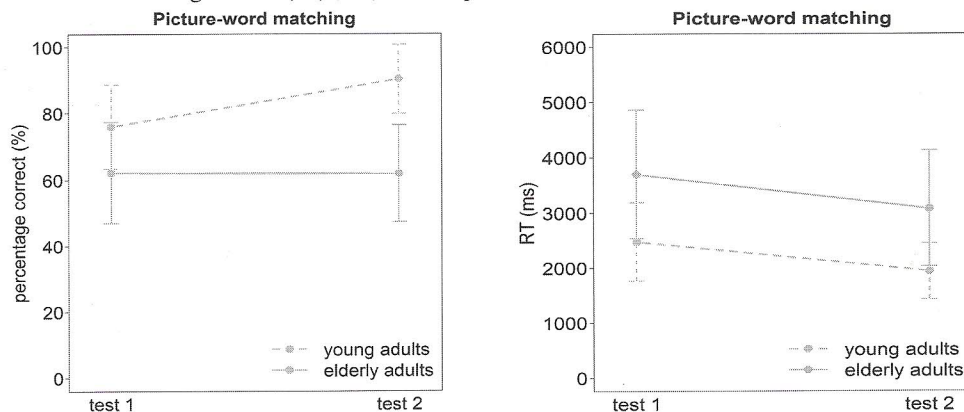


Figure 1. The averages of the two groups on the two test days, in the picture-word matching task (left - the proportion of correct answers, right - reaction times)

Levene's test was used to assess the equality of variances. With regard to the proportion of correct answers in the picture-word matching task, there was no significant difference between the variances. For reaction times ($p = 0.003$) distributions differed, there was great variation in the elderly group, while the young adults exhibited a more uniform performance.

Rule learning

A two-way analysis of variance was performed on the proportion of correct responses for the grammar learning task (picture-sentence matching for young adults, grammaticality judgment

task for the elderly). The main effect of the group factor was not significant ($F(1, 84) = 0.88, p = 0.35$), so there was no difference in the performance of the two groups. The test day factor was not significant either ($F(1, 84) = 1.05, p = 0.31$), that is, practicing did not result in much higher performances on the second test day (Figure 2). The interaction was not significant ($F(1, 84) = 0.18, p = 0.68$).

We calculated the d-prime scores (signal detection) for each participant regarding the correct and incorrect matches (the average of young adults: $d' = -0.13$, the elderly group: $d' = 0.09$). A negative d-prime score indicates that the false-alarm rate is higher than the hit rate, but since these scores are close to 0 for both groups, we can conclude that the subjects responded randomly, they could not distinguish the correct sentences from incorrect ones.

Reaction time data analysis revealed no significant difference between test days ($F(1, 84) = 1.14, p = 0.29$). We did not find significant differences between the reaction times for correct answers among the groups in the grammar learning task (picture-sentence matching task / grammaticality judgment task) ($F(1, 84) = 2.79, p = 0.098$). The interaction between factors was not significant ($F(1, 84) = 0.01, p = 0.909$).

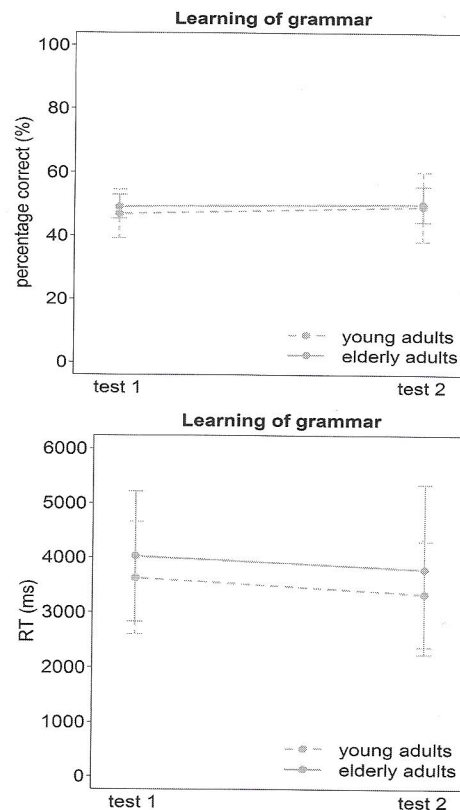


Figure 2. The average of the two groups (young adults, elderly adults) on the two test days, in grammar learning

The equality of variances was assessed using Levene's test. In grammar learning there was a greater variation in the correct responses of young adults ($SD_{\text{young}} = 0.108$) compared to the elderly ($SD_{\text{elderly}} = 0.057$) ($p = 0.026$) (Fig. 3). Reaction times in grammar learning ($p = 0.013$), varied more among the elderly group than among the young group.

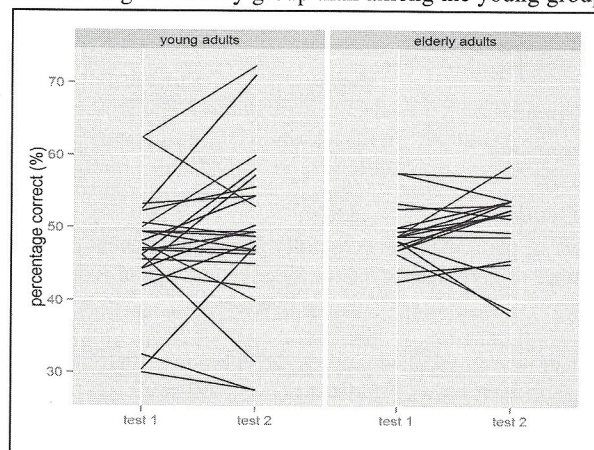


Figure 3. The rate of correct answers on the two test days for test subjects in the two groups.

Figure 4 shows the average results of the two groups with respect to the grammatically incorrect sentences in the grammar learning on the second test day. It can be seen that the grammatical gender rule and the object-marking rule were both problematic for the participants. The ANOVA showed a significant difference between the performances on sentences involving gender rule and object-marking rule ($F(1, 84) = 4.33$, $p = 0.04$). However, neither group reached 50%, so no grammar learning occurred.

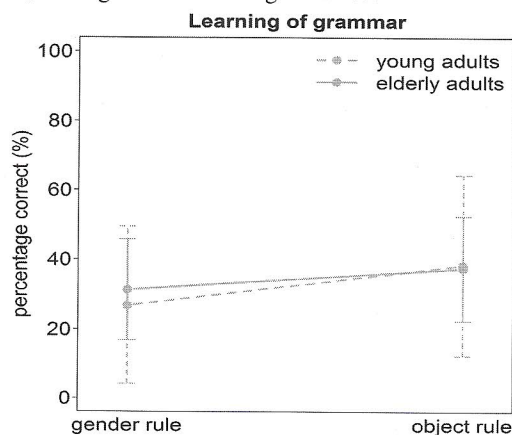


Figure 4. The average result of grammatically incorrect sentences in the young and elderly groups on the second test day.

Interview Results

During the interviews participants were asked to formulate the rules of the novel language, and to recall the words they had memorized. Table 1 indicates the number of participants who were able to name the rule regarding at least one of the endings (the number of participants

mentioning only the possible endings of words – but no rule – are in parentheses). More young adults were able to formulate the rules, while the elderly group only noticed the endings, most of the time they could not figure out the actual rules. Younger participants were able to formulate the object-marking rule more often than the grammatical gender rule. However, due to the small sample size, we cannot draw far-reaching conclusions from the results shown in the table.

	Young	Elderly
Object-marking rule	6 (7)	1 (4)
Gender rule	2 (3)	1 (7)

Table 1. The number of participants successfully formulating each rule on the second test day (the number of participants mentioning the endings of words – but no rule – are in parentheses).

Regarding the number of words recalled during the interview, there were vast differences between the groups (group factor was significant ($F(1, 42) = 77.52, p < 0.001$). The young group performed better (88.6%). On test day 2, the elderly group was able to recall 32% of the words seen during the study.

Implicit learning and explicit interview

A two-way ANOVA was performed, with the first factor being the group (young/elderly), and the second factor the formulation of the rule (formulates rule / does not formulate rule). The formulation of the object-marking rule as a factor showed a significant main effect ($F(1, 40) = 4.75, p < 0.05$), so better performance in grammar learning is associated with better explicit knowledge of the rules in the case of the young group. However, our results should not be interpreted more than mere tendencies, due to the small sample size of each group (see Table 1).

If we compared the performance of subjects during the interview and in the picture-word matching task (Figure 5), ANOVA results were as follows: task type was significant ($F(1, 84) = 14.0, p < 0.001$) and so was the group factor ($F(1, 84) = 130.3, p < 0.001$). The interaction also showed significance $F(1, 84) = 14.4, p < 0.001$.

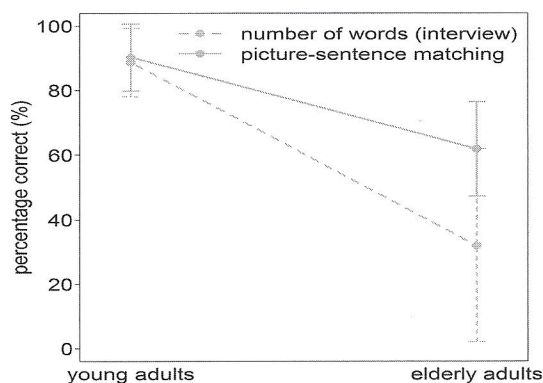


Figure 5. Results of the picture-word matching and the interview in the two study groups

We examined the correlation between the number of words recalled in the interview and the results of the picture-word matching task. Results were significant for the elderly group ($r=0.8$, $p<0.001$). Regarding young adults ($r=0.36$, $p=0.08$), the correlation coefficient showed a weak to moderate relationship. It was not significant, but close. The explanation for this is that young adults performed uniformly well in both tasks.

Foreign language proficiency

Proficiency in foreign languages showed no correlation with the results of the picture-word matching task (young group $r=-0.03$, $p=0.9$; elderly group: $r=0.04$, $p=0.85$) or grammar learning task (young group $r=-0.09$, $p=0.66$; the elderly group: $r=-0.26$, $p=0.29$).

Discussion

Our analysis focused on four aspects of foreign language learning: the expansion of passive vocabulary, rule learning on sentence level, the relationship between implicit grammar learning and its reporting (recognition and recall), and the influence of existing foreign language knowledge. Our research aim was to explore what aspects of a language can be mastered successfully by the elderly, compared to young people, at the beginning of the language learning process. Our first assumption was that there will be a difference between the young and elderly groups in learning the artificial language, the young group being more successful. Results suggested that young people (not surprisingly) did better in some tasks compared to the elderly group. This supports the earlier conclusion that with aging, performance gradually decreases in regard to the cognitive processing systems (Czigler 2012).

The young group learned more words during both recognition (picture-word matching) and recall tasks (interview). In these tasks results approached 90% by the end of the study. The results of the elderly group suggested that effective word learning mechanisms are available at an older age, too, as long as the material to be learnt is of the right proportions and the conditions of learning are simplified (training material is not only read but also listened to, distraction factors are reduced to a minimum). To put it differently, when learning a foreign language, throwing the elderly in at the deep end does not help.

The elderly group's recognition performance is quite weak (62%). The word recall result of the interviews is 32%, demonstrating that recall is difficult for the elderly. Heine, Ober & Shenaut (1999) have studied the tip-of-the-tongue (TOT) phenomenon in young adults, in the elderly (60-70 years) and in old aged people (80-92 years). Their results showed that all three groups differed in the occurrence of this phenomenon and in the time required for finding the solution, but if enough time was available for the old and elderly subjects, they could also resolve these situations. This suggests that they possess lexical knowledge, but lexical access is more difficult for them than for people of a younger age. This phenomenon is also supported by our results.

Incidental learning of novel words in young adults, - and especially in the elderly -, is an under-researched area. Previous studies (Polonyi - Abari - Nótin 2009, Laine - Polonyi - Abari 2013) showed that adults were able to generalize the features of words based on two representatives of a language and could develop orthographic representations of words. The results of the current study show that in certain cases, semantic content of the words can easily and quickly evolve in the young and elderly alike. A short-term passive observation of a simple language should suffice to acquire a small set of vocabulary, thus allowing for an understanding of a novel language if words are carefully chosen (see the summary of Hazenberg - Hulstijn 1996).

Grammar learning is equally unsuccessful in both age groups. Subjects did not recognize the rules in the implicit tests in general, although there were some who performed well. The results of the interviews on the other hand revealed that some subjects were able to recall some word endings, and some even learnt the rules. One explanation might be that the knowledge of rules has not manifested itself during the implicit tests because the first strategy developed (poor strategy) was abandoned too late and by the time they had figured out the actual rules, there were no more test stimuli to confirm them.

Participants often judged incorrect sentences to be correct. One explanation for this is that lexical and grammatical information could not be linked to each other in such a short time. It can also be argued that subjects did not perceive the grammatical organization of the language (bearing in mind that they were not instructed to observe the endings, and suffixes may not have been sufficiently prominent perceptually). Schmidt (1990, 2001) introduced the concept of *noticing* in the field of foreign language learning, referring to a very low level of awareness regarding the attributes of inputs, the absence of which may cause failure in acquiring some aspects of a foreign language. The adult language learner treats the levels and sub-processes of a second language as separate, independent elements. Some are paid thorough attention to, while the rest are ignored consciously or unconsciously due to their uninteresting, unnecessary or unlearnable traits (Abrahamsson 2012).

Learning grammar turned out to be a greater challenge for subjects than learning words. The detection and inferring of a novel language's rules requires inductive language learning ability (Otto – Nikolov 2003) and being a component of language learning aptitude (Carroll 1981). Language learning aptitude is a talent, consisting of relatively stable skills independent of intelligence (Segalowitz 1997, Ganschow – Sparks 2001), allowing for estimates of the foreign language learning pace. However, we believe that our results do not indicate that there is a deficit in the subjects' rule extraction ability, rather that grammar development commences with difficulty if the vocabulary of a particular language does not reach a critical size.

For young adults the gender rule proved to be harder, very few were able to report and formulate it correctly. The object-marking rule is characteristic of the Hungarian language, probably making this rule easier to master. In our previous study (Polonyi – Abari – Nagy – Sántha – Gnanadt, in press) we compared the learning performances of Finnish and Hungarian young adults. Our results showed that a grammatical rule that is present in our first language can be learnt more effectively, than rules that are not present.

During the initial phase of foreign language learning, the effects of knowledge of the first language are prominent (MacWhinney 2005), however, as learning experience accumulates in the second language, the impact of our first language mastery on the development of proficiency in the foreign language diminishes (Csapó – Nikolov 2009). The present study suggests (but does not prove) that the influence of the mother tongue on foreign language learning is more notable in young adults, than in the elderly. This phenomenon may be influenced by the fact that the young adults participating in our study are currently attending university making them more active users of languages, including their first language.

During the early stages of our study, we assumed that according to the deceleration hypothesis, the elderly's reaction time for several tasks will be longer than that of younger adults. Our results supported this assumption. By the end test 2, elderly subjects were quicker in word recognition, but there were no improvements in speed when the task was to detect the grammatical rules (NB. no learning occurred). A typical assumption of previous studies is that decline in performance is due to the deceleration of cognitive processes and thereby the decrease in the efficiency of the processing operations. In the word recognition task the elderly are roughly 1.5 times slower than young adults (Allen – Madden – Crozier 1991). In other areas (e.g. choice reaction time, cued reaction time and mental rotation) (Hale –

Myerson – Wagstaff 1987), which tend to be linked to fluid intelligence, the deceleration is more drastic, reaching about 2.05-2.15 (Czigler 2000). The Processing-Speed Theory was proposed to account for some of the age-related differences (e.g. Salthouse 1996). This theory states that the cognitive problems faced by the elderly are rooted in a slowing down of the brain's processing systems. The more complex these processes become, the more deceleration accumulates, resulting in a greater difference between the performance of the young and elderly.

Longer reaction times may also be due to the interference of response systems. Multitasking is more productive, especially in the case of the elderly, when the subject is to respond verbally to the task, instead of pressing a button (Brouwer et al. 1991). This may be related to working memory: if the coordination of information-processing operations demanded by two or more tasks is less effective, then multitasking will also be less successful (Baddeley 1986, 1990). Performance also deteriorates significantly in the cases when a memory-, decision-making process is involved in the task (Strayer – Wickens – Braune 1987). Furthermore, with age, the rate of processes not related to the operation of current information-processing, such as background activity behind the processing procedures, may interfere with the more specific processes (Allen 1991), thus deceleration may also be caused by too many irrelevant processes inhibition.

Previous research examining the abilities of the elderly assert that the deterioration of cognitive performance is far from universal within or between individuals (Czigler 2000). The latter is mainly due to different external influences (e.g. lifestyle, fitness, social status, the presence of various risk factors). Our results indicate that in the elderly group there is a great variation in response times in both recognition tasks, which also suggests that elderly people should not be regarded as having equivalent learning abilities, also bearing in mind that there were subjects who completed the word recognition task with high precision.

It was assumed that those subjects who had a higher rate of previous foreign language knowledge would perform better in the artificial language learning situation. It has been stated that the more languages one knows, the easier it is to learn a novel language (Cenoz 1998 Cenoz – Lindsay 1996, Cenoz – Valencia 1992). Our results do not support this stance, since we found no correlation between participants' language skills and performance in the tasks, that is, those who knew several languages, did not perform better than those who knew less. Perhaps this effect prevails in later stages of foreign language learning, but not at the beginning.

Physical and psychological symptoms of aging are not related primarily to bodily and neurological degeneration, but rather to the abandonment of activities preserving different skills and functions. Those seniors who have tasks, responsibilities and roles are more likely to lead a healthy, harmonious elderly life compared to those who do not have this opportunity. However, occupations have a protective effect only if they involve sufficient physical and/or mental activity, involve human relationships and are not of a compulsive nature (Szemán, Hegyi – Bakó – Molnár 2007).

Studies of nuns conducted by Snowdon et al. (1996) showed a correlation between poor language skills at an early age and the development of dementia. Good linguistic skills at an early age serve as a backup in the event of subsequent cognitive decline, and promote the development of effective strategies for encoding and recalling information. According to the deceleration hypothesis, the slowing down of mental processes can be offset to some extent by the accumulation of knowledge (de Bot – Makoni 2005).

Some studies (e.g. Baltes – Lang 1997) suggest that negative effects of aging can be delayed by learning experiences (or other intellectual activities, crosswords, active learning). Snowdon et al. (1996) proposed that low linguistic abilities accelerate the development of Alzheimer's disease. Moreover, Bialystok et al. (2004) found that bilingual elderly people have

highly developed inhibitory functions, given their second language is not disregarded while the other is in use, rather there is a constant ongoing rivalry in the language production system. In a study, bilinguals showed symptoms of dementia 4 years later than monolinguals (Bialystok et al 2007). Based on all these findings the question arises as to which is a good method for successful language learning (and which methods may compensate for changes in old age). Our results show that there are certain implicit (unconscious) learning processes, but they may prevail mostly in relation to word learning. Incidental learning is not effective in grammar learning, not even in the case of young adults. Providing specific explanations is likely to be more beneficial for the learner at the beginning of the learning process. Our explicit knowledge can later be transformed into implicit knowledge through practice, becoming automatic.

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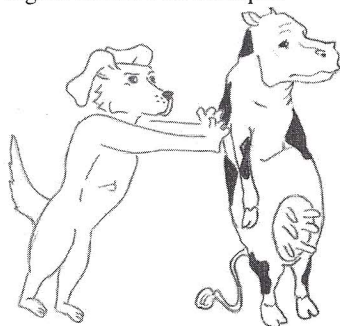
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APPENDIX

Description of the artificial language used in the study

Our language uses a set of digitized drawings in which 20 animals indyadic pairs perform 10 actions⁹. The names of the animals and the actions can be freely combined, generating a large number of scenes (for example: "The dog hugs a lion."). The description of the image in the artificial language is displayed below the images; for example, if in the image a horse is pulling the penguin, below it reads "Rireho reli lemaper". Thus, participants learn the words and grammar of this novel language at the same time, as in a foreign language learning situation.

Figure 6 shows an example.



Garomi poha tunuker.

Figure 6. The equivalent of this sentence:

"The dog pushes the cow."

⁹The co-creator of the Animal Farm picture series was Professor Matti Laine from Åbo Academy, Finland

The language consists of 20 nouns and 10 verbs. All words are randomly generated using the WORDGENERATOR software (<http://www.kolumbus.fi/trekking/wordgenerator.html> - Héjja, 2007). None of the generated words resemble Hungarian words.

The 20 nouns are names of people-like drawn animals like a frog or an elephant, the verbs are transitive verbs that can be used to describe the interactions among the animals in the pictures (e.g. chases someone, kisses someone). Every noun is of CVCVCV (C - consonant, V - vowel) structure, every verb is of CVCV structure. Verbs and objects in the test sentences were defined by a grammatical system based on two rules: grammatical gender rule and object-marking rule. The object-marking rule (characteristic of the Hungarian language) is as follows: if the word ends with an "-o" or "-u", the subject in the sentence will get the suffix "-m" (e.g. dosudu - dosudum). If the noun ends with "-e" or "-i" the suffix is "-r" (e.g. tuvipi-tuvipir). The grammatical gender rule (not present in the Hungarian language) is: if the subject ends with "-u" or "-i" ("feminine"), the verb ending is "-a" (e.g. poha). If the subject ends with "-o" or "-e" ("masculine"), the suffix of the verb is "-i" (e.g. pahi). The male and female roles are assigned to the nouns arbitrarily, so half of the nouns (10) are masculine, and the other half (10) are feminine. Taken together, 5-5 nouns are placed in each category (feminine + "-r"+transitive, masculine + "-r" +transitive, feminine + "-m" +transitive, and masculine + "-m" + transitive).

The training material consists of 80 sentences: 50 SVO (subject-verb-object) sentences, 10 SOV (subject-object-verb) sentences, and 20 SV (subject-verb) sentences. The artificial language has a free word order (as in the first language of the participants). SV-type sentences are introduced in order to assist in the recognition of the subject and the verb. Each noun appears four times as the subject, and three times as the object, every verb appears eight times in two forms (e.g. poha, pahi), four with masculine and four with feminine endings.