

Age Effects and Language Aptitude in SLA: Focusing on Ultimate Attainment in Morphosyntax

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Abstract

Based on relevant theoretical background and empirical findings concerning the age effects on ultimate attainment in morphosyntax, this paper probes into the roles of age and language aptitude in SLA for early learners and late learners. In this paper, main attributes of language aptitude and two orientations towards second language (L2) development are firstly explored. Then Critical Period Hypothesis and Fundamental Difference Hypothesis are discussed in combination with child-adult underlying disparity in language learning mechanism. Through the analysis of three selected empirical studies, the ceiling effects of L2 learning in morphosyntax for early learners are confirmed, and it is suggested that more studies should be carried out to examine the nature of morphosyntax development mechanism for learners of different age of onset.

Keywords

SLA; Age effects; Language aptitude; Ultimate attainment in morphosyntax.

1. Introduction

Second language (L2) aptitude has been described as 'the individual's initial state of readiness and capacity for learning a foreign language' (Carroll, 1981:86). According to Skehan (1989), language aptitude can be regarded as the most successful predictor of L2 outcomes. The predictive power of language aptitude reflects in its relatively stable impact on ultimate L2 attainment.

Contemporary researchers who are interested in the effects of critical period or sensitive period have investigated how language aptitude relates to ultimate L2 outcomes (Ortega, 2009). Some studies provide empirical evidence that there are significant negative correlations between age of onset and ultimate attainment in L2 acquisition among early learners, but no significant association is demonstrated for late learners (Abrahamsson, 2012). On the contrary, language aptitude makes no significant difference for child learners, but it plays a role for older learners (DeKeyser, 2000). However, scholars have not reached an agreement on the effects of age and aptitude, and their relationship in L2 ultimate attainment. Besides different starting ages, aptitude may play different roles in various linguistic domains under different empirical conditions (Granena & Long, 2013).

2. Theoretical Background

2.1. Main Attributes of Language Aptitude and Two Orientations to L2 Learning

Previous studies have provided evidence for the stability of language aptitude since it cannot be changed in general after training on specific cognitive ability (Harley & Hart, 1997). The prognostic function of anticipating how well a learner can acquire a foreign language constitutes a static view of language aptitude (Li, 2015). However, McLaughlin (1990) believed

that language aptitude is not a static personality trait. Instead, aptitude can be enhanced by prior L2 learning experience (McLaughlin, 1990). The experience hypothesis that early immersion learners will exhibit greater language aptitude has not been supported by the study of Harley and Hart (Harley & Hart, 1997). Previous or new experiences are unlikely to lead to major changes in language aptitude (Skehan, 2015).

Another important attribute is that aptitude is in itself componential. According to Carroll (1990), language aptitude is composed of several cognitive abilities rather than a unified concept. Carroll (1981) proposed that language aptitude comprises four components: phonetic coding ability, grammatical sensitivity, rote-learning ability for L2 materials and inductive language learning ability. The conception that aptitude is componential makes researchers take individual differences into consideration. When different learner types are matched with corresponding teaching approaches, both types can achieve successful L2 attainment (Skehan, 1989). Two learner types have been found in studies of Wesche (1981) and Skehan (1986): One group of learners had relatively high ability in memory and another group of learners had good grammatical sensitivity, which is a reflection of high analytical language ability. Skehan (1986) pointed out that the former group was composed of younger learners and the latter group consisted of older learners. Based on the research results, Skehan (1989:37) suggested two orientations to language development: memory orientation and analytical orientation. Whether one orientation is more closely associated with L2 development for early starters and the other orientation is more likely to be related with L2 learning for late starters has been regarded as a key question in this research area (Harley & Hart, 1997). Later empirical studies indicate that the memory orientation is more closely related to an early immersion program, and the analytical orientation is more likely to be associated with a late immersion program (Granena & Long, 2013). One possible explanation for the disparity between different age groups is that a holistic memory-oriented approach is involved in the language processing of early immersion program, in which children extract meaningful chunks of memorized language without internalization, so that the analytical ability will not be adopted (Harley & Hart, 1997). Another interpretation is in keeping with the notion of biologically-based maturational constraints, that is, learners with different age of L2 exposure will rely on different cognitive abilities in language learning because of maturational changes (Granena & Long, 2013).

The age effects on language aptitude cannot be well examined without considering the Critical Period Hypothesis and, arguably, Sensitive Period Hypothesis. In the next part, I will give an overview of the Critical Period Hypothesis.

2.2. Critical Period Hypothesis

Since Lenneberg (1967) found an optimal age period for language learning, the notion that children can learn a language better than adults has become a popular belief. A natural predisposition in children's brain for L1 acquisition has been supported by relevant neurolinguistic data (Ortega, 2009). A biological explanation for the existence of critical period was given: Human brains would undergo the loss of plasticity when the process of lateralization in left brain hemisphere for language functions is completed by the start of puberty (Lenneberg, 1967). The evidence for a corollary in L2 learning is reflected in the observations that children are also adept learners in foreign language acquisition (Ortega, 2009).

Although the hypothesis of a critical period or sensitive period for L2 acquisition has become natural since Lenneberg (1967), this concept continues to be controversial. First, there is less agreement on the explanation of age effects (DeKeyser, 2000). Negative association between age of first L2 exposure and ultimate attainment is still not sufficient to support the biological explanation (Granena & Long, 2013). Second, conflicting phenomena have been found in many studies. Based on the findings of 23 studies concerning L2 acquisition published between 1962 and 1979, Krashen et al. (1979) concluded that adults is better in L2 learning initially, but this

advantage for adults will disappear since children can catch up and do better eventually. In other words, early starters have unquestionable advantage over late starters in ultimate L2 attainment. Many contemporary researchers highlight the importance of taking a long-term view to evaluate the end state of L2 development, and the influences of age in SLA should be carefully examined in different contexts (Ortega, 2009).

Besides the relationship between age and ultimate L2 attainment, another key issue in the Critical Period Hypothesis is the possibility for adult learners to perform like native speakers (Abrahamsson, 2012). On the basis of the Critical Period Hypothesis, it is thought that there is a ceiling of L2 learning (Ortega, 2009). If learners who start learning L2 after the close of critical period can achieve a nativelike command of L2, then the assumed critical period effects will be contradicted. Based on this rationale, the approach of investigating the incidence of nativelikeness has been used in some empirical studies. In the study of Abrahamsson and Hyltenstam (2009), it was found that although the late L2 learners of Swedish can produce apparently nativelike conversations in daily life, their performances in phonology, grammar and other L2 abilities is significantly lower than the level of native speakers. Up to now, no study has been able to show that an adult learner can fully realize comparable nativelike L2 proficiency in all relevant aspects (Abrahamsson, 2012). Therefore, the term 'near-native' is preferred by some researchers rather than 'nativelike' when describing these L2 learners (Abrahamsson & Hyltenstam, 2009).

Despite conflicting findings about age effects, evidence on the Critical Period Hypothesis indicates that differences in starting age can influence how a specific ability or skill is developed. As discussed before, biological changes can partially explain the disparity in learning process. Another explanation is that during the early years of human life, children learn a language in an implicit and natural way, which is fundamentally different from explicit learning for late L2 learners (DeKeyser, 2000). An underlying difference in language learning mechanism between children and adults has been reflected in this concept, which is compatible with the well-known Fundamental Difference Hypothesis. In the following part, Fundamental Difference Hypothesis will be explained in detail and the age effects will be linked to language aptitude.

2.3. Fundamental Difference Hypothesis

Many SLA researchers believe that children and adults arrive at their L2 knowledge through different brain mechanisms. Children can achieve a high level proficiency in their first language because they can make use of their cognitive and linguistic endowment through entirely implicit mechanism, whereas adolescents and adults must rely on explicit learning strategies like analysis and analogy (Ortega, 2009). The Fundamental Difference Hypothesis put forward by Bley-Vroman (1990) has given impetus to the research in the area of aptitude and age. According to Bley-Vroman (1990), children acquire knowledge through an automatic domain-specific cognitive mechanism, which is an implicit and incidental language learning process; for post-critical period learners, a new language is approached through a domain-general mechanism, which is an explicit and intentional language learning process. According to Abrahamsson (2012), incidental acquisition is linked to the whole language system, and all aspects of the system develop at the same time, whereas intentional learning requires explicit instruction and learners' special interests. In DeKeyser's (2000) study, the late learners who had achieved nativelike performance in L2 also get higher scores in the standardized aptitude test, which is a reflection of their high general cognitive learning ability (DeKeyser, 2000). Those late learners have to use their general cognitive abilities or language aptitude to compensate the loss of innate domain-specific learning mechanism (Abrahamsson, 2012).

Because memory is closely related to implicit language learning and analytical ability is heavily involved in explicit language learning, memory may play a more important role in SLA for early-starting learners and analytical capacity might be more predictive for late-starting learners

(Harley & Hart, 1997). This corollary is compatible with the findings that have been discussed in the first part of this section. Another corollary of the Fundamental Difference Hypothesis is that the significant correlations between aptitude and L2 learning outcomes should be demonstrated only or mostly after a certain critical period (Ortega, 2009). The claim that aptitude does not matter before puberty has been supported by some empirical studies. In the study of Johnson and Newport (1989), for early learners whose starting ages were between 3 and 15, little individual variation was shown in the negative correlation between the age of exposure and their performances in grammaticality judgment test, but this finding was replaced by significant individual variation for learners after the starting age of 15. Similar to Johnson and Newport's (1989) study, Ross et al. (2002) found that the importance of aptitude does not emerge before the age of 12. Besides providing evidence to support the claim that aptitude matters only after puberty, their study gave another explanation for the results. Ross et al. (2002) pointed out that changes in learning context may also lead to the result that the importance of aptitude grows larger with the increasing of the age of onset. Due to less natural exposure and more formal classroom instruction, adolescents and adults do not have enough opportunities to acquire a second language in a natural and automatic way (Ortega, 2009). Therefore, the effects of differences in learning contexts should not be ignored in the research concerning the fundamental differences between child learners and adult learners.

Important issues about the Fundamental Difference Hypothesis have been described and discussed in this part. The last part of this section will focus on the effects of age in the development of morphosyntax.

2.4. Age of Onset and Ultimate Attainment in Morphosyntax

Some researchers suggest that multiple sensitive or critical periods may exist in various language domains (Granena & Long, 2013). That is to say, different age effects may be shown in the acquisition of phonology, grammar and other language skills. Compared to the studies on phonology acquisition, relatively few researches have investigated the age effects on ultimate attainment in morphosyntax (DeKeyser, 2000). In this part, a brief literature review is given to explore the age effects in morphosyntax acquisition.

In a pioneering study of Patkowski (1980), 67 second language learners of English were rated in terms of their global syntax proficiency. It was found that learners who had begun acquiring English before the age of 15 achieved much better mean scores than those who had begun acquiring English after the age of 15. The results of the syntax ratings provide evidence for the concept that there is a critical period in L2 learning. Patkowski also used a grammaticality judgement test to the same group of participants, and the results were consistent with the findings in syntax, which further supported the ceiling effects for pre-puberty learners in SLA (Patkowski, 1980). Another seminal study was conducted by Johnson and Newport (1989). Just as what I have mentioned before, this study supported the claim that aptitude does not matter before the puberty because early starting learners showed little individual variation in their responses on grammaticality judgement test and the negative relationship between starting age and test scores abruptly disappeared after age 17 (Johnson & Newport, 1989). Although this study has been frequently cited in SLA literature, it has been criticized on several aspects: first, the length of residence may not be enough for all learners to achieve ultimate attainment; second, the grammar test was so long that may cause excessive fatigue for participants; third, the variable 'age of arrival' was obscured by the 'age of test taking' (Bialystok & Hakuta, 1994). Besides focusing on the correlation between age and learners' responses on L2 grammar tests, researchers in the area of L2 morphosyntax also pay attention to the upper limits of nativelike late L2 development (Ortega, 2009). Some studies have compared the L2 grammar knowledge of proficient L2 learners with that of native speakers to provide evidence against the Critical Period Hypothesis. Successful Arabic acquisition by two adult learners whose first language

was English was documented in the study of Ioup et al. (1994). Both the tutored and the untutored learners in this study seem to have achieved identical ultimate attainment in grammar as native speakers (Ioup et al., 1994). However, DeKeyser (2000) argues that their performances in Arabic are still far from the norm of native speakers, and these results do not contradict the Critical Period Hypothesis. Exceptional results were also demonstrated in the study of Bialystok (1997), in which participants who began acquiring L2 after the age of 15 received higher scores than the learners who started earlier (Bialystok, 1997). However, the L2 performances in this study cannot be fully regarded as ultimate L2 attainment but the reflection of learning rate, because learners' length of residence may not be long enough for them to reach ultimate L2 attainment. According to previous studies on age effects, the rate of short-term learning cannot represent the end state of L2 acquisition since adults have the initial rate advantage (Krashen et al., 1979). Therefore, this study does not actually pose a threat to the Critical Period Hypothesis, either.

Generally, findings in studies on age differences and ultimate morphosyntax attainment are consistent with the concept of critical period. Some findings like strong negative relationship between starting age and L2 acquisition with little individual variation among early learners also indirectly demonstrate that language aptitude is not a significant predictor of successful L2 acquisition before the critical period. In the next section, three important empirical studies will be analysed and discussed for further exploring the effects of age and language aptitude in L2 morphosyntax acquisition.

3. Review of Empirical Studies

In order to provide empirical evidence on the effects of age and language aptitude in L2 morphosyntax development, three important empirical studies conducted by Abrahamsson and Hyltenstam (2008), DeKeyser et al. (2010) and Granena and Long (2013) are chosen for analysis. I will first give a summary of these three empirical studies and then discuss them to answer the following research questions:

- (1) What are the effects of starting age and language aptitude on ultimate morphosyntax attainment for early learners?
- (2) What are the effects of starting age and language aptitude on ultimate morphosyntax attainment for late learners?

3.1. Empirical Study of Abrahamsson and Hyltenstam (2008)

Abrahamsson and Hyltenstam's (2008) study was designed to examine a finding in previous studies that only adults with high verbal aptitude can achieve nativelike ultimate L2 attainment. It is also aimed to investigate whether both early and late learners who were regarded as native speakers in this study were necessarily nativelike in morphosyntax when their L2 performances were scrutinized in linguistic detail. The third aim was to test a hypothesis in DeKeyser's (2000) study that aptitude did not play a significant role in successful L2 learning for child learners. 42 Spanish learners of Swedish who passed for native speakers and 15 native speakers of Swedish were selected to participate in this study. The L2 speakers were assigned into two groups: one included learners who started learning Swedish between the age of 1 and 11, and the other comprised learners who started learning Swedish between the age of 13 and 23. Grammaticality judgement tests and a version of the Swansea LAT were chosen as instruments to measure participants' L2 grammatical intuition and language aptitude.

The results clearly bore out the first prediction that all near-native late starters should have above-average language aptitude. With respect to nativelikeness, the data showed that most of the adolescent and adult learners and nearly half of the child learners performed below the level of native speakers on the grammaticality judgement tests, indicating that most late

learners and some early learners cannot reach entirely nativelike in morphosyntax under linguistic scrutiny. Finally, in contrast to the findings in DeKeyser's (2000) study, language aptitude had shown small but significant impacts on L2 learning for child learners in this study.

3.2. Empirical Study of DeKeyser et al. (2010)

In order to examine the age effects in the acquisition of different languages, two parallel studies concerning the ultimate attainment of two distinct second languages were presented in the research of DeKeyser et al. (2010). This research aimed to test two hypotheses: First, the strong negative relations between age of exposure and ultimate attainment in grammar disappeared for adolescent and adult learners. Second, aptitude had significant impacts on successful L2 acquisition for older arrivals only. All participants in the research were native speakers of Russian, with 76 second language learners of English participating in the first study and 62 second language learners of Hebrew participating in the second study. Different grammaticality judgment tests and the same aptitude test were used in the two studies.

Although English and Hebrew are distinct languages, especially in terms of morphosyntax, the results for both samples showed remarkably similar pattern. The findings in the two studies confirmed both hypotheses. For early learners (below the age of 18), age of arrival rather than language aptitude strongly predicted the ultimate L2 attainment in grammar. For adult starters (ages 18-40), the results were just the opposite. For oldest starters (over the age of 40), neither age of arrival nor language aptitude was a good predictor.

3.3. Empirical Study of Granena and Long (2013)

Granena and Long (2013) conducted this study to identify the scope and timing of sensitive periods in three different language domains: phonology, lexis and collocations, and morphosyntax. Besides, the mediating roles of age and language aptitude were examined in different domains at different times. The participants were composed of 65 L2 learners of Spanish, with 12 native speakers as controls. The L2 participants' starting age ranged from 3 to 29 and they were assigned into three groups according to age of exposure: 3-6, 7-15, and 16-29 years. Participants' language aptitude was measured by the LLAMA test and five measures were involved to assess morphosyntax: a gender-assignment task, a picture-guided narrative, a grammaticality judgment test and two word-order preference tasks. Since the space is limited, I will not specify the instruments of other two linguistic domains.

In conclusion, the findings first confirmed the existence of multiple sensitive periods for different linguistic domains. The offset of sensitive period for morphosyntax began at age 6 and closed in the mid-teens. With respect to aptitude, in the 16-29 age of onset group, the results indicated significant positive relations between language aptitude and ultimate attainment in phonology and lexis and collocations, but no correlation was demonstrated in the domain of morphosyntax. The finding that aptitude did not have a significant effect on ultimate morphosyntax attainment for late acquirers contradicted the results in previous studies.

3.4. Discussion

In a meta-analytic review of the empirical studies concerning the effects of language aptitude on L2 grammar acquisition, Li (2015) classified aptitude research into two different types: one is predictive empirical research, examining how aptitude predicts ultimate L2 attainment; the other is interactional empirical research, investigating how aptitude mediates the comparative effects of different treatment types. Only the first type of research is the focus of my paper. Three predictive empirical studies have been chosen to answer my research questions. Another common feature is that all selected studies were carried out in naturalistic settings instead of classroom contexts. Review of empirical studies in this paper aims to investigate the roles of age and language aptitude in ultimate morphosyntax attainment for learners with different starting ages.

My first research question is about the effects of age of onset and aptitude on ultimate morphosyntax attainment for early starters. In each study, the participants were divided into different groups according to their age of onset. The age effects on morphosyntax for early starting group(s) are generally consistent in all studies. Strong negative correlations between age of first exposure and performances on grammar texts were demonstrated for early learners. This finding indicates that age plays a significant role in L2 morphosyntax acquisition before puberty and it further confirms the existence of critical period or sensitive period in SLA.

In terms of language aptitude, the studies conducted by DeKeyser et al. (2010) and Granena and Long (2013) provide direct evidence for the insignificant effects of aptitude in morphosyntax development for the child arrivals. However, Abrahamsson and Hyltenstam (2008) found that the early starters who scored within the range of native speakers on the grammaticality judgment tests also exhibited higher ratings in language aptitude. One possible explanation is that the grammaticality judgment tests used in the study of Abrahamsson and Hyltenstam (2008) are remarkably more complex and difficult than those in other studies. Different degrees of non-nativeness or near-nativeness in the performances among the early learners can only be observed through fine-grained discrimination because of the strong ceiling effects for early starters (Abrahamsson & Hyltenstam, 2008). In other words, for the early learners, language aptitude is not necessary for near-native ultimate L2 attainment, but it is an advantageous condition for them to achieve the identical level of native proficiency. Therefore, the state that language aptitude plays a small but certain role for early starters is more appropriate than the claim that aptitude plays no significant role in childhood SLA.

My second research question is about the effects of starting age and language aptitude on ultimate morphosyntax attainment for later starters. As for the correlation between age of exposure and ultimate L2 outcomes, all studies have shown similar results. When a critical period or sensitive period is over, the negative correlations between starting age and ultimate L2 development become very small and insignificant. In the study of Granena and Long (2013), although the sensitive period for morphosyntax closed after that of the other two linguistic domains, similar patterns of relationship for late learners were shown in all domains.

Different from the findings on age effects, the results concerning the role of language aptitude for late learners in ultimate morphosyntax attainment are not that consistent. Both the study of Abrahamsson and Hyltenstam (2008) and the research of DeKeyser et al. (2010) confirmed the hypothesis that language aptitude instead of starting age predicts the level of ultimate attainment in morphosyntax for late starters. However, according to Granena and Long (2013), this positive correlation between aptitude and ultimate L2 attainment was reflected in the domains of phonology and lexis and collocation, but not in morphosyntax. The finding that there is no relation between language aptitude and morphosyntax performances in Granena and Long's (2013) study contradicts the claim that aptitude should matter when individuals start learning the L2 after a certain age.

These conflicting findings can be reconciled by the following two explanations. The first explanation is that grammatical rules are generally finite and limited, so that rule-learning can be completed in a short period. Thus, length of residence is more relevant to morphosyntax learning instead of the language aptitude (Granena and Long, 2013). Second, different grammaticality judgment tests may influence the effects of aptitude on outcomes for late learners. In the study of DeKeyser et al. (2010), each item in the tests would be played for a second time to participants after three seconds and a six-second interval was given between each sentence. For the grammaticality judgment tests in Abrahamsson and Hyltenstam's (2008) study, each item was presented once and participants were given ten seconds to response to each complex item. As a result, both of the studies tapped the analytic component of language aptitude. In contrast, sentences in the tests of Granena and Long's (2013) study were relatively short and simple, and they were only presented once without a pause. This type of task is more

likely to tap the implicit L2 knowledge. Therefore, a positive correlation between aptitude and scores in grammaticality judgment tests was facilitated in the first two studies, but not in the third study. Granena and Long (2013) suggest that more speeded and on-line measures may better reflect the underlying linguistic competence of L2 learners. In short, the role of language aptitude for late starters depends on how morphosyntactic knowledge is measured or which dimension of language aptitude is assessed. It is also noteworthy that besides the classification of early learners and late learners, DeKeyser et al. (2010) analysed a group of oldest learners (over age 40 on arrival). For those oldest learners, neither age of onset nor language aptitude played a significant role in their SLA, instead, age at testing can be regarded as a good predictor.

4. Conclusion

This paper aims to investigate the roles of age and language aptitude for early learners and late learners in the ultimate morphosyntax attainment. Recent studies in the area of age and language aptitude more or less based on the Critical Period Hypothesis (Lenneberg, 1967) and the Fundamental Difference Hypothesis (Bley-Vroman, 1990). According to these two hypotheses, it is predicted that age of first exposure will be a strong predictor of ultimate L2 attainment for early acquirers, and a high language aptitude will compensate for the loss caused by negative effects of a critical period for later acquirers.

In the selected empirical studies, researchers have reached an agreement on the age effects for both child learners and adult learners: a strong negative relationship between starting age and ultimate morphosyntax attainment for child learners, but not for adult learners. Despite different findings in terms of the role of language aptitude for early starters, it is reasonable to conclude that aptitude plays a small but certain role for child learners if the morphosyntactic knowledge is scrutinized in linguistic detail (Abrahamsson and Hyltenstam, 2008). For late starters, language aptitude plays a significant role in ultimate morphosyntax attainment when analytic ability is highly involved in the grammaticality judgment test, but no relationship will be found when automatized knowledge of the L2 is highly involved (Granena and Long, 2013). To sum up, the findings of the three selected empirical studies all demonstrate the ceiling effects of L2 learning in morphosyntax for early learners. The Critical Period Hypothesis has been supported by the evidence of differences in age effects between early learners and late learners. However, the clear-cut differences in learning mechanism between child learners and adult learners in the Fundamental Difference Hypothesis are not reflected in study of Granena and Long (2013). Whether implicit learning is partially available to adult learners or not is unclear and requires further research. Therefore, in order to identify the role of language aptitude in ultimate morphosyntax attainment, more studies should be carried out to examine the nature of language learning mechanism for early learners and late learners in terms of morphosyntax development.

References

- [1] Abrahamsson, N. (2012). Age of onset and natively-like L2 ultimate attainment of morphosyntactic and phonetic intuition. *Studies in Second Language Acquisition*, 34(2), 187-214.
- [2] Abrahamsson, N., & Hyltenstam, K. (2008). The robustness of aptitude effects in near-native second language acquisition. *Studies in Second Language Acquisition*, 30(4), 481-509.
- [3] Abrahamsson, N., & Hyltenstam, K. (2009). Age of onset and nativeness in a second language: Listener perception versus linguistic scrutiny. *Language Learning*, 58, 249-306.
- [4] Bialystok, E. (1997). The structure of age: In search of barriers to second language acquisition. *Second Language Research*, 13, 116-137.

- [5] Bialystok, E., & Hakuta, K. (1994). In other words: The science and psychology of second-language acquisition. New York: BasicBooks.
- [6] Bley-Vroman, R. (1990). The logical problem of foreign language learning. *Linguistic Analysis*, 20, 3-49.
- [7] Carroll, J. B. (1981). Twenty-five years of research on foreign language aptitude. In K. Diller (Ed.), *Individual Differences and Universals in Language Learning Aptitude* (pp. 83–118). Rowley, MA: Newbury House.
- [8] DeKeyser, R. M. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition*, 22, 499-533.
- [9] DeKeyser, R. M., Alfi-Shabtay, I., & Ravid, D. (2010). Cross-linguistic evidence for the nature of age effects in second language acquisition. *Applied Psycholinguistics*, 31(3), 413-438.
- [10] Granena, G. & Long, M. H. (2013). Age of onset, length of residence, language aptitude, and ultimate L2 attainment in three linguistic domains. *Second Language Research*, 29(3), 311-343.
- [11] Harley, B., & Hart, D. (1997). Language aptitude and second language proficiency in classroom learners of different starting ages. *Studies in Second Language Acquisition*, 19, 379–400.
- [12] Ioup, G., Boustagui, E., El Tigi, M., & Moselle, M. (1994). Reexamining the Critical Period Hypothesis: A case study of successful adult SLA in a naturalistic environment. *Studies in Second Language Acquisition*, 16, 73-98.
- [13] Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*, 21, 60-99.
- [14] Krashen, S., Long, M. H., and Scarcella, R. (1979). Accounting for child-adult differences in second language rate and attainment. *TESOL Quarterly*, 13, 573-582.
- [15] Lenneberg, E. H. (1967). *The biological foundations of language*. New York: Wiley.
- [16] Li, S. F. (2015). The associations between language aptitude and second language grammar acquisition: A meta-analytic review of five decades of research. *Applied Linguistics*, 36 (3), 385-408.
- [17] McLaughlin, B. (1990). The relationship between first and second languages: Language proficiency and language aptitude. In B. Harley, P. Allen, J. Cummins, & M. Swan (Eds.), *The development of second language proficiency* (pp. 158-178). Cambridge: Cambridge University Press.
- [18] Ortega, L. (2009). *Understanding second language acquisition*. London: Hodder Education.
- [19] Patkowski, M. (1980). The sensitive period for the acquisition of syntax in a second language. *Language Learning*, 30, 449-472.
- [20] Ross, S., Yoshinaga, N., & Sasaki, M. (2002) Aptitude –exposure interaction effects on wh-movement violation detection by pre- and post-critical period Japanese bilinguals. In P. Robinson (Ed.), *Individual differences and instructed language learning* (pp. 267-299). Amsterdam: John Benjamins.
- [21] Skehan, P. (1986). Cluster analysis and the identification of learner types. In V. Cook (Ed.), *Experimental approaches to second language learning* (pp. 81-94). Oxford: Pergamon Press.
- [22] Skehan, P. (1989). *Individual differences in second-language learning*. London: Edward Arnold.
- [23] Skehan, P. (2015). Foreign language aptitude and its relationship with grammar: a critical overview. *Applied Linguistics*, 36(3), 367-384.
- [24] Wesche, M. B. (1981). Language aptitude measures in streaming, matching students with methods, and diagnosis of learning problems. In K. C. Diller (Ed.), *Individual differences and universals in language learning aptitude* (pp. 119-154). Rowley, MA: Newbury House.