A Study on L1 and L2 Acquisition Parallels:

Looking Focus as a Learning Instrument for Second Language Acquisition

by

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Abstract

There is an ongoing debate on whether language acquisition processes supporting first language acquisition extend to the acquisition of a second language. Previous research suggests young infants make use of a language acquisition mechanism in the form of an increased looking focus towards the mouth of the interlocutor when hearing their native or foreign language. However, this increased focus was not seen in the attention distribution of adult controls. The present study aimed to find out whether this increased focus is still present in the attention distribution of adolescent learners as they listen to foreign language, whether attention distribution relates to a foreign language being learned or not, and ultimately whether L2 learners seem to adopt selective attention towards the mouth as an instrument for L2 acquisition. This was done by means of an eye-tracking experiment in which a total of 80 Dutch secondary school students who learned English a second language watched and listened to videos featuring two speakers speak Dutch, English, and Hungarian. Second language proficiency, measured using a phoneme discrimination task and LexTALE, was shown to have no effect on attention distribution. Crucially, there was an increased focus on the mouth when non-native language is heard, regardless of whether it was a language that was learned or not.

1. Introduction

Throughout the years, research has led to a multitude of theories on the workings of language acquisition. At first, much of the research focused on the structure of language. Many of the resulting theories attempt to explain similar aspects of language acquisition through different means and are, at least partially, mutually exclusive. One of the earliest examples of such mutual exclusivity would be the clash between behaviourism (Skinner, 1957) and generative grammar (Lees & Chomsky, 1957) in the 1950s. As time passed, the area of interest in the field of language acquisition broadened and came to include research comparing first (L1) and second (L2) language acquisition. Currently, there are two prominent theoretical perspectives in second language learning research. One movement claims that processes underlying language acquisition of the L1 and L2 are similar whilst the other claims they are different.

On one side of the debate it is theorised essentially the same processes are at play in L1 and L2 acquisition. In this manner the usage-based theory of language acquisition, as proposed by Tomasello (2003), suggests that language acquisition relies heavily on the use of cognitive skills. It posits that language is learned through intention-reading and pattern-finding. This translates into language learning processes such as distributional analysis and generalisation through analogy, which ultimately lead to association between phonological form and meaning. Although Tomasello (2003) argues that children's and adult language do not look alike he claims "the processes working at different developmental stages are constant" (p. 324). Similarly, Bailey et al. (1974) claimed that "children and adults use common strategies and process linguistic data in fundamentally similar ways" (p. 235). In Krashen's (1982) publication on the input hypothesis he states "language acquisition, first or second, occurs only when comprehension of real messages occurs" (p. 11). Following research on morpheme studies conducted by Dulay and Burt (1974), Krashen (1982) asserts that L1 and L2 language acquisition of a given language follows a "natural order" (p. 15) of acquisition of grammatical structures. Although Krashen and Tomasello recognise differences in L1 and L2 learning such as learning pace and a qualitative difference between adult and child language, they argue that essentially similar acquisition processes are used in learning an L1 and L2.

On the other side of the debate researchers argue that L1 and L2 acquisition are guided by fundamentally different processes. For example, Clahsen and Muysken (1989) suggest that differences between L1 and L2 acquisition are "due to Universal Grammar principles guiding

L1, but not L2 acquisition" (p. 1). Instead, they claim learners rely on "the addition of new rules or patterns" (p. 24) in L2 acquisition. They argue that although the developmental outcome of the L2 can resemble that of the L1, it does not mean the same processes are underlying its acquisition (p. 24). A similar comparison between L1 and L2 acquisition is made by Ullman (2001). According to the declarative/procedural model proposed by Ullman the "declarative and procedural memory systems underlie the learning, representation, and use of aspects of lexical and grammatical knowledge, respectively" (p. 105). Ullman argues that grammar acquisition relies on declarative memory in the L2 opposed to procedural memory in the L1. This argument is based on electrophysiological tests that suggest the brain regions associated with procedural memory are less active during grammatical processing in the L2 relative to the L1 (p. 118). Thus he argues that L2 learners acquire language through the memorisation of grammatical rules and apply them consciously whilst L1 learners do so automatically and implicitly.

The research on language acquisition processes extends to the field of phonological attainment. One of the most prevalent questions in the field of phonology is why L2 learners are relatively less successful in the ultimate attainment of phonology than L1 learners. It has been suggested that there is a critical period for L2 acquisition of phonology that is passed at around the age of six (Long, 1990, p. 32). Much of the literature on L2 phonology relates to most late L2 learners having a strong accent in their L2 or being relatively less successful at discriminating non-native sounds. As such, Flege (1991) argues L2 learners already acquired the phonology of their L1 and are "apt to be hindered by the earlier attunement of auditory perception to phones in the L1" (p. 250). Hence, for example, pubescent Dutch L2 learners of English in an educational setting might need to be repeatedly instructed to pay attention to the pronunciation of the initial /θ/ sound in *three*, which is not in the Dutch phonemic inventory, to learn to observe the contrast with /t/ in *tree* and /ð/ in *the*. Contrarily, Werker and Tees

(2002) found that infants learning their L1 do not need such specific instruction and pick up phonetic contrasts unfamiliar to them automatically. Their research found infants between 6 and 12 months old were able to "discriminate many of the phonetic distinctions used across natural languages without relevant experience" (p. 132). They argued that the decline of this ability could be attributed to a narrowing of scope towards the native language after sufficient native language experience had been obtained.

A recent study by Lewkowicz and Hansen-Tift (2012) offers more insight in this mechanism underlying infants' keen sense in phonetic distinction. In human interaction the eyes form the area of interest most looked at and they facilitate social communication (Itier et al. 2007). Furthermore, it is known that infants process faces by paying most attention to the eyes (Oakes & Ellis, 2013). However, Lewkowicz and Hansen-Tift (2012) predicted that infants would start looking more at the mouth of a person speaking to them as infants started to engage in canonical babbling, from approximately 6 months of age onwards. In this stage infants start mimicking a variety of sound combinations, such as *baba*, and the mouth may prove useful as its salient movements could provide the infants with useful speech information regarding production. Consequently, Lewkowicz and Hansen-Tift predicted that less attention to the mouth would be given as the infants pass this stage, as its movements would then prove to be redundant. They hypothesised, however, that infants hearing a non-native language would retain their attention towards the mouth as this might help them learn and distinguish the unknown sounds of the language. To validate their predictions they "tracked 4–12-mo-old English-learning infants' and adults' eye gaze while they watched and listened to a female reciting a monologue either in their native (English) or non-native (Spanish) language" (p. 1431). As predicted, the 12 months old infants remained focused more on the mouth than on the eyes in the non-native condition, for respectively 42% and 12% of the total looking time. The adult controls, however, looked more at the eyes when hearing the foreign language. Lewkowicz and Hansen-Tift stated that the 12 months old infants look more at the mouth than adults when hearing foreign language as they “revert to reliance on redundant audiovisual information to disambiguate an unclear speech signal” (p. 1435). They argue the difference between adults and infants in this condition might suggest the attentional shift when hearing non-native speech “begins later in development than the shift for native speech” (p. 1433). This implies that looking focus, which appears to function as a language acquisition mechanism for phonology and comprehension, is not always used to the same extent and is dependent on age and proficiency.

In the light of the debate on what and whether language acquisition processes extend from L1 to L2 acquisition and the findings of Lewkowicz and Hansen-Tift (2012) it might prove fruitful to gain insight on what the attention distribution of adolescents looks like when they listen to native, a learned second, and non-native language. The question that arises is whether the shift of attention distribution when listening to non-native language occurs during adolescence, as it was proposed by Lewkowicz and Hansen-Tift to occur between infancy and adulthood (p. 1433). Furthermore, their study only provides insight in the attention distribution of infants and adults listening to their native and a foreign language. Not much is known about what learners of an L2 pay attention to when hearing their L2. It is known, however, that gaze and eye contact serve a multitude of functions such as providing information or regulating interaction (Kleinke, 1986) and it is possible for these functions to have a higher priority than being attentive to the redundant speech information the mouth can provide. Hence, research into the attention distribution of L2 learners might show whether the L1 acquisition mechanism is still active in L2 acquisition. Lastly, it would be interesting to see whether L2 proficiency holds a relation with L2 attention distribution, similar to the relation between native language expertise and infants’ L1 attention distribution as suggested by Lewkowicz and Hansen-Tift (2012, p. 1433).

In an attempt to find answers to these questions this study will seek to find out whether adolescent L2 learners focus more on the mouth when listening to their L2 or a foreign language than when listening to their L1. The study will also attempt to find whether the level of L2 proficiency is related to L2 attention distribution. The study aims to do so through an eye-tracking experiment at a Dutch secondary school where English is being learned as an L2.

2. Research question and hypotheses

In an attempt to shed more light on the attention distribution of adolescent L2 learners this study will address the following questions and hypotheses:

Research question: Do adolescent L2 learners focus more on the mouth when listening to their L2 relative to the L1?

It is unknown which part of the face of an L2 speaking interlocutor attracts the most attention by L2 learners. The adults in the study by Lewkowicz and Hansen-Tift (2012) were found to focus their attention towards the eyes when presented with a foreign language that they did not aspire to learn. In contrast, the infants in the study directed their attention towards the mouth when hearing the non-native language. Attention towards the mouth can be beneficial in speech comprehension and the acquisition of speech production. Thus, it is hypothesised that adolescent L2 learners, who are motivated to learn the language, make use of selective attention towards the mouth to understand and possibly acquire the L2.

Sub-question: Is there a relation between looking focus and whether the language listened to is learned or foreign?

The adults in the study by Lewkowicz and Hansen-Tift (2012) did not aspire to learn the language they listened to in the non-native condition. However, it might be so that there is an increased focus on the mouth only if a language is being learned. In this case, learners will only pay more attention to the mouth when listening to a foreign language they are learning, but not when listening to any other foreign language.

Sub-question: Is there a relation between L2 proficiency and the looking focus of adolescent L2 learners?

In the study by Lewkowicz and Hansen-Tift (2012) infants gained and lost interest in the mouth as they first had to familiarise themselves with the sounds of their first language and later acquired sufficient first language expertise to no longer rely as heavily on speech information provided by the mouth. The same tendency might be observed as learners of an L2 become more proficient in it. A relation between L2 proficiency and attention distribution where adolescent learners of English as their L2 will gradually look less at the mouth and more at the eyes as they become more proficient in the L2 would point to a language acquisition mechanism similar to that of infants.

3. Method

3.1 Subjects

The participants were Dutch secondary school students, from a school in Gelderland, who followed either lower general secondary education (MAVO), senior general secondary education (HAVO) or pre-university education (VWO). Apart from HAVO and VWO, the school offered only the MAVO track, also known as the theoretical programme, which is the highest level within the pre-vocational track (VMBO)[1]. Participants were 40 men and 40 women aged 12 to 18 years (men: $M = 14.6$, $SD = 1.61$; women: $M = 14,4$, $SD = 1,53$) and were spread across the first until fifth years of secondary school. There were nine students with dyslexia and three with autism spectrum disorder. Their results were noted in the data processing as a precaution. One of the researchers was employed at the school and arranged for the study to be carried out there. Through a newsletter, the school briefly informed parents about the study taking place on its premises, also offering them the option to exclude their children from the study. Students were to participate in the study on a voluntary basis and were not granted compensation such as bonus points.

3.2 Materials

This study examined the attention distribution of adolescents at different stages of learning English as a second language. In the Netherlands, children are taught English as a foreign language from their first year of secondary school onwards, regardless of the level of education they follow. However, some children might already have been taught English at primary school or at home. As a result, the levels of English proficiency within groups of children enrolled in the same year and level might differ greatly. Therefore it was crucial for the study to control for each of the students' English proficiency using various measures. For this purpose the study administered two proficiency tests. After guiding the students through the tests they were led through the eye-tracking experiment.

3.2.1 LexTALE

A lexical decision task served as the first measure of the participants' English proficiency. LexTALE (Lemhöfer & Broersma, 2012) is a standardised lexical test available in Dutch,

[1] More information on the Dutch secondary school system and all sub-levels can be found at https://www.government.nl/topics/secondary-education.

English, and German, of which the scores correlate substantially with overall proficiency. The scores obtained on the test offer insight into the participants' lexical as well as phonotactic knowledge about the language. The LexTALE test provides the participant with a string of letters to which the participant needs to reply whether it is an existing word in the target language. It is made up of 40 existing words and 20 non-words, totalling 60 items. LexTALE is offered as a free instrument and is available to use online. For practical reasons, however, the LexTALE test was programmed into a Java application by the researchers. This allowed for easier data collection and ensured that each participant went through exactly the same process. Although the instruction for the test was presented on screen for the participant to read in Dutch, the researcher also briefly elaborated on what the participant was expected to do.

3.2.2 Phoneme Discrimination Test

A phoneme discrimination task served as the second measure of proficiency. It was constructed to measure to what extent a participant was able to recognise and distinguish unknown sounds in English. The score on this task allowed the researchers to relate the phoneme discrimination ability of a participant to the data gathered from the eye-tracking experiment.

However, for the purpose of this study, the phoneme discrimination task featured items that focused on the differences between the Dutch and English phonemic inventories. As such, the target non-words were minimal pairs in CVC structure with the target contrasting sounds in either initial or final position when it was a consonant, or in medial position when it was a vowel. In total, a list of 20 minimal pairs was made with contrasting sounds such as /fɒd/ and /θɒd/ or /wʌb/ and /wɜ:b/. There also were minimal pairs with a contrasting diphthong in the vowel position such as /tɪək/ and /teək/. The minimal pairs always differed in only one sound segment. The non-word minimal pairs were generated by a Java script written by the researchers. Ultimately, the phoneme discrimination task consisted of the target minimal pairs, control pairs where the same non-word was repeated, and control pairs with only sounds from the Dutch phonemic inventory. The entire list of stimuli can be found in Appendix A.

Using Java, the researchers programmed the task into the same application as the LexTALE test. Apart from keeping track of the number of items correctly answered by the participant as a total, the program also did so per item across all participants, which allowed for statistical reliability tests to be performed. The items in the task were presented in a set order that was randomised once. The standardised order ensured all participants followed the same procedure and that there could be no effect of order between participants.

To construct the phoneme discrimination task a male native speaker of English, with an accent that might be called Estuary English, was recorded pronouncing non-words. The audio was recorded using a Sennheiser me-64 microphone in a sound-proof lab. The audio was edited with Audacity audio editing software to fit the aims of the task. The speaker had knowledge of phonology and taught it at university. He was, therefore, presented with phonetic transcriptions. He was aided with orthographic representations of the sounds and instruction from one of the researchers.

3.2.3 Eye-Tracking Test

The aim of the eye-tracking test was to find out what parts of the face were being looked at most by adolescents L2 learners of English when listening to a person speaking Dutch, English, or an unknown language. Therefore appropriate stimuli had to be made with which the eye-focus of the participants could easily be registered. This study focused on the mouth and eyes as separate areas of interest.

A trilingual speaker of Dutch, English, and a foreign language would best fit the aims of this test. This would exclude an effect of speaker on the attention distribution of the participants across different languages. Unfortunately, however, no such speaker could be found and the study made use of a design with two speakers. The first speaker was a native speaker of both Dutch and English and was 22 years old. The second speaker was a native speaker of both Dutch and Hungarian and was 24 years old.

Firstly, there was a condition in which the participant heard and saw someone speaking English. Secondly, a reference point to compare these looking patterns with was required. A condition with the same speaker talking Dutch, the participants' native language, served this purpose. Furthermore, a condition with a language completely unbeknownst to the participant was required to find whether looking patterns differed between language that is learned and language that is not. For this purpose a condition with a speaker of Hungarian was made. Lastly, another condition in which this speaker spoke Dutch was necessary to control for an effect of speaker on attention distribution. Hungarian was chosen as the foreign language as it is not part of the Indo-European language family and therefore unrelated to the Germanic languages English and Dutch. Moreover, it was highly unlikely that the participants would be familiar with the language.

It was important that the stimuli were interesting to listen to and look at, as it might have influenced the looking patterns of the participants if they were not. Therefore, each condition featured a speaker performing a carefully constructed monologue about fictional school experiences totalling approximately 400 words each. The monologues were about friendship, studying for exams, and going on a school trip to a foreign country. The order in which the stimuli were presented might also have been of influence on the attention distribution of the participants. To control for such an effect four lists were constructed in which the stimuli were presented in a set order. Across the four lists each condition would be presented only once in each position and the speakers would alternate.

For optimal video and audio quality the stimuli were recorded using a Panasonic SDR-H80 camera that could record up to a resolution of 1920 by 1080 in combination with a Sennheiser me-64 microphone. As with the phoneme discrimination task, the recordings were made in a sound-proof lab. A Tobii 1750 eye-tracker was used to conduct the eye-tracking experiments. The proportional looking times at the mouth and eyes were calculated using Clearview software and a Java script written by the researchers.

3.3 Procedure

Data was gathered from the 9th until the 20th of May 2016, totalling 9 days excluding weekends and a holiday. On the first day, eye-tracking equipment was transported to the school and set up in a reserved room. The proficiency tests were carried out in a different room that was also reserved for the timeframe of the study. During their classes, students were asked to participate and were excused from class for at most 45 minutes. The study featured stratified random sampling, on the assumption that there would be a strong correlation between students' English proficiency and year of secondary school. This meant that, in an attempt to obtain participants across the entire continuum of L2 proficiency, an equal number of students were asked to participate across the years of secondary school. When selected, students were told that they were to do several English tests and that, apart from these tests being interesting and fun to take part in, feedback could be provided on their scores. They were also told that they were to watch several videos of a person talking about school experiences.

Firstly, a participant was taken to the test room. The application created by the researchers guided the participant through the proficiency tests and kept track of all test scores and other data such as age, gender, or whether a student had dyslexia. The researcher also asked the students about how and when they started learning and hearing English and made note of this. The participants were promised anonymity and were therefore given a participant number. Using the program, the participant went through a LexTALE test and a phoneme discrimination task while one of the researchers observed and would troubleshoot if necessary. At the end of the tests the program would output the data in a CSV format text document that was suitable for processing by statistical analysis software. The student would then be taken to the eye-tracking room. The other researcher would take over and informed the participant that four videos would be shown in which someone talked about school experiences. The participant was instructed to try and understand what was being said in each monologue in such a manner that the stories could be summarised in keywords. The researcher would make sure that the equipment was calibrated and ready for use. After the videos had been shown, the participant would be given the option to receive feedback on the proficiency test scores, with which the experiment concluded.

4. Results

There were two participants that did not complete the LexTALE test due to an initial error in the proficiency test application. One participant scored below probability level on the controls in the phoneme discrimination task. There were nine participants of whom the eyes could not be tracked properly.

4.1 Proficiency Tests

As predicted, there was a positive correlation between LexTALE score ($r(78) = .25$, $p = .028$) and level ($r(78) = .48$, $p < .001$). The score distribution on the LexTALE test can be found in Fig. 1. A phoneme discrimination task served as a second measure for English proficiency (*M*

= 88.09, *SD* = 14.871, N = 79). A reliability test showed that Cronbach's Alpha amounted to .879 for the phoneme discrimination task, which did not change significantly had items been deleted. Unlike the LexTALE score, the extent to which a participant scored well on the English targets did not correlate with level ($r(79) = .04$, $p = .719$) or year ($r(79) = -.04$, $p = .751$). There was no correlation between the performance on the phoneme discrimination task and LexTALE test scores ($r(77) = -.03$, $p = .784$), which suggests that they measured different constructs. There were too few participants with dyslexia or a form of autism to perform valid statistical tests with regards to LexTALE score, as distribution across year and level is of importance. Independent t-tests suggested neither dyslexia or autism had a significant effect on scores on the phoneme discrimination task (all *p* values above 0.05).

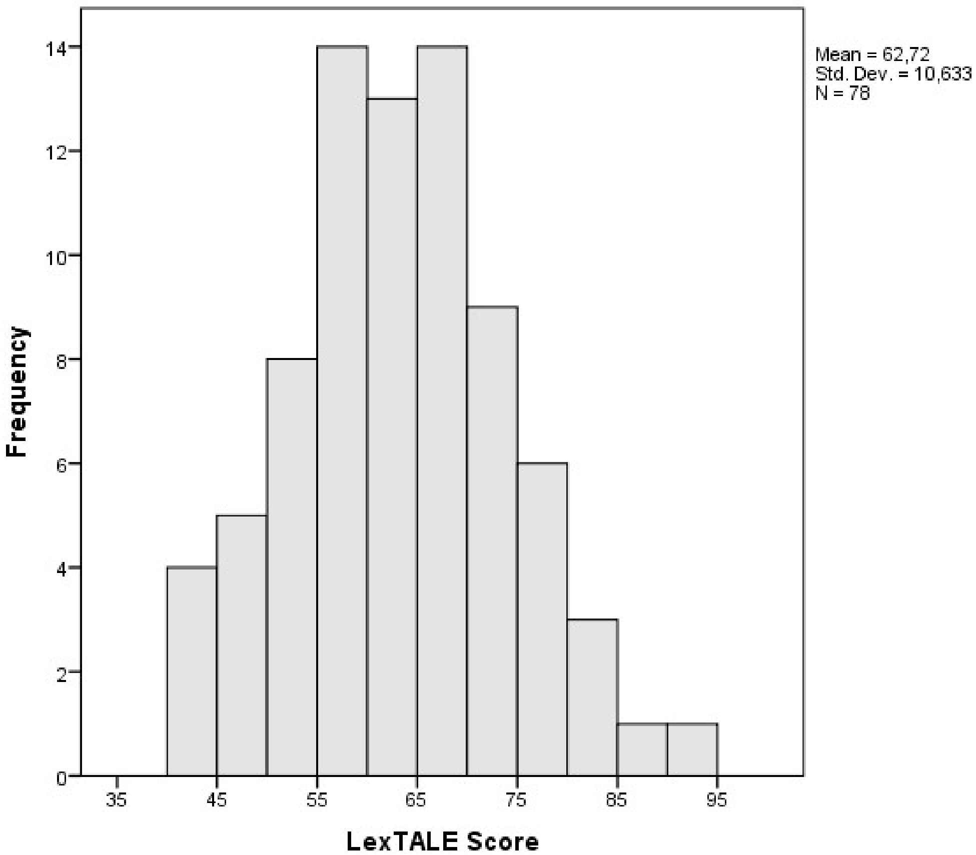

Figure 1

The LexTALE score distribution across all participants.

4.2 Eye-tracking

There were significant main effects of speaker ($F(1,70) = 102.263$, $p < .001$, partial $\eta_p^2 = .594$) and language ($F(1,70) = 5.336$, $p = .024$, partial $\eta_p^2 = .071$) on attention distribution. There was no interaction effect between speaker and language on attention distribution ($F(1,70) = 0.042$, $p = .838$). The main effect of speaker, as seen in Fig. 2, means that the proportional looking time towards the mouth is greater in conditions featuring one speaker relative to the conditions featuring the other. The main effect of language means there was more focus on the mouth in the conditions in which the participants were exposed to a language not native to them, as compared to the native language conditions.

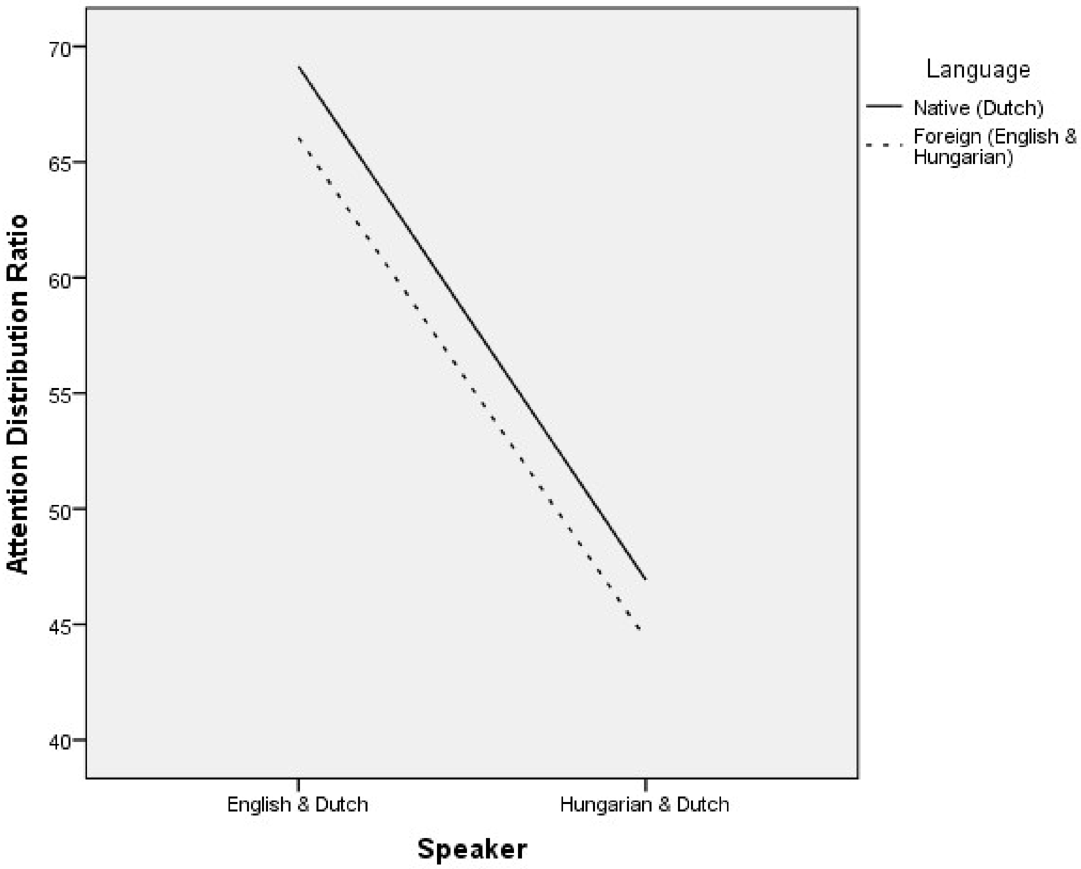

Figure 2

Attention distribution expressed in mean ratios of proportional looking time towards the mouth, a ratio of 0, and the eyes, a ratio of 100, across the conditions.

An independent t-test and multiple factor ANOVA showed neither gender nor the order in which the stimuli were presented had a significant effect on attention distribution of the participants across the conditions (all *p* values above 0.05). There was no relation between proficiency and attention distribution, as the LexTALE and English target scores on the phoneme discrimination task held no significant correlations with the attention distribution ratios across all conditions (all *p* values above 0.05). Yet, there was a weak significant correlation between the attention distribution in only the English condition and age ($r(71) = .235$, $p = .049$).

5. Discussion

This study aimed to find whether there is a relation between attention distribution and whether a foreign language is being learned or not. It also aimed to find whether the L1 acquisition mechanism infants seem to use, selective attention towards the mouth, can also be found during L2 acquisition. Lastly, the study sought to find whether there was a relation between L2 proficiency and L2 attention distribution on the assumption that a high level of proficiency would result in less attention towards the mouth. The study tried to find answers through an eye-tracking experiment that provided insight into the attention distribution of adolescent Dutch L2 learners of English across the eyes and mouth of someone reciting a monologue in their L1, L2, and Hungarian.

The results indicate that the attention distribution is subject to what language is heard. Most attention to the mouth is being paid when a non-native language is heard relative to when the native language is heard. Crucially, whether the non-native language is being learned or not does not seem to matter as the increased focus on the mouth was found in both the English and Hungarian conditions. Furthermore, the results demonstrate that the attention distribution over the eyes and mouth is heavily subject to change per interlocutor. In addition, L2 proficiency seems to hold no relation with L2 attention distribution. Lastly, although the results do not exclude it, the study is only able to speculate on whether selective attention distribution in the L2 is an extension of the L1 acquisition learning mechanism.

The increased focus on the mouth in the non-native language conditions might serve as a selective attention strategy, either consciously or unconsciously, that helps obtain supplemental information from the source of the speech signal to disambiguate and help understand what is being said. This is especially so because the present study instructed the participants to try and summarise what was being said in each video of the eye-tracking test. It might be so that less attention to the mouth would be paid in the English and Hungarian conditions if this instruction had not been given. However, the instruction ensured active participation in the eye-tracking test and is likely to have resulted in a more natural attention distribution, as interlocutors also try to understand each other during conversation.

The study by Lewkowicz and Hansen-Tift (2012) shows a great increase in proportional looking time towards the eyes in the non-native condition between adults and 12 months old infants. Lewkowicz and Hansen-Tift suggest the shift in attention when listening to non-native language occurs between infancy and adulthood (p. 1433). The findings of the present study seem to suggest that the attention distribution of adolescents when listening to foreign language is still predisposed towards the mouth as compared to when listening to native language. However, the significant main effect of speaker suggests that a different experimental setup is required to be able to compare the attention distribution of all different age groups appropriately, as attention distribution is heavily influenced by factors such as facial features and expressions that differ per person. So, although the present study found that adolescents have an increased focus towards the mouth in the non-native conditions, it is not possible to conclude whether the supposed shift of attention prior to adulthood has already occurred.

Unfortunately, the current study is unable to draw conclusions about whether the increased focus on the mouth in the L2 condition is evidence for a language acquisition mechanism similar to that of the infants in the study of Lewkowicz and Hansen-Tift (2012). The attention distribution of the infants was found to be related to their language expertise, expressed in phoneme discrimination ability, and stage of language development. This study found no such relation, which was assumed to be present between the measures of proficiency, a lexical decision and L2 phoneme discrimination task, and attention distribution. There are multiple possible explanations for the absence of this relation. One such explanation is that there simply is no effect of proficiency in a foreign language on attention distribution. Another explanation is that the target group of the current study might have already passed the stage in which there is a relation between attention distribution and, for example, L2 phoneme discrimination ability. This explanation is plausible as the participants of this study were already able to discriminate most of the L2 phonemes without error. Their success in the discrimination of English phonemes might be attributed to children in the Netherlands generally being exposed to English from an early age onwards. To test this, research on the attention distribution of L2 learners would need to be conducted that takes length of exposure to into account and controls for the extent of acquisition of the L2 phonology.

Interestingly, however, the current study found a significant positive correlation between the attention distribution ratios in the English condition and age. This translates to a decrease in attention towards the mouth when exposed to the learned language as L2 learners age. The question that arises is where this age effect derives from. It might be so that it holds a relation with length of exposure to the L2, as the length of exposure is known to increase per year of secondary school a student has attended.

While the current study offers more insight in the attention distribution of adolescents across their native and non-native languages it also raises new questions. Future research on for example the attention distribution of bilinguals or multilinguals might further test whether there is a difference in attention distribution between non-native and native languages. Furthermore, research focusing on the attention distribution of different age groups of L2 learners with varying lengths of exposure might provide more insight in whether the increased focus on the mouth is an age-related phenomenon and to what extent attention distribution is dependent on to what extent a language sounds new. Although the current eye-tracking technology might not be able to do so yet, the rapid development in eye-tracking technology might make it possible to conduct eye-tracking experiments in real time in the near future. When this time comes it might be fruitful to conduct research on the attention distribution across the L1 and L2 in other conversational settings such as in a real-time dialogue. This might more realistically showcase language acquisition processes at work.

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Appendix A

A broad phonetic transcription of all the minimal pairs has been provided below. The orthographic representation is given after each pair. Unvoiced-voiced pairs that are difficult to represent orthographically like Thimu, Thimv have been marked with an asterisk.

1. /fɒd/ and /θɒd/ Fod, Thod
2. /jæf/ and /jæθ/ Yaf, Yath
3. /pep/ and /peb/ Peb, Peb
4. /puːŋ/ and /buːŋ/ Puung, Buung
5. /tʊʧ/ and /dʊʧ/ Tootch, Dootch
6. /rət/ and /rəd/ Rut, Rud
7. /ʧIb/ and /ʤIb/ Chib, Djib
8. /sɑʧ/ and /sɑʤ/ Sach, Sadj
9. /kɔɪv/ and /gɔɪv/ Koive, Goive
10. /ʃɪk/ and /ʃɪg/ Shik, Shig
11. /θIm/ and /ðIm/ Thimu, Thimv *
12. /bIθ/ and /bIð/ Bithu, Bithv *
13. /dep/ and /dæp/ Dep, Dap
14. /tɒn/ and /tɑn/ Ton, Tan
15. /wʌb/ and /wɜːb/ Wub, Wub (difference is difficult to present orthographically)
16. /dʊp/ and /dɔːp/ Dohp, Doop
17. /ʃɒv/ and /ʃʊv/ Shov, Shoov
18. /tɪək/and /teək/ Tiuhk, Teuhk
19. /baʊd/ and /bəʊd/ Baood, Beood
20. /faɪk/ and /faɪg/ Faik, Faig

The order in which the sound files appeared to the participants in the phoneme discrimination task has been provided below.

1 Shik Control,
2 Rut Control,
3 Dootch Control,
4 Koive Goive,
5 Tiuhk Control,
6 Bithu Control,
7 Shov Shoov,
8 Doop Control,
9 Tootch Control,
10 Puung Control,
11 Rud Control,
12 Sach Control,
13 Teuhk Control,
14 Thimu Control,
15 Dap Control,
16 Pep Control,
17 Baood Control,
18 Wuhb Control,
19 Tan Control,
20 Pep Peb,

21 Dep Control,
22 Tiuhk Teuhk,
23 Chib Jib,
24 Wub Wuhb,
25 Beood Control,
26 Wub Control,
27 Goive Control,
28 Thimv Control,
29 Bithu Bithv,
30 Dohp Control,
31 Rut Rud,
32 Bithv Control,
33 Sadj Control,
34 Shov Control,
35 Yaf Yath,
36 Peb Control,
37 Jib Control,
38 Fod Control,
39 Shig Control,
40 Sach Sadj,
41 Thod Control,
42 Doop Dohp,
43 Fayk Control,
44 Dep Dap,
45 Yath Control,
46 Thimu Thimv,
47 Ton Tan,
48 Fod Thod,
49 Yaf Control,
50 Shoov Control,
51 Koive Control,
52 Fayk Faig,
53 Puung Buung,
54 Shik Shig,
55 Baood Beood,
56 Faig Control,
57 Ton Control,
58 Tooch Dooch,
59 Buung Control,
60 Chib Control.