Individual differences in foreign language learning success: a psycholinguistic experiment

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Abstract
This article describes a psycholinguistic protocol designed to elicit individual differences in performance regarding phonological and lexical aspects of learning Italian as a foreign language. Thirty native speakers of Danish participated in two experiments which examined their discrimination ability for a novel Italian consonant contrast (Experiment 1) and their ability to memorize novel vocabulary items (Experiment 2). The experiments revealed a wide range among participants regarding the number of novel vocabulary items memorized as well as a minor spread regarding the discrimination of a novel Italian consonant contrast. No correlation could be revealed between learning success in vocabulary acquisition and phonological discrimination. We conclude that the two types of tasks can be used as instruments for quantifying aspects of learning Italian as a foreign language. This study is the first half of a larger study, where the second half is an EEG study (to be presented separately elsewhere) aiming at mapping the possible neurophysiological correlates of more or less successful foreign vocabulary memorization and sound distinction.

1. Foreign language learning success

Successful foreign language learning depends on a wide variety of factors, which can be grouped according to whether they are subject external factors or subject internal factors. Subject external factors include *type of contact*

Sten Vikner, Henrik Jørgensen & Elly van Gelderen (eds.): ***Let us have articles betwixt us – Papers in Historical and Comparative Linguistics in Honour of Johanna L. Wood.***
Dept. of English, School of Communication & Culture, Aarhus University,
pp. 299-318, © The author(s), 2016.

with the language to be learned and – if the process is guided – teaching setting aspects such as *classroom setting* and the *pedagogical approach, materials,* and *processes*. However, even if external factors are controlled experimentally, learners still show important differences in their learning success. These individual differences (ID) are described by ID psychology, which is an approach that, instead of describing the typically shared features of human behavior, focuses on its varieties. Among the individual factors influencing foreign language learning, ID psychology investigates *personality, motivation, learning styles, learning strategi*es and *language learning aptitude* (Dörnyei 2006:42; 46; 48ff). The latter factor has been measured by various *language aptitude tests* (see e.g. the contribution to Dogil 2009 and Dörnyei 2006:46ff. or Grigorenko 2000:390-392 for discussion). Carroll (1981:105) described foreign language aptitude as consisting of the following components: *phonetic coding ability* ("ability to identify distinct sounds, to form associations between these sounds and the symbols representing them, and to retain these associations"), *grammatical sensitivity* ("ability to recognize the grammatical functions of words (or other linguistic entities) in sentence structures"), *rote learning ability* ("ability to learn associations between sounds and meaning rapidly and efficiently, and to retain these associations") and *inductive language learning ability* ("ability to infer or induce the rules governing a set of language materials, given samples of language materials that permit such inferences"). More recent research has focused on the context dependence and on the interrelation of these ID factors. According to Dörnyei (2006), one of the most promising directions in language aptitude studies is the investigation of the relationship between foreign language learning and the cognitive function of *working memory* which "may be one (if not the) central component of this language aptitude" (Miyake & Friedman 1998:339). *Working Memory*, as described by Baddeley & Hitch (1974), is a complex loop system with different functional modules constantly interacting with one another and controlled by a supervisory *attention* component. The *attention* system controls *a visuo-spatial short term memory (STM) function* (dealing with visual and spatial material) as well as a *phonological STM function* (holding verbally coded information). *Phonological short term memory* reflects itself in the ability (impaired in e.g. dyslexic individuals) to repeat phonological sequences (words, numbers, non-words) which in turn predicts a learner's ability to acquire vocabulary in first, second, and foreign language learning. As for *attention*, this concept "is necessary in order to understand virtually every aspect of second language acquisition

(SLA), including […] the role of individual differences such as motivation, aptitude and learning strategies in L2 learning […]" (Schmidt 2001:3). Furthermore, this author points out that *"attention"* covers a variety of mechanisms such as *alertness, orientation, pre-conscious registration* (detection without awareness), *selection* (detection with awareness within selective attention), *facilitation,* and *inhibition*. In the field of attention research, there is much debate as to whether learning is possible without attention ("incidental learning"). While some studies, e.g. on visual perception, seem to give a positive answer to that question (DeSchepper &Treisman, 1996), Schmidt (2001:28) has doubts about the relevance of these findings for foreign language learning, given the very different nature of its input. For Schmidt (2001:29), "learning in the sense of establishing new and modified knowledge, memory, skills, and routines is […] largely, and perhaps exclusively, a side effect of attended processing." Furthermore, as DeSchepper and Treisman (1996) have shown, previously ignored (suppressed) information is more difficult to access (as can be seen by a delay in response time in subsequent tasks that involve this information) than completely new information, so "we might have an explanation, not for development in language learning, but for non-learning through habituation of the self-instruction to ignore something" (Schmidt 2001:28). Thus, if attention is seen as an important prerequisite of learning in general and foreign language learning in particular, an individual deficit with regard to this cognitive mechanism is likely to lead to less efficient acquisition processes.

More recently, it has been suggested that working memory also contains a component referred to as *semantic STM*. According to Haarmann et al. (2003:322), "semantic STM stores lexical-semantic item representations (i.e., word meanings) that are actively maintained until they can be integrated into a meaning relation with words that occur later in the sentence" and individual differences in the capacity of semantic STM seem to predict complex language tasks, such as single-sentence and text comprehension.

Neurolinguistic research seems to have been able to map correlations between semantic working memory and particular patterns of neurological activity for quite some time (e.g., Klimesch 1999; Haarmann 2005). It was therefore our aim to develop a test that could make individual differences in foreign language learning success emerge, while at the same time being suitable for mapping their potential neurophysiological correlates by a follow-up EEG study.

The assumptions presented above on working memory and the central role of its phonemic and semantic components regarding foreign language learning, together with its consequences for individual differences in learning success, provided the motivation to design a foreign language learning test containing both a task on word memorizing as well as a task on sound discrimination.

The following sections present a test of this type together with the results of an experiment, conducted at the Italian Department at Aarhus University with 30 native Danish speaking participants without any prior knowledge of Italian.

2. Foreign language learning capacity: the experiment

2.1 Participants

36 monolingual[1] native Danish speakers (20 female, 16 male) aged 19 to 33 (mean: 25.5 years) without any previous knowledge of Italian volunteered as participants. The participants were current or former university students, recruited by analog and digital advertisements as well as personal contacts. After the experiment, the participants completed a questionnaire about their socio-cultural background, including questions about their knowledge of other foreign languages and their personal evaluation of own abilities and desire to learn a foreign language. The participants received a cinema voucher worth 75 Danish kroner (10 Euro) in compensation for their participation.

The sound discrimination task yielded a complete data set from 36 participants. However, results from the word learning task from six participants (3 m, 3 f) had to be excluded from analysis because of an equipment malfunction. Therefore, the comparison of the data between the vocabulary learning and the sound discrimination tasks is based on the results from the 30 participants for whom complete data sets for both tasks exist.

2.2 Method

2.2.1 Consonant discrimination

2.2.1.1 Stimuli and procedure

The ability to discriminate Italian speech sounds was examined using a categorical AXB task. Each trial in this task consists of a triplet of physically distinct speech sounds. The task of the listener is to determine

[1] I.e. with exclusively Danish as their native language (all Danes learn English as an L2 at school, many also German as an L3).

whether the sound in the middle ("X") is "more like" or "equivalent to" the sound presented first ("A") or the sound presented last ("B").

The present experiment examined the discriminability of the Italian /ʎ/-/l/ contrast.[2] Italian /l/ is realized just like Danish /l/, i.e., as an alveolar lateral approximant. Italian /ʎ/, which is a palatal lateral approximant, does not exist as a separate phoneme in Danish (but Danish has [ʎ] as a medial allophone of /l/ before /j/). To obtain the stimuli, a female native speaker of Italian read twenty tokens of /ʎi/ and of /li/, as well as several other Italian monosyllables, from randomized lists. The recordings were made with high-quality digital recording equipment in a sound-attenuated environment. The target syllables were segmented from the original recordings, and each syllable was normalized for peak intensity. From this corpus, six tokens each of /ʎi/ and of /li/ were selected for the perception experiment as optimally representative exemplars by the first author.

Using the speech perception module in Praat (Boersma & Weenink 2001), participants were presented with AXB triplets and had to decide whether the second syllable in each triplet was categorically identical to the first or the last syllable in the triplet. Tokens of /li/ or of /ʎi/ could appear in the A or the B position, and the medial X tokens were categorically, but never physically, identical to either /li/ or or /ʎi/ (possible combinations: $[li]_A$-$[ʎi]_X$-$[ʎi]_B$, $[ʎi]_A$-$[ʎi]_X$-$[li]_B$, $[ʎi]_A$-$[li]_X$-$[li]_B$ e $[li]_A$-$[li]_X$-$[ʎi]_B$).

After familiarization with the AXB task (using /pu/ and /bu/ tokens), participants were presented with 96 randomly arranged triplets. Participants responded after each trial by clicking with a mouse on a computer display which presented as response alternatives either "1" (corresponding to the first token in each triplet) or "3" (corresponding to the third token in each triplet). Completion of the discrimination task took approximately 12 minutes.

2.2.2 Vocabulary memorization

To examine vocabulary memorization success, we used the method of paired associates (Mårtensson/Löwdén 2011), combining Danish words with Italian pseudowords which conformed to the phonotactic rules for Italian, but were void of semantic content (e.g. *svaccia*, *loddo*, *ubbo*).

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[2] We conducted a series of pilot experiments to determine which Italian consonant contrast would be difficult to discriminate for native Danish listeners. Based on the first author's 13 years of experience as an Italian teacher in Denmark and knowledge of Danish learners' production problems, we examined the discrimination of Italian contrasts /tsɛ/ - /dzɛ/, /tʃɛ/- /dʒɛ/, /dʒɛ/ - /dzɛ/, /li/ - /ʎi/, /ni/ - /ɲi/, and /ʎi/ - /ɲi/. Danish listeners performed at or near ceiling for the discrimination of all contrasts except /li/ - /ʎi/.

The pseudoword method was chosen to avoid compromising the data by participants' unpredictable individual (beforehand) vocabulary knowledge. Even if the criterion for participation in the study was to have no prior knowledge of Italian, knowledge of single (existing) words by some of the subjects could not be excluded. In order to avoid potential association patterns between Danish words and Italian pseudowords that might be the same for many particpipants and thus skew the results, the two word lists were associated with each other in a new, randomized way for each individual participant, with the expectation that single individual associations would even each other out at group level.

2.2.2.1 Stimuli Presentation

We employed auditory stimuli to avoid potential confounding effects due to participants' different reading ability. All instructions prior to every test round were presented auditorily from recordings by a male Danish speaker, while all stimuli (Danish words and Italian pseudowords) were presented auditorily from recordings by a female Danish speaker and a female Italian speaker, respectively.

2.2.2.2 Vocabulary memorization: General design

The experiment consisted of three stages with the same internal structure, which permitted the repetition of the individual task types and the identification of a possible learning curve from stage to stage for each participant. Each stage consisted of a memorization part, a recognition task, and a production task. All tasks were based on one of two lists of 40 Danish words and 40 Italian pseudowords each[3].

The memorization part consisted of the auditory presentation of 40 word pairs, with randomized attribution of Danish words to Italian pseudowords, different for each participant, in randomized order, varying from stage to stage.

The recognition task included the auditory presentation of 80 word pairs, consisting of a Danish word and an Italian pseudoword, in random order. Of these 80 word pairs, the participant had already heard 40 of them during the memorization part ("correct" pairs), whereas in the other 40 pairs, the Danish words and Italian pseudowords were combined differently than during the memorization part ("incorrect" pairs). Responses were logged

[3] The two lists were distributed between participants according to even and odd participant numbers respectively.

using a button box, and the participants were instructed to press a button for "correct" and another button for "incorrect" according to their own ratings of the respective pairings. Additionally, on the computer screen, the buttons from the button box were represented in an iconic manner according to their respective colors and placement, along with the words "correct" and "incorrect". The participants had 2 seconds to respond, after which a new word pair was presented. For responses made within a 2 second time window, response type and response time were logged. Both delayed and absent responses were logged as empty.

The production task consisted of an auditory presentation of the 40 Danish words individually, along with instructions to produce the corresponding Italian pseudoword from memory after a signal tone. The answers were digitally recorded. It took the participants a little less than an hour to complete the three stages.

Prior to the beginning of the experiment, the three different task types as well as the button box were presented to the participants. In order to avoid doubts in the participants regarding the authenticity of the "Italian" words and thus a possible drop in their learning motivation, it was explained that the words came from an Italian dialect and that the words had no etymological roots in common with standard Italian. The participants were informed about the artificial nature of the words about six months later, after an additional experiment, which examined the long term consolidation of the memorized words. The results of this last experiment will not be presented in the present study.

2.2.2.3 Stimuli

2.2.2.3.1 Danish stimuli

We selected 85 Danish nouns from a list of the most frequent monosyllabic concrete Danish count nouns as presented by Asmussen et al. (2002). Homonyms (*kort*, 'short' and 'map'), homophones (*hjul* ('wheel')/*jul* ('Christmas')), words indicating occupations (*kok*, 'chef') and social roles (*mor*, 'mother') were not used, along with some words which were found to be acoustically ambiguous in a pre-test with Danish speakers (see below).

To obtain the stimuli, a female native Danish speaker read three tokens each of 85 Danish words from randomized lists. The recordings were made with high-quality digital recording equipment in a sound-attenuated environment. The target words were segmented from the original recordings, and each word was normalized for peak intensity.

From this corpus, one token of each of the 80 Danish words was selected for the vocabulary memorization experiment as an optimally representative exemplar, as determined by the first author.

The naturalness and intelligibility[4] of the recorded words were verified by having 3 native Danish speakers transcribe the tokens in standard Danish orthography. Five words were removed from the preliminary list because of being acoustically ambiguous, for example *torv* ('town square'), which was repeatedly misheard as either *tåre* ('(a) tear') or *tov* ('rope').

2.2.2.3.2 Pseudo-Italian stimuli

The pseudowords were constructed in a way to respect both linguistic and – in view of their use in a subsequent neuro-linguistic experiment – neurological requirements, that latter of which will be discussed elsewhere.

From a foreign language learning point of view, Italian has several consonants which are known to cause problems for native Danish speakers, at least regarding production, but not necessarily regarding perception. Notoriously challenging sounds in this context are voiced stops (/b/, /d/, /g/), affricates (voiceless: /ts/, /tʃ/ and voiced: /dz/ and /dʒ/) as well as voiced and voiceless geminate stops and geminate affricates /pː/, /tː/, /kː/, /bː/, /dː/, /gː/, /tsː/, /dzː/, /tʃː/, /dʒː/, which are not part of the Danish phonological system.[5]

All stimuli were constructed around a medial geminate consonant. The first 30 of the 40 stimulus words on each list consisted of a set of 15 first syllables (e.g. *fò-*, *cri-*, *cró-*, *pa-*, *fa-*) each of which were combined with two different second syllables[6] (*cró-ccio*, *cró-ggia*) taken from a set of 10 second syllables (e.g. *-ccio*, *-ggia*) which were combined with three different first syllables (*fò-ccio*, *cri-ccio*, *cró-ccio*; *pa-ggia*, *fa-ggia*, *cró-ggia*).

The last 10 stimuli on each list were constructed from five first syllables (e.g. *qué-*) in combination with two second syllables, the latter always a minimal pair with a voiceless/voiced geminate consonant (*-ccio*, *-ggio*), thus creating minimal word pairs (*qué-ccio*, *qué-ggio*).

[4] "intelligible" here understood as "heard as intended by the speaker".

[5] The integration of phonetic challenges in the vocabulary to be memorized opens up the possibility of studing the interaction between the two linguistic levels. The relevant data has yet to be analyzed, however.

[6] "Syllable" is here not used in the phonemic sense, as the geminate consonant cannot acoustically be divided in the cutting process. In Italian phonology, the geminate consonant is considered to be ambisyllabic.

The words which matched this pattern had previously been chosen from among pseudowords generated by a computer algorithm developed by Keuleers (see Keuleers & Brysbaert 2010). This algorithm is capable of generating pseudowords using a digital syllabified and frequency ranked encyclopedia for the target language. The algorithm was adapted to Italian by feeding it with the syllabified Italian encyclopedia by Goslin et al. (2013), which again is based on *Corpus e Lessico di Frequenza dell'Italiano Scritto* (CoLFIS) by Bertinetto et al. (2005).

The lists with the pseudowords were subsequently recorded following the same criteria and procedures used in preparing the Danish stimuli lists (see 2.2.2.3.1).

The acoustic naturalness and intelligibility of the words created in this way were then verified by having four native Italian speakers transcribe and at the same time note the degree of opening of the vowels "e" and "o" along with the voiced or voiceless character of "z".

2.2.2.4 Assessment criteria for the vocabulary production data

Given the participants' possible problems with correctly pronouncing the memorized words, it was necessary to establish clear and rigorous criteria for distinguishing objectively between incorrectly memorized words on one hand and well-memorized, but incorrectly produced words on the other. This concerned especially the plus/minus voicing of the words' central geminate consonants. Based on the assumption that the participants were able to identify a central voiced stop (e.g. /d/) in a target word, a Danish-like unvoiced and aspirated t-sound [t^{s}] was considered to be an error ("voiceless"[7] stops in Danish being aspirated and affricated in initial word position), while the articulation of a voiceless, unaspirated stop was considered correct (as "voiced" Danish stops differ from "voiceless" by lack of, or very short, aspiration). On the other hand, the recognition of an Italian voiceless stop (/t/) was not automatically considered unproblematic (as the Italian pronunciation of the grapheme "t" in many cases corresponds to the non-fricativized pronunciation of initial Danish /d/), and therefore both unaspirated pronunciations (corresponding to the "voiced" Danish speech sounds) and aspirated pronunciations (corresponding to "voiceless" Danish speech sounds) were considered successful. Regarding the geminate

[7] The terms "voiced" and "voiceless" are in quotation marks here, as they refer to the Danish stops represented by the graphemes "t" and "d", even though both are voiceless, the difference being one of no or very short aspiration for Danish /d/ and of long aspiration for Danish /t/.

nature of the central consonant in the Italian pseudowords, neither the non-realization of an extended closure before the stop or affricate[8], nor the realization of the preceding vowel as long[9] were considered errors. The extended closure does not exist in Danish and its recognition did not seem to be a reasonable learning target for beginners. Vowels preceding geminate consonants in orthography are equally short in Danish, however, short vowels do not only appear in these positions and are therefore not automatically linked to geminate consonants in orthography by Danish speakers (a fact well documented by spelling errors). As these problems or inaccuracies also occur in more advanced students of Italian, it did not seem justified to consider them errors for absolute beginners.

Along with the words which were considered to be successfully memorized, the participants also produced *almost correct* words (e.g. *staggia* instead of *staggio*), *similar* words (e.g. *svazza* instead of *staggio*) and completely *incorrect* words (e.g. *trutto* instead of *staggio*). These error types will be further investigated in a future study.

3. Results and discussion

The results for each participant in each task are presented below in terms of percent correct responses. Table 1 shows the percent correct scores for the consonant discrimination task ("AXB"), for the word recognition task ("R1", "R2", and "R3" for the three stages), together with those of the word production task ("P1", "P2", and "P3" for the three stages). As mentioned previously, the first six participants provided usable data only for the AXB task.

Participant	**AXB**	**R1**	**R2**	**R3**	**P1**	**P2**	**P3**
1	84						
2	86						
3	80						
4	88						
5	66						
6	82						
7	91	51	68	69	13	13	20

[8] Which marks their gemination in Italian.

[9] Vowels are always short before geminates in Italian.

8	95	61	76	79	13	38	48
9	94	49	54	66	0	5	15
10	94	45	62	70	0	3	20
11	91	28	31	50	0	3	13
12	97	56	61	90	0	5	8
13	89	51	76	88	3	13	20
14	91	69	86	91	5	18	33
15	86	64	75	91	3	20	30
16	99	56	81	90	8	33	48
17	100	59	73	81	5	18	40
18	96	58	70	93	3	28	33
19	90	62	86	90	15	23	30
20	92	49	65	78	5	18	63
21	96	44	62	56	3	5	5
22	82	49	59	81	8	28	38
23	96	49	71	89	0	8	20
24	99	56	71	73	0	15	25
25	91	45	69	83	8	28	33
26	90	51	62	74	3	28	43
27	96	64	66	86	3	28	43
28	83	68	85	95	10	18	23
29	95	46	79	95	8	28	43
30	98	39	65	69	3	10	15
31	85	48	65	76	3	8	20
32	94	50	60	69	0	0	5
33	99	58	66	81	5	13	20
34	96	39	65	78	0	3	0
35	95	35	58	80	5	5	5
36	99	62	66	83	3	30	38

Table 1: Results for all participants for all tasks: Percent correct responses

This table shows clearly that the different tasks differed in degree of difficulty for the participant group as a whole. The discrimination task, with percent correct scores ranging between 66% (participant 5) and 100% (participant 17), was easier overall than the word recognition task, with percent correct scores between 50% (participant 11) and 95% (the participants 28 and 29) in the third stage. Not surprisingly, the most difficult task was the production task, in which the percent correct scores ranged from 0% (participant 34) to 63% (participant 20) in the third stage.

3.1 Consonant discrimination (AXB)

The percent correct scores in the consonant discrimination experiment were remarkably high. As shown in Table 1, the result of 66% by participant 5 is an outlier. The remaing participants discriminated the /li/ - /ʎi/ contrast near ceiling, with scores ranging between 80% and 100%. Recall that this contrast was the only one that indicated discriminability problems in the pilot experiments (see footnote 2). Given that native Danish students of Italian usually have pronunciation problems with /ʎ/, it is striking that these problems apparently do not manifest themselves in a discrimination task, but only in production. This represents a challenge for teachers who wish to improve the pronunciation of their students. Studies have shown that the speech perception ability of foreign language learners can be trained through systematic exposure to the language in question, leading to a significant improvement of the pronunciation of such learners (e.g. Sereno & Wang 2007). It seems less obvious how to improve language production not based on perception difficulties without the use of methods that require technically advanced tools normally not present in a classroom – for instance palatography or glossometry (e.g., Flege & Bohn: 1989).[10]

Regardless of this fact, a two-tailed t-test revealed that discrimination of the /ʎ/ -/l/ contrast was significantly more accurate when /l/ occurred in medial position in the AXB trials (95.1 % correct, SD = 5.8) than when /ʎ/ occurred in medial position (89.4% correct, SD = 8.6), $t(70) = -3.344$, $p > .01$. (See Figure 1).

[10] Palatography is a technique which shows the parts of the speech organs that are involved in the production of particular speech sounds. The sounds in questions are pronounced by a subject, whose oral cavity has been supplied with a substance that leaves a mark on contact surfaces, e.g. between the tongue and the palate, which then can be photographically documented. Glossometry is a technique using an optical-electric instrument creating pictures of the tongue's position during the articulation of particular speech sounds.

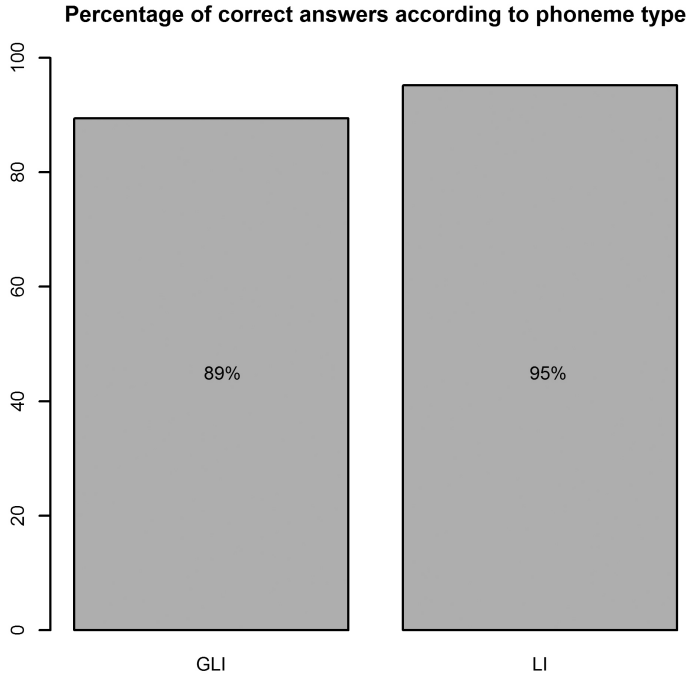

Figure 1: Percentage of correct answers (participants 1-36) for /ʎi/ and /li/ in position X in the AXB task.

This result shows that discrimination, not surprisingly, was slightly more difficult if the token which A and B had to be compared to was the unfamiliar, non-native syllable (/ʎi/).

3.2 Vocabulary recognition

As mentioned above, the vocabulary recognition task (classification of pairs of Danish words and Italian pseudowords as "associated correctly" or "associated incorrectly") turned out to be clearly more difficult than the sound discrimination task. However, it should be noticed that the type of task itself (with two possible answers: "correct" or "incorrect") involves a chance level of 50% correct answers, which limits the variability of the results. The task therefore seems less suitable for clearly distinguishing individual differences based on success rates, at least at first sight. However, as shown below, the comparison of these data with the data from the production task confirms the reliability of this type of task for the purpose in question.

Figure 2 shows the learning curves (from the first across the second to the third stage) for all participants. A general increase from stage to stage is observable, and the resulting curves are more or less parallel. There is only one participant (number 21), whose results decreased in the last stage (from 62% in the second to 56% in the third stage), which can probably be attributed to fatigue. The results of participant 11 are visible as an isolated curve in the bottom of the figure. As mentioned above, the percent correct results in the third stage range between 50% (participant 11) and 95% (participants 28 and 29).

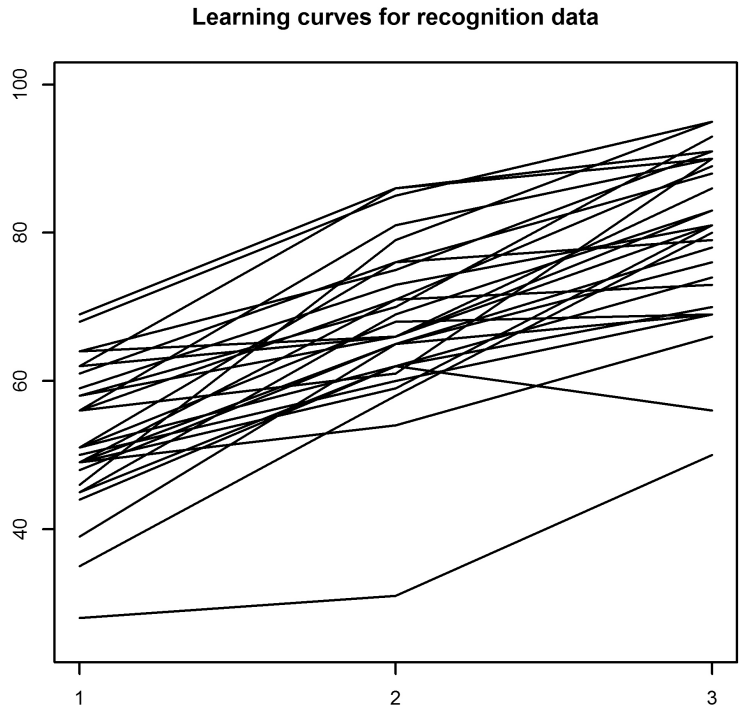

Figure 2: Learning curves for all participants (7-36) in the three stages of the word recognition task

3.3 Vocabulary production

The vocabulary production task was the most difficult – with results ranging from 0% (participant 34) to 63% (participant 20) in the third stage, and it also most clearly revealed individual differences, as shown by the dispersion of the individual learning curves in Figure 3.

The curves in Figure 3 also show that a relative success in the third stage depended, in general, on a substantial two-step progress (both between the first and the second and between the second and the third round, e.g. participants 16 and 26). Participants who did not substantially improve their results either between the first and the second (participant 10) or between the second and third stage (participant 15), remained at an intermediate level. Participants who did not make any progress between the rounds remained at a low level of performance (e.g. participants 12 and 21).

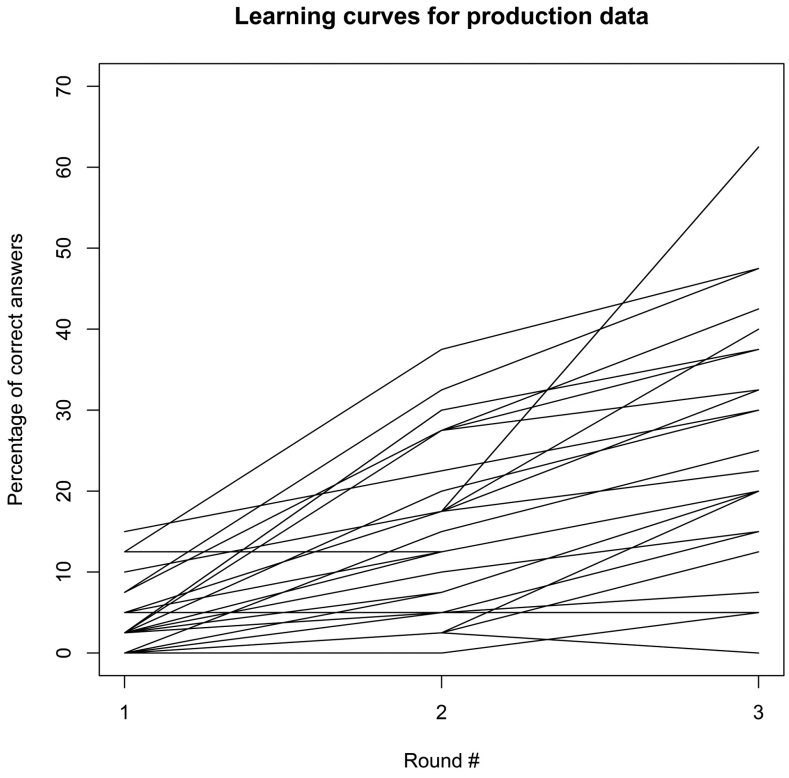

Figure 3: Learning curves for all participants (7-36) in the three rounds of the word production task

The only exception from this tendency was participant 20, whose increase in performance from the first to the second stage was only minor, but who then showed a large increase between the second and the third stage, with the best final performance of all participants.

3.4 Correlation between vocabulary recognition and vocabulary production

Even though the final learning results for each subject were not distributed in exactly the same way for the two different tasks, a Pearson product-moment correlation revealed a significant correlation (r = .402, p= .028). Figure 4 shows the raw data (percent correct responses in the third stage for each of the 30 participants (number 7 to 36) for vocabulary recognition (on top) and vocabulary production (at the bottom) which yielded the significant correlation.

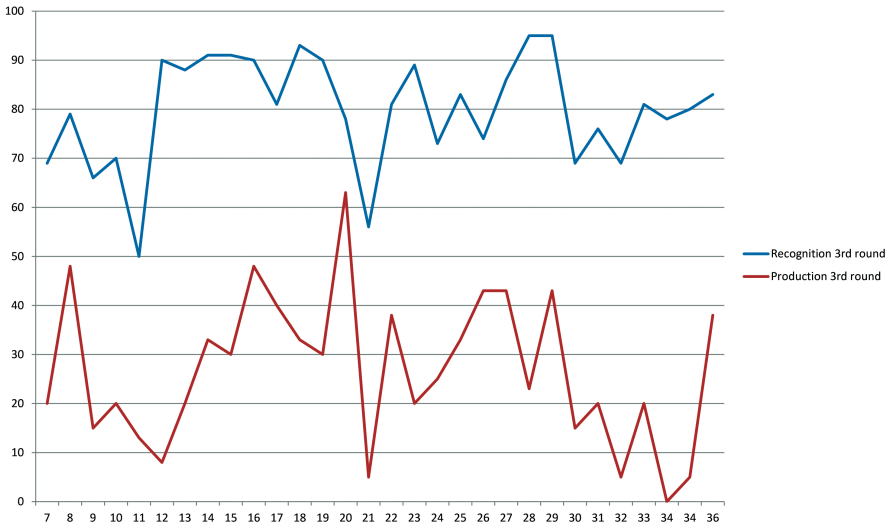

Figure 4: Correlations between the results in the third stage: recognition (upper graph) and production (lower graph) for the whole group (7-36)

3.5 Correlation between consonant discrimination and vocabulary memorization: Recognition and production

The discriminability of the /ʎ/-/l/ contrast was not related to the success at learning foreign vocabulary in our study. The correlations (Pearson product-moment) were non-significant for both the relation between percent correct scores in the consonant discrimination task and vocabulary recognition (r = -0.1019324, p = 0.592), and for the relation between percent correct scores in the consonant discrimination task and vocabulary production (r = -0.05080971, p = 0.7897).

It should be mentioned, however, that the speech sound which was not familiar to the participants (/ʎ/), did not figure in the (pseudo)words to be memorized, all of which were based on a central geminate stop or affricate (voiced or unvoiced).

We can conclude that in order to obtain more accurate and significant data regarding the correlation between successful foreign sound distinction and successful foreign vocabulary learning, studies with a more rigorous and more specifically tailored design are needed.

4. Conclusions

This chapter presented a study which examined vocabulary learning success and consonant discrimination in native Danish learners of Italian. The thirty participants varied considerably in their performance on both the vocabulary production task and, to a lesser degree, the vocabulary recognition task. Performance on these two tasks was moderately correlated. Performance on the consonant discrimination task, which also revealed individual differences but was high throughout, was not correlated with the vocabulary learning tasks. We conclude that the two types of tasks are suitable for quantifying individual performance differences on tasks related to learning Italian as a foreign language (vocabulary memorization, consonant discrimination). The study is the first half of a larger study, where the second half (to be presented separately elsewhere) is aimed at verifying whether any correlations exist between quantifiable behavioral success at the above described foreign language learning tasks and electrophysiological correlates measured by EEG.

Acknowledgements

We would like to thank the following institutions and persons for their contributions. Without them, it would not have been possible to complete this project in its present form: *AU Ideas Project Startup Grant*/Aarhus University, Søren Bo Andersen, Valentina Bambini, Pier Marco Bertinetto, Det Danske Sprog- og Litteraturselskab, Esteban Fredin, Jeremy Goslin, Hannie van Hooff, Emmanuel Keuleers, MINDLab Project Initiation Peer Circle/Aarhus University, Karl Møller, Michael Nygaard Pedersen, Christina Romani, Donald Smith, Camilla Søballe Horslund, David Vernon, Philip Michael Zeman.

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