Crosslinguistic influence in L3 acquisition: Evidence from artificial language learning

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Abstract: This study investigates the role of lexical vs structural similarity in L3 acquisition. We designed a mini-artificial language learning task where the novel L3 was lexically based on Norwegian but included a property that was present in Russian and Greek yet absent in Norwegian (grammatical case). The participants were Norwegian-Russian and Norwegian-Greek bilinguals as well as a group of Norwegian L1 speakers. All participants also knew some English. The morphological expression of the L3 target property was more like Russian than Greek in that case was marked on the noun itself, not on articles. The results of our study indicate that previous experience with a language that is structurally like the L3 (Russian) is facilitative, even when the L3 lexically resembles a language that lacks this grammatical property (Norwegian). Our results suggest that the overt morphological expression of the target property also plays a role: previous experience with Greek that marks the target contrast on determiners did not seem to be facilitative at early stages of acquisition. Overall, our results are in line with models of L3/Ln acquisition which assume that both previously acquired languages influence the development of the L3 and that structural, morphological and lexical similarity play a role.

Keywords: morphological similarity, lexical similarity, facilitative transfer, cross-linguistic influence

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1. Introduction

In this paper we investigate crosslinguistic influence (CLI) at very early stages of multilingual acquisition by using an artificial language as the target language. We address three issues, currently hotly debated in L3 acquisition (L3A): 1) whether CLI comes exclusively from one language or whether the target language may be influenced by both previously acquired languages, 2) whether CLI is dependent on lexical similarity or whether structural similarity may also play a role, and 3) in case structural similarity also has an effect at an early stage, whether abstract similarity is sufficient or whether the property in question must also have a similar overt morphological realization. The languages involved in our study are Norwegian, Russian and Greek (as well as English), and the structural property investigated is morphological case. While Norwegian does not have case on nouns at all, Russian expresses case as suffixes on the noun, and Greek marks case on all nominal elements. However, the Greek case system involves a high degree of syncretism, which means that for feminine and masculine nouns, it is the case marking on the article that provides the relevant disambiguating information.

In our experiment, we investigate three groups of participants, Russian L1 and Greek L1 speakers living in Norway, speaking Norwegian as an L3, as well as Norwegian L1 speakers. All participants also know some English as an L2, which means that our target language, called

Aliensk, is strictly speaking the L4 of the first two groups and the L3 of the L1 Norwegians. However, knowledge of English is not relevant for our study, as English (like Norwegian) does not have case. We will therefore generally ignore English in this study and refer to the participant groups as Russian-Norwegian and Greek-Norwegian bilinguals as well as Norwegian L1 speakers. Aliensk has lexical items that are identical to Norwegian, but unlike Norwegian, Aliensk has no articles or definiteness marking, but instead has unambiguous case suffixes on nouns (NOM vs. ACC), similar to how case is expressed in Russian. By extension, while both Greek and Aliensk share the property of abstract case, the morphological realization of case is different in the two languages: case-bearing articles and (largely ambiguous due to syncretism) noun suffixes in Greek vs. (unambiguous) noun suffixes in Aliensk.

Our main experiment involves a picture-sentence matching task, where the sentences in Aliensk are simple structures with SVO and OVS word order (both grammatical in Aliensk) and the nouns are marked with NOM or ACC case. After a relatively short training phase, participants were tested on both grammatical and ungrammatical sentences in Aliensk and asked to judge whether the sentences matched the corresponding picture. In grammatical SVO and OVS sentences, subjects were marked with NOM and objects with ACC case; in ungrammatical sentences, the case marking was the other way around (see section 3.1).

2. Background

2.1 Cross-linguistic influence in L3 Acquisition: Full Transfer or Full Transfer Potential (co-activation)

In the close to two decades of formal research on L3 acquisition, the field has mainly been concerned with the question of CLI in this process. In second language (L2) acquisition, there

is only one possible source of CLI, the first language (L1). In L3 acquisition, on the other hand, the influence can in principle be from either or both of the previously acquired languages. A number of models have been developed to account for this process, based on various findings from L3 studies; see e.g., Rothman et al. (2019) for a recent overview. While certain studies have found CLI from the L1 (e.g., Jin, 2009), other studies have found that the influence on the L3 is mainly from the L2, leading to the model referred to as the L2 Status Factor (L2SF, Bardel & Falk, 2007, 2011). Furthermore, other proposals have argued that language use/recency of use and language proficiency/dominance may influence the strength of CLI, with stronger influence coming from the language that is more 'active' in the learner's mind (see Fallah & Jabbari, 2016; Lloyd-Smith et al., 2017). In this paper we will focus on models that argue for linguistic similarity or proximity as the main factor responsible for CLI, i.e., the Typological Primacy Model (Rothman, 2011, 2013, 2015), the Linguistic Proximity Model (Westergaard et al., 2017; Westergaard, 2021a, b), and the Scalpel Model (Slabakova, 2017).

The three models differ considerably with respect to how they define CLI. For the Linguistic Proximity Model and the Scalpel Model, CLI in L3 acquisition is the result of co-activation of the previously acquired languages in language processing (for interpretation as well as production); see Westergaard (2021b) and Westergaard et al. (2023) for more details. This means that CLI is a cumulative process that takes place one linguistic property at a time. This also means that CLI can be from either or both previously acquired languages, often for the same property. The main factor responsible for CLI is abstract structural similarity, while superficial lexical similarity may also play a role, especially at early stages of L3 acquisition. Co-activated structures from the previously acquired languages compete in processing, and the winner is the one with the strongest activation. Over time, the (initially weak) L3 representations produced by processing will become more stable and eventually be able to block CLI from the previously acquired languages. According to the Linguistic Proximity Model and

the Scalpel Model, any structure from one language can potentially influence another language in the mind of a multilingual. This is referred to as Full Transfer Potential (see Westergaard et al., forthcoming for an overview).

The Typological Primacy Model, on the other hand, is heavily influenced by the Full Transfer/Full Access Hypothesis of L2 acquisition (Schwartz & Sprouse, 1996), which argues that the initial state of the L2 is a "copy" of the L1 that will be restructured as a result of parsing failures with L2 input. Similarly, an initial L3 grammar is a full copy of **one** of the previously acquired languages, the one that the parser considers more similar to the L3 early on in the acquisition process, based on a four-way hierarchy (see the next section). While the Typological Primacy Model recognizes the existence of processing effects (most recently referred to as crosslinguistic effects (CLE) in Rothman at al., 2019), these are considered to be temporary bleeding of one language structure into another and thus different from what the authors refer to as "representational transfer", i.e., wholesale copying of one of the previously acquired languages onto the L3.

2.2 The role of structural (abstract) similarity and overt (formal) similarity

Language similarity or linguistic proximity is among the most studied factors in the literature on CLI in multilingualism (Bardel & Lindqvist, 2007; Montrul et al., 2011; Rothman, 2013, 2015; Westergaard et al., 2017). Structural similarity often refers to the proximity between abstract linguistic properties (e.g., whether two languages have case systems), while overt similarity refers to actual morphological similarity (whether two languages employ the same grammatical strategy to mark a linguistic property, e.g., case morphology overtly realized in the form of a suffix on the noun). Both types of similarity can occur between languages which are either genetically close or distant (cf. Pirvulescu et al., 2022).

As mentioned in the previous section, the notion of similarity and its different manifestations are key to several influential models of crosslinguistic influence in L3 acquisition, most clearly expressed in the Typological Primacy Model (Rothman, 2013, 2015) and the Linguistic Proximity Model (Westergaard et al., 2017; Westergaard, 2021a, b). According to the Typological Primacy Model, transfer in L3 acquisition takes place wholesale from one of the previously acquired languages at the so-called "initial stages", based on what is referred to as typological similarity. This similarity is based on the parser making a comparison between the L3 and the previously acquired languages according to the following hierarchy: the lexicons, phonological systems, morphological paradigms, and last, syntactic structures. This ordering of the various levels of linguistic analysis entails an implicational hierarchy; that is, if no decision can be made on the lexical level (either because neither or both languages are lexically similar to the L3), the parser moves down to phonology, if no decisive evidence can be found at that level, the parser moves down to the morphological level, and if no evidence can be found there either, the parser finally considers the syntactic level. In the Linguistic Proximity Model, where CLI is considered to be the result of co-activation of the previously acquired languages, the main factor responsible for crosslinguistic influence is abstract structural similarity, although superficial (especially lexical) similarity may be influential especially at an early stage. The reason for this is that superficial/lexical similarity is immediately available in the acquisition process, while it will take somewhat longer for learners to be able to parse abstract morphosyntactic similarity (Westergaard et al., 2017; Westergaard 2021b). Importantly, this similarity is determined on a property-by-property basis for each linguistic phenomenon. Furthermore, as also emphasized by the Scalpel Model (Slabakova, 2017), other factors such as recency or frequency (i.e., construction frequency in the input) may play a role for the strength of the co-activation of competing structures in the previously acquired languages.

There are various notions subsumed under the polysemous terms 'language similarity' and 'language proximity', and it seems that the most prominent uses of these terms across different models are those that refer to overall typological proximity and/or structural similarity across languages. Precise predictions about the specific influence of overt similarity are scarce in the relevant literature. The polysemy surrounding these terms contributes to the vagueness of the term 'similarity'. As Eden (2018: 23) puts it, "a 'language' is more or less similar to other languages - but what does that mean? Is it the percentage of shared cognates which is important (e.g., Lees, 1953, see also Otwinowska, 2015), or the phonemic inventory (e.g., Bartelt, 1989; Bardel & Lindqvist, 2007)? Is it a matter of overlapping grammatical representations? All of these factors together?". When comparing two sets of languages, phonological properties may pattern similarly in one set, but the other language set may be more similar in terms of the lexicon (e.g., Cabrelli et al. 2013), giving rise to ambiguous conclusions about overall language similarity. Studies often use language family as a proxy for determining typological distance, but this may lead to unwarranted assumptions of similarity (Eden, 2018). Furthermore, the question arises as to how to assess overall similarity on each of the linguistic 'levels' of the hierarchy proposed by the TPM. For instance, how do we measure overall phonological similarity, what is the level of abstractness in such comparison (see Archibald, 2021, 2023), and what should be given more 'weight' in such a summative assessment (see Archibald, 2017; Nelson et al., 2021 for a discussion)?

Another dimension that lends some ambiguity to the term 'language similarity' comes from psychotypology. This refers to similarities and differences between languages as *perceived* by the speaker/signer (Kellerman, 1983). Some L3 studies have explicitly investigated the learners' perceived similarity of the L3 to the previously acquired languages. The earliest versions of the Typological Primacy Model (e.g., Rothman, 2011) also referred extensively to psychotypology, but the idea of typological primacy was soon replaced by the hierarchy

mentioned above (Rothman, 2015). There seems to be good reason to question the concept of psychotypology (in L3 acquisition): While several studies have suggested that the psychotypological factor and metalinguistic awareness are crucial components that come into play when language learners are faced with challenges in their L3 (Laoire & Singleton, 2009; Jessner, 2014), research on multilingual contexts has shown that there is usually a preferred language for expression of emotion (Dewaele, 2010). While transfer and (meta)linguistic awareness indeed guide language learners in their L3, one's perception of proximity may be muddled by emotionally loaded reasons and preferences. For instance, speakers of Spanish that are against Catalan for political reasons, often undermine their ability to understand it. This happens not because the two languages are not really close (by all metrics and standards, they are), but because other reasons affect one's perception of what 'close' is. Also, not all bilinguals are able to reflect on their languages in an equal way. For example, people who ascribe a low sociolinguistic prestige to their home variety may downplay the differences between the dialect and the most proximal standard variety and thus reduce the dialect to nothing more than "an accent" (Arvaniti, 2010). Given that social and racial factors seem to modulate judgments about one's linguistic performance in both monolingual and bilingual speakers (Kutlu, 2020), the possible discrepancies between actual typological proximity and perceived linguistic distance may not be uniform across the members of a linguistic community, weakening claims about overall proximity.

Finally, the difference between input and intake should also be considered. To compare abstract similarity between languages or individual properties within these languages (e.g., make a comparison on the phonological or syntactic levels), the learner needs to be able to assess the relevant underlying representations. This process may take a different amount of time depending on the complexity, salience, novelty etc. of the specific property, and there are good

reasons to believe that not all underlying representations are assigned in a target-like manner at the early stages of acquisition.

2.3 Case in the three relevant languages

Nouns in modern Norwegian (except for very few dialects, Eyþórsson et al. 2012) do not inflect for case, and thematic relations are expressed through word order and the use of function words, typically prepositions. In contrast, both Russian and Greek have case, and for this reason the languages more frequently allow non-canonical word orders such as OVS.

The case paradigm in Russian involves six cases: nominative, genitive, dative, accusative, instrumental, and prepositional. Since Russian lacks articles, case is marked as a bound morpheme on nouns, adjectives, pronouns, and quantifiers, as illustrated in (1). According to Gvozdev (1961) and Ceitlin (2009), case forms are typically in place already at the two-word telegraphic speech stage (before the age of 3 years) in monolingual first language acquisition.

(1) etot/etogo/etomu/etogo/etim/etom slon/slona/slonu/slona/slonom/slone
this.NOM/GEN/DAT/ACC/INSTR/PREP.MASC elephant.NOM/GEN/DAT/ACC/INSTR/PREP.MASC

In Standard Modern Greek (henceforth, Greek), nouns inflect in four cases: nominative, genitive, accusative, and vocative. Case is marked on all nominal elements: the determiner, the adjective, and the noun. Due to a high degree of paradigmatic syncretism, case may not be unambiguously identifiable on the noun (2), but it is disambiguated by the determiner and the word order. This high degree of syncretism influences acquisition. In a cross-linguistic study, Xanthos et al. (2011) found that Greek-speaking monolingual children took longer to acquire nominal morphology compared to their Russian-speaking peers. Possible differences may be

attributed to the fact that Russian shows great morphological richness, but low paradigmatic syncretism.

(2) i/tis/tin poli/polis/poli.

the.NOM/GEN/ACC.FEM city.NOM/GEN/ACC.FEM

2.4 Research questions

The current study considers L3 learning as a window into multilingualism, using an artificial language learning paradigm that targets case marking. More specifically, we aim to disentangle the influence of the various types of linguistic similarity (more specifically, lexical, abstract grammatical, and overt grammatical similarity) through contrasting opportunities that are predicated either on structural/grammatical similarity or overall typological similarity (based on lexical overlap between the languages). Furthermore, the morphological expression of the L3 target property is more like Russian than Greek. Aliensk and Russian do not mark case on the articles (both languages do not have articles), but on the noun itself. In this respect, the L3 is different from Greek, which marks case on prenominal articles. This difference between Russian and Greek allows us to contrast abstract grammatical (overt case) versus abstract *and* superficial grammatical similarity (overt case morphologically marked on the nouns and not on the articles).

Our three Research Questions are the following:

(1) Does CLI come exclusively from *one language* at early stages of acquisition, or can the target language be influenced by *both previously acquired languages*?

(2) Is CLI mostly dependent on *lexical similarity* or can *structural similarity* also play a role and be a significant predictor of CLI early in the acquisition process?

(3) Is pure abstract structural similarity (e.g., overt case marking) enough to facilitate learning of this category at early stages of acquisition or is it more facilitative if supported by overt grammatical similarity (e.g., case morphologically marked in a similar way)?

3. The Aliensk study

3.1 Sentence-picture verification task

To test the three research questions of the study, we created a mini-artificial language which was lexically based on Norwegian but included a novel grammatical property that is absent in Norwegian but present in Russian and Greek, i.e., nominal case marking. More specifically, the existing Norwegian nouns appeared inflected with either a novel NOM case marker (*-il*) or a novel ACC case marker (*-su*), added as suffixes on the noun. This made Aliensk lexically identical to Norwegian, but structurally similar to Russian and Greek. However, Aliensk differed from Greek in that case was unambiguously marked on the noun (as in Russian), while it is unambiguously marked on articles in Greek (as well as on the noun itself). Thus, the target morphosyntactic property in our study was not only structurally similar to Russian, it was also expressed in an identical manner (as suffixes on nouns). Thus, the study addresses the issue of lexical vs. structural similarity as well as the type (expression) of structural similarity (abstract or overt).

Our goal was to capture the very earliest stages of the acquisition process. We achieved this by minimizing the memorization task connected to lexical learning. All lexical items of the

novel language were high-frequency Norwegian nouns and verbs. All sentences that were included in the experiment were simple three-word utterances of two types: SVO or OVS.

The experiment started with a training phase that included 10 items: five SVO and five OVS sentences with correct case marking (i.e., reflecting the thematic roles of the referents in the accompanying picture), presented in a randomized order. Figure 1 illustrates two training items: an SVO sentence (a) and an OVS sentence (b).

(a) *Zebra-il tegner sopp-su*

Zebra-NOM draws mushroom-ACC

'The zebra is drawing a mushroom'

(b) *Hatt-su holder rev-il*

Hat-ACC holds fox-NOM

'The fox is holding a hat'

The participants were informed that the sentences they would hear are typically used in Aliensk to describe the pictures that appeared on the screen. The participants' task during the training phase was to pay attention and listen to the sentences while looking at the pictures. In the test phase, the participants were instructed to press one of two keys to indicate whether a new set of pictures that they would see on the screen corresponded to the new set of sentences they would hear (see the full set of instructions in Appendix 2). The sentences appeared one by one in a randomized order with an equal number of correct and incorrect sentences. The participants were randomly assigned to one of two lists and judged a total of 60 sentences each.

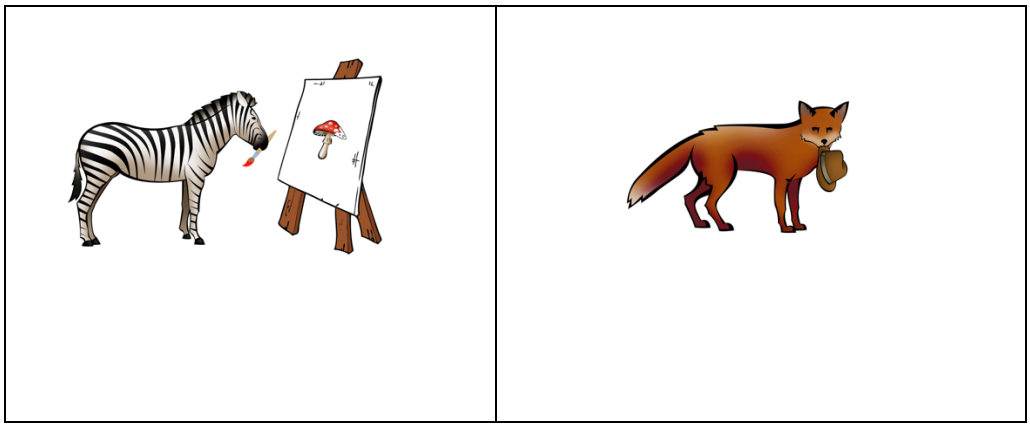


Figure 1. Training items (SVO and OVS):

(a) *Sebra-il*$_{NOM}$ *tegner sopp-su*$_{ACC}$ 'The zebra$_{NOM}$ is drawing a mushroom$_{ACC}$'

(b) *Hatt-su*$_{ACC}$ *holder rev-il*$_{NOM}$ 'The fox$_{NOM}$ is holding a hat$_{ACC}$'.

3.2 Design and Materials

We created 120 novel three-word sentences, describing 30 pictures representing simple transitive events. For the purpose of the task, we selected five predicates that corresponded to five high-frequency disyllabic Norwegian verbs: *spise* 'eat', *finne* 'find', *holde* 'hold', *tegne* 'draw' and *sparke* 'kick'. Each of the predicates was used in six different scenarios with various referents (e.g., *spise* 'eat': seal/salmon, baker/soup, etc.). The pictures were drawn specifically for this experiment. We manipulated word order and case marking to create linguistic stimuli in four experimental conditions: a) Correct SVO: agent-first sentences with correct case marking (NOM-ACC); b) Incorrect SVO: agent-first sentences with incorrect case marking (ACC-NOM); c) Correct OVS: patient-first sentences with correct case marking (ACC-NOM); d) Incorrect OVS: patient-first sentences with incorrect case marking (NOM-ACC). The audio stimuli were recorded by a professional radio presenter in a sound-proof studio (at NRK, Norwegian Broadcasting Corporation). The sentences were recorded at a normal speech rate with neutral prosody.

The experimental sentences were then split into two experimental lists, each containing 60 sentences, such that each picture appeared in two conditions per list. The four experimental conditions are illustrated in Figure 2. For the full list of experimental items see Supplementary materials (link provided in the Data availability statement)

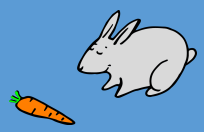
Picture: A rabbit finding a carrot 	Case	WO
A. Rabbit-NOM finds carrot-ACC	correct	SVO
B. Rabbit-ACC finds carrot-NOM	incorrect	SVO
C. Carrot-ACC finds rabbit-NOM	correct	OVS
D. Carrot-NOM finds rabbit-ACC	incorrect	OVS

Figure 2. Experimental conditions in the picture-matching task.

In addition to the experiment, the participants also filled in a background questionnaire and a Norwegian A2 placement test. The aim of the placement test was to make sure the participants had *sufficient* knowledge of Norwegian to understand the lexical items involved in the artificial language learning experiment. As correctly pointed out by the reviewer, we only used the proficiency task to ensure that the participants knew enough Norwegian to understand the lexical items and did not collect data that would allow us to estimate actual Norwegian proficiency of the participants and include it to model their performance on the artificial language learning task.

3.3 Participants

Data collection was conducted in two rounds. Before the pandemic, the participants were tested one by one in the lab. During the pandemic, the experiment was moved online, and the participants were tested via the internet. The Norwegian L1 and the Russian-Norwegian speakers were tested in the lab, while the Greek-Norwegian participants were tested partly in the lab (n=9) and partly online (n=11). All participants received a gift card for their participation. The project was registered and approved by the Norwegian Social Science Data Service (NSD, http://www.nsd.uib.no). Data collection was conducted in accordance with NSD's ethical principles. The online version of the experiment was run on the JATOS server of UiT-The Arctic University of Norway. Written informed consent was obtained from all participants prior to testing. We recruited 27 Norwegian L1 speakers (21-55 years, Mean age=32), 23 Russian-Norwegian speakers (18-58 years, Mean age=37), and 20 Greek-Norwegian participants (23-58 years, Mean age=37). The participants were comparable in age, as the mean ages show. Four Norwegian L1 speakers were excluded due to prior knowledge of a language with grammatical case marking (German, Icelandic, Bosnian, and Japanese). The inclusion criteria for the Russian-Norwegian and Greek-Norwegian groups were (i) more than 5 years of residency in Norway, and (ii) successful completion of the A2 level placement task used at the 'Norwegian for International students' classes at UiT-The Arctic University of Norway. Note that the goal of the placement task was to ensure that the participants were proficient enough to understand the lexical items in the main artificial learning experiment, and not to establish their actual proficiency. We leave it for future research to investigate the role of proficiency on the potential effects of CLI.

3.4 Predictions

The models presented in section 2.1 make different predictions with respect to the results of our artificial L3 experiment. The TPM, which assumes wholesale transfer, argues that the grammar of the typologically closest language is taken as the basis for the developing L3 at 'initial stages' of acquisition. Thus, according to Rothman (2015: 2), "complete transfer takes place at the earliest moment the parser is able to identify enough linguistic information from the L3 input stream to determine which of the two languages is likely typologically closer to the target L3." Lexical similarity is predicted to be decisive and override structural similarity between individual grammatical properties. Thus, the TPM would predict wholesale transfer from Norwegian in this case. In contrast, models that argue for property-specific CLI and cumulative influence of previously acquired languages, such as the LPM and the Scalpel Model, predict that structural similarity between individual grammatical properties may override lexical similarity.

To sum up, with respect to our experiment, if lexical similarity prompts morphosyntactic transfer from Norwegian for all groups (as per the TPM), no difference between the groups is predicted across experimental conditions, as all groups would be expected to copy their Norwegian grammar onto the L3 (as the L3 is lexically identical to Norwegian). However, if case-licensed flexible word order can be selectively supported by any previous language (as argued by the LPM), Russian-Norwegian and Greek-Norwegian bilinguals would have an advantage.

More specifically, if differences are attested between the groups, we expect them in conditions where case-marking and word order do not align (SVO sentences with incorrect case marking and OVS sentences with correct case marking). The LPM also predicts a stronger effect in the Russian-Norwegian group, where structural similarity is supported by overt

similarity, than in the Greek-Norwegian group, where the case marking is structurally, but not overtly similar to the new artificial L3[1]. Figure 3 summarizes the predictions of the TPM and the LPM for the three participant groups.

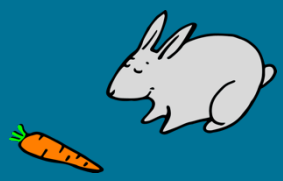
Picture: A rabbit finding a carrot 	Case	WO	NOR	NOR-RUS NOR-GRE (TPM)	NOR-RUS (LPM)	NOR-GRE (LPM)
A. Rabbit-NOM finds carrot-ACC	correct	SVO	Accept			
B. Rabbit-ACC finds carrot-NOM	incorrect	SVO	Accept		Reject	Reject?
C. Carrot-ACC finds rabbit-NOM	correct	OVS	Reject		Accept	Accept?
D. Carrot-NOM finds rabbit-ACC	incorrect	OVS	Reject			

Figure 2. Experimental conditions and the predictions of the TPM and the LPM

3.5 Results and Interim discussion

Figure 4 summarizes the participants' accuracy scores by group across the four conditions. As we see, the Norwegian L1 speakers score high on the two conditions where word order and case forms align, i.e., SVO word order with correct case marking and OVS word order with incorrect case marking. The Russian-Norwegian group has high scores also on the mismatched conditions, while the Greek-Norwegian group is more similar to the Norwegian L1 speakers.

[1] We would like to highlight that this does not entail that we *expect* to find a difference between the Russian-Norwegian and the Greek-Norwegian participants. In fact, we say "if differences are attested between the groups", precisely because we did not have a firm expectation, since it is difficult to have a clear-cut difference between the two types of grammatical similarity. Not much research has been done on the effect of morphological expression on CLI, so we could not have relied on previous studies in order to formulate a strong(er) prediction in this respect.

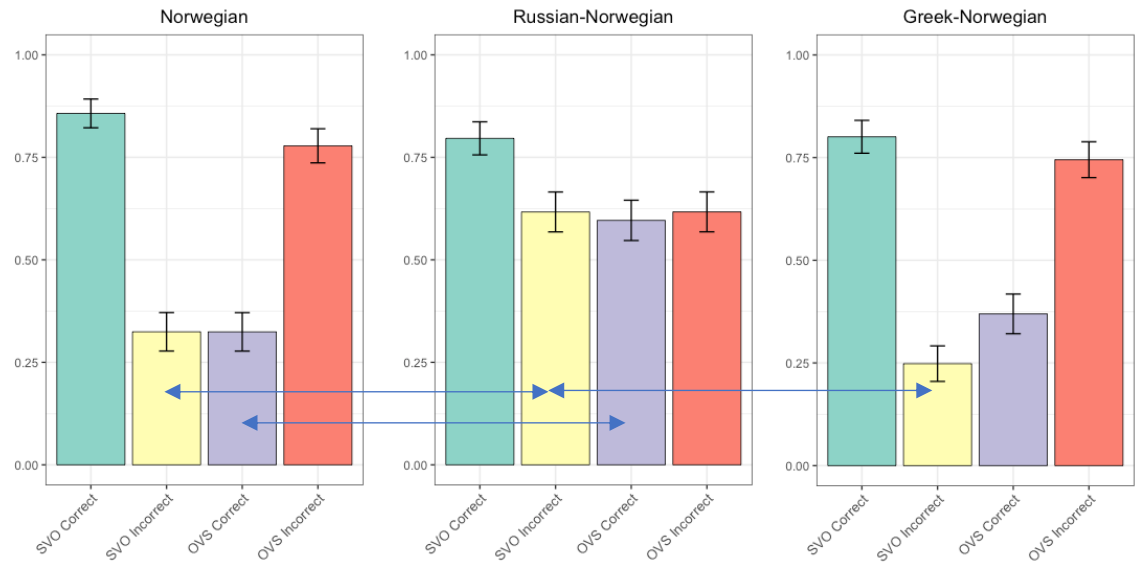


Figure 4. Accuracy scores across conditions and groups (blue arrows indicate significant differences between the groups within conditions).

To assess the differences statistically[2], we fit a generalized linear mixed effects binomial logistic regression, where accuracy was predicted as an interaction of two factors: condition and group and random condition by participant slopes. The output of the model is summarized in Table A1 in Appendix 1. Post-hoc pairwise comparisons of groups within conditions with alpha levels adjusted for multiple comparisons revealed that the Russian-Norwegian participants were significantly more likely than the Norwegian L1 speakers to reject SVO sentences with incorrect case marking (p=0.02) and marginally better at accepting OVS sentences with correct case marking (p=0.05). Furthermore, the Russian-Norwegian participants significantly outperformed the Greek-Norwegian participants in the incorrect SVO condition (p=0.02). No other differences between the groups were significant (see Table A2 in Appendix 1 for a summary of the post-hoc pairwise contrasts).

[2] For the analysis we used the package *lme4* (Bates et al., 2015) and *emmeans* (Lenth et al., 2018) of the statistical software R, version 4.2.1.

To sum up, the results revealed that the Russian-Norwegian group was more successful in using the grammatical case cue in a novel L3 to reject incorrect SVO and accept correct OVS sentences than the Norwegian L1 speakers.

In contrast, the Greek-Norwegian group did not differ significantly from the Norwegian L1 speakers and were significantly less likely to reject SVO sentences with incorrect case marking than the Russian-Norwegian group, indicating that they did not manage to pick up the function of the nonce endings in a novel artificial language from such a short training phase, despite familiarity with a language that shares this grammatical property. We discuss the results and their implications for L3A models in section 4.

3.6 Follow-up study

The results of our main study show that in order to pick up on the case-marking property of the target language at a very early stage of acquisition, it is crucial that learners have previous experience with a case-marking language that expresses case in the same way as in Aliensk (i.e., as suffixes on the noun). However, we do not know if experience with Norwegian has any effect on the results of the Russian-Norwegian participants. In order to address this issue (stated in RQ1), we conducted a follow-up study where we created another artificial language which was like Russian on both the lexical and structural levels. We used Russian lexical roots in combination with the same novel case endings as in the main study (*-il* for NOM, and *-su* for ACC), which were different from the existing case suffixes in Russian. A new set of audio stimuli were recorded in a professional studio by a native speaker of Russian. We replicated the overall set-up of the experiment but replaced Norwegian-based audio stimuli by Russian-based ones.

The motivation for testing the Russian-speaking group on a different artificial language with the same novel morphological case endings but with Russian-based (instead of Norwegian-based) lexical items was to probe for the combined effects of lexical and grammatical similarity vs just grammatical similarity. In an ideal world, the same group of Russian-Norwegian speakers should have participated on both tasks. However, the pool of Russian-Norwegian participants we could recruit was too small to be divided between the two tasks. Testing the same participants twice with the same set of pictures in a similar set-up would inevitably mean that they would be influenced by their experience from the first session. This is why we recruited a new group of learners: Russian-speaking students who did not know Norwegian. This was appropriate because the follow-up experiment did not require familiarity with Norwegian lexemes.

We recruited 21 participants (19-58 years, Mean age=31) who grew up speaking Russian as their only first language and reported that Russian was their dominant and strongest language. The participants were tested in person, in Moscow, Russia. All participants signed an informed written consent and received a gift card for their participation.

In Figure 5, which illustrates the results of the follow-up task in comparison with the results of the bilinguals and the Norwegian L1 speakers from the main experiment, we observe at-ceiling performance on all conditions in the Russian L1 speakers. We fit a binomial linear mixed effects logistic regression to assess accuracy based on the interaction of group and condition, with random slopes for participants within conditions. The output of the model is summarized in Table B1 in Appendix 1. To fully assess the differences between groups within individual conditions, we subsequently ran post-hoc pairwise comparisons with adjusted alpha levels. The analysis revealed significant differences between all groups in the critical conditions: correct OVS and incorrect SVO sentences. The Russian group was the most successful group in following the case cue in accepting correctly marked OVS sentences and

rejecting the incorrectly marked SVO sentences, followed by the Russian-Norwegian group, which in turn surpassed the Norwegian group (see Table B2 in Appendix 1). This indicates that lexical similarity plays a role in addition to structural similarity, as the participants were more likely to accept non-canonical word order and identify the novel grammatical case cues in a language that was lexically like Russian than in a language with Norwegian lexical roots. This result indicates that the performance of the Russian-Norwegian bilingual participants was influenced by both of their previously acquired languages; that is, their ability to learn the case-marking property of Aliensk was affected by facilitative influence from Russian and non-facilitative influence from Norwegian.

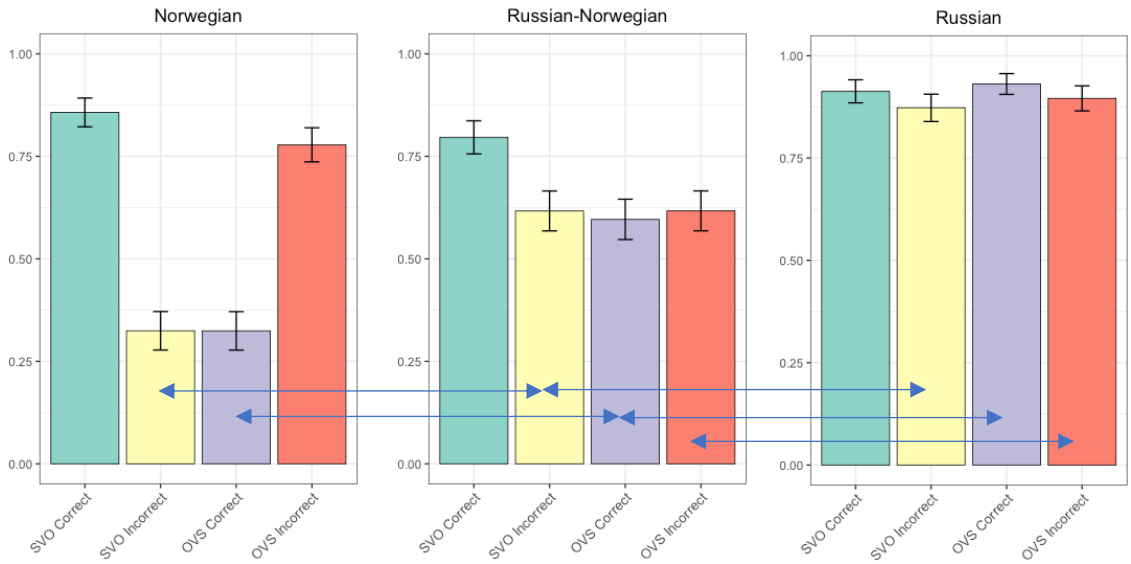


Figure 5. Accuracy scores across conditions and groups (blue arrows indicate significant differences between the groups within conditions).

4. Discussion

In this study we set out to investigate the contribution of structural similarity when it is contrasted with overall lexical similarity (Experiment 1) as well as when both structural and lexical similarity align (Follow-up task). To test this, we created two artificial languages: one based on Norwegian lexical roots and one based on Russian lexical roots. Both languages had grammatical case to distinguish between grammatical subjects and objects, which was overtly and unambiguously marked on the nouns as inflections (*-il* for NOM to mark agents and *-su* for ACC to mark patients). The novel languages allowed two types of word order: canonical (SVO) and non-canonical (OVS).

Our research questions are repeated here for convenience:

(1') Does CLI come exclusively from *one language* at early stages of acquisition, or can the target language be influenced by *both previously acquired languages*?

(2') Is CLI mostly dependent on *lexical similarity* or can *structural similarity* also play a role and be a significant predictor of CLI early in the acquisition process?

(3') Is pure abstract structural similarity (e.g., overt case marking) enough to facilitate learning of this category at early stages of acquisition or is it more facilitative if supported by *overt grammatical similarity* (e.g., case morphologically marked in a similar way)?

The results of our study revealed that Russian-Norwegian bilinguals were significantly more likely to identify and follow the grammatical case cues than the Norwegian L1 speakers. We observed significant differences between the groups in the two conditions when word order and

case marking did not align: correct OVS and incorrect SVO. This indicates that previous experience with a language with grammatical case marking and flexible word order (in this case, Russian) can be facilitative when the learner is acquiring a new language with a similar structural property (our artificial language Aliensk). This can happen in situations when the novel language is lexically very similar to Norwegian (a language that lacks nominal case marking), indicating that there is no wholesale grammatical transfer at early stages from a lexically 'more similar' language. We can conclude that our results go against the idea that there is wholesale transfer of the typologically more similar language at early stages of acquisition. Significant differences between the Norwegian L1 speakers and the Russian-Norwegian participants indicate that that the latter group did not transfer the complete Norwegian grammar onto Aliensk in one fell swoop at an early stage of acquisition, contra the predictions of the TPM. In contrast, we observed that structural similarity between individual properties (in our case, grammatical case) was a significant factor that had an effect early in development despite the overall lexical similarity between Norwegian and Aliensk. Thus, our answer to RQ2 is that there is no wholesale transfer at initial stages based on lexical similarity, and that structural similarity may play a role also at very early stages of multilingual acquisition.

At the same time, the results of the Follow-up task, where structural and lexical similarity were aligned in the artificial language, indicate that both structural and lexical similarity may play a significant role as predictors of relative activation of individual representations and are important contributing factors in additional language acquisition. This resonates with recent findings in Jensen and Westergaard (2022), showing that both lexical and syntactic cues in the input play a role for CLI in early L3 acquisition. Our Russian participants who were exposed to a novel artificial language that was both lexically and structurally like Russian performed at ceiling on all conditions, were able to inhibit the subject-first bias, and follow the case cue in conditions where the case cue and word order were in a mismatch. In our view, this indicates

that both lexical and structural similarity play a role in additional language acquisition. The results from our experimental scenario suggest that learners find it easier to identify and follow grammatical case cues and suppress word order cues if the novel language bears both lexical and structural resemblance to a language that allows this, as compared to the situation when lexical and structural similarity do not align (cf. the performance of the Russian-Norwegian group on the main experiment). Thus, our answer to RQ1 is that both/all previously acquired languages may be activated in early multilingual language acquisition.

Addressing the question of superficial vs abstract structural similarity, we attribute the differences in the performance of the Norwegian-Russian and the Norwegian-Greek bilingual groups to the different linguistic properties of these speakers' L1. The artificial learning paradigm we developed marks case as suffixes on nouns. Consequently, the Russian-speaking group benefits from this overt morphological similarity between their L1 and the tested paradigm. This is much more difficult for the Greek-speaking group. While the employed grammatical strategy (i.e., marking case on the noun as a suffix) is present in Greek too, the high degree of syncretism in Greek grants to determiners a prominent, disambiguating role for case marking, at least in NOM and ACC, for both masculine and feminine nouns. Unlike in Greek, definite and indefinite articles do not exist in either Russian or Aliensk. Therefore, our results suggest that superficial similarity matters in L3 acquisition, confirming that language is acquired based on the direct inspection of saliently accessible morphophonological cues (Fasanella, 2014; Leivada & Murphy, 2022). Our answer to RQ3 is that for structural similarity to have an effect at very early stages of multilingual language acquisition, the morphosyntactic property in question must also be expressed in a similar manner.

One observation that could be voiced in relation to all artificial language learning studies, and ours is no exception, is that they typically measure some type of pattern recognition, and this may be markedly different from the task of actual language acquisition occurring in a

naturalistic setting. Although the different character of the two acquisition targets is incontestable, especially in terms of their breadth, we would argue that our experiment involves pattern recognition in a similar way to how this occurs in natural language learning. Most language acquisition models assume some sensitivity to pattern recognition; in fact, this is a rare point of agreement across different theoretical frameworks in linguistics. From Chomsky's (2001) *Uniformity Hypothesis* that links variation to easily detectable properties of utterances which translate to salient morphophonological cues that children use to extrapolate a target grammar (Westergaard, 2014; Fasanella, 2014; Leivada & Murphy, 2022), to acquisition models that predict learning on the basis of exemplars (Ambridge, 2020), recognizing patterns and regularities in the input is a key component of the learning process. From this perspective, our artificial language learning experiment involves pattern recognition as a proxy to how this occurs in language acquisition.

5. Conclusion

This paper tests one of the key issues in multilingual language acquisition in a study that uses an artificial language as the L3/Ln, viz. the effect of lexical vs structural similarity between the target language and the previously acquired languages. Using case as the grammatical property to be acquired, the study shows that structural similarity plays a significant role, in that there may be a facilitative effect from a language with a similar grammatical property, even in a situation where the L3/Ln is lexically very similar (or even identical) to the other previously acquired language. However, at a very early stage of acquisition, abstract structural similarity is not sufficient for CLI and/or learning to take place; the similarity must also be morphologically expressed in a similar manner (that is, both languages must have case expressed on determiners or as suffixes on the noun). The study thus adds to the growing body

of L3/Ln research showing that both previously acquired languages are activated in the learning process, that structural similarity may play a role in addition to lexical similarity, but that some superficial similarity is necessary at very early stages of acquisition.

Data availability statement

The data that support the findings of this study and the experimental materials are openly available at https://osf.io/jv674/?view_only=edcf8ea3d0bd48a48411634178733d55

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Competing Interests Declaration

The authors declare no competing interests.

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Appendix 1

Table A1. Formula: glmer (Accuracy ~ Group*Condition+ (1 + Condition |Code)

		Accuracy	
Predictors	*Odds Ratios*	*CI*	*p*
(Intercept)	9.87	2.75 – 35.47	**<0.001**
Group [Nor]	3.26	0.54 – 19.91	0.200
Group [RuNor]	1.59	0.27 – 9.26	0.608
condition [SVO Incorrect]	0.01	0.00 – 0.13	**<0.001**
condition [OVS Incorrect]	0.44	0.24 – 0.83	**0.011**
condition [OVS Correct]	0.04	0.00 – 0.39	**0.006**
Group [Nor] * condition [SVO Incorrect]	0.29	0.01 – 6.64	0.435
Group [RuNor] * condition [SVO Incorrect]	10.50	0.47 – 234.42	0.138
Group [Nor] * condition [OVS Incorrect]	0.49	0.19 – 1.26	0.139
Group [RuNor] * condition [OVS Incorrect]	0.31	0.13 – 0.73	**0.008**
Group [Nor] * condition [OVS Correct]	0.14	0.01 – 3.48	0.230
Group [RuNor] * condition [OVS Correct]	2.78	0.12 – 66.25	0.527
ICC	0.71		
N_{Code}	66		
Observations	3830		
Marginal R^2 / Conditional R^2	0.232 / 0.776		

Table A2. Post-hoc pairwise comparisons (estimated marginal means)

Condition	**Contrast**	**Estimate (SE)**	**p-value**
SVO_Correct	Greek-Norwegian – Norwegian	-1.22 (0.93)	0.38
	Greek-Norwegian – Russian-Norwegian	-0.44 (0.91)	0.87
	Russian-Norwegian - Norwegian	0.78 (0.91)	0.67
SVO_Incorrect	Greek-Norwegian - Norwegian	0.06 (1.09)	0.99
	Greek-Norwegian – Russian-Norwegian	-2.85 (1.08)	**0.02***

	Russian-Norwegian - Norwegian	-2.90 (1.06)	**0.02***
OVS_Correct	Greek-Norwegian - Norwegian	0.08 (1.01)	0.71
	Greek-Norwegian – Russian-Norwegian	-1.46 (0.99)	0.30
	Russian-Norwegian - Norwegian	-2.27 (0.98)	**0.054.**
OVS_Incorrect	Greek-Norwegian - Norwegian	-0.46 (0.65)	0.75
	Greek-Norwegian – Russian-Norwegian	0.71 (0.64)	0.49
	Russian-Norwegian - Norwegian	1.18 (0.63)	0.14

Results are given on the log odds ratio (not the response) scale.

P value adjustment: tukey method for comparing a family of 3 estimates

Table B1. Formula: glmer (Accuracy ~ Group*Condition+ (1 + Condition |Code)

		Accuracy	
Predictors	*Odds Ratios*	*CI*	*p*
(Intercept)	28.10	7.50 – 105.33	**<0.001**
Group [RuMon]	2.39	0.35 – 16.54	0.376
Group [RuNor]	0.47	0.08 – 2.66	0.390
condition [SVO Incorrect]	0.01	0.00 – 0.05	**<0.001**
condition [OVS Incorrect]	0.28	0.12 – 0.65	**0.003**
condition [OVS Correct]	0.00	0.00 – 0.04	**<0.001**
Group [RuMon] * condition [SVO Incorrect]	121.18	4.94 – 2971.75	**0.003**
Group [RuNor] * condition [SVO Incorrect]	21.53	1.19 – 390.70	**0.038**
Group [RuMon] * condition [OVS Incorrect]	2.26	0.66 – 7.73	0.195
Group [RuNor] * condition [OVS Incorrect]	0.61	0.24 – 1.60	0.319
Group [RuMon] * condition [OVS Correct]	141.86	6.10 – 3299.33	**0.002**
Group [RuNor] * condition [OVS Correct]	37.98	2.30 – 626.38	**0.011**
ICC	0.71		
N_{Code}	66		
Observations	3815		
Marginal R^2 / Conditional R^2	0.279 / 0.788		

Table B2. Post-hoc pairwise comparisons (estimated marginal means)

Condition	**Contrast**	**Estimate (SE)**	**p-value**
SVO_Correct	Norwegian – Russian	-0.78 (0.97)	0.71
	Norwegian – Russian-Norwegian	0.87 (0.89)	0.60
	Russian – Russian-Norwegian	1.66 (0.95)	0.19
SVO_Incorrect	**Norwegian – Russian**	-5.78 (1.23)	**<.0001*** **
	Norwegian – Russian-Norwegian	-2.85 (1.08)	**0.02***
	Russian – Russian-Norwegian	-5.69 (1.10)	**0.03***
OVS_Correct	**Norwegian – Russian**	0.08 (1.01)	**<.0001*** **
	Norwegian – Russian-Norwegian	-2.30 (0.97)	**0.046***
	Russian – Russian-Norwegian	3.39 (1.03)	**0.003****
OVS_Incorrect	Norwegian – Russian	-1.68 (0.85)	0.11
	Norwegian – Russian-Norwegian	1.25 (0.75)	0.22
	Russian – Russian-Norwegian	2.94 (0.84)	**0.001****

Results are given on the log odds ratio (not the response) scale.

P value adjustment: tukey method for comparing a family of 3 estimates

Appendix 2

Instructions before the experiment.

1. Welcome!

   In this experiment you will first listen to some sentences in Aliensk (a new language), which describe the picture you will see in the center of the screen.

   (Press the space bar to continue)

2. Afterwards, you will see more pictures and hear sentences about them.

   Your task will be to indicate if the sentence correctly describes the picture.

3. If you think it is correct, press the YES button (key 9 on the keyboard).

   If you think it is wrong, press the NO button (key 1 on the keyboard).

4. Let's do one sentence as practice. We know that at this point you don't understand Aliensk, but simply respond by pushing the YES or NO button.

5. In the actual experiment, you will only have 3 seconds from the moment the sentence ends, so try to be quick!

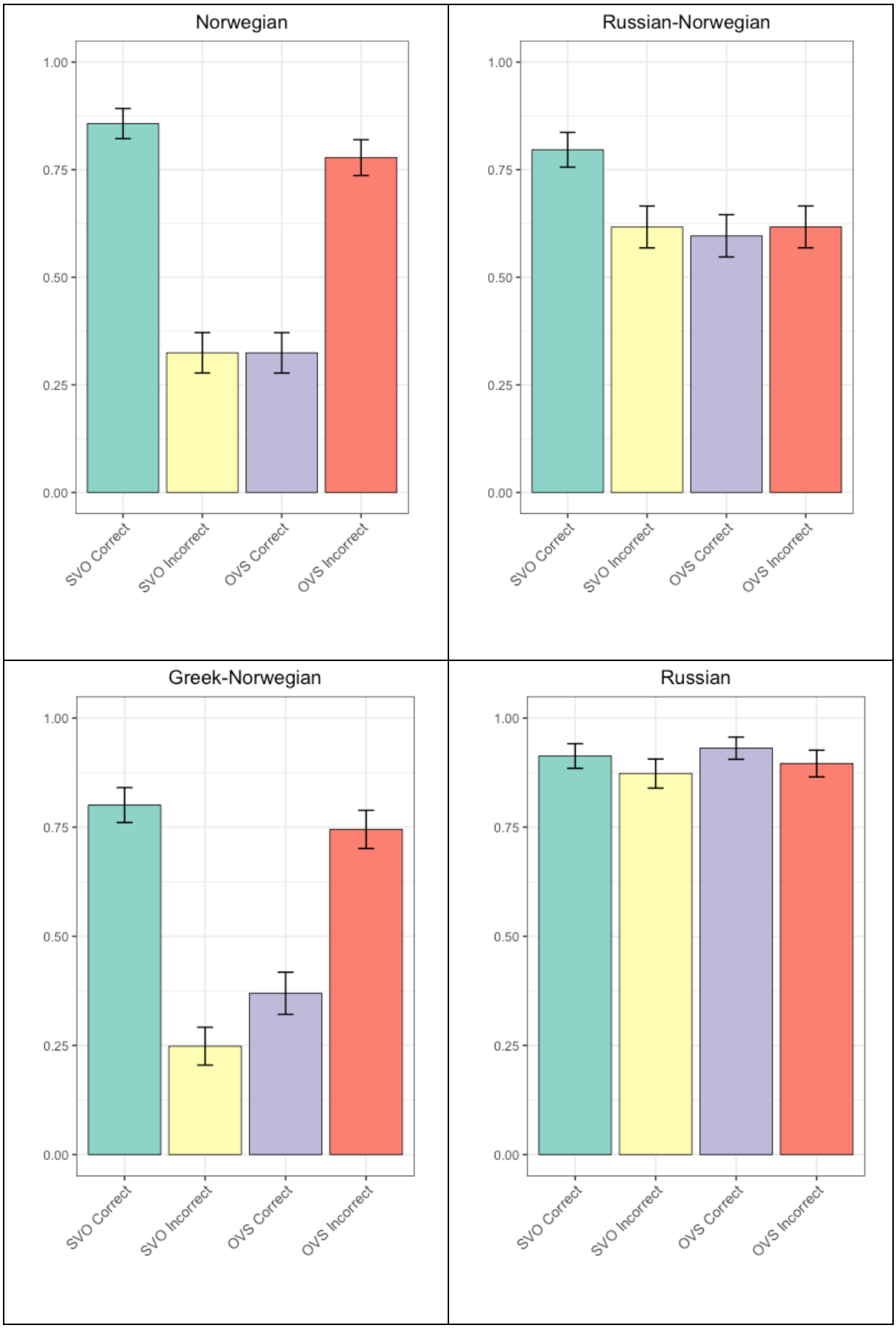
6. Time to learn! You will now hear some grammatically correct sentences in Aliensk describing the pictures that you see on the screen. Press the space bar to move to the next sentence. Your task is to understand how to make sentences in Aliensk.

7. That's all! We hope you have learnt some Aliensk. (Press any key to continue)

8. Now to the experiment. You will see some more pictures and hear sentences about them, like before. Please indicate if the sentence correctly describes the picture. Try to be as quick and as accurate as possible

9. When you are ready to begin, place your fingers on the response buttons (1=NO, 9=YES) and press any of them.

10. Experiments starts in…5 seconds


Norwegian
1.00
0.75
0.50
0.25
0.00
SVO Correct
SVO Incorrect
OVS Correct
OVS Incorrect
Russian-Norwegian
1.00
0.75
0.50
0.25
0.00
SVO Correct
SVO Incorrect
OVS Correct
OVS Incorrect
Greek-Norwegian
1.00
0.75
0.50
0.25
0.00
SVO Correct
SVO Incorrect
OVS Correct
OVS Incorrect
Russian
1.00
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SVO Correct
SVO Incorrect
OVS Correct
OVS Incorrect