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EMPIRICAL STUDY

Syntax Matters: Exploring the Effect of Linguistic Similarity in Third Language Acquisition

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Abstract: Over the last two decades, the question of to which linguistic cues learners pay attention when they decode a new language has been subject to controversy in the field of third language (L3) acquisition. In this article, we present an artificial language learning experiment that investigated how lexical and syntactic similarities between an artificial L3 and preexisting grammars impact crosslinguistic influence at the very beginning of the acquisition process. We exposed four groups of 30 Norwegian–English bilinguals each to one of four L3s and gave them training in that L3. The participants gave forced-choice acceptability judgments on pairs of nonsubject-initial declarative clauses that differed in word order, one grammatical in English, the other grammatical in Norwegian. The participants had not been exposed to nonsubject-initial declaratives during the exposure and training phases to avoid confounds with learning. The results showed that both lexical and syntactic similarities affect crosslinguistic influence. We discuss this result considering contemporary accounts of L3 acquisition.

Keywords crosslinguistic influence; wholesale transfer; property by property; artificial language learning; third language acquisition

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Introduction

In second language (L2) acquisition, it is easy to identify the source of crosslinguistic influence because there is only one candidate—the first language (L1). Determining the source(s) of influence in third language (L3) acquisition is a more complicated task because it might come from the L1, the L2, or from both preexisting grammars. Currently, there is little consensus among L3 models about whether learners select a primary, or even sole, source of influence, which would involve inhibiting (at least for a short period of time) one of the preexisting grammars or whether learners have access to both previously acquired languages as sources of influence throughout the acquisition process. Another issue is whether learners' (subconscious) choices are determined by the linguistic similarity between the L3 and previously acquired languages. And if so, how do learners determine whether the L1 or the L2 is more similar to the L3? In this article, we present an artificial language learning experiment that contributes to novel insights about the relative influence of lexical and syntactic similarities between an artificial L3 and preexisting grammars. Using an artificial language allowed us to explore the very first meeting with a L3 and to have full control over the stimuli. We also isolated effects of crosslinguistic influence from learning by testing a linguistic representation that the participants had not been exposed to in the L3.

Background Literature

Crosslinguistic Influence in L2 Acquisition

The full transfer/full access hypothesis (FT/FA; B. D. Schwartz & Sprouse, 1996) has received considerable empirical support in the L2 literature (e.g., Grüter, 2006). In short, the FT/FA argues that a copy of the L1 final state constitutes the L2 initial state. That is, all linguistic representations acquired in the L1 should "immediately carry over as the initial state of a new grammatical system on first exposure to input from the target language" (B. D. Schwartz & Sprouse, 1996, p. 41). This copying mechanism is referred to as wholesale transfer. Consequently, the FT/FA predicts that the L2 is systematically treated as the L1 at the beginning of the acquisition process because the L2 interlanguage consists of stable, fully specified L1 representations. Facilitative influence is explained by L1–L2 matches and nonfacilitation by mismatches. The representations are restructured when/if parsing failures occur. It follows that crosslinguistic influence is best seen early in the acquisition process, but the timing for restructuring is individual, depending on variables such as the L1–L2 overlap, input quantity and quality, and others.

The idea of full transfer has been challenged by Westergaard's (2021b) full transfer potential (FTP) position that addresses the question of what full transfer really entails. FTP proposes that learners have access to everything in the L1, but crosslinguistic influence (facilitative or nonfacilitative) will only take place at the moment when a particular property is needed (in production or comprehension). Consequently, crosslinguistic influence takes place property by property. This means that, in contrast to what wholesale transfer predicts, the L2 grammar starts small, with unstable linguistic representations, and grows incrementally (Westergaard, 2021b). Facilitative influence is a result of L1–L2 matches, but nonfacilitative influence could be a consequence of misanalysis (typical in comprehension) or insufficient input (typical in production). FT/FA and FTP cannot be distinguished in L2 acquisition, but they make different predictions about crosslinguistic influence in L3 acquisition. Both accounts are similarity-driven and can be contrasted to default accounts.

Similarity-Based Accounts of L3 Acquisition

Wholesale Transfer

The typological primacy model (Rothman, 2011, 2015; Rothman et al., 2019) extends FT/FA to L3 acquisition by arguing that bilinguals subconsciously copy one of their previously acquired languages as the baseline L3 system. It follows that this should be a fully specified grammar with robust L1 or L2 representations (or one of the L1s if the learners are simultaneous bilinguals). The parser should select the preexisting grammar that is linguistically more similar to the L3—a decision that is made by means of a subconscious modular assessment of how the L3 input overlaps with the L1 and L2. Rothman (e.g., 2013, 2015; see also Rothman et al., 2019) proposed that the linguistic modules are assessed from least to most influential in the order:

> Lexicon → Phonology/phonotactics → Morphology → Syntax
> (adapted from Rothman, 2015, p. 185)

The order of the cues is based on considerations of saliency and availability in the input because knowledge of words is a prerequisite for parsing syntax (González Alonso et al., 2020, p. 5).

According to Rothman et al. (2019), if the top cue in the hierarchy, the lexicon, reveals unambiguous and sufficient similarities to a previously acquired language, this language should be selected as the source of influence. There is then no reason for the learners to consider subordinate levels. Only when "the motivation for selection cannot come from the lexicon, knowledge of the

particular languages' phonological, morphological and syntactic systems will become paramount" (Rothman et al., 2019, p. 162).

In one of the earliest descriptions of the typological primacy model, Rothman (2011) proposed wholesale transfer for the initial state of L3 acquisition. As empirical support, Rothman compared two groups of bilinguals, L1 Italian–L2 English and L1 English–L2 Spanish speakers acquiring a Romance L3 (Spanish and Brazilian Portuguese, respectively) at beginner–intermediate levels. The results showed that both groups demonstrated knowledge of structures that are present in Romance, that is, the first group was influenced by their L1 and the second group by their L2. Rothman (2015) argued that wholesale transfer in the L3, unlike in the L2, does not take place at the initial state but rather at the initial stages. There is no fixed time frame for initial stages, but they are expected to occur very early in the acquisition process (e.g., Cabrelli Amaro et al., 2015; González Alonso & Rothman, 2017; Rothman, 2015).

As a result of the unspecified timing, proponents of wholesale transfer have argued that the absence of stable representations from the linguistically more similar language in a cross-sectional experimental design does not necessarily mean that wholesale transfer does not occur. Rather, it might simply mean that the process takes place earlier or later. In short, this is what González Alonso et al. (2020) argued for in an artificial language learning experiment that tested the impact of lexical similarity between artificial L3s and the learners' preexisting grammars, L1 Spanish and L2 English. The L3s were either lexically like English (mini-English) or like Spanish (mini-Spanish). The learners were exposed to and trained on gender agreement—a morphological similarity to Spanish, suggesting that there were incongruent cues in mini-English. The behavioral data collected for response time and grammaticality judgments showed no between-groups differences because both groups were relatively accurate (68–69%) in detecting gender violations in the L3 (González Alonso et al., 2020). González Alonso et al. also collected event-related potentials, expecting that wholesale transfer of the lexically more similar language would be reflected in sensitivity to gender violations (a P600 component) by learners of mini-Spanish. The results showed no such component. However, the study found a between-groups difference in brainwave patterns for a P300 component in the mini-Spanish group, a pattern that is typically observed for low-probability items. González Alonso et al. argued that this finding indicated attention to the relevant properties of gender violations. They concluded that, although the absence of a component related to processing of syntactic violations suggested that wholesale transfer had not occurred at the time of testing, the

P300 could have reflected pretransfer stages, defined as the time between the first exposure to the L3 and the moment in which wholesale transfer occurred.

Property by Property

L3 models that argue for crosslinguistic influence as a property-by-property process have included the cumulative enhancement model (Flynn et al., 2004), the scalpel model (Slabakova, 2017), and the linguistic proximity model (Westergaard, 2021a). In line with FTP, these models reject the idea of wholesale transfer because they argue that bilinguals have access to and may use both previously acquired languages as sources of influence throughout the acquisition process. According to Westergaard (2021a), this means that both preexisting grammars are activated in parallel, nominating all linguistic representations as candidates for L3 influence (cf. Sharwood Smith, 2021; Truscott & Sharwood Smith, 2019). The candidates compete against each other for the overall best fit to the L3 input. The outcome of the competition determines the candidates' degree of influence on the L3. This means that crosslinguistic influence can come from the L1, from the L2, or from both previously acquired languages. This has been argued, for example, by Listhaug et al. (2021), who found influence from both L1 Norwegian and L2 English in L3 French, as well as by Westergaard et al. (2017), Jensen et al. (2021), and Kolb et al. (2022), who found empirical evidence for simultaneous facilitative and nonfacilitative crosslinguistic influence in L3 English, both from a lexically similar language—Norwegian or German—and a more distant language—Russian—which shares a particular property with the L3.

A given candidate's strength of activation is determined by several variables, but the most influential one should be the degree of shared features with the L3 (Truscott & Sharwood Smith, 2019; Westergaard, 2021a). However, the relative impact of shared features differs across linguistic modules and time because of variables such as early availability and saliency of cues in the L3 input (Slabakova, 2017; Westergaard, 2021a). For example, L3 learners have immediate access to information about overlapping lexical items and phonology/phonotactics because this requires no lexical learning. In contrast, it is typical that no syntactic structures are involved at the very beginning of the decoding process of an unfamiliar language because this does require that lexical learning and structural learning have taken place. Consequently, lexico-phonological/phonotactic L3–L1/L2 crossover should be particularly influential at the very beginning of the L3 acquisition process. Westergaard (2021a) expected syntactic matches to become increasingly influential as learners become more advanced in the target language.

The impact of early availability of linguistic cues has been investigated, for example, by Culbertson et al. (2017), who compared the effect of saliency and early availability of phonological and semantic gender cues in adult artificial language learning (see also Culbertson et al., 2019, for a discussion of child artificial language learning). The results indicated that when adults learn a noun classification system such as grammatical gender, they tend to select the more salient cue regardless of whether the cue is phonology or semantics. Crucially, when the participants in Culbertson et al.'s (2017) study were exposed to one cue type before the other cue (e.g., semantics before phonology or vice versa), they were more likely to use the earlier available cue type when the saliency was equal (p. 354). In other words, a cue that is available earlier is more likely to be used unless there are substantial differences in the saliency of the cues.

Default-Based Accounts of L3 Acquisition

Other accounts of crosslinguistic influence in L3 acquisition by sequential bilinguals have argued that the nature of the target language has no impact. Instead, the L1 or L2 is selected as the primary source of influence by default, suggesting that bilingual speakers of the same language combination should behave similarly regardless of how the L3 overlaps with the L1 or the L2. A default L2 effect would explain the results bound by Bohnacker (2006), who reported that L1 Swedish–L2 English learners of L3 German used the nonfacilitative English word order when producing German instead of the facilitative word order that was available from Swedish. Because German is lexically more similar to Swedish than English, similarity-driven models would not predict such behavior.

Previous studies have presented arguments for both a L1 default effect (e.g., Hermas, 2010, 2015; Mollaie et al., 2016; Na Ranong & Leung, 2009; Park, 2016) and a L2 default effect (e.g., Bardel & Falk, 2007; Bayona, 2009; Berends et al., 2017; Falk & Bardel, 2011; Williams & Hammarberg, 1998). However, only the L2 default effect position has been formalized as a L3 model called the L2 status factor (Bardel & Falk, 2007; Falk & Bardel, 2011; Falk et al., 2015). The rationale for a L2 default effect is that explicitly learned nonnative languages (as opposed to implicitly acquired L1s) are typically more similar in terms of variables such as age of onset (later than the L1), learning context (classrooms vs. naturalistic settings), and metalinguistic awareness/knowledge (typically higher in explicitly acquired languages). Importantly, it is not clear whether the L2 status factor can make predictions about our study because, for example, Falk et al. (2015) argued that a L2 can become so similar to a L1 that the L2 effect disappears. A typical example

of such a case is a L2 that is introduced at an early age and is present in the everyday life of a speaker through the media. According to Falk et al. (2015, pp. 232–234), this is typical for English in Sweden, and it is also true for English in Norway. Because English was the L2 of the learners in our experiment, we could not directly test the claims of the L2 status factor; rather we investigated the possibility of a L1/L2 default effect more generally.

The Present Study

In our study, we investigated crosslinguistic influence at the very beginning of L3 acquisition by asking how lexical and syntactic similarities between the L3 input and previously acquired languages affect word order preferences in the L3. We exposed Norwegian–English sequential bilinguals to different types of artificial languages that varied in lexical and syntactic crossover with the participants' L1 Norwegian and L2 English. We named the artificial languages as Languages A, B, C, and D. Languages A and C were lexically and phonotactically based on Norwegian; Languages B and D were based lexically and phonotactically on English. Syntactically, Languages A and B overlapped with both English and Norwegian, but Languages C and D revealed a syntactic similarity either to English or Norwegian.

The participants completed a one-session procedure in which they were exposed to and trained on six nonce words and sentences in the L3 before they were given a forced-choice acceptability judgment task in which they had to choose between sentence pairs that only differed in word order. We used a binary response scale because we were interested in the straightforward qualitative question of whether the bilinguals preferred the word order from Language X or the word order from Language Y when they were exposed to an unknown language (Schütze & Sprouse, 2014). Crucially, the participants had not been exposed to the experimental items prior to the acceptability judgment task to avoid confounds with learning. In this study, we asked the research question:

> How do lexical and syntactic similarities between the L3 and previously acquired languages affect crosslinguistic influence at the very beginning of L3 acquisition?

To answer this question, we investigated the dependency relationship between word order preferences, as a proxy for crosslinguistic influence, and Languages A, B, C, and D by fitting a mixed-effects binomial regression model to the forced-choice acceptability judgment task data. We tested the following three hypotheses (Hs):

- H_0: There is no relationship between word order preferences and similarities between the L3 and the L1/L2.
- H_1: There is a relationship between word order preferences and **lexical** similarity between the L3 and the L1/L2.
- H_2: There is a relationship between word order preferences and **syntactic** similarity between the L3 and the L1/L2.

A similarity-driven account would predict a rejection of H_0. If wholesale transfer based on the lexical input had taken place, we should have observed behavior in line with H_1. Behavior in line with H_2 would have indicated that wholesale transfer had not taken place. Behavior in line with H_2 would also have been compatible with a property-by-property explanation of L3 acquisition.

Method

Participants

We recruited 120 sequential bilingual speakers of L1 Norwegian–L2 English. The participants had acquired English in school from ages 5 to 12 years. We recruited the participants through schools and the online recruitment service Prolific (https://www.prolific.co). The participants ranged in age from 16 to 72 years ($M = 25.73$, $SD = 13.70$). There were 69 female and 51 male participants.

At the end of the experiment, we gave the participants two mini acceptability judgment tasks—one in Norwegian and one English—in which they had to accept or reject nonsubject-initial declaratives that differed in word order (two declaratives per language; see Appendix S1 in the Supporting Information online). This was to ensure that the participants had judged English and Norwegian as we expected them to do. Importantly, we gave the participants these acceptability judgment tasks after the artificial language learning experiment to avoid task priming. The participants also filled out a cloze task (see Appendix S2 in the Supporting Information online) and a modified version of Anderson et al.'s (2018) Language and Social Background Questionnaire (see Appendix S3 in the Supporting Information online). The Language and Social Background Questionnaire reflects three variables: L2 proficiency and home use, L2 use in societal and community contexts, and L1 proficiency. We calculated individual bilingualism scores by combining these variables following the method described by Anderson et al. (2018). We used the scores to group the participants as monolinguals, bilinguals, or speakers with ambiguous language backgrounds. None of the participants were monolingual. There were 24

participants with ambiguous language backgrounds, and 96 participants were bilinguals (see details in Appendix S4 in the Supporting Information online).[1]

We excluded participants who failed to meet at least one of the following criteria:

- Correct acceptance/rejection of the relevant properties in Norwegian and English.
- No higher education and/or teaching experience in languages/linguistics to avoid substantial differences in metalinguistic awareness because this variable has been argued to affect crosslinguistic influence (Falk et al., 2015).
- No higher proficiency levels than beginner in other languages than Norwegian and English. We were able to limit, but not completely avoid, knowledge of other languages because an additional foreign language other than English is offered in Norwegian schools.

We excluded 23 participants (16.1%) on the basis of these criteria. We replaced those excluded to attain a final sample of 30 participants in each L3 group.

Materials

L3 Input

The lexical items were either (pseudo)cognates (verbs, function words, and adverbials) or nonce nouns. We created the six nonce nouns in a series of three steps. First, we determined which sounds to include. We selected unique sounds, that is, those that exist in English but not in Norwegian, and vice versa. The purpose was to avoid ambiguous cues in the input. Because the input was written, we also took advantage of orthographic differences between Norwegian[2] and English.[3] We used the letters *z* and *w*, which are typically found only in loan words in Norwegian, and *ø* and *å*, which are not used in English. We also included the consonant clusters *fn* and *kj*, which are common in Norwegian but not in English.

Second, we took into consideration the frequency and distribution of sounds and syllable structure in Norwegian and English by analyzing the 30 most frequent nouns in each language (Kilgarriff et al., 2014; see Appendices S5 and S6 in the Supporting Information online). The nouns were either monosyllabic (around 60%) or disyllabic in both English and Norwegian. For that reason, most of the artificial nouns were monosyllabic, but we included one trisyllabic noun in each input (*aporo*, "apple") to strengthen the illusion of the L3 as foreign despite clear similarities to a preexisting grammar.

Table 1 Norwegian-based nonce nouns used in Languages A and C

Noun	Syllable structure	ND (count)	Neighbors	Norwegian equivalent
aporo	VC.V.CV	0	–	eple (apple)
føm	CVC	10	føl, føn, fø, øm, tøm, røm, søm, før, fød, føk	vannmelon (watermelon)
åkra	VC.CV	1	okra	appelsin (orange)
fnipp	CCVC	2	flipp, snipp,	jordbær (strawberry)
kjobe	CV.CV	0	–	banan (banana)
gau	CV	7	sau, dau, tau, au, aur, ga, gaur	kirsebær (cherry)

Note. ND = neighborhood density; V = vowel; C = consonant.

Table 2 English-based nonce nouns used in Languages B and D

Noun	Syllable structure	ND (count)	Neighbors	Norwegian equivalent
aporo	VC.V.CV	0	–	apple
neeb	CVC	3	need, neb, nee	watermelon
wesh	CVC	5	wash, mesh, wish, west, welsh	orange
wez	CVC	8	fez, wiz, wet, web, wee, wed, we, wen	strawberry
poty	CV.CV	7	pity, pony, poly, pots, pot, pouty, potty	banana
pronlim	CCVC.CVC	0	–	cherry

Note. ND = neighborhood density; V = vowel; C = consonant.

Finally, we made sure that the nonce nouns did not violate universal principles of natural languages (cf. Hyman, 2008; Lindblom, 1986; J. Schwartz et al., 1997). Tables 1 and 2 show the spelling, meaning, and neighborhood densities of the nonce nouns used in the Norwegian- and English-based lexicons, respectively. Lexical neighbors refer to the words that can be created in Norwegian (Table 1) and English (Table 2) by adding, removing, or changing one sound of a word. A *t* test showed that the mean neighborhood densities in the Norwegian- and English-based nouns were not statistically significantly different at an alpha level of .05. We also conducted a norming task in which

we asked 10 native Norwegian speakers with high self-rated proficiency in English to rank the words on a scale of 0–10 for how Norwegian or English the words sounded. We did not find a statistically significant difference when we compared the Norwegian score for the Norwegian-based nouns with the English score for English-based nouns. This suggested that the six nonce nouns in Languages A, B, C, and D were comparable and likely to trigger the intended associations.

For the syntactic input, we exposed all the participants to main declarative clauses with Subject–Verb–Object (SVO) word order in the L3. Importantly, this was the only syntactic cue in Languages A and B. Both Norwegian and English are considered SVO languages, as Example 1a illustrates, and, for that reason, we refer to SVO as a neutral cue because it did not contribute to the establishment of either Norwegian or English as syntactically more similar to the L3. Examples 1b and 1c show SVO sentences in the input where the lexical items were either Norwegian- or English-based, respectively. We kept the grammatical number of the subjects constant to avoid confounds with grammatical number agreement.

Example 1

a. *Emma elsker lingvistikk*.
   Emma loves linguistics.
   "Emma loves linguistics."
b. *Ej hettir Manene*.
   I called Manene.
   "My name is Manene."
c. *I eaf wesh ons Daytue*.
   I eat orange on Tuesday.
   "I eat oranges on Tuesdays."

Language C did not only include SVO sentences but also *do*-support—a syntactic feature that exists in English but not in Norwegian, as Example 2a illustrates. Example 2b shows an example of *do*-support in the artificial language. This meant that the learners of Language C were exposed to incongruent cues, with the syntax being similar to English and the lexicon to Norwegian.

Example 2

a. *Jeg liker ikke druer*.
   I like not grapes.
   "I do not like grapes."

Table 3 Summary of linguistic crossover in the Norwegian–English–third language (L3) triads

L3	Lexicon	Syntax	Congruency
A	Norwegian-based	Norwegian- & English-based (neutral)	Congruent
B	English-based	Norwegian- & English-based (neutral)	Congruent
C	Norwegian-based	English-based	Incongruent
D	English-based	Norwegian-based	Incongruent

b. *Ej do neit beudro knurk*.
I do not like grapes.
"I do not like grapes."

In Language D, the additional syntactic cue to SVO word order was provided by postnominal possessives that represented a similarity to Norwegian, as Example 3a shows. Norwegian also accepts prenominal possessives, as Example 3b illustrates, but English accepts only prenominal possessives. This meant that there was a mismatch between the L3 (Language D) and English. Hence, there was incongruence between the cues, as the syntax was English-based and the lexicon was Norwegian-based. Example 3c shows a sentence with a postnominal possessive in the artificial language.

Example 3

a. *Navnet mitt er Kari*.
Name.DEF my is Kari.
"My name is Kari."
b. *Mitt navn er Kari*.
My name is Kari.
"My name is Kari."
c. *Thamey miz ef Manene*.
Name.DEF my is Manene.
"My name is Manene."

Table 3 summarizes how Languages A, B, C, and D varied in their lexical and syntactic matches to Norwegian and English.

The Experimental Task and Critical Condition

The main task was a forced-choice acceptability judgment task in which the participants chose between sentence pairs. There were 18 pairs in total: 12

fillers and six critical items (see all items in Appendix S7 in the Supporting Information online). The critical condition was one of nonsubject-initial declarative clauses that only differed in word order. Half of the sentences had the structure Adverbial–Verb–Subject (XVS); the other half had the structure Adverbial–Subject–Verb (XSV). Examples 4a and 4b illustrate the XVS and XSV structures in Languages A and C, respectively, and Examples 4c and 4d illustrate the XVS and XSV structures in Languages B and D, respectively. The participants had been exposed to and trained on all the sentence constituents but had not encountered fronted sentences during the exposure and training phases.

Example 4

a. *Pån dagman knetter ej aporo*. [XVS]
   On Monday eat I apples.
   "On Mondays I eat apples."
b. *Pån dagman ej knetter aporo*. [XSV]
   On Monday I eat apples.
   "On Mondays I eat apples."
c. *Ons Daymon eaf I aporo*. [XVS]
   On Monday eat I apples.
   "On Mondays I eat apples."
d. *Ons Daymon I eaf aporo*. [XSV]
   On Monday I eat apples.
   "On Mondays I eat apples."

Norwegian and English exhibit mismatching word orders in nonsubject-initial declarative clauses. In Norwegian, the finite verb moves to the second position, resulting in XVS word order (Vikner, 1995; Westergaard & Vangsnes, 2005), as Example 5a illustrates. In English, the verb stays in the third position, resulting in the word order XSV, as Example 5b shows.[4] This means that Norwegian–English bilinguals have two candidate structures for word order in their mind when they parse nonsubject-initial declarative clauses in a new language: the English XSV and the Norwegian XVS.

Example 5

a. *På mandager spiser jeg appelsiner*.
   On Mondays eat I oranges.
   "On Mondays I eat oranges."
b. *On Mondays I eat oranges*.

A forced-choice acceptability judgment task gave us information about the bilinguals' preferences for one word order over another when each was acceptable/unacceptable in a previously acquired language. Crucially, the participants' behavior could not have been the result of L3 exposure and/or training because they had never been exposed to nonsubject-initial declaratives in the L3 prior to the acceptability judgment task. Instead, we interpreted a preference for a given word order as a function of crosslinguistic influence.

Procedure

We created and carried out the experiment with the online application Gorilla Experiment Builder (https://gorilla.sc; Anwyl-Irvine et al., 2020). We told the participants that they would be exposed to and learn words from a new language and tested on what they had learned. We gave all instructions in animated videos that demonstrated the tasks so as to avoid priming the participants with language used in the instructions. We made all videos using the animation software Animaker (2021). The experiment consisted of three phases inspired by the works of Culbertson et al. (2012). On average, the experiment took the participants around 60 minutes to complete. We ended the data collection when we had reached 30 participants per group.

The Exposure Phase

Upon entering the experiment, the participants were randomly assigned to Languages A, B, C, or D, with 30 participants in each L3 group. The participants were first introduced to the L3 in an animated video where a female native speaker of the L3 introduced herself and her family. The speaker explained that she eats fruit every day and specified on which weekday she eats which fruit. Importantly, the speaker presented the fruit schedule in SVO sentences. There were 20 sentences in each video. After the video, the nonce nouns were repeated twice, each displayed for 3,000 ms. After each display, the noun was used in a sentence displayed for 4,000 ms. Figure 1 shows examples from the video exposure for Language D.

The Training Phase

After the exposure phase, the learners practiced remembering the nonce nouns and weekday labels in two matching tasks in which we used images taken from the website Freepik (https://www.freepik.com). The first task included picture-label matching, as Figure 2 exemplifies, and the second task involved assigning fruit labels to the correct weekday according to the fruit schedule introduced in the video.

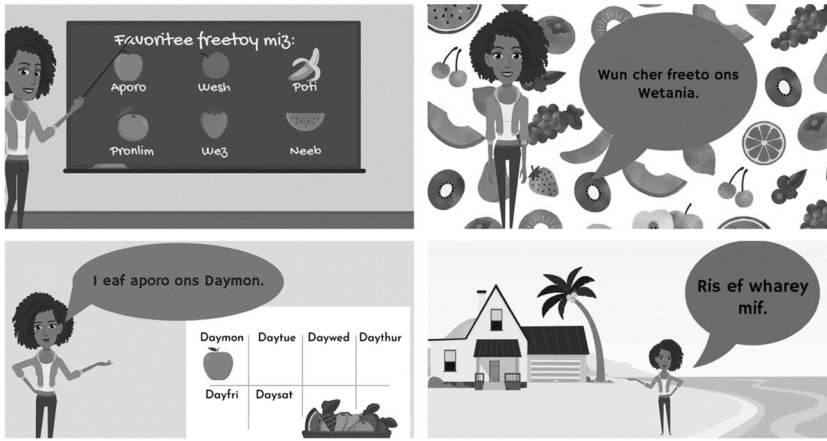

Figure 1 Example of video exposure to Language D, an artificial third language.

Figure 2 Example of the picture–label matching task.

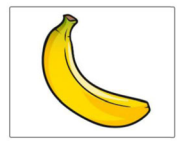

Figure 3 Example of the forced-choice acceptability judgment task.

The Testing Phase

We tested the participants' word order preferences in a forced-choice acceptability judgment task that consisted of 18 trials of six target items and 12 fillers (see Appendix S7 in the Supporting Information online). In each trial, the participants saw two sentences that differed only syntactically. The sentences in the critical condition differed in word order (XSV vs. XVS), as Figure 3 shows.

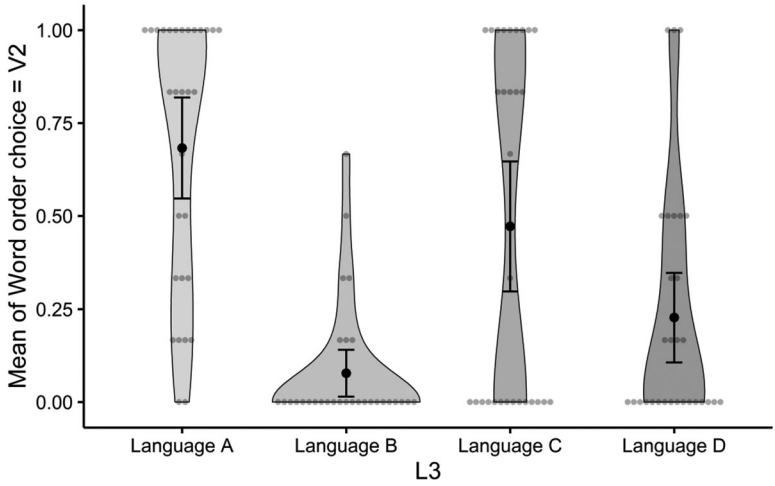

Figure 4 Mean proportion of verb position V2 responses by group. The error bars enclose 95% confidence intervals; the middle dot = the mean; the width = distribution density (frequency); the scattered dots = individual observations. Language A = Norwegian-based lexicon/neutral syntax; Language B = English-based lexicon/neutral syntax; Language C = Norwegian-based lexicon/English-based syntax; Language D = English based lexicon/Norwegian-based syntax.

We asked the participants to click on the sentence that they felt to be more natural to them. Once the participants had selected a sentence, they were automatically directed to the next trial. All trials were randomized.

Results

We analyzed the data using the statistical software R (R Core Team, 2021). The full dataset is available on the IRIS repository (Jensen & Westergaard, 2022) and in Appendix S8 in the Supporting Information online. Out of the 720 observations, declarations with the word order of verb in the third position (V3) were selected 457 times (around 63%; see the raw scores in Appendix S9 in the Supporting Information online). We used the rempsyc R package (Thériault, 2022) to create Figure 4 that illustrates the mean proportions for the selection of verbs in the second position (V2) in the forced-choice acceptability judgment task by group (Languages A, B, C, and D). This figure shows that word order preferences were distributed unevenly across the L3s, ranging from around 68% V2 selections in Language A (Norwegian-based lexicon/neutral syntax) to around 8% V2 selections in Language B

(English-based lexicon/neutral syntax). When the lexical cues were Norwegian-based and the syntax English-based (Language C), the participants selected the V2 and V3 word orders equally often (a near 50–50 split). When the clues were in the opposite order, that is, English-based lexicon and Norwegian-based syntax (Language D), the participants preferred the V3 position (around 23% V2 selections).

We fitted a mixed-effects binomial regression model with participants and items as random intercepts to the data (estimated using maximum likelihood and the BOBYQA optimizer; Powell, 2009) in a manual stepwise step-up forward elimination procedure (e.g., Gries, 2013; see Appendices S8 and S10 in the Supporting Information online for the dataset and R script),[5] using the lme4 R package (Bates et al., 2015). To predict the variance in the response variable word order choice (V2 = 1, V3 = 0), we added the variables lexicon (English-based vs. Norwegian-based) and congruency between the lexical and syntactic cues (congruent vs. incongruent) and the Lexicon × Congruency interaction as potential fixed effects. Because there were no obvious baselines in the levels of the variables, we used sum contrasts for the categorical variables. By default, the reference levels for the variables lexicon and congruency were English-based and congruent, respectively.

We added the potential fixed effects and their interactions successively. For each addition, we checked if the inclusion led to problems regarding multicollinearity, assessed by extracting variance inflation factors (VIFs). If there were no substantial problems with multicollinearity (VIFs < 3), we examined the model's Akaike information criterion (AIC), Bayesian information criterion (BIC) and p value. We accepted a model only if the added predictor improved the model's goodness-of-fit (defined by decreased AIC and BIC values) and significantly correlated with the response variable. To evaluate statistical significance, we set the alpha level to .05. We used the Wald approximation to compute 95% confidence intervals and p values. Table 4 summarizes the model-fitting procedure. The table shows that including the predictor lexicon and the Lexicon × Congruency interaction improved the model and correlated significantly with the response variable.

The final minimal adequate model performed significantly better than an intercept-only baseline model, $\chi^2(3) = 48.38$, $p < .001$ (see Appendix S11 in the Supporting Information online), and had a near optimal fit (Harrell's C = .98, Somers' $D_{xy} = .96$). Together the random and fixed effects explained a substantial amount of the variance in the response variable ($R^2_{\text{conditional}} = .89$); Table 5 summarizes the model. The intercept represents the overall mean across the levels.

Table 4 Summary of the model-fitting procedure: Mixed-effects binomial logistic regression

Model	Term added	Compared to	AIC (BIC)	χ^2	*p*
Baseline	1 (Intercept)	–	572.76 (586.50)	–	–
Model 1	1 + Lexicon	Model 0	536.46 (554.78)	38.30	< .001
Model 2	Congruency	Model 1	538.44 (561.34)	0.02	.883
Model 3	Bilingualism group	Model 1	538.45 (561.35)	0.01	.917
Model 4	Proficiency group	Model 1	537.02 (559.92)	1.44	.230
Final	Congruency + Lexicon × Congruency	Model 1	530.38 (557.86)	10.08	.006

Table 5 Model summary predicting word order choices (V2 = 1, V3 = 0) in a forced-choice task

			95% CI			
Fixed effects	*b*	*SE*	Lower	Upper	*z*	*p*
Intercept	−1.94	0.52	−2.95	−0.91	−3.73	< .001
Lexicon	−2.79	0.57	−3.90	−1.67	−4.90	< .001
Congruency	0.12	0.45	−0.77	1.01	0.27	.079
Lexicon × Congruency	−1.38	0.46	−2.28	−0.47	−2.98	.003

Random effects	Variance	*SD*
Participants (intercept)	15.96	4.00
Items (intercept)	0.25	0.50
Residua		

R^2_{marginal} = .33, 95% CI [.20–.46]; $R^2_{\text{conditional}}$ = .89, 95% CI [.85–.93]

Note. Generalized linear mixed model fit by maximum likelihood (Laplace approximation); family: binomial (logit); response variable: word order choices (verb positions V2 or V3); fixed effects: lexicon and congruency; random effects: participants (N = 120) and items (k = 11); control: optimizer = BOBYQA (Powell, 2009); total number of observations = 720.

The main effect of lexicon showed that there was a difference between the languages with an English-based lexicon (Languages B and D) and the languages with a Norwegian-based lexicon (Languages A and C). More specifically, Table 5 shows that the participants selected V2 word order less frequently when the lexical items were based on English. The Lexicon × Congruency interaction effect showed that, when the lexicon was Norwegian-based, there

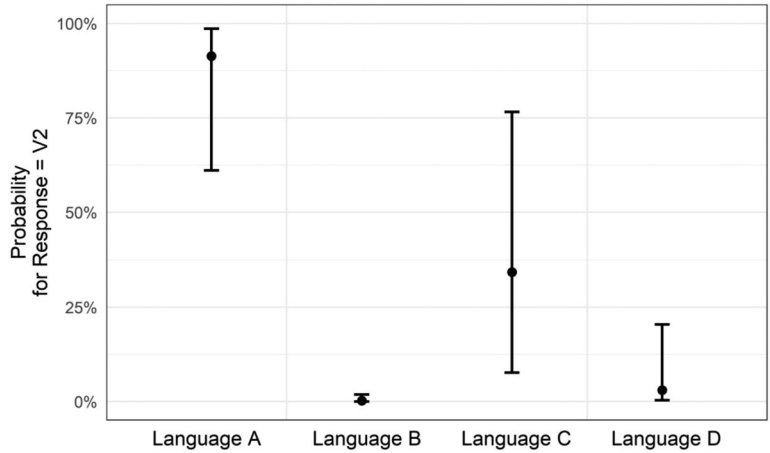

Figure 5 Probability of selecting V2 over V3 verb position word order in a forced-choice task by the type of artificial language as predicted by the final minimal adequate model. The error bars enclose a 95% confidence interval for the effect.

was a higher probability for V2 to surface when the syntax was neutral Language A than when the syntax was English-based Language C. We used the sjPlot R package (Lüdecke, 2021) to visualize this effect in Figure 5. Importantly, this difference was not present when the lexical input included English-based Languages B and D; the probability for V2 was close to zero, regardless of whether Norwegian-based syntax was present or not in the input.

Discussion

In this experiment, we asked how lexical and syntactic similarities between an artificial L3 and the L1/L2 affect word order preferences as a proxy for crosslinguistic influence at the very beginning of L3 acquisition. We randomly assigned 120 Norwegian–English sequential bilinguals to one out of four possible L3s that varied between being lexically similar to Norwegian or English and syntactically similar to Norwegian, English, or both languages. The participants underwent an exposure phase, a training phase, and a testing phase. The testing phase included a forced-choice acceptability judgment task with experimental items to which the participants had not been exposed.

A mixed-effects binomial regression model reported a positive correlation between the probability of selecting Norwegian-like V2 word order and exposure to a Norwegian-based lexicon. An interaction effect showed that V2 selections were substantially less likely to appear for input with English-based

syntax (and Norwegian-based lexicon) compared to input with Norwegian-based lexical items and neutral syntax.

The Effect of Lexicon

The statistically significant effect of lexicon indicated that we should reject H_0: There is no relationship between word order preferences and any of the predictor variables. This finding extends, for example, the results of González Alonso et al. (2020), who found that overall linguistic similarity, as opposed to the manner of acquisition, determines the source of syntactic crosslinguistic influence in L3 acquisition. Such results support similarity-driven accounts of L3 acquisition—both property-by-property and wholesale transfer—because these accounts predict a strong impact of lexical cues at the beginning of the acquisition process due to early availability and saliency compared to syntactic information that can be accessed only after a certain level of lexical learning.

The rejection of H_0 is incompatible with a default explanation of crosslinguistic influence in L3 acquisition as previous studies have suggested (e.g., Bardel & Falk, 2007; Bayona, 2009; Berends et al., 2017; Falk & Bardel, 2011; Hermas, 2010, 2015; Mollaie et al., 2016; Na Ranong & Leung, 2009; Park, 2016). A L1 or L2 default would predict that bilingual speakers of the same language combination should behave similarly regardless of the nature of the L3, a conclusion that is not compatible with the results of our experiment.

The Interaction Effect of Lexicon and Congruency

The statistically significant Lexicon × Congruency interaction shows that not only lexical cues determine word order preferences at an early stage but also that syntactic similarity between the L3 and a previously acquired language also determined word order preference—a result that is compatible with H_2: There is a relationship between word order preferences and syntactic similarity between the L3 and the L1/L2. This is an important finding because it shows that wholesale transfer based on the lexical input cannot have taken place at the initial state as Rothman (2011) hypothesized. That is, if wholesale transfer had taken place, we would not have observed an effect of incongruent syntactic cues because the learners would have decided which language to transfer based on the lexical cues alone, as proposed by the linguistic hierarchy (e.g., Rothman, 2013, 2015; Rothman et al., 2019). In other words, we should not have observed the drop in V2 selections in the group who had learned Language C, that is, the participants who had been exposed to Norwegian-based

lexical items and English-based syntax. The behavior of the participants who had learned Language C is incompatible with the idea of wholesale copying of the grammar that was lexically more similar to the L3 input at the initial stages. Thus, our results corroborate the findings of González Alonso et al. (2020), who also reported results that were inconsistent with the occurrence of wholesale transfer very early in the process. González Alonso et al. argued that their findings reflected so-called pretransfer stages, indicating that wholesale transfer could take place later in the acquisition process. In principle, the same could be argued for the findings in our study. Although we have clearly shown that there had been no wholesale transfer at the time of testing, we cannot rule out the possibility that wholesale transfer might take place at a later stage. However, while Gonzalez Alonso et al. (2020) argued for the existence of a pretransfer stage based on the lack of an early P600 effect, our results show that learners are sensitive to linguistic properties at the bottom of Rothman's (2013, 2015) hierarchy at this very early stage.

Thus, if the participants' behavior in our experiment reflects pretransfer stages of the L3 acquisition process, this raises the question of how the linguistic hierarchy actually works. As we mentioned previously, the hierarchical system predicts that, as soon as the parser discovers lexical similarity between the L3 and one of the previously acquired languages, the lexical level will be chosen as the sole determiner of the source of influence. This means that L3 learners should assess only modules at subordinate levels if a higher level cannot motivate a selection (Rothman et al., 2019, p. 162). This idea is problematic considering our results because we have shown that even when lexical cues are extremely clear in favor of only one of the previously acquired languages and also highly influential for the preferences of the learners, the syntactic input also affects the participants' word order choices (as seen in the interaction effect). It is unclear how the hierarchy could account for such behavior.

In our view, a more plausible explanation for the impact of syntactic cues is that crosslinguistic influence is available from both previously acquired languages throughout the acquisition process as property-by-property accounts of L3 acquisition have argued (Flynn et al., 2004; Slabakova, 2017; Westergaard, 2021a). Such an explanation attributes the effect of both lexical and syntactic similarities between the L3 and preexisting grammars to parallel activation of associated structures during the acquisition process, that is, that learners pay attention to and actively assess incoming input across modules. Candidate structures, in this case V2 word order, were activated in parallel

and competed against each other for the overall best fit. The outcome of the competition determined the candidates' degree of influence on the L3 (cf. Truscott & Sharwood Smith, 2019, p. 53). This can explain why we saw a strong effect of lexical crossover in the congruent inputs; the lexicon was the only cue that contributed to the outcome of the competition. It also explains why there was more variation in the preferences across the incongruent inputs; the parser then had to take into consideration conflicting lexical and syntactic cues. As we mentioned previously, such variation cannot be explained solely by attention to lexical cues.

Furthermore, the interaction effect (Figure 5) showed that V2 word order was clearly preferred in the absence of English-like syntax, but the learners who had been exposed to English-based syntax selected fewer occurrences of V2 word order—that is, exactly the prediction if syntactic overlap influences crosslinguistic influence. Crucially, this contrast was not present between the two inputs with English-based lexicons; V3 word order was consistently preferred over V2 (close to zero probability of a V2 selection) even when the syntax was Norwegian-like. In other words, Norwegian-based syntax did not affect the preference for word order. Although this could have been due to the increased impact of cues that were available early as argued by Westergaard (2021a) and empirically shown by Culbertson et al. (2017), this does not account for why we did not see the same behavior when the syntax was English. Thus, a possible explanation is that V3 (XSV) represents an unmarked word order in the sense that it involves no syntactic movement. Several other studies (e.g., Listhaug et al., 2021; Stadt et al., 2020) have found a general preference for nonmovement over movement in different L3 populations. Another, and possibly related, explanation is that this asymmetry reflects a foreign language/L2 effect, but only when cues are incongruent because we did not observe the same in congruent inputs where the lexicon alone indicated a similarity to a preexisting grammar (Figure 5). For instance, Bohnacker (2006) found a similar result, where Swedish–English learners of German used the nontarget like word order XSV in German nonsubject-initial declaratives (interpreted as nonfacilitative influence from their L2, English), rather than the facilitative XVS word order from Swedish, which is another V2 language that closely resembles Norwegian. However, we have already shown that a default L2 analysis cannot account for our results. Thus, our findings seem to best be accounted for by a property-by-property similarity-driven model of L3 acquisition, with an additional effect of a preference for the unmarked (to explain the general preference of V3 over V2), possibly in combination with a foreign language effect.

Limitations and Future Directions

We designed our experiment to investigate how differences in lexical and syntactic cues in the input may affect the acquisition of a L3 by bilingual speakers of the same language combination. A limitation of the study is that we tested the participants after very brief exposure to a L3, and we therefore cannot distinguish between two possible explanations of the participants' behavior. That is, the results could in principle reflect pretransfer stages in line with the idea of wholesale transfer or simultaneous crosslinguistic influence due to co-activation of both previously acquired languages in line with property-by-property accounts of L3 acquisition. To investigate these two positions further, it would be advisable to apply a longitudinal design because the timing for wholesale transfer has not yet been specified. We argue that our results support the linguistic proximity model and the scalpel model, but additional variables that may affect crosslinguistic influence in L3 acquisition, such as frequency and recency of use, should be explored in further research.

Conclusion

In our study, we investigated how lexical and syntactic similarities between the L3 input and previously acquired languages affect crosslinguistic influence of syntax by exposing Norwegian–English sequential bilinguals to four different artificial L3s that varied in lexical and syntactic overlap with the L1 and L2. We found that both lexical and syntactic cues in the input affected crosslinguistic influence, and the presence of English-based syntax in the L3 appeared to be particularly influential. Our results suggested that adult sequential bilinguals are influenced by both lexical and syntactic similarities between the L3 and previously acquired languages after minimal exposure to the target language, and that lexical cues are particularly influential. This may be attributed to the immediate access to information about lexical crossover, but information about overlaps in syntactic structure requires a deeper knowledge of the L3 (Rothman, 2013; Westergaard, 2021b). This finding was compatible with similarity-driven models of L3 acquisition (Flynn et al., 2004; Rothman, 2011, 2015; Slabakova, 2017; Westergaard, 2021a), as opposed to accounts that have argued for a default L1 or L2 effect (e.g., Bardel & Falk, 2007; Bayona, 2009; Berends et al., 2017; Falk & Bardel, 2011; Hermas, 2010, 2015; Mollaie et al., 2016; Na Ranong & Leung, 2009; Park, 2016). Our results did not support the idea of wholesale transfer at the initial state as proposed by Rothman (2011), nor did the findings support the idea of wholesale transfer taking place as soon as the parser detects similarity between the L3 and one of the previously acquired languages (at the initial stages) based on the four-way hierarchy of Rothman

(2013, 2015)—lexicon, phonology, morphology, syntax. However, our findings could not preclude the possibility that wholesale transfer takes place later in the acquisition process as discussed by González Alonso et al. (2020). In our view, a more plausible explanation for our results is that learners have access to both previously acquired languages throughout the acquisition process as proposed by property-by-property accounts of L3 acquisition (Flynn et al., 2004; Slabakova, 2017; Westergaard, 2021a). Finally, we observed that the presence of syntactic cues from the L2 in the L3 input affects crosslinguistic influence more strongly than does the presence of syntactic cues from the L1—a finding that could indicate a foreign language/L2 effect.

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Open Research Badges

This article has earned an Open Data badge for making publicly available the digitally-shareable data necessary to reproduce the reported results. The data are available at http://www.iris-database.org.

Notes

1 We added bilingualism and proficiency groups as potential fixed effects in the regression analysis, but we did not find a significant correlation of these grouping variables with the response variable, nor did the inclusion of these grouping variables contribute to the improvement of the model's fit.
2 The spelling of the Norwegian-based inventory followed the most widely used written variety of Norwegian, Bokmål.
3 The spelling of the English-based inventory followed subsets of Standard British English and Standard American English, that is, we avoided elements that are found in only one of these varieties.
4 Although English is not considered a V2 language, the verb occurs in the second position in some constructions such as *wh*- questions (Rizzi, 1996) and declaratives with informationally light verbs (Westergaard, 2007).
5 We based the statistical analyses in this study on the statistical analyses conducted by Schweinberger (2021a, 2021b).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Accessible Summary
Appendix S1. Acceptability Judgment Task in Norwegian and English.
Appendix S2. Cloze Task in English.
Appendix S3. The Language and Social Background Questionnaire.
Appendix S4. Participant Information.
Appendix S5. Word Frequency List in Norwegian.
Appendix S6. Word Frequency List in English.
Appendix S7. Forced-Choice Acceptability Judgment Task.
Appendix S8. Dataset.
Appendix S9. Raw Scores in the Forced-Choice Acceptability Judgment Task.
Appendix S10. R Script.
Appendix S11. Comparison of the Baseline and Final Models.