Endogenous sources of variation in language acquisition

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A fundamental question in the study of human language acquisition centers around apportioning explanatory force between the experience of the learner and the core knowledge that allows learners to represent that experience. We provide a previously unidentified kind of data identifying children's contribution to language acquisition. We identify one aspect of grammar that varies unpredictably across a population of speakers of what is ostensibly a single language. We further demonstrate that the grammatical knowledge of parents and their children is independent. The combination of unpredictable variation and parent–child independence suggests that the relevant structural feature is supplied by each learner independent of experience with the language. This structural feature is abstract because it controls variation in more than one construction. The particular case we examine is the position of the verb in the clause structure of Korean. Because Korean is a head-final language, evidence for the syntactic position of the verb is both rare and indirect. We show that (*i*) Korean speakers exhibit substantial variability regarding this aspect of the grammar, (*ii*) this variability is attested between speakers but not within a speaker, (*iii*) this variability controls interpretation in two surface constructions, and (*iv*) it is independent in parents and children. According to our findings, when the exposure language is compatible with multiple grammars, learners acquire a single systematic grammar. Our observation that children and their parents vary independently suggests that the choice of grammar is driven in part by a process operating internal to individual learners.

syntax | language acquisition | learning | verb raising | quantifier scope

The tension between nature and nurture permeates the study of learning in humans and animals. In the domain of human language, this tension has proven especially difficult to resolve because all human language learners are awash in linguistic data. When children learn a particular feature of their language, did the data of experience allow for the construction of knowledge through general cognitive mechanisms of categorization and generalization, or did that experience play more of a triggering role, facilitating the expression of abstract core knowledge in a way that is consistent with the speech of the ambient community? In other areas of biology, this kind of tension is often resolved experimentally through selective rearing (1–3). Restricting the exposure of the learning organism to only a subset of the data that a normally developing organism receives allows us to identify the role of data in typical development. Such experiments are unethical to conduct with human children, but nature may sometimes provide them by accident. One commonly discussed case concerns the language acquisition profiles of children who are not exposed to a natural language, due to a combination of biological and sociological factors, as in the case of deaf children without access to a signing community (4, 5). In this paper, we demonstrate that even typical language learners can be restricted in the data they have access to and that these restrictions allow us to apportion explanatory force between the organism and the environment in shaping language outcomes.

The particular case we examine reveals that (*i*) in a population ostensibly speaking the same language, there is substantial variability with respect to one particular feature of grammar and (*ii*) this variability is independent in parents and children. In this case, one piece of abstract knowledge ties together two superficially distinct sentence types, but children's acquisition of this knowledge is not determined by the speech of their parents. Indeed, we argue that it is not determined by any aspect of experience at all because the experience of the language learner does not contain the necessary environmental trigger. This is the first demonstration that we know of that identifies a dissociation between the grammatical knowledge of children and their parents that does not involve incomplete acquisition.

The relevant phenomenon concerns the interpretation of negation and the position of the verb in Korean clause structure. In earlier work (6), we identified variability compatible with multiple grammars in this domain in both adults and children. In the current paper, we provide evidence that speakers do not maintain multiple grammars simultaneously. Rather, each speaker acquires a single grammar of verb placement, although the distribution of these grammars is seemingly random throughout the population. We show that (*i*) speakers are consistent in their judgments across testing sessions, (*ii*) they are consistent across syntactic environments, and (*iii*) the judgments of children and their parents are uncorrelated. Points *i* and *ii* argue that speakers do not maintain multiple grammars simultaneously. Point *ii* also highlights the abstract nature of the acquired knowledge. Point *iii* argues that children do not learn this feature of the grammar from the environment, but rather acquire only one of the two grammars that are consistent with their exposure on the basis of an internally driven learning mechanism.

Verb Placement in Korean

The position of the verb in the clause structure differs across languages, even when the order of subject, object, and verb is the same. Languages with the verb in different positions demonstrate systematically different behavior with respect to other elements of the sentence. For example, French and English place the verb before its object, as in *i* and *ii* below, but differ in placing the verb with respect to an adverb.

Significance

Children are exposed to vast quantities of data exhibiting the key structural features of their language. Are these structural features acquired from the data or are they imposed on the data by learners? We identify a piece of grammatical knowledge that is systematic within an individual speaker but varies unpredictably across a population of speakers of ostensibly a single language. Further, parents' knowledge in this domain does not predict children's knowledge. The independence of parents' and children's knowledge indicates that the relevant grammatical structures are not acquired from experience, but are supplied by learners. This dissociation between the grammatical knowledge of children and their parents demonstrates that children actively construct grammatical knowledge from highly ambiguous evidence.

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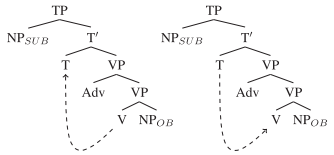

Fig. 1. French verb raising (*Left*) and English tense lowering (*Right*).

i) Kim critique souvent Lee.
Kim criticizes often Lee (French)

ii) Kim often criticizes Lee. (English)

In French, the verb must precede the adverb (*i*), but in English, it must follow the adverb (*ii*). These word order facts diagnose the hierarchical placement of the verb in the clause structure, with the French verb occurring in a higher position than the English verb, as illustrated in Fig. 1 (7, 8). The hierarchical positioning of the verb reflects processes that link the verb with the tense of the clause, with French verbs raising to associate with tense and English tense lowering to connect with the verb. These processes are instances of a more general phenomenon of movement, whereby, for explanatory purposes, elements are analyzed as being displaced, as indicated by the arrows in Fig. 1. Movement in Fig. 1 allows us to explain the fundamental symmetry between French and English with respect to the verb–object relation while also explaining the differences in word order. In simple sentences lacking the diagnostic elements, the hierarchical position of the verb is not evident, potentially posing a problem for language learners (9).

Korean, however, is head-final, and so tests based on word order cannot be used to make conclusions about the position of the verb. Because the verb is at the end of the sentence (*iii*), it is compatible with both the French (verb-raising) and English (tense-lowering) structures, as in Fig. 2, *Left* and Fig. 2, *Middle*, respectively. The verb-final word order thus removes one source of evidence for learners in determining the hierarchical position of the verb (NOM, nominative; ACC, accusative; PRES, present tense; DECL, declarative):

iii) Kim-i cacwu Lee-lul piphanha-n-ta.
Kim-NOM often Lee-ACC criticize-PRES-DECL

"Kim often criticizes Lee." (Korean)

In ref. 6, we showed that many of the alternative tests proposed for identifying the verb position in Korean (10–13) are in fact consistent with both verb-raising and tense-lowering analyses. In contrast, the scope of negation and object quantified phrases (QPs) is a good diagnostic of the position of the verb in a Korean speaker's representation of clause structure. However, the rarity of the construction questions its utility for children trying to acquire this representation. Three background facts about Korean are necessary to understand the scope diagnostic.

First, in Korean, QPs exhibit frozen scope: Scope is determined by the hierarchical position of the QPs, reflected by the word order. In sentence *iv* with two QPs in a canonical subject–object–verb word order, the only reading available is the one on which the subject scopes over the object (some > many) (14). The reading where the object scopes over the subject (many > some) is not available. This is unlike English, where a sentence such as "Someone criticized many people" is ambiguous between both scopal interpretations (PST, past tense):

iv) Nwukwunka-ka manhun salam-ul piphanhay-ss-ta.
someone-NOM many person-ACC criticize-PST-DECL

some > many: "A particular person criticized many."

many > some: "*For many people, some person or other criticized him."

Second, the object in a transitive sentence must occur to the left of (i.e., higher than) verb phrase (VP) adverbs, such as *cal*, "well," as in *v*. This implies that objects raise from a VP-internal position to a projection higher in the structure, as in Fig. 2, *Right* (15).

v) Toli-ka **maykcwu-lul cal** masi-n-ta.
Toli-NOM beer-ACC well drink-PRES-DECL

"Toli drinks beer well."

Third, Korean has two forms of negation: long negation is postverbal and requires *ha* to support tense and other verbal inflections, similar to English *do*-support, as in *vi*, whereas short negation is preverbal, with no *ha*, as in *vii*. Both have the status of clitics and form a unit with the main verb in syntax. Long negation must occur immediately before *ha*, and short negation immediately before the lexical verb (CONN, connective; NEG, negation):

vi) Toli-ka maykcwu-lul cal masi-ci **ani ha-n-ta.**
Toli-NOM beer-ACC well drink-CONN NEG do-PRES-DECL

"Toli doesn't drink beer well."

vii) Toli-ka maykcwu-lul cal **an masi-n-ta.**
Toli-NOM beer-ACC well NEG drink-PRES-DECL

"Toli doesn't drink beer well."

Given the scope freezing effect, the scope of QPs is determined in their surface position. Consequently, the relative scope of negation and a QP will be determined by the position of negation in the clause structure. Given that objects must raise out of the VP and that negation is a unit with the verb, the scope of negation and an object QP will tell us whether the verb or *ha* has raised. If the verb raises, negation will occur in a position higher than an object QP and will therefore take scope over this QP. However, if the verb remains low, negation will also remain low and the object QP will take scope over it.

The predictions are clear, but the scope judgments reported in the literature often conflict with one another (15–20), such that it has been unclear whether Korean is a verb-raising language or not. We, however, show that the variability in scope judgment exists between speakers and not within a speaker, suggesting that, in fact, some Korean speakers have a verb-raising grammar and some do not.

In ref. 6, we used the truth value judgment task (21) to test scope judgments of sentences containing a subject or an object universal QP and long or short negation. Example short negation sentences with a subject QP and an object QP are provided in *viii* and *ix*:

viii) **Motun mal-i** wulthali-lul **an** nem-ess-ta.
every horse-NOM fence-ACC NEG jump.over-PST-DECL

"Every horse didn't jump over the fence."

ix) Khwuki monste-ka **motun khwuki-lul an** mek-ess-ta.
cookie monster-NOM every cookie-ACC NEG eat-PST-DECL

"Cookie monster didn't eat every cookie."

In a trial, a participant watched a short video clip of an experimenter enacting a scenario using toys followed by a puppet

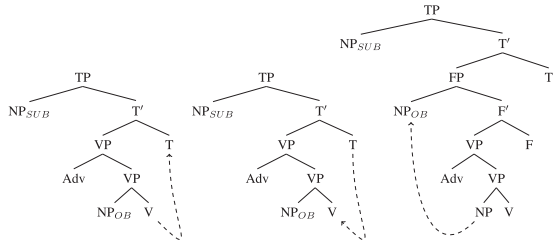

Fig. 2. Korean verb raising (*Left*), tense lowering (*Middle*), and object raising (*Right*).

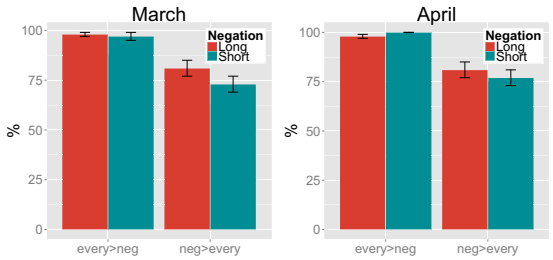

Fig. 3. Mean percentages of acceptances: two test sessions. Error bars indicate one SE from the mean.

making a statement (test sentence) about the scenario. The participant's task was to indicate whether the puppet's statement is true. For example, in the scenarios that tested the neg > every reading with test sentences in *viii* and *ix*, two out of three horses (i.e., not all horses) jumped over the fence, and two out of three cookies (i.e., not all cookies) were eaten. In the scenarios that tested the every > neg reading, none of the horses jumped over the fence and none of the cookies were eaten.

We found that with subject QPs, speakers in general accepted the every > neg reading and rejected the neg > every reading. This is predicted by the clause structure: Regardless of negation type or verb raising, the subject is structurally high in the clause structure, above the verb. However, speakers seem to be divided when it comes to the neg > every reading with object QPs. They exhibited a bimodal distribution of responses: Only about half of the participants accepted the neg > every reading, with the other half rejecting it. In addition, we found that 4-y-old Korean children were divided in the same way in accepting the neg > every reading with object QPs. This variability could not be attributed to aspects of the task because English-speaking children and adults, tested with nearly identical materials, uniformly accepted the neg > every reading, and in clear cases of ambiguity, English-speaking adults readily access both interpretations (22, 23).

We argued that this bimodal distribution in responses reflects two grammars in competition within the speech community of Korean: those speakers who have acquired the verb-raising and *ha*-raising grammar accept the neg > every reading with object QPs, and those who have acquired the non-verb-raising grammar reject this reading. The reason for the coexistence of two grammars is that children acquiring Korean are unlikely to receive sufficient input that provides clear evidence about the syntactic height of the verb. Learners of Korean therefore choose one grammar over the other, without triggering data from the environment. That we see the same pattern in 4-y-olds and adults suggests that the choice is made at least by age 4 y.

This two-grammar hypothesis makes three predictions. First, a given speaker of Korean should show the same pattern of behavior for both long and short negation because for both types of negation the height of the verb that hosts negation determines the scope of negation in the same way. The study reported in ref. 6 showed roughly the same size split in the population for both long and short negation, but it was a between-subjects study and as such does not tell us whether any given individual would show the same pattern for both types of negation. Second, speakers should show the same pattern of behavior over time. We hypothesized in ref. 6 that a speaker controls a single grammar, either a verb-raising or a non-verb-raising grammar. However, there is an alternative interpretation of the results in ref. 6 in which each individual maintains both grammars (24, 25). This is because in the experimental task of ref. 6 it may be that the grammar that was chosen on the first item, whichever that is, may be exerting an influence over subsequent items, priming the participants' answers. This kind of priming effect would give the appearance of two populations of speakers when in fact there was a single population in which each speaker controlled two competing grammars. Under this alternative interpretation, a speaker could show different patterns of behavior across test sessions. Third, the behavior between parents and children should be uncorrelated. If learners of Korean choose only a single grammar because of the lack of relevant input, then we would expect to find no correlation between the two groups. Parents would have chosen one grammar and their children, faced with the same indecisive evidence, might make the same choice or the opposite one. The first and the second predictions are tested in experiment 1, and the third prediction is tested in experiment 2.

Experiment 1

Design. Using the truth value judgment task in a within-subjects experiment, we tested adult speakers of Korean on the scope of negation and object QP on two separate occasions, 1 month apart. We only tested sentences with object QPs and not subject QPs, because these are potentially informative about the structural height of the verb. The experiment tested three factors: negation type (short vs. long) × scope (every > neg vs. neg > every) × test session (March vs. April).

Findings. Fig. 3 summarizes the mean percentages of acceptances by condition. We constructed generalized linear mixed-effects models, fitted using the software package R, to analyze the participants' responses as a function of scope, negation type, and test session, with participants and sentences included as random effects.

We found a main effect of scope ($\beta = -3.86$, SE = 0.50, $z = -7.78$, $P < 0.001$), with participants more likely to accept the every > neg than the neg > every reading, but no other effects. This suggests that the speakers behaved uniformly across negation types and test sessions: Those who rejected the neg > every reading did so on both test sessions and for both types of negation, and those who accepted the neg > every reading did so on both test sessions and for both types of negation.[†] To confirm the uniform behavior of each individual participant across negation types, we calculated, per participant, the difference score between the acceptance rate in short negation/neg > every condition and the acceptance rate in long negation/neg > every condition for both March and April sessions. A negative difference score indicates that a participant was more likely to accept the neg > every interpretation for long negation than short negation and a positive difference score indicates that a participant was more likely to accept the neg > every interpretation for short negation than long negation. A difference score of zero means that a participant behaved the same across negation types. Fig. 4 plots the count of difference scores. The figure shows that the majority of participants behaved the same across negation types in both March and April.

In the March session, the average difference score between short and long negation was −0.08 (SE = 0.03). Participants were slightly more likely to accept the neg > every interpretation in long negation over short negation [$t(30) = -0.3.24$, $P < 0.003$], as shown in Fig. 4, *Left*. This significant difference derives from the fact that 10/31 participants gave one more "yes" response for long negation than short negation, although only one participant gave one more "yes" response for short negation than long negation. However, because the difference scores are so close to zero in all cases, we do not take this to show that people are inconsistent in judgments across long and short negation. Further evidence for this conclusion comes from the April data, where the mean difference score between long and short negation was −0.02

[†]A question arises as to why the acceptance rate for the every > neg reading of the object QP is near 100%. The every > neg reading entails the neg > every reading, and as such a sentence with the neg > every reading will be true in an every > neg context. Consequently, speakers with a verb-raising grammar as well as those with a non-verb-raising grammar will say the sentence is true. One way to avoid this entailment problem might be to use numeral quantifiers in test sentences. Ref. 26 reports on an experimental study using sentences with numeral quantifiers in Japanese. It reports that while participants split in responses in the neg > numeral condition, the majority of participants accepted the numeral > neg reading. It is suggested in ref. 26 that the high acceptance rate of numeral quantifier sentences in the numeral > neg condition, unexpected under the two-grammar hypothesis, may be due to the fact that numerals are typical indefinites that can take scope using a choice function strategy.

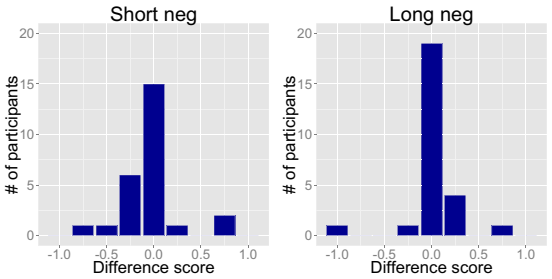

Fig. 4. Number of participants in each difference score between short negation and long negation in neg > every conditions.

(SE = 0.02), as shown in Fig. 4, *Right*. This difference score was not significantly different from zero [$t(30) = -0.9$, not significant].

Turning now to the potential effect of test session, we find no significant effects. We calculated, per participant, the difference score between the acceptance rate of March/neg > every condition and April/neg > every condition for both short negation and long negation. Fig. 5, which plots the count of difference scores, shows that the majority of participants behaved the same across test sessions for both short and long negation. For short negation (Fig. 5, *Left*), the mean difference score between March and April was −0.03 (SE = 0.06). This is not significantly different from zero [$t(25) = -0.64$, not significant]. For long negation (Fig. 5, *Right*), the mean difference score was 0.01 (SE = 0.05), which was again not significantly different from zero [$t(25) = 0.35$, not significant]. Thus, for both negation types, we have no evidence that participants changed judgments across test sessions.[‡]

Experiment 2

Design. We tested negation (long vs. short) as a within-subjects factor and relation (child vs. parent) as a between-subjects factor. The experiment was thus divided into four different conditions, each condition testing whether children or their parents accept the neg > every reading in long or short negation sentences containing an object QP. We did not include scope as a factor, because we did not want the testing sessions to be too long for preschool-aged children. In both the study in ref. 6 and experiment 1, the mean percentages of acceptances in the every > neg conditions reached near 100%. We can thus assume that all native speakers of Korean will readily accept negative sentences with object QPs in the every > neg context.

Findings. The mean percentages of acceptances by condition are summarized in Fig. 6. The results are similar to those reported in ref. 6: The acceptance rates in both short negation and long negation conditions for both children and their parents hover around 40%. Moreover, as in ref. 6, we found a bimodal distribution of responses for both children and parents, as shown in Fig. 7: Speakers tended to either always accept or always reject the neg > every reading. In Fig. 7, participants are divided into three groups based on their acceptance rates on the neg > every reading: accept (≥75% acceptance), ambivalent (50% acceptance), and reject (≤25% acceptance).

We constructed generalized linear mixed-effects models to analyze the participants' responses as a function of negation and relation, with participants and sentences included as random effects. The analysis revealed no main effect of negation or relation, and no interaction between the two factors. We thus found no difference in the pattern of behaviors between the children and their parents: In both groups, only about half of the participants accepted the neg > every reading in both short negation and long negation sentences with object QPs.

The results of the generalized linear mixed-effects analysis, however, do not tell us whether children's behavior can be predicted by their parents'. To address this question, we ran two linear regressions using the children's and their parents' proportions of "yes" responses. The first linear regression was run on the proportions in the short negation condition (adjusted $R^2 = -0.05$), and the second on the proportions in the long negation condition (adjusted $R^2 = -0.05$). The graph in Fig. 8, *Left* plots the children's proportions as a function of their parents' proportions in the two negation conditions. It includes the line of best fit for each regression. In both, the correlation coefficients were not different from zero, and thus there is no evidence of a relation between the children and their parents' behaviors.

We also ran two linear regressions to test whether our participants' responses for short negation sentences can be predicted by their responses for long negation sentences. The first regression was run on the children's proportions of "yes" responses only (adjusted $R^2 = 0.96$, $t = 23.21$, $P < 0.001$), and the second on the parents' proportions only (adjusted $R^2 = 0.67$, $t = 6.43$, $P < 0.001$). The graph in Fig. 8, *Right* plots the proportions in the short negation condition as a function of the proportions in the long negation condition for children and parents, including the line of best fit for each regression.

Unlike the regressions testing the correlation between the children and their parents' behaviors, the regressions testing the correlation between the participants' behaviors in short negation sentences and long negation sentences revealed that the correlation coefficients are significantly different from zero. That is, both the children and their parents behaved uniformly across negation types: Those who accepted the neg > every reading did so for both negation types, and those who rejected the neg > every reading did so for both negation types. These results are consistent with the findings in experiment 1.

Discussion

Experiments 1 and 2 tested three predictions of the hypothesis that two populations of Korean speakers exist with respect to the grammar of verb raising. We found that (*i*) speakers are consistent in their scope judgments across negation type, (*ii*) speakers are consistent in their scope judgments across different testing sessions, and (*iii*) scope judgments of parents and children do not correlate.

These results are predicted by the two-grammar hypothesis. In the population that has not acquired a verb-raising grammar, the neg > every reading for an object QP in short negation sentences is not available because the grammar only generates the structure in which the object scopes over negation. In the same population, *ha* raising does not take place, and so the neg > every reading for an object QP is also unavailable in long negation sentences. However, the population that has acquired a verb-raising grammar generates the neg > every reading for an object QP in short negation sentences because the grammar generates the structure in which negation scopes over the object. In the

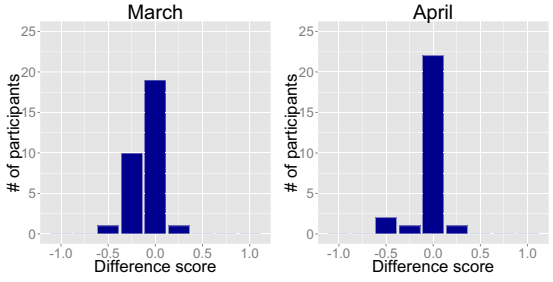

Fig. 5. Number of participants in each difference score between March and April in neg > every conditions.

[‡]The acceptance rates of neg > every in our within-subjects experiment were somewhat higher than in the between-subjects experiment in ref. 6. In ref. 6, the mean percentages of acceptances in neg > every/object conditions for short negation and long negation were 37% and 46%, respectively, whereas in the current within-subjects experiment they range from 73% to 81%. This could be a consequence of the particular participants chosen. In experiment 2, we see acceptance rates more like those in ref. 6, suggesting that the high acceptance rates here were due to variance in the population. It is also worth noting that ref. 27 reports 54.6% as an acceptance rate of neg > every reading for short negation in a separate within-subjects truth value judgment task experiment. This acceptance rate is again close to the acceptance rates in ref. 6.

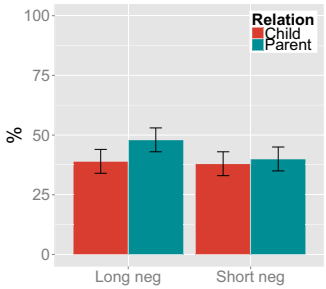

Fig. 6. Mean percentages of acceptances: children and parents. Error bars indicate one SE from the mean.

same population, in sentences with long negation, *ha* raising will take place, again generating the neg > every reading for an object QP. Moreover, lack of sufficient input will force a learner to choose either a grammar of verb raising or a grammar of non-verb raising, and thus children do not necessarily acquire their parents' grammar of verb placement. As such, both the children and their parents split in their responses, with about half of each group accepting the neg > every reading and the other half rejecting it, but children's scope patterns cannot be predicted by their parents'. This does not mean, however, that the kind of scope data we are looking at never show correlational patterns. We found that for both children and their parents, a speaker's pattern of responses with short negation can be predicted from the pattern of responses with long negation. Indeed, the fact that the two different syntactic expressions of negation (long vs. short) show the same pattern within an individual indicates that learners have acquired one abstract feature of grammar that controls the placement of the tensed verb in both kinds of negative sentences.

The findings presented here support that the linguistic experience of Korean learning children is not sufficient to guarantee uniform convergence to a single grammar. The data that would force children to choose either verb raising or non-verb raising is not readily available. Consequently, learners seem to choose a single grammar and discard the other option. If speakers maintained both grammars simultaneously, then we would expect them to fluctuate in which grammar they chose to use for any given sentence. Because we did not see such fluctuation, we are led to the conclusion that learners maintain only one grammar. Moreover, because there is no basis for the choice in grammar, we find some learners choosing one grammar and others choosing another, and as such, children's grammars cannot be predicted by their parents' grammars. Although we attribute the variability in scope judgments to the grammar of verb placement, it remains possible that this variability is due to some other feature of the grammar that is underdetermined by the input. Subsequent work should identify potential corroborating evidence for the role of verb placement in explaining this phenomenon, and also search for other independent syntactic evidence for verb placement.

Child language learners are undeniably highly sensitive to the distributional properties of the language they are exposed to. At the same time, however, it is widely acknowledged that what children acquire is not merely a recapitulation of their input. Children acquire a system that allows them to produce and understand sentences that fall outside of their experience. The central puzzle of language acquisition is to determine which features of the acquired abstract system are constructed on the basis of experience and which features require specialized knowledge structures that restrict the ways that children generalize. Typically, we see the influence of children's learning mechanisms through patterns of overgeneralization (28–32), patterns in which children amplify less-reliable statistical patterns (33–35), or patterns in which children's knowledge goes beyond what is expressed in their exposure (23, 36–41). Here, we have found a previously unidentified source of evidence for the child's contribution to language learning: a pattern of unpredictable individual variation among speakers, including children and their own parents, of ostensibly a single language.

Mismatches between the language of exposure and the acquired grammar give us insight into two distinct aspects of the mechanisms underlying language acquisition. First, they allow us to formulate hypotheses about the range of possible variation found among languages, and how this restricted range might shape the hypotheses that children consider in the course of language acquisition (36, 39, 42–47). Second, they allow us to examine the computational mechanisms that are engaged in relating the experience of the learner to the space of possible languages (25, 30, 48–56).

A major focus of work from the latter tradition has been to explore the availability of data that unambiguously provide evidence for one particular analysis over a restricted range of alternatives (25, 51, 56, 57). For instance, ref. 25 puts forth the hypothesis that the time course of acquisition of a grammatical feature depends on the relative availability of data that distinguishes that grammatical feature from the available alternatives. Those grammatical features that produce sentences that are most distinct from the alternatives are acquired early, whereas those that produce sentences that overlap highly with the alternatives are acquired later. In the limit, one might expect that there are some alternatives that could never be distinguished on the basis of the exposure language. We have seen in this paper that such a case leads to distinct grammars' being acquired by individuals exposed to the very same language. This result opens the further question of how widespread such underlying variability is and how often it goes undetected within a language population. Finally, we note that the observation that learners in this situation choose only one grammar does not imply that learners cannot maintain multiple grammars simultaneously. In cases where a single speaker controls more than one dialect, this speaker is exposed to multiple dialects with distinct surface properties, and hence each grammar is independently supported. What makes the case discussed here special is that all (or nearly all) sentences of the learners' experience are compatible with both grammatical systems.

Materials and Methods

In experiment 1, 31 adult speakers of Korean were tested in the first session (March session), and from these 26 speakers were tested again after a month (April session). Five participants from the first session chose not to participate in the April session. Each participant was paid $10 for participating in each test session. Participants were shown a videotaped version of the scenarios. In each test session, after four practice trials, participants were shown 16 test trials and 12 filler trials in a pseudorandom order. They were given a score sheet and were instructed to indicate, for each story, whether the puppet spoke truthfully, and to provide a brief justification for their answers. The participants were tested in groups of four or five in a small classroom. We constructed a set of 16 scenarios for the first session and a different set of 16 scenarios for the April session, all similar to the ones used in ref. 6. In each set, eight scenarios made the neg > every reading true and another eight made the every > neg reading true. Participants were given 16 test trials (four trials per scope/negation combination) in each test session. Short negation sentences and long negation sentences in the March session were turned into long negation sentences and short negation sentences, respectively, and were used in the opposite scope conditions in the April session. Three fillers each tested the comprehension of subject QPs, object QPs, short negation, and long negation. The same set of fillers were used in both test sessions. The test

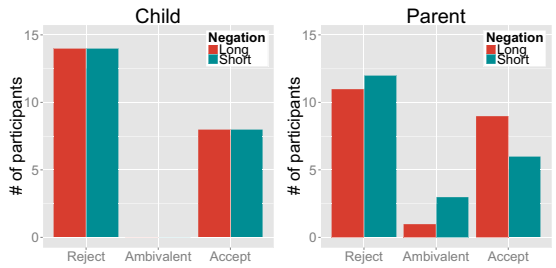

Fig. 7. Number of participants accepting neg > every: children and parents.

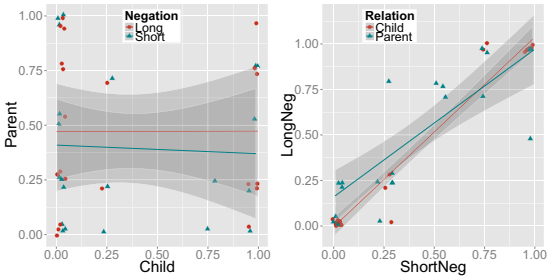

Fig. 8. Correlation between parents and their children's proportions of "yes" responses (*Left*) and correlation between mean acceptance rates of short negation and long negation (*Right*).

sentences used in the March session are in *Supporting Information, section 1*, and the ones used in the April session are in *Supporting Information, section 2*. The filler sentences are in *Supporting Information, section 3*.

In experiment 2, 22 Korean children between the ages of 4 y 0 mo and 5 y 6 mo (mean 4 y 8 mo) from a preschool in Pwuntang, Korea were tested. Mothers of 21 children that participated in the experiment were also tested. The mother of one child chose not to participate. Children were tested individually in a quiet room away from the class. They saw a videotaped version of the scenarios, and an experimenter recorded their responses on a score sheet. The parents were tested separately from their children, individually in the same room used for testing the children at the preschool. Both the children and their parents were introduced to the task with two practice trials followed by eight test trials and six filler trials in one of the two pseudorandom orders. The materials came from experiment 1. Participants were given eight test trials (four trials for long negation condition and four for short negation condition). Two fillers each tested the comprehension of object QPs, short negation, and long negation.

In both experiments 1 and 2, the correct responses to filler trials were counterbalanced between "true" and "false." In experiment 1, the mean proportions of correct responses in fillers were 0.97 in the March session and 0.99 in the April session. In experiment 2, the parents' mean proportion of correct responses was 0.97 and the children's was 0.89. The participants' high performance on fillers indicates that they had no difficulty with the task or with negation or universal quantification in isolation. Moreover, because participants gave both true and false responses correctly in fillers, their consistent response as either true or false in test trials cannot be attributed to an experimental artifact that participants have a tendency to give the same response across trials.

The experiments were approved by Simon Fraser University, Office of Research Ethics. Adult participants in experiment 1 provided written informed consent. The director of the preschool provided written informed consent on behalf of the children and their parents in experiment 2. In addition, each parent and child participant provided verbal consent. Child participants were told that they were going to play a game and could quit at any point if they did not feel like playing anymore.

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