BUCLD 47 Proceedings To be published in 2023 by Cascadilla Press Rights forms signed by all authors

Overly Strong Interpretations of Modal Verbs In Child Language

Frank Staniszewski, Rachel Stacey, and Athulya Aravind¹

1. Introduction

A growing body of work has shown that children use modal verbs in non-adult ways (see Dieuleveut et al., 2019, Cournane, 2020; Moscati, Zhan, & Zhou, 2017, for overviews). Here we focus on a particular type of their non-adult behavior, involving over-acceptance of possibility modals in necessity contexts. We argue that there is a pattern to this non-adultness: children interpret possibility modals as virtually identical to necessity modals, but only in positive contexts. We suggest that this behavior results from reasoning over a non-adult set of alternatives, resulting in over-strengthening

1.1 Modal Background

Modals make claims about possible ways the world can be. They express that the sentence (φ) they attach to is either a possibility or a necessity relative to a domain D, of possible worlds. *Allowed to*, in (1), is a possibility modal, which existentially quantifies over possible worlds, while *have to*, in (2), is a necessity modal, which universally quantifies over possible worlds (Kratzer, 1977, a.o.).

- (1) Possibility: The TV is allowed to be on. $\exists w' \in D^w.\phi(w')$ There are at least some worlds in the domain of worlds that satisfy the rules in which the TV is on. (The TV being on is compatible with the rules)
- (2) Necessity: The TV has to be on. ∀w' ∈ D^w.φ(w') Every world in the domain of worlds that satisfy the rules are ones in which the TV is on. (The TV being on necessarily follows from the rules)

¹ Frank Staniszewski (fjstan@MIT.edu), Rachel Stacey, Athulya Aravind (aravind@MIT.edu), Massachusetts Institute of Technology, Department of Linguistics & Philosophy. Thank you to the children and parents who participated in our study, and to our undergraduate research assistants for assistance with data collection. For helpful comments and discussion, we thank Danny Fox, Sabine Iatridou, Kai von Fintel and the audiences at MIT and BUCLD47.

We assume that the particular subset of worlds that a modal quantifies over (the modal base) is determined by the context, and is lexically constrained by the modal item (Kratzer, 1977). This property of a modal verb is referred to as its "modal flavor." The modals in (1-2) above, for example, exhibit a "deontic" modal flavor and quantify over the modal base $D^w = \{w': w' \text{ is compatible with} \text{ the rules or ideals in w}\}$. For the remainder of the paper, we will abstract away from issues related to modal flavor, and focus on children's use of modals as it pertains to modal force (possibility vs. necessity). This is the feature that determines the relative strength of the modal assertions, and which is the focus of the work surveyed in the following subsection.

1.2 Children's non-adult modal use: previous work

Previous studies show that children, unlike adults, tend to accept possibility modals in necessity contexts (Cournane, 2020; Dieuleveut, et al., 2019; Hirzel, et al., 2019; Moscati et al., 2017; Noveck, 2001; Ozturk & Papafragou, 2015). Noveck, 2001, for example, reports data from a truth value judgment task (TVJT) that illustrates this behavior. In Novek's task, children were presented with three boxes: one containing a parrot and a bear (P+B), another containing only a parrot (P) and a final box that remained covered (?). The child is then told that the third box is identical to one of the two other boxes: either it is (P+B) or (P). In other words, all evidence points to a parrot being in the covered box. Children accepted the possibility modal, *might*, in this context at a much higher rate than adults do (80% for 7yr olds as opposed to 35% for adults).

- (3) a. Context: All evidence points to a parrot being in the box
 - b. Sentence: There might be a parrot in the box
 - c. Percent "Yes" by age: 5yr: 72, 7yr: 80, 9yr: 69, Adult: 35

This led Novek to propose what we will call the "purely logical" hypothesis. According to this hypothesis, adults are more sensitive to pragmatic reasoning, while children are more pragmatically tolerant ("purely logical"). The putative pragmatic reasoning that leads to unacceptability of (5b) for adults is as follows.

Using the possibility modal, *might*, while logically true, is less informative than the competing necessity modal alternative *have to*. Assuming that Gricean principles of conversation drive speakers to use the most informative true alternative, the use of the possibility modal, *might*, leads to the inference that the necessity statement "*There must be a parrot in the box*" is false, which is incompatible with the context. If children, however, take into account only the logical meaning, the sentence would be acceptable.

In a later study, Hirzel, et al., 2019 (reported in Cournane 2020) found that children also over-produce possibility modals to describe necessity situations. In an elicited production task, children were presented with pictures that presented two different scenarios as in Fig. 1. In each, there were two roads that lead to a destination that a cartoon character, Kat, wanted to get to. In one scenario

(labeled Priority-Possibility), both paths were open (i.e. it is possible to use either path). In the other scenario, one path was open but the other one was blocked (i.e. it is necessary to use the yellow path). Participants were then presented with audio saying the sentence below, in which **shh** represents static that disguises the word, and asked to guess the missing word.



Figure 1: Hirzel, et al., 2019

(4) "Kat is going to the balloon store to get balloons! There are two ways to get to the balloon store. One way is to go down the brown path...
...but, uh oh! It's blocked!" So, Kat *shh* go down the pink path

As illustrated in Fig.1, children produced the possibility modals *could/can* \sim 50% of the time in the "Priority-Necessity" context. Since children do not typically produce under-informative sentences (Katsos and Smith 2010), the authors suggest that the problem lies in delayed mastery of necessity modals (see also Dieuleveut et al. 2019), in what we call the "necessity delay" hypothesis.

Our experiment builds on these earlier works, and tests children's interpretations of modal force. We will, however, test a new hypothesis that children's interpretations of possibility modals are not merely compatible with necessity contexts (i.e. purely logical), but as virtually identical to a necessity interpretation. The following section will outline the details of the hypothesis, its theoretical underpinning, and the way it will be tested.

2. A new hypothesis about child modals: Homogeneity

Homogeneous modals (in adult language) don't distinguish between possibility and necessity. These are modals that have been described as having the "neg-raising" property. They are necessity-like in positive environments, and possibility-like in negative environments.

(5) Homogeneity: Given MODAL φ , if φ is possible, then φ is necessary.

This variable pattern constitutes a puzzle for compositional semantic analysis, and is thus traditionally assumed to follow from some additional syntactic, semantic or pragmatic process (see Križ, 2015 for an overview). An example of a modal that displays homogeneity in adult language is *supposed to* (Homer, 2011; Staniszewski 2021, a.o.)

(6)	a. The TV is supposed to be on.	
	Affirmative necessity	$\forall w' \in D^{w}.\varphi(w')$
	b. The TV isn't supposed to be on.	
	Negative possibility	$\neg \exists w' \in D^{w}.\phi(w)$

Recent work has proposed that modal homogeneity is the result of a systematic pattern of scalar implicature (SI) generation that occurs with items that lack a scalar alternative in the lexicon (Staniszewski 2019, 2021; Jeretič 2021). Under this theory, *supposed to* is a possibility modal that lacks a scalar alternative, which strengthens to a necessity meaning in environments that are conducive to SIs (e.g. existentials in affirmative contexts) (Staniszewski, 2021).

This type of SI has been proposed to generate "free-choice disjunction", as illustrated in (6) (Fox, 2007). In addition, this proposal also has a particularly relevant precedent in Singh et al., 2016's analysis of children's conjunctive interpretations of "or". In a TVJT, they found that a subset of children identified sentences like (7a) as false as a description for a scene in which a cartoon boy was holding only an apple. Additionally, sentences like (7b) were judged false when two out of three boys were holding only an apple, and the other one was holding only a banana. They would be judged true only if the individual boy in (7a) was holding both, and likewise if every boy was holding both in (7b).

- (6) You can have cake or pie \Rightarrow You can have cake AND you can have pie.
- (7) a. The boy is holding an apple or a banana.b. Every boy is holding an apple or a banana.

Singh et al. argue that this pattern of interpretations is predicted by the mechanism proposed for free choice in Fox, 2007, with the additional assumption that children don't access the same alternatives as adults do. Specifically, they hypothesize that children don't access alternatives from the lexicon, as has been suggested by previous acquisition work (Barner, 2011).²

We hypothesize that an analogous logic obtains for children's interpretations of modals, which we call the "homogeneity hypothesis."

(8) Homogeneity Hypothesis: Children compute non-adult SIs due to not accessing lexical alternatives. Thus, they over-strengthen, attributing homogeneity to modals that adults do not.

Under this hypothesis, modals with a basic possibility semantics should strengthen to a necessity meaning in affirmative sentences, as is suggested for

² The conjunctive interpretation of children's "or" is not fully settled: while some have replicated the pattern (Tieu et al. 2015), others attribute it to confounds in design (Skordos et al. 2020).

homogeneous modal *supposed to* in the adult grammar (Staniszewski, 2021). And additionally, the same logic predicts that modals with an underlying necessity meaning, and which also lack a scalar alternative, should strengthen in negative sentences (where logical strength relations are reversed) to reflect a negated possibility meaning (Jeretič, 2021). In other words, if modals generally lack a scalar alternative, they are predicted to exhibit homogeneity regardless of whether their underlying semantics expresses possibility or necessity. The following sections present an experiment to test this hypothesis

3. Experiment

3.1 Participants

Participants were English native-speaking children within the age range of 5;0 to 6;11 (N=69 out of 72 pre-registered). They were recruited through the participant database for online studies at the MIT Language Acquisition Lab. Participants received a digital certificate of completion upon finishing the study. An additional 7 children were recruited, but excluded due to inattentiveness (1), failure to complete task (1), failure to pass at least 4 out of 6 controls (4), and failure to pass training (1).

3.2 Design

We used a novel Contradiction Assessment Task, in which participants judge the coherence of sequences of two sentences that both contain the same modal verb and that take contradictory propositions in their complement (e.g. MODAL φ and MODAL $\neg \varphi$). Modals that give rise to contradictions in positive sentences, but not negative sentences, can be deduced to have a uniform necessity meaning. This is the case for the adult interpretation of *have to*, as in (9). Modals that give rise to contradictions in negative sentences, but not positive sentences, can be deduced to have a uniform positive sentences, can be deduced to have a uniform positive sentences, can be deduced to have a uniform positive sentences, can be deduced to have a uniform possibility meaning. This is the case for the adult interpretation of *allowed to*, as in (10). Modals that give rise to contradictions in both positive and negative sentences can be deduced to have a homogeneous meaning (i.e. necessity-like in affirmative sentences and possibility-like in negative sentences). This is the case for the adult interpretation of *supposed to*, as in (11).

- (9) Contradictions in affirmative sentences only \Rightarrow necessity meaning a. #The TV has to be on and it has to be off.
 - b. The TV doesn't have to be on and it doesn't have to be off.
- (10) Contradictions in negative sentences only ⇒ possibility meaning
 a. The TV is allowed to be on and it is allowed to be off.
 b. #TheTV isn't allowed to be on and it isn't allowed to be off.
- (11) Contradictions in both affirmative and negative sentences

- \Rightarrow homogeneous meaning
- a. #The TV is supposed to be on and it is supposed to be off.
- b. #The TV isn't supposed to be on and it isn't supposed to be off.

Our study utilized a 3 x 2 design based on (9-11) above, crossing modal type (necessity, possibility, homogeneous) with polarity type (affirmative, negative). We then use the unique pattern of contradictions for each modal type as the key diagnostic in deducing participants' interpretation of the modal.

3.2 Materials and Procedure

The study was carried out live via Zoom video-conferencing with the experimenter. Participants were introduced to puppet characters, half of which are "from Earth" and half of which are "from an upside-down planet," where things are very different from our planet. The puppets are distinguished based on their visual features, with the upside-down puppets having unusual features (e.g. funny hats). Participants were told that the puppets will tell them about their daily lives, and were reminded that the Earth puppets say things that *make sense* to us and the upside-down puppets say things that *don't make sense*.

After being guided through 4 training trials, in which the puppets say sensible ("Yesterday, I ate a banana") or nonsensical ("Yesterday, I slept a banana") things in accordance with their planet of origin, the puppets hide behind an occlusion. Children were tasked with figuring out whether the speaker of subsequent utterances is from Earth or Upside down planet. Each child saw 6 critical items (1/condition), and 6 control items. See Fig. 2. Sample sentences are given in (15)-(16). We assume that sentences judged to be uttered by an Earth puppet corresponded to being coherent, and that those judged to be uttered by an Upside Down puppet corresponded to being contradictory.



Figure 2: Experiment workflow

- (15) Example Critical Items:
 a. When we go apple picking... The basket is allowed to be full and it's allowed to be empty.
 b. When we watch TV... The dog doesn't have to be inside and he doesn't have to be outside.
- (16) Example Control Items:a. When we watch a movie... The lights are allowed to be off and it is allowed to be very dark.b. When we play games... The toys don't have to be big and they don't have to be new.

4. Predictions

This section presents the expected idealized response profiles that would provide evidence for or against our hypothesis. One possibility is that, contrary to our hypothesis, the participants' interpretations of modals will match the expected response pattern for adults (H0). This result would be consistent with children having acquired the adult-like semantics of the modals, as well as the adult-like abilities with respect to SI calculation and access to lexical alternatives. This response pattern is illustrated in Fig. 3, where a "Yes" response indicates that the sequence is coherent, and "no" indicates that it is contradictory. This profile reflects the pattern of judgments given in (9)-(11) above.



Figure 3: Expected response profile for adults (H0)

In addition to this, we consider two additional non-adult hypotheses derived from the literature, and our own. The response profile in Fig. 4, left supports the "purely logical" hypothesis, which proposes that children interpret modals with the adult-like semantics, but do not calculate SIs. This hypothesis, in conjunction with the assumption that *supposed to* has a basic possibility meaning (as presented in section 2), predicts a response profile that reflects under-strengthening with respect to the expected adult response. In this case, the response profile for *supposed to* should be equivalent to that of possibility modal *allowed to*. The response profile in Fig. 4, right would support the "necessity delay" hypothesis, which posits that children have yet to learn necessity modals and use in their place the possibility modals they have already mastered. Note that this hypothesis makes no predictions about homogeneous modals.

The additional non-adult hypothesis we consider is the homogeneity hypothesis. A response profile that supports this hypothesis would be one in which all modals are interpreted as homogeneous (as possibility in affirmative sentences, and necessity in negative sentences). This pattern of responses will predict the response profile in Fig. 5 below.



Figure 4: Expected profile supporting "purely logical" hypothesis (left) and "necessity delay" hypothesis (right)



Figure 5: Expected response profile supporting "homogeneity" hypothesis

5. Results and discussion

Our primary question was how the rate of judging a sequence as uttered by the Earth puppet and thus coherent – coded here as a "Yes" response – varied as a function of Modal and Polarity. To test this, we built a generalized logistic mixed effects model, predicting the probability of responding "Yes" from Modal (*allowed, have, supposed*), Polarity (*affirmative, negative*), and their interaction as fixed effects, with a random intercept of participant. Modal was helmert coded, allowing us to compare (i) *have to* vs. *allowed to* and (ii) the mean of the two non-homogeous modals with the homogenous modal *supposed to*. Polarity was sum coded. We found a significant interaction of polarity and the contrast between *have to* and *allowed to*. This was driven by the fact that with the modal *allowed to* (but not *have to*), participants were less likely to respond "Yes" to negative trials compared to affirmative ones (β =-0.80, *z*=-2.67, *p*= 0.008).

Critically, however, across conditions, "Yes" response rates were strikingly low and significantly below chance. See Figure 6. Of special note are the affirmative possibility and negative necessity sentences in the critical conditions. These sentences are in fact coherent, but children judged them as contradictory 78.9% of the time for *allowed to* and 80.3% for *have to*.



Fig. 6: Critical Items: Proportion of children's 'Yes' (= non-contradictory) responses by modal / polarity type

5.1 Sanity check based on responses on controls

To ensure that the responses on the critical items were not the result of a "No" bias, we had included control sentences in which "Yes" responses were expected under any quantificational interpretation of the modal. These are for

allowed to in the affirmative condition, and *have to* in the negative condition (examples are given in (16)). Participants responded accurately, accepting the sequences 77% for *allowed to* and 72% of the time for *have to*. Although this indicates that a "No" bias is not a significant factor, it raises a question as to why the controls were not at ceiling. In order to assuage any concerns that this casts doubt on our result, we explored the behavior of those participants (N=38) that responded with 100% accuracy on all control sentences. As shown in Fig. 7, the data for this subset of children displays only minor divergence from the full sample, with approximately 75% rejection rates overall on affirmative possibility and negative necessity conditions. They also displayed similar rates of over-acceptance in affirmative necessity and homogeneous conditions.

Together, these results are most compatible with our hypothesis: these response patterns are what is expected if indeed children interpret all three categories of modals as homogeneous. The "purely logical" hypothesis cannot explain the overly strong interpretations of the logically weak *allowed to* and *doesn't have to*. The "necessity delay" hypothesis fails to explain children's adult-like behavior with affirmative *have to* on the one hand, and their non-adult behavior with affirmative *allowed to*, on the other.

The selective nature of children's divergence from expected behavior can be seen as further support for the homogeneity hypothesis. Because our hypothesis attributes non-adult-like strengthening to non-adult SIs, we expect problems only in those cases where the basic meaning is weak. This follows from the nature of SIs in general. They are not predicted to be generated when the basic meaning of a sentence is already stronger than all of the alternatives. In our experiment, the conditions with sentences that are on the strong end of a scale are negative possibility, and affirmative necessity. The responses for these conditions closely follow the pattern of expected adult response provided in (9)-(11). The fact that the divergence from the expected adult response pattern is systematically concentrated on only the environments that are conducive to SIs (affirmative possibility and negative necessity) would not be explained if children simply don't understand modal meanings (see also Novek 2001, Singh et. al. 2016 for similar arguments).



Figure 7: Critical Items among 100% control accuracy subset: Proportion of children's 'Yes' (= non-contradictory) responses (N = 38)

5.2 Qualitative data suggestive of homogeneity hypothesis

This subsection surveys information gleaned from modal production data that was generated through participant justifications. For each sequence that was judged as uttered by a puppet from the Upside Down planet,, we asked the participant for a justification ("Can you tell me why?"). We collected 253 justifications on critical trials, of which 159 were potentially informative (i.e. not simply stating that the sequence "didn't make sense").

When examining these informative justifications, there were some notable qualities to some of the sentences that participants offered. It was not uncommon for participants to offer a justification that used a different modal from the one in the item that they were responding to. Of particular interest were the examples below, showing that children sometimes swap a homogeneous modal for a possibility modal, as in (17)-(18). There were 13 instances of such swaps, distributed across 11 children.

- (17) a. Item: The basket is allowed to be full and it is allowed to be empty.b. Response (age 6;5): Doesn't make sense.
 - c. Justification: "The bucket is supposed to be full and he had it say empty, too ."
- (18) a. Item: The basket is allowed to be full and it is allowed to be empty.b. Response (age 6;10): Doesn't make sense.
 - c. Justification: "Apples supposed to be full and empty."

A plausible way to understand these justifications is that the participant may consider the two modals synonymous, both expressing a homogeneous meaning.

There were also occasions in which *allowed to* was produced with an apparent necessity meaning. In the following example, sentences with *allowed to* were used to justify why a negative *supposed to* item doesn't make sense. The justifications suggest that the participant wanted to express that the two conjuncts are logically incompatible, not simply pragmatically odd.

- (19) a. Item: The TV isn't supposed to be on and it isn't supposed to be off.b. Response (age 5;0): Doesn't make sense.
 - c. Justification: "If it's allowed to be off and it's allowed to be on how could it be both?"
- (20) a. Item: The TV isn't supposed to be on and it isn't supposed to be off.
 b. Response (age 5;8): Doesn't make sense.
 - c. Justification: "Allowed to be on AND off"

This, too, appears to indicate that *allowed to* and *supposed to* are being used synonymously with a uniformly homogeneous meaning. The use of modals produced in these justifications is suggestive of the possibility that these children interpret possibility modal *allowed to* and homogenous modal *supposed to* as both giving rise to a uniform homogenous meaning.

5.3. Explaining children's behavior

We propose that children compute different SIs because they reason over different alternatives. Specifically, children don't readily access lexical alternatives (Barner et al., 2011 and Singh et al., 2016). In contrast to lexical alternatives, we assume by hypothesis that children (as well as adults) do access "subdomain alternatives." These are alternative smaller restrictions of a quantificational domain, and have been proposed to account for negative-polarity and free choice phenomena (Chierchia, 2013, a.o.).

The suggestion that children can indeed access these types of alternatives is consistent with Barner et al. and Singh et al.'s proposals. This is because they argue that children's limited abilities with alternatives are confined to difficulties accessing alternatives involving replacements of one lexical item with another. Subdomain alternatives are qualitatively different in that they don't require knowledge of the lexicon in the same way that lexical scalar alternatives do. They are instead the result of replacing a given domain with its subsets.

In addition to these assumptions about alternatives, we assume that children do possess the adult exhaustification mechanism responsible for generating SIs (in particular we assume the EXH operator from Bar-Lev & Fox, 2020). At a stage of acquisition with this profile (accessing only subdomain alternatives and not lexical scalar alternatives), possibility modals strengthen to a necessity meaning in affirmative sentences. This result obtains because exhaustification generates an SI that amounts to asserting universal quantification over the subdomain alternatives. That is, the generated SI states that φ is possible for every subdomain, which entails that φ is necessary.

Under negation, however, where entailment is reversed, the basic possibility meaning is preserved. This is parallel to an analysis of neg-raising modals proposed in Staniszewski, 2021, which are assumed to lack scalar alternatives in the adult grammar, thus generating homogeneous interpretations when exhaustification applies. As argued for in section 5.1 above, this view gains support from the fact that non-adult-like interpretations occur predictably in SI-environments (affirmative possibility / negative necessity). In addition, this view also provides a way to understand children's non-adult behavior with modals as an example of a generally occurring phenomenon in natural language (homogeneity), which additionally relates directly to independently-motivated work on children's access to lexical alternatives.

5.4. Open Questions

The proposal above raises the question of how children come to acquire the adult state. A conceivable hypothesis is that they retain the homogeneous meanings until they understand that an item has a dual, at which point they learn that the dual pair are lexical alternatives to one another. This raises another question as to what types of input makes this possible.

We propose that some features of our result are suggestive of a hypothesis. Our theoretical assumption up to this point is that children have acquired the adult state for the underlying semantics of modals, which includes their underlying quantificational force. Based on this assumption, the pattern of results in affirmative necessity environments in Fig. 6 is somewhat surprising. As discussed in section 5 above, these show a minor deviation from the expected adult response. While this effect is too small to base any conclusions on, it could provide the basis for a hypothesis for further experimentation. There could be at least some children that entertain a basic possibility meaning for *have to*, which in turn could be preserved if strengthening does not occur. This suggests that the default state for the basic meaning of all modals is existential and lacking a dual.

Following this line of thinking, one crucial piece of data that could guide a learner to the correct meaning would be sentences of the following form.

(21) You're allowed to go, but you don't have to.

This is different from the sequences that we tested in that it contains two different modals. Sequences like this are instructive, since the only interpretation that isn't contradictory is one in which the modal in the first conjunct expresses possibility, and the one in the second conjunct expresses necessity (all other combinations would be contradictory).

Given this, a possible follow-up study would involve testing sentences like the one in (21) with a similar contradiction assessment task. If both modals are interpreted as homogenous, the sentence should be contradictory. The explicit use of both modals in the same sentence, however, could have the effect of making the lexical alternatives salient enough to give rise to the adult-like SIs, and thus give rise to the non-contradictory adult interpretations.

References

- Bar-Lev, M. E. and D. Fox (2020). Free choice, simplification, and innocent inclusion. Natural Language Semantics 28(3), 175–223.
- Barner, D., N. Brooks, and A. Bale (2011). Accessing the unsaid: The role of scalar alternatives in children's pragmatic inference. *Cognition*.
- Cournane, A. (2020). Learning modals: A grammatical perspective. Language and Linguistics Compass. Chierchia, G. (2013). Logic in grammar: Polarity, free choice, and intervention, Volume 2. Oxford University Press.
- Chierchia, G. (2013). Logic in grammar: Polarity, free choice, and intervention, Volume 2. Oxford University Press.
- Dieuleveut, A., van Dooren, A., Cournane, A., & Hacquard, V. (2019). Acquiring the force of modals: Sig you guess what sig means. In Proceedings of BUCLD42.
- Fox, D. (2007). Free choice and the theory of scalar implicatures. In Presupposition and implicature in compositional semantics. Gajewski, J. (2005). Neg-raising: Polarity and presupposition. Ph. D. thesis, MIT.
- Hirzel, M., V. Hacquard, and A. Cournane (2019). Learning to map modals to meanings: An elicited production study on 'force' and 'flavor'. Poster presented at BUCLD 44.
 Homer, V. (2011). Polarity and modality. Ph. D. thesis, UCLA..
- Jeretič, P. (2021a). Neg-raising modals and scaleless implicatures. Ph.D. thesis, NYU..
- Katsos, N., & Smith, N. (2010). Pragmatic Tolerance or a speaker–comprehender asymmetry in the acquisition of informativeness. In In Proceedings of BUCLD 34.
- Kratzer, A. (1977). What '*must*' and '*can*' must and can mean. Linguistics and philosophy 1(3), 337–355.
- Križ, M. (2015). Aspects of homogeneity in the semantics of natural language. Ph. D. thesis, Ph. D. thesis, University of Vienna.
- Moscati, V., Zhan, L., & Zhou, P. (2017). Children's on-line processing of epistemic modals. Journal of child language.
- Noveck, I. A. (2001). When children are more logical than adults. Cognition.
- Ozturk, O., & Papafragou, A. (2015). The acquisition of epistemic modality. Language Learning and Development.
- Singh, R., K. Wexler, A. Astle-Rahim, D. Kamawar, and D. Fox (2016). Children interpret disjunction as conjunction: Consequences for theories of implicature and child development. Natural Language Semantics 24(4), 305–352.
- Skordos, D., Feiman, R., Bale, A., & Barner, D. (2020). Do children interpret 'or' conjunctively?. Journal of Semantics, 37(2), 247-267.
- Staniszewski, F. (2019). Wanting, acquiescing, and neg-raising. In Proceedings of NELS, Volume 49.
- Staniszewski, F. (2021). A variable force analysis of positive polarity neg-raising modals, in Proceedings of Sinn Und Bedeutung.
- Tieu, Lyn, Kazuko Yatsushiro, Alexandre Cremers, Jacopo Romoli, Uli Sauerland, & Emmanuel Chemla. (2015). "Disjunction in child language: Inclusive, exclusive, or conjunctive?" Paper presented at the 48th Annual Meeting of the Societas Linguistica Europaea, University of Leiden, Netherlands, 03 Sep.