On the prosody of presupposition projection: A production experiment*

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1. Introduction

The content of the complement of a factive predicate like *discover* is standardly analyzed as a presupposition (e.g., Heim 1983, van der Sandt 1992, Abrusán 2011). Such analyses capture that the content of the complement (CC, henceforth) can project over entailment-canceling operators, like the epistemic modal adverb *perhaps* in (1): when the CC, that Mary is a widow, projects, the speaker is taken to be committed to the truth of the CC.

(1) Perhaps Kim discovered that Mary is a widow.

The CC of factive predicates can, but does not have to, project: for instance, in the naturally occurring example in (2), the author is not taken to be committed to the CC of *discover*, that the method is wombat-proof.

(2) They [the mattress springs] also work well to deter rabbits & foxes from digging into the chook-pen (Hen-run). Dig a shallow trench the width of a single mattress, then place the springs flat in the trench. [...] I haven't tried this with wombats, though, & if anyone discovers that the method is also wombat-proof, I'd really like to know! (adapted from (Beaver 2010: 79))

How do listeners (and readers) identify for any given utterance with a factive predicate whether the CC projects, i.e., whether the speaker (or writer) is committed to the truth of the CC? Beaver (2010) suggested that information structural focus provides a cue to the projection of the CC. To illustrate his suggestion, consider the examples in (3), which differ in the placement of information structural focus, which is indicated by $[\ ]_F$. Whereas

*We thank Craige Roberts, the participants of Speerlab at OSU and the audiences at NELS 49 and SALT 26 for feedback on this work. We also thank Jessi Sadaka for assistance in running the experiment and in data annotation. We gratefully acknowledge financial support from the *National Science Foundation* grant BCS-1452674.

Maggie Baird & Jonathan Pesetsky (eds.): NELS 49, Vol. 3, 241–254.
GLSA Amherst.

(3a) "conjures up an image of complicity between the all-knowing professor and the guilty student" (p.93), i.e., the CC projects, (3b) "does not suggest that the student is guilty" (*ibid.*), i.e., the CC does not project.

(3) A professor to a student: (Beaver 2010: 93)

a. If the T.A. [discovers]$_{\mathrm{F}}$ that your work is plagiarized, I will be [forced to notify the Dean]$_{\mathrm{F}}$.

b. If the T.A. discovers that your work is [plagiarized]$_{\mathrm{F}}$, I will be [forced to notify the Dean]$_{\mathrm{F}}$.

The idea that information structural focus plays a role in presupposition projection has recently been incorporated in projection analyses (e.g., (Abrusán 2011, 2016, Simons, Beaver, Roberts, and Tonhauser 2017)). While these analyses differ in detail, they all predict that the CC of a factive predicate is less likely to project when the complement is in focus than when it is not in focus. Since the prosodic realization of an American English utterance provides a cue to focus (e.g., (Cooper, Eady, and Mueller 1985, Eady and Cooper 1986, Ladd 2008)), these projection analyses predict that the prosodic realization of American English utterances with factive predicates provides a cue to whether the CC projects.

To this date, empirical support for this prediction has been provided by comprehension experiments. Cummins and Rohde (2015), who investigated the CC of factive predicates as well as other presuppositions, found that listeners were more likely to take the speaker to be committed to the presupposition in their 'focus' condition, in which there was "a pitch accent on the last word of the sentence" (p.7), than in their 'neutral' condition (which was not further described). Tonhauser (2016) found that the prosodic realization of utterances with factive predicates influences projection of the CC in a series of three experiments. In her Experiment 1, for instance, participants listened to utterances of sentences like *Perhaps he noticed that she's a widow* in two prosodic conditions, illustrated in (4). In the H*-on-predicate condition in (4a), the sentences were produced with a high tone pitch accent on the predicate (and no other pitch accents), a low intermediate phrase accent and a low intonational phrase boundary (H* L-L% in the Tones and Break Indices (ToBI) annotation system, Beckman and Ayers 1997). In the L+H*-on-content condition in (4b), the last content word of the complement clause was produced with a complex pitch accent consisting of a low tone preceding a high tone that was aligned with the stressed syllable. The sentence was realized without any other pitch accents and, again, a low intermediate phrase accent and a low intonational phrase boundary (L+H* L-L% in ToBI notation).

(4) Dana (about Scott and Valeria)
[Context: overhearing a conversation at a party]

a. Perhaps he [noticed]$_{H*}$ that she's a widow L-L%

b. Perhaps he noticed that she's a [widow]$_{L+H*}$ L-L%.

Tonhauser (2016) found that participants were less likely to take the speaker to be committed to the CC in the L+H*-on-content condition than in the H*-on-predicate condition. Under the assumption that the CC is more likely to be in focus in the L+H*-on-content condition than in the H*-on-predicate condition, her findings are compatible with the prediction that the CC of a factive predicate is less likely to project when it is in focus. For similar findings see Djärv and Bacovcin 2017.

The aforementioned comprehension experiments show that listeners attend to prosody to determine whether the CC projects. These findings are compatible with the assumption that prosodically marked focus provides a cue to the projection of the CC. There are, however, at least two ways in which the evidence for the influence of information structural focus on presupposition projection can be strengthened. First, the prosodic realizations of the stimuli in the various conditions of the experiments were based on linguists' intuitions about prosodic realizations that matter for presupposition projection instead of on observations about the prosody of utterances produced by theoretically untrained speakers. Second, because the stimuli in the experiments in Cummins and Rohde 2015, Tonhauser 2016 and Djärv and Bacovcin 2017 were each produced by a single speaker, the findings have limited generalizability. In this paper, we take a first step towards strengthening the evidence for the influence of focus on presupposition projection by presenting the findings of a production experiment conducted with theoretically untrained speakers that investigated the prosody of presupposition projection. In future work, these productions can serve as stimuli for comprehension experiments that address the generalizability concern.

2. Production experiment

Recall from above that there are projection analyses according to which information structural focus plays a role in presupposition projection (e.g., Abrusán 2011, 2016, Simons et al. 2017). These analyses predict not only that listeners attend to prosody in determining whether a factive presupposition projects, but also that the prosody of a speaker's utterance contains cues about whether the presupposition projects. The production experiment we report on here was designed to investigate this prediction for sentences with factive predicates. The experiment elicited utterances of sentences in which a factive predicate and its clausal complement occurred embedded under the epistemic possibility adverb *perhaps*, as in (5).

(5) Perhaps she was aware that he was unreliable.

The sentences were each produced as part of two discourses: one in which the CC projects, i.e., the speaker is committed to its truth, and one in which it does not. Comparing the prosodic realizations of the uttered sentences in the two discourses thereby allows us to investigate prosodic cues to presupposition projection.

2.1 Methods

Participants 14 undergraduate students (9 female, 5 male; age 18-27; median age: 22) from The Ohio State University participated in the experiment for partial course credit.

Materials In the target sentences, a factive predicate and its clausal complement occurred embedded under the epistemic possibility adverb *perhaps*. We created 15 target sentences from 5 factive predicates (*be aware, discover, know, notice, realize*) and 3 distinct clausal complements each, as shown in (6).

(6) 15 target sentences

D1 Perhaps he discovered that she had gone out.
D2 Perhaps he discovered that he's a father.
D3 Perhaps she discovered that he was hiding something.
R1 Perhaps he realized that the list was too long.
R2 Perhaps she realized that the computer had a virus.
R3 Perhaps he realized that she was cheating on him.
K1 Perhaps they knew that he had been at the crime scene.
K2 Perhaps he knew that she was married.
K3 Perhaps she knew that he was wrong.
A1 Perhaps she was aware that he was a terrible administrator.
A2 Perhaps she was aware that he was unreliable.
A3 Perhaps she was aware that he had bad reviews.
N1 Perhaps he noticed that she was missing something.
N2 Perhaps she noticed that he had bad breath.
N3 Perhaps he noticed that she was trying to escape.

The 15 target sentences were embedded in two discourses, for a total of 30 discourses: in one discourse, the content of the clausal complement (CC) projects over *perhaps* (the 'projecting condition') and in the other discourse the CC does not ('non-projecting condition').[1] The pair of discourses for the target sentence A2, also in (5), is given in (7). For the full set of discourses, see Appendix A in the GitHub repository at `https://github.com/elena-vaiksnoraite/projectivity-and-prosody`.

[1]We ran several norming experiments with self-declared speakers of American English recruited on Amazon's Mechanical Turk platform to ensure that native speakers of American English assess the CC of the target sentences to project in the discourses in the projecting condition and to not project in the discourses in the non-projecting condition. For details on these norming experiments see Appendix B in the GitHuB repository.

(7) a. **Projecting condition:** My friend Sam is a landscape architect. He just got fired from his job because he didn't keep his appointments and is generally irresponsible. Even his sister refused to hire him. Perhaps she was aware that he was unreliable. He's in trouble.

b. **Non-projecting condition:** My church was looking for a new financial administrator. We interviewed a very well-qualified man who had great references and a lot of experience. We were completely shocked when our pastor refused to hire him, and she didn't want to tell us why. Perhaps she was aware that he was unreliable. Or perhaps she just didn't like him.

The target sentences were not the last sentences of the discourses, to avoid discourse-final prosody being realized on them. Furthermore, the content words of the target sentences did not occur in the preceding sentences of the discourses in either condition, to ensure that content words were not deaccented due to having been previously used.

The 30 discourses were divided into two blocks (A, B) of 15 discourses each so that each block included each target sentence only once. The order of the target sentences in each block was identical, but pseudo-randomized, to ensure that the target sentences of adjacent discourses did not feature the same factive predicate. Roughly half of the discourses in each block were in the projecting condition. Two lists were created: on list 1, block A preceded block B; on list 2, block B preceded block A.

Procedure Participants were randomly assigned to a list (half to list 1, half to list 2) and seated in a sound-attenuated booth in front of a computer screen and a table-top microphone. On each trial, participants were first shown the discourse, which they were instructed to read silently. On the next screen they were shown a comprehension question, which was not about the target sentence; they responded using the microphone. On the final screen of the trial they were shown the discourse again: they were instructed to read the discourse out aloud, in a lively manner. (They were told that their recordings would be used as part of podcast episodes.) In the case of false starts or misreadings, participants were asked to repeat the discourse. Participants took a break after 15 trials to fill out a background questionnaire about their age, their gender and languages spoken natively; they were also offered breaks after the 7th and 22nd trial. The recordings were made using Audacity with a sampling rate of 44,100 Hz and 16-bit resolution.

2.2 Data exclusion

Prior to analysis, we excluded the productions of 2 participants who were not self-reported native speakers of English and the productions of a participant with a bad cold. We also excluded 2 productions of discourses for which the answer to the comprehension question was incorrect, as well as 30 discourses with disfluencies in the utterances of the target sentences. 7 discourses were not recorded due to an experimenter error. The final data set consists of 291 utterances of target sentences by 11 participants (6 female, 5 male).

2.3 Data annotation and statistical analysis

The 291 utterances were phonologically transcribed by two annotators according to Mainstream-American English Tone and Break Indices conventions (Beckman and Ayers 1997). The annotators (one of which was the last author, a near-native speaker of American English; the other annotator was a native speaker of American English) were blind to the condition in which the target sentences had been uttered. Disagreements in the two annotations were resolved by consensus.

As shown in (6), there are 7 target sentences in which the subject of the clausal complement is a pronoun and the verb is a copula or a light verb (i.e., the subject and the verb are not content words), namely D2, K2, K3, A1, A2, A3 and N2. For the 114 utterances of these 7 target sentences, we automatically extracted, using Praat (Boersma and Weenink 2011), the durations of the stressed syllables and the words. We also measured the minimum, maximum and mean f0 of the stressed syllables, of the words and of the entire utterances. These f0 measurements were extracted automatically using Praat and hand-corrected using waveform and spectrum displays, as necessary. The results presented in section 3 are based on these 114 utterances; an analysis of the full set of (syntactically more heterogeneous) target sentences is left for future research.

To investigate the influence of the projection of the CC on the prosodic realization of the target sentences, we fit linear and logistic mixed effects models using the package *lme4*, (Bates, Sarkar, Bates, and Matrix 2007), v 1.1-17) in R (R Core Team 2014, v. 1.0.143). These models predicted one of the annotated prosodic properties from condition (with the 'projecting' condition as the reference level) and the maximal random effects structure that allowed the models to converge: random by-participant intercepts (capturing differences in participants' use of prosody) and random by-item intercepts (capturing differences in prosodic realization between utterances).

3. Results

The experiment was designed to investigate the question of whether utterances of sentences with factive predicates systematically differ in prosody depending on whether the CC projects. Specifically, we hypothesized that utterances in which the CC projects differ from utterances in which the CC does not project in the prosodic cues to information structural focus. We considered the prosodic properties in (8) as potential cues to projectivity based on previous descriptions of how informational structural focus is marked in American English (e.g. (Eady and Cooper 1986, Ladd 2008, Breen, Fedorenko, Wagner, and Gibson 2010)). This research has established that an expression is more likely to be realized with longer duration, a higher f0 and a (rising) pitch accent when it is in focus than when it is not. As shown in (8), we analyzed the duration and the mean f0 of the entire utterance, the complement clause, the factive predicate and the last content word of the complement clause. We also considered the type of pitch accent realized on the factive predicate and the last content word. The motivation for considering the duration, mean f0 and type of pitch accent of the factive predicate and the last content word comes from the assumption that focus projects from these expressions to the clauses they are contained

in. For the complement clauses, we hypothesized that the nuclear pitch accent would be realized on the last content word. Generally, the function words in our utterances were not realized with a pitch accent.

(8) *Prosodic properties analyzed*[2]

Duration	factive predicate, last content word, complement clause, entire utterance
Mean f0	factive predicate, last content word, complement clause, entire utterance
Pitch accent type	factive predicate, last content word

The analysis presented in this section is based on the aforementioned subset of 114 utterances, 49 of which were produced in the projecting condition and 65 in the non-projecting condition. We found a significant effect of projection on three prosodic properties: i) the type of pitch accent on the last content word; ii) the duration of the last content word; iii) the mean f0 of the entire utterance.[3] In the following, we provide details on these three findings.

Pitch accent on the last content word All 114 last content words were produced with a pitch accent. This was expected given that these words were first mentioned in the target sentences, as discussed in section 2. Different types of pitch accents were realized on the last content word, as shown in (9), where the pitch accents are ordered from left to right by relative prominence. The most common types of pitch accent realized on the last content words were H* and !H*. In the non-projecting condition, more L+H* and H* accents were produced on the last content word than in the projecting condition.

(9) *Count of types of pitch accent realized on the last content words by condition*

	L+H*	H*	!H*	H+!H*	L*
projecting	3	21	14	4	7
non-projecting	10	32	13	6	4

In Mainstream American English ToBI, L+H* and H* are taken to be distinct pitch accents that make different contributions to interpretation (e.g. Pierrehumbert and Hirschberg 1990): L+H* is argued to indicate contrastive focus and H* is associated with new information focus (for discussion see, e.g., Ladd and Schepman 2003, Calhoun 2012, Tonhauser 2019 for discussion). Since both pitch accents are assumed to mark focus and evoke a set of alternatives, the two pitch accents were combined in the statistical analysis. By contrast, (H+)!H* and L* are not usually associated with a focus meaning. Instead, they are

[2]Other f0 values were also analyzed, namely f0 minimum and f0 maximum. There was no significant effect of condition on these f0 values. We also analyzed the prosodic properties of the entailment cancelling operator *perhaps*. Across conditions, it was almost exclusively realized with L+H* (97% of the utterances). There was no significant effect of condition on the duration or f0 of this word.

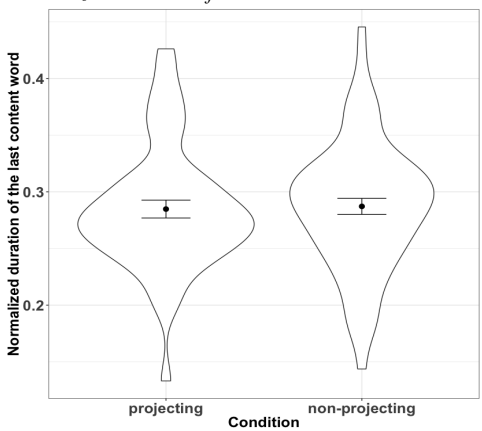
[3]The extracted values, the code for the analyses and figures are provided in the GitHub repository.

realized on expressions that denote accessible and given discourse referents, respectively (Pierrehumbert and Hirschberg 1990).

To allow for the use of binomial logistic mixed-effects regression models, the pitch accent types were simplified to a binary distinction between the pitch accents associated with focus (L+H*, H*) and those not associated with focus (L*, !H*, H+!H*). A binomial logistic mixed-effects regression model was fitted to the data predicting the type of pitch accent from condition (with the projecting condition as the reference level) and random by-participant and by-item intercepts. The model revealed a significant effect of condition on the pitch accent type such that the last content word was more likely to bear L+H* or H* in the non-projecting than the projecting condition (β = 0.9287, SE = 0.4473, z = 2.076, p $<$ .05). This result is consistent with the claim that the CC is less likely to project when it is in focus (Beaver 2010, Simons et al. 2017).

Duration of the last content word To account for by-participant variability in speech rate, the duration of the last content word was normalized by the duration of the whole utterance. The violin plot in (10) shows the distribution of the normalized duration of the last content word in the two conditions: the width of the contour on the x-axis shows the density distribution and the length of the contour on the y-axis shows the range of values. The means are shown as black dots and error bars indicate the standard error. The probability density of the normalized duration of the last content word is larger at a higher region in the non-projecting than in the projecting condition. This suggests that the normalized duration of the last content word is longer in the non-projecting condition than in the projecting one.

(10) *Normalized duration of the last content word*

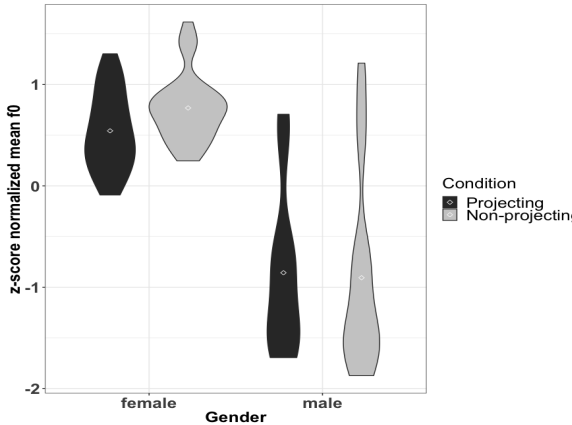


We fitted a linear mixed effects model predicting the normalized duration of the last content word from the fixed effect of condition with the projecting condition as the reference level.

To control for the influence of monotonal and bitonal pitch accents on duration the duration of the last content word, this model also included a fixed effect of type of pitch accent (monotonal versus bitonal). The model also included random intercepts for participant and item. The model confirmed that the last content word was significantly longer in the non-projecting condition than in the projecting condition (β = 0.0099, SE = 0.0046, t = 2.17, p $<$ .05). This finding is compatible with the hypothesis that the last content word is in focus in the non-projecting condition. If we assume that focus projects from the last content word to the entire complement clause, our finding is consistent with the claim that the CC is less likely to project when it is in focus (Beaver 2010, Simons et al. 2017).

Mean f0 of entire utterance To control for participants' differences in f0 range, the mean f0 values of the utterances were z-score normalized. The distribution of normalized mean f0 values in the two conditions is shown in the violin plot in (11) by gender. The means are shown as black dots. There was a lot of variation in the f0 ranges of male participants, therefore the violin plots are long and narrow. Overall, both female and male participants produced the utterances with higher f0 in the non-projecting condition than in the projecting condition.

(11) *z-score normalized mean f0 of the target utterances*



A linear mixed effect model was fitted to the data, predicting normalized mean f0 values from the fixed effect of condition with the projecting condition as the reference level. To control for the influence of high (L+H*, H*, H+!H*, !H*) versus low (L*) pitch accents on f0, this model also included a fixed effect for the pitch accent on the factive predicate and a fixed effect for the pitch accent on the last content word (high versus low pitch accent) The model also included a fixed effect of gender and random intercepts for participant and item. The normalized mean f0 was significantly higher in the non-projecting than the projecting

condition (β = 0.11, SE = 0.042, t = 2.62, p $<$ .05), suggesting that utterances in the non-projecting condition were produced with a higher f0 than utterances in the projecting condition.

As mentioned above, focused expressions in English tend to have a higher f0 than non-focused expressions. It is not clear whether the finding that the entire utterance has a higher mean f0 in the non-projecting than the projecting condition is relatable to the hypothesis that the CC is in focus in the non-projecting condition. Furthermore, contrary to expectation from the focus literature, we did not find that the f0 of the complement clause or of the matrix clause was predicted by condition. We leave the question of how to interpret the finding about the mean f0 of the entire utterance to future research.

Summary The production experiment revealed that English utterances with factive predicates differ in at least three prosodic properties depending on whether the CC projects: the type of pitch accent on the last content word, the duration of the last content word and the mean f0 of the entire utterance. Both pitch accent type and duration lend prosodic prominence to the last content word, indicating that it is focused. These findings are consistent with previous research on focus marking in English (Ladd 2008, Breen et al. 2010) and thus support the hypothesis that information structural focus is implicated in the projection of the CC of factive predicates.

4. Discussion

In this section, we discuss how the findings of our production experiment relate to the findings of the comprehension experiments. We also consider the implications of our findings for empirically adequate projection analyses.

Relating the findings of the production and the comprehension experiments. As discussed in the introduction, the comprehension experiments provided empirical support for the hypothesis that listeners attend to prosody in identifying whether a presupposition projects (Cummins and Rohde 2015, Tonhauser 2016, Djärv and Bacovcin 2017). Our production experiment has now provided empirical support for the hypothesis that speakers' utterances differ in their prosodic properties depending on whether the presupposition projects. Thus, there is now evidence from both comprehension and production that prosody is implicated in presupposition projection.

Which specific prosodic properties are implicated in presupposition projection? Our production experiment suggests that at least the type of pitch accent on the last content word, the duration of the last content word and the mean f0 of the entire utterance may play a role. Unfortunately, the comprehension experiments to date do not provide information on exactly which prosodic properties matter. One reason is that the description of the stimuli is impoverished. In Cummins and Rohde 2015, for instance, the prosodic properties of the stimuli were not analyzed: stimuli were only said to either realize "a pitch accent on the last word of the sentence" or not (p.7); Djärv and Bacovcin (2017: 123) merely described their stimuli as having "stress" on either the predicate or the embedded subject.

A second reason is that the models fitted to the data of the comprehension experiments only predicted projection from condition, not from specific prosodic properties. Tonhauser (2016), for instance, provided more detailed information about the prosodic properties of the stimuli in the three comprehension experiments described, namely information about the placement and types of pitch accent, the duration of the factive predicate and of the relevant words in the complement clauses. However, the models that she fitted to the data only predicted projection from condition, not from the prosodic properties of the stimuli, thereby limiting the conclusions we can draw about which prosodic properties influenced the listeners' judgments.

Nevertheless, the findings of the comprehension experiments are at least compatible with the hypothesis that the placement of pitch accents matters (Tonhauser 2016, Djärv and Bacovcin 2017) as well as the type of pitch accent (Cummins and Rohde 2015, Tonhauser 2016). In Tonhauser's (2016) Experiment 3, for instance, the stimuli differed in the relative prominence of the pitch accents on the factive predicate and the last content word. In the first condition, the predicate was realized with a more prominent pitch accent ((L+)H*) than the last content word (!H*). In the second condition, the predicate was realized with a less prominent pitch accent (H*) than the last content word ((L+)H*). Tonhauser found that the projection ratings for the CC were lower in the second condition than the first, thus suggesting that pitch accent type may be a cue to projection. There is, therefore, converging evidence from both comprehension and production experiments that pitch accent type may be a cue to presupposition projection.

Tonhauser (2016) reported that the the factive predicate and the last content word in the two conditions of Experiment 3 varied not only in the type of pitch accent realized, but also in f0 and duration. Specifically, for the predicate, the mean f0 was higher and the mean duration was longer in the first condition than the second, and, for the last content word, the mean f0 was higher and the mean duration was longer in the second condition than the first. It is thus possible that listeners' projection ratings for the CC were influenced by the type of pitch accent, by the f0, by the duration of the relevant words, or by a combination of the three (as well as other differences between the stimuli). Future comprehension experiments will need to explore which prosodic properties listeners attend to and what the relative contributions of these properties to presupposition projection are.

Implications for empirically adequate projection analyses. Given that there is mounting empirical support from both comprehension and production experiments for an interaction between information structural focus and presupposition projection, we can ask whether projection analyses that are currently on the market lead us to expect such an interaction. As mentioned above, some projection analyses explicitly incorporate information structural focus. For instance, according to the analysis developed in Abrusán 2011, 2016, the CC of factive predicates projects when it is backgrounded, i.e., when it is not the main point of the utterance. One way in which the CC of factive predicates can become the main point, and therefore not project, is when the CC expresses "the most direct answer to the (grammatically signaled) background question" (Abrusán 2011: 509), i.e., when the CC is the information structural focus of the utterance. Similarly, under Simons et al.'s (2017)

analysis, the CC of a factive predicate projects if it is not at-issue with respect to the Current Question addressed by the utterance, i.e., if the focus of the utterance, as constrained by the Current Question, is not the CC. Thus, both analyses lead us to expect that listeners attend to prosodic cues to information structural focus in identifying whether the CC of factive predicates projects. Likewise, both analyses lead us to expect that speakers produce prosodic cues to information structural focus to convey whether they are committed to the truth of the CC of factive predicates.

In Abusch's (2002, 2010) analysis, information structure is implicated less directly and less generally. Presuppositions are generated from sets of alternative propositions; roughly speaking, what is presupposed is that the disjunction of the alternatives is true, i.e., what is presupposed is the proposition that follows from all alternatives. For some expressions, the relevant set of alternatives is derived from a lexical specification. Crucially, however, sets of alternatives can also be induced by information structural focus. It may therefore be possible for the CC of a factive predicate to project under Abusch's analysis if focus induces a set of alternatives such that the CC follows from each alternative. If so, Abusch's analysis, too, may lead us to expect that listeners attend to and speakers produce prosodic cues to projection.

For other projection analyses currently on the market, like those in Heim 1983, van der Sandt 1992 or Romoli 2015, it is less clear how the mechanism by which the CC of factive predicates projects might be influenced by information structural focus. Under Romoli's (2015) analysis, the projectivity of the CC of factive predicates is derived as a scalar implicature. As discussed in detail in (Tonhauser, de Marneffe, Speer, and Stevens 2019), Romoli's (2015) analysis might allow for the projectivity of the CC to be influenced by information structural focus, but it is not clear whether Romoli allows for such an interaction, as he seems to suggest (p.200) that focus-induced inferences do not influence the projectivity of the CC of factive predicates.

According to the analyses in Heim 1983 and van der Sandt 1992, the CC of a factive predicate is lexically specified as presupposed content. If the presupposition is not already entailed by or satisfied by the common ground of the interlocutors, then it is accommodated – globally, by default, and locally, if global accommodation leads to contradiction, uninformativity or problem with binding. Because global accommodation (i.e., projection) is the default, information structure can, at best, influence projection by resulting in local accommodation (i.e., non-projection). The question, thus, is whether the information structure of the utterance with the factive predicate can lead to contradiction or uninformativity. Recently, Djärv and Bacovcin (2017) suggested that that is indeed possible: roughly speaking, they argued that the information structure of the utterance can convey that the utterance is taken to address a Question Under Discussion (QUD) that suggests that the speaker is not committed to the truth of the CC of the factive predicate. In such a case, what is suggested by the QUD (that the speaker does not know whether the CC is true) could be taken to contradict a globally accommodated CC (which would require the speaker to be committed to the truth of the CC). An important question for future research on projection is whether it is more empirically adequate to lexically specify content as projective and rely on information structure to override projection, as suggested in Djärv and Bacovcin 2017, or to abandon lexical specification and to more directly implicate information structure in

projection, as in Simons et al. 2017. In the end, it may be the case that both types of analysis are needed, albeit for different types of projective content (see Tonhauser et al. 2019 for discussion).

5. Conclusions

Recent projection analyses argue that projection is influenced by information structure (Abrusán 2011, 2016, Simons et al. 2017). Supplementing comprehension experiments, which provide some empirical support for these analyses (Cummins and Rohde 2015, Tonhauser 2016, Djärv and Bacovcin 2017), this paper has provided empirical support for such projection analyses from production. We found that native speakers of American English produced utterances with factive predicates differently depending on whether the content of the complement projects. Our production experiment identified three potential cues to projection: the type of pitch accent on the last content word, the duration of the last content word and the f0 mean of the entire utterance. Our findings are based on productions of target sentences whose complement clauses only contained one content word. The next steps are to investigate which prosodic properties are implicated in the projection of the content of complement clauses with more content words and to investigate which prosodic properties listeners attend to in utterances produced by theoretically untrained native speakers.

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