Contrast + givenness, local + non-local. The influence of complex information-structural settings on the prenuclear, nuclear and post-nuclear regions in exclamatives and questions

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Abstract: The prosodic effects of contrast, which requires an increase of prosodic prominence, and givenness, which requires a decrease of prosodic prominence, so far only have been studied independently of each other, that is for contrastive new or for non-contrastive given elements. We present data from a production study in German testing the combined effects of contrast and givenness on the prosodic prominence balance in *wh*-exclamatives and *wh*-questions. Our study shows that the prosodic requirements of contrast and givenness result in additive effects: contrastive given elements are prosodically less prominent than contrastive new elements. This is reflected both in categorical and in gradient acoustic measures. We also found that contrastive given elements are less prominent than non-contrastive new elements. Importantly, the effects generally are both local and non-local, with the pre-nuclear and post-nuclear regions substantially contributing to the prominence balance within the utterance. Our study furthermore corroborates earlier findings that exclamatives and questions differ on the one hand in their sensitivity to information-structural requirements, with exclamatives showing fairly rigid accentuation patterns independently of information structure, and on the other hand in the concrete realization of prosodic prominence: In rising questions, prominent elements are marked with L* accents, rather than (L+)H* accents. The results can be accounted for if prosodic prominence is conceptualized in terms of the *prominence balance* of an intonation phrase, which captures large local deviations from the falling vs. rising pitch base line (high positive balance), small local deviations (level balance) as well as non-local prominence adaptations.

Keywords: givenness, contrast, additive effects, prenuclear region, prominence balance, questions, exclamatives

1 Introduction

In intonation languages like German, information structure (IS) influences the prosodic prominence relations within an utterance. Givenness is typically associated with a prominence reduction on the given element, while narrow focus or contrast are typically associated with an

increase in prosodic prominence. These observations have mostly been made for assertions (e.g., Batliner, 1989; Baumann, 2006; Baumann & Grice, 2006; Baumann & Riester, 2013; Baumann, Röhr & Grice, 2015; Braun, 2006; Féry, 1993; Kohler, 1991; Kügler & Féry, 2008; Uhmann, 1991). Recent research shows that, although the general patterns obtain for non-assertive speech acts like exclamations and questions, there are also significant interactions of IS marking and speech act type, such as a lack or decrease of prominence reduction for given information in speech acts that have a requirement for high prosodic prominences like exclamations (Repp, 2015, 2020; Repp & Seeliger 2020, 2023; Seeliger & Repp 2020, 2023).

Most if not all investigations of prosodic reflexes of IS (other than topicality) have treated IS as a generally scalar phenomenon, with given information being at one end of the scale, and contrastive information being at the other end. The scale can be viewed as consisting of three subscales, where the endpoint of a subscale is the starting point of the next subscale. The first subscale is the givenness scale, and it is uncontroversial that there are degrees of givenness such as *fully given, accessible, unused, brand new* (with recent accounts distinguishing referential and lexical givenness, which we gloss over here; see Baumann & Riester, 2013). New expressions can then be in broad, narrower and narrow focus (second subscale). Narrowly focused expressions can be non-contrastive or contrastive, with contrast having been argued to have scalar properties as well (see Repp, 2016 for an overview; also Asher and Lascarides, 2003; Calhoun, 2010; Molnár, 2006; Paoli, 2009) (third subscale). The complete IS scale seems well-motivated in view of the fact that investigations both of the choice of lexical expressions (zero forms, pronouns, full noun phrases) and of the prosodic realization of expressions have shown that prosodic prominence seems to increase along this scale (e.g., Ariel, 1990; Baumann et al. 2006; 2015; Baumann & Riester, 2013; Gundel, Hedberg & Zacharski, 1993; Prince, 1981).

It is important to note, however, that the scale collapses several IS dimensions (Krifka, 2008). Givenness and newness are in the same dimension. As already mentioned, it is uncontroversial that this dimension is scalar in the sense illustrated above. Focus and background form a different dimension. Focus indicates that alternatives are relevant for the interpretation of the utterance (for the notion of *alternatives in language*, see Repp & Spalek, 2021. Different from what is reflected in the IS scale, the focus-background dimension is orthogonal to the given-new dimension. Consider the dialogue in (1): The answer to the question contains the given narrowly focussed constituent *the Franks*. If the same answer is given in the context of the less explicit question in (2), the same constituent is still narrowly focussed but now it is new.

(1) Q: I'm not sure I can remember Ann's dissertation subject. Which Germanic peoples is she studying for her dissertation again, the Goths or the Franks?

A: She is studying the Franks.

(2) Q: Which Germanic peoples is Ann studying for her dissertation again?

The issue arising at this point is whether the givenness of *Franks* is marked prosodically. Intuitively, it seems clear that *Franks* must be accented: it is the focus of the answer. This view is also advocated by semantic accounts of IS marking (e.g., Schwarzschild, 1999). Still, there might be prosodic differences depending on whether the question already introduced the constituent that is in narrow focus in the answer, as in (1), or not, as in (2). This issue cannot be addressed with a conception of IS as a single scale. Rather, it concerns the interaction of IS dimensions.

Contrast does not form its own IS dimension but builds on focus because contrast requires alternatives. Contrast may relate to two rather different semantic-pragmatic domains (Repp, 2016). The first domain concerns contrastive constituents. A constituent typically is considered contrastive if there is an *explicit* alternative for the constituent in the context. For instance, in example (3), the constituents *the Goths* and *the Franks* can be considered to be in contrastive focus because they are explicit alternatives for each other. Note that both expressions are new. If answer (1A) above is a response to (2) above, the constituent *the Franks* (1A) is not contrastive, because the *wh*-phrase in the question only introduces *implicit* alternatives.

(3) Ann is studying the Goths, and she is also studying the Franks.

Constituent contrast can be crossed with the given-new dimension in the same way as the focus-background dimension can. We are illustrating this in (4) and (5) with two examples where the contrastively focused element is in a question (italicized). In B's question in (4), *Franks* is given and contrastive: it contrasts with *Goths* in the context, and it is mentioned in the sentence preceding the question. In (5), *Franks* is also contrastive, but it is new.

(4) A: Have you heard? Ann has specialized in Goths for her dissertation now.

B: Yes, I know. She is always on research trips. Just recently she was in Wielbark in Poland because of burial practices of the Goths. But I think she is also traveling a lot because of her much-loved Franks. *Do you happen to know where she went to study Franks?*

(5) A: Have you heard? Anna has specialized in Goths for her dissertation now.

B: Yes, I know. She is always on research trips. Just recently she was in Wielbark in Poland because of burial practices of the Goths. But I think she is traveling a lot not only because of the Goths. *Do you happen to know where she went to study Franks?*

Thus, for constituent contrast, i.e., contrastive focus, the same issue arises as for non-contrastive focus: is the givenness of a focused element marked prosodically?

The other domain of contrast concerns discourse relations. The examples in (1) and (3) above are non-contrastive in terms of discourse relations, but if we replace *and* in (3) with *but*, see (6), the discourse becomes contrastive. In discourse relation theories, such discourses are classified as having a CONTRAST relation due to the presence of *but* (e.g., Asher and Lascarides, 2003; Mann and Thompson, 1988), although a more precise term like OPPOSE (Repp, 2016) is preferrable because it avoids confusion with the notion of constituent contrast.

(6) Ann is studying the Goths, but she is also studying the Franks.

A minimally different variant of (3) is (7), which introduces a polarity contrast. (7) is more contrastive than (6): it is a correction, which is the most contrastive discourse relation. Note that corrections can also occur with questions as antecedents (8).

(7) Ann is not studying the Goths. She is studying the Franks.

(8) Q: At which university is Ann studying the Goths?
A: She is studying the Franks.

Previous research of the prosodic effects of contrast has not investigated if the 'addition' of discourse contrast to constituent contrast has prosodic effects. Most investigations comparing non-contrastive narrow focus to contrastive focus implement contrast in terms of discourse relations, usually in corrections. From these investigations we cannot conclude that constituent contrast would have similar prominence-enhancing effects as discourse contrast.

This paper contributes to disentangling dimensions of IS in their impact on prosodic prominence. Specifically, we are exploring the prosodic reflexes of IS marking by crossing constituent contrast with the given-new dimension. In a production study in German, we are comparing the prosodic characteristics of utterances containing elements that are (a) new and non-contrastive, (b) new and contrastive, (c) given and non-contrastive and (d) given and contrastive. The terms *given*, *new* and *contrastive* are defined as follows. A word or phrase is *given* if its referent has been mentioned in the context preceding the relevant utterance. An element is *new* if its referent has not been mentioned in the preceding context. We speak of *contrast* if there are explicit alternatives for the relevant expression in the context, otherwise there is no contrast.

We are investigating the interplay of the given-new dimension with constituent contrast in non-assertive speech acts: in questions and in exclamatives. This enables us to assess reflexes of the

functional load of IS categories in interaction with speech act marking, and thus to explore how prosodic requirements from two IS dimensions as well as from speech act marking are weighed up against each other (see below for details). The structures that we investigate are transitive verb-final *wh*-structures in German, see (9), which can be used as exclamations or as non-canonical questions, e.g., repeating questions or questions embedded in a matrix sentence.

(9) Wo die schon überall Germanen erforscht hat ?/!
where she$_{DPRON}$ *already everywhere Germanic peoples researched has*

'Where has she already researched Germanic peoples? /
'The places where she has already researched Germanic peoples!'

The paper is structured as follows. In Section 2, we review recent findings on prosodic reflexes of IS in non-assertive speech acts in German, the language under investigation in this study. Section 3 discusses previous literature on the semantic-pragmatic and prosodic characteristics of German *wh*-exclamatives and *wh*-questions. Section 3 introduces the hypotheses that we test in our study. Sections 4 and 5 present the experiments that we conducted to test the hypotheses. Section 6 offers the General Discussion. Section 7 concludes.

2 Information structure in non-assertive speech acts

As mentioned in Section 1, there have been many investigations into the prosodic reflexes of IS in assertions. Summarizing very roughly, it is uncontroversial that givenness is associated with a reduction in prosodic prominence on the given constituent in terms of deaccentuation, the choice of less prominent accent types (e.g., GToBI L*, H+L* or H+!H* rather than H* or L+H*), shorter duration or lower pitch peaks and excursion (e.g., Baumann, 2006; Baumann & Riester, 2013; Baumann & Röhr, 2015; Baumann, Röhr & Grice, 2015). Narrowly focused new information and (new) contrastive elements (constituent contrast or discourse contrast), on the other hand, typically are realized with increased prosodic prominence on the relevant element such as accentuation with more prominent accents types, longer duration, higher pitch and pitch excursion, accompanied by post-focal reduction (e.g., Batliner, 1989; Baumann, Becker, Grice & Mücke, 2007; Braun, 2006; Braun & Tagliapetra, 2010; Féry 1993; Grice, Baumann & Benzmüller, 2005; Grice, Ritter, Niemann, & Roettger, 2017; Kügler & Féry 2017; Kügler & Gollrad, 2015). Whether or not there also is prominence reduction in the prenuclear region is debated (Baumann, Grice, Steindamm, 2006 vs. Kügler & Féry, 2017), but there is accumulating evidence that there is such reduction for instance for corrective vs. non-contrastive narrow focus (Baumann et al., 2006; Roessig, 2023). Thus, the marking of contrastive and narrow non-contrastive focus has both local prosodic reflexes (on the focused

constituent) and non-local prosodic reflexes (post-nuclear region, and for corrections also prenuclear region).

Turning to non-assertive speech acts, recent research on questions and exclamations has shown that IS marking interacts with speech act marking (for German, Niebuhr, Bergherr, Huth, Lill, Neuschulz, 2010; Repp, 2015, 2020; Repp & Seeliger 2020, 2023; Seeliger & Repp 2020, 2023). For instance, prosodic requirements imposed by the speech act may override requirements of IS marking. This is the case for givenness marking in exclamatives. Exclamatives come with the requirement for a highly prominent accent, which has been argued to be part of a *constructional prosodic default* for exclamations by Repp & Seeliger (2020). This prosodic default comprises inter alia the presence of a highly prominent accent (the 'exclamative accent') and a certain IS inertness (see Section 4 for further details). Thus, the default may hamper givenness marking. For two types of exclamatives – *wh*-exclamatives and polar exclamatives – it has been shown that there is no, or only diminished, prominence reduction for given information (Repp, 2015, 2020; Repp & Seeliger 2020; Seeliger & Repp, 2020, 2023).

Givenness marking has also been shown to be minimal or missing in polar questions in certain discourse contexts (Seeliger & Repp, 2023). Prima facie this is surprising because polar questions do not have a requirement for high prosodic prominence. However, note that the deaccentuation of given constituents that in out-of-the blue sentences would carry the default nuclear accent, requires an *accent shift* away from the given constituent elsewhere. Importantly, accent shifts might not be available in the same way in different speech acts: The different semantic-pragmatic characteristics of polar questions vs. assertions may affect the pragmatic licensing conditions for accent locations in different discourse contexts. For instance, all-given assertions, which may be used to highlight the truth of a discourse-given proposition, typically come with VERUM marking (Höhle, 1988, 1992), which in German is an accent on the finite verb (e.g., *Sie HABEN Peter angerufen*. lit. they HAVE Peter called, 'They did call Peter', as a reaction to a previous statement doubting whether 'they' called Peter). In all-given polar questions, which may be used to double-check the truth of a discourse-given proposition, an accent on the finite verb has different semantic-pragmatic effects, which might make it inappropriate in a specific context. As a result, speakers resort to the default nuclear contour that they would also use in an all-new polar question. Seeliger & Repp (2023) suggest that producing the default contour ensures the prosodic well-formedness of the intonation phrase, which requires the presence of a head constituent. Thus, depending on the specific discourse context, givenness marking may be dispensed with in polar questions. The same has been observed for biased positive declarative questions (Repp & Seeliger, 2023) and biased negative

declarative questions (Seeliger & Repp, 2023), both in slightly different discourse contexts and for different semantic-pragmatic reasons.

Still, questions are not inert for givenness marking. Givenness-induced prominence reduction has been observed in *wh*-questions (Repp, 2015, 2020), which have different semantic-pragmatic licensing conditions for accent shift than polar or biased declarative questions. Furthermore, there is givenness marking in biased declarative questions if in addition to the given constituent there is a contrastive element in the utterance, which can carry the nuclear accent (Repp & Seeliger, 2023).

The prosodic marking of contrastive (new) information, which has been investigated for constituent contrast in comparison to narrow non-contrastive focus, seems to be less affected by speech-act-specific prosodic requirements. Still, there are some differences between assertions and non-assertive speech acts. Similar to assertions, polar questions and polar exclamatives have been reported to show local and non-local prosodic effects of contrast (Niebuhr et al., 2010; Seeliger & Repp 2020, 2023). Different from assertions, however, polar exclamatives showed quite strong prenuclear reduction (Seeliger & Repp, 2020, 2023): The exclamative-typical, i.e., speech-act marking prominent accent towards the beginning of the exclamative (the 'exclamative accent') was not produced in half of the utterances with a contrastive object later in the clause. In the utterances where it was produced, the accent was phonetically reduced in prominence in comparison to utterances with a non-contrastive new object: it had a lower maximum pitch, a lower pitch range and a shorter duration.

Seeliger & Repp (2023) argue that prenuclear deaccentuation and gradient prominence reduction contribute to what they call the *prominence balance* in an utterance. This balance must be *positive* for contrast. Contrast increases the prominence for the contrastively focused word, while at the same time reducing the prominence of other words. In utterances with prenuclear deaccentuation, the positive prominence balance required for contrast is very pronounced but note that this comes at the price of not using the speech-act-typical early accent. Seeliger & Repp argue that speakers pay this price because the constructional prosodic default only requires that there be *a* highly prominent accent, without fixing the accent position. This assumption is corroborated by the observed prosodic differences between contrastive and non-contrastive objects in terms of probabilistic accent choice (between H* and L+H*) and gradient phonetic measures: contrastive objects have higher pitch, greater pitch excursion, duration and intensity. Still, as mentioned above, deaccentuation concerned only about half of the early potential accents, which means that *typical* speech act marking is in conflict with contrast marking. In fact, when speakers do not deaccent early in the utterance, they produce double-

accent structures, which have a smaller positive prominence balance for contrast than single accent structures.

Questions also show some differences with assertions with respect to constituent contrast marking. If polar questions are rising, increased prominence of the contrastive element has been observed to come with lower rather than higher pitch, that is a low pitch accent before a high boundary tone is realized even lower (Seeliger & Repp, 2023). In fact, contrastive information has been observed to be realized with a L* accent both in rising polar questions and in rising biased declarative questions (ibid.; Repp & Seeliger, 2023). Thus, there is no need for contrastive elements – which are expected to be highly prominent – to occur with rising pitch accents (L+H* / L*+H), which are assumed to be highly prominent (Baumann & Röhr, 2015; Baumann, Röhr & Grice, 2015), and which have been argued to mark contrast (Baumann et al., 2007; Grice et al., 2005; Kohler, 1991; 2005; Ritter & Grice, 2015; also cp. Pierrehumbert & Hirschberg, 1990). A low accent can be prominent in a rising contour. Repp (2020) argues with Kügler & Genzel (2012) that focus marking by high pitch in assertions may be conceptualized as a prominent deviation from the pitch baseline. If this baseline is high (rising) in questions, a prominent deviation therefore is predicted to be downward.

Having said this, it seems that for contrast marking in questions it matters which element exactly is contrastive. For rising biased declarative questions, Repp & Seeliger (2023) observe that contrastive objects occurring before a clause-final (given) verb are realized as part of the default contour that is observed for all-new and all-given sentences. Clause-final contrastive verbs, in comparison, are marked by accentuation, as well as prenuclear reduction, albeit by only around half of the speakers in their study, with the other speakers resorting to default prosody. In other words, in certain types of questions, contrast marking seems to be less 'reliable' and only occurs (if at all) if the nuclear accent is shifted away from its default position on the object. The reasons for this might be prosodic (articulatory effort) or pragmatic.

3 Hypotheses

Given the state of the art regarding prosodic reflexes of IS in non-assertive speech acts, we formulated two alternative hypotheses for the interplay of the given-new dimension and contrast regarding prominence relations. The first hypothesis, *NoGivCon*, builds on the findings reviewed above that givenness marking but not contrast marking seems to have a low functional load and may be dispensed with in the speech acts under consideration: givenness marking is largely overridden by speech act marking in exclamations, and it is eschewed in favour of prosodic well-formedness in certain discourse contexts in questions.

(10) **Hypothesis NoGivCon:** Givenness marking is dispensed with on contrastive elements.

For the interplay of the given-new dimension and contrast, hypothesis *NoGivCon* predicts that we should not observe an effect of givenness marking on contrastive constituents, so that utterances with given contrastive constituents vs. new contrastive constituents are prosodically identical. In line with previous research, we expect contrastive constituents and non-contrastive new constituents to have a positive prominence balance, but contrastive constituents should be more prominent than non-contrastive new constituents. The differences should be reflected in local effects such as more prominent accent types and higher phonetic prominence for contrastive constituents, and in non-local effects, specifically in greater phonetic post-focal reduction and in greater prenuclear reduction. Prenuclear reduction might include a higher probability of deaccentuation in exclamatives, and if there is no deaccentuation, phonetic reduction.

Hypothesis *NoGivCon* makes no specific predictions for non-contrastive given constituents. On the basis of earlier findings, we expect exclamatives with a given non-contrastive constituent to be prosodically identical to exclamatives with a new non-contrastive constituent because exclamatives lack givenness marking. For questions, givenness marking depends on the precise discourse conditions, which we will come back to when we discuss the specifics of our study.

The second hypothesis, *GivPlusCon*, builds on our observation that previous research always compared singular IS categories with each other, for instance *given information – narrowly focussed new information – (new) contrastive information*. As just mentioned, this research could not find differences in the prosodic realization of given vs. new information for exclamatives; for questions the results were similar but varied with the context. Importantly, these findings do not necessarily imply that givenness *never* is marked because givenness marking only ever was investigated for non-contrastive constituents. Since contrast is on a different IS dimension (as a special case of the focus-background dimension), it might well be the case that givenness is marked on contrastive constituents. If this is the case, we may assume that givenness is marked *in addition*[1] to contrast.

(11) **Hypothesis GivPlusCon:** Givenness is marked in addition to contrast.

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[1] It might be counter-intuitive to speak of 'addition' because contrast and givenness have opposite effects in terms of prominence increase or decrease. However, since we typically compare the prosodic characteristics of given or contrastive elements to non-given and non-contrastive elements, respectively, it is givenness that is marked (and not, e.g., newness), and contrast. We are thus interested if both givenness and contrast have prosodic reflexes at the same time.

By hypothesis *GivPlusCon*, we expect that a given contrastive element is prosodically less prominent than a new contrastive constituent, irrespective of speech act. So, we may expect local effects of givenness marking on the contrastive constituent, specifically reduced phonetic prominence. Givenness-typical deaccentuation is not expected because this would be clearly incompatible with the requirement for contrast marking, and as we saw earlier contrast marking is more 'robust' than givenness marking. Furthermore, we expect non-local effects of givenness, specifically less post-focal reduction for given than for new contrastive elements, and there also might be less prenuclear reduction. As a result, new contrastive constituents are expected to have the larger positive prominence balance when compared to given contrastive constituents. In fact, their prominence balance should be the largest of all the combinatorial possibilities.

An interesting question under hypothesis *GivPlusCon* is whether utterances with a given contrastive constituent and utterances with a new non-contrastive element differ from each other prosodically. We propose two sub-hypotheses. According to **Hypothesis GivPlusCon1$_{\text{Focus}}$**, the specific discourse context plays a role. Concretely, if there are implicit alternatives for the new non-contrastive constituent in the discourse context, this constituent is in focus, just like the given contrastive constituent. It is a plausible assumption that the (given) contrastive focus is marked by higher prosodic prominence than the (new) non-contrastive focus.

Hypothesis GivPlusCon2$_{\text{neutralization}}$ is based on a naïve conception of the prominence balance. Concretely, it might be the case that givenness 'neutralizes' the effect of contrast: If contrast requires a positive prominence balance, and givenness requires a negative prominence balance, the two requirements may cancel each other out. In view of previous findings this is unlikely, though, because givenness marking always seems to 'lose out' compared to other prosodic requirements. Still, the prediction would be that contrastive given and non-contrastive new constituents do not differ in their prosodic prominence.

In our hypotheses, we spoke of more or less prominent constituents, and of a larger or smaller positive prominence balance. This choice of words insinuates that prominence is a matter of degree, which it is. However, prominence marking also is a matter of probabilistic choices. Recall that in the study reported by Seeliger & Repp (2023), the speech-act-marking 'exclamative' accent is not produced in about half of the utterances that in non-contrastive conditions had this 'exclamative' accent. So, for half of the utterances, speakers felt that the functional load of marking contrast on the object was large enough to deaccent. In the other half of the utterances, speakers did not. Neither did they deaccent in utterances with a new non-

contrastive object. The observation that accentuation or the choice of accent type is probabilistic is of course not new. It is familiar from many studies on IS in assertions (e.g., Grice, et al., 2017; Röhr, Baumann & Grice, 2022). It also follows from the conception of prominence balance as proposed in Seeliger & Repp (2023). They suggest that prominence balance, which is fed by many ingredients (categorical and gradient alike) is best analyzed in a phonetic-phonological optimality-theoretic account as has been proposed for segmental phonology by Flemming (2001), with constraints over phonetic detail and with constraints making reference to the maximization of phonological contrasts/distinctiveness. For instance, foregoing the production of an early 'exclamative accent' maximizes the distinctiveness of the deaccented constituent from the highly prominent contrastive object, thus ensuring a positive prominence balance for the contrastive object. Yet, as we already saw, although the constructional prosodic default only requires one prominent accent, *speech-act-typical* accentuation patterns persevere, which interferes with contrast marking, and speakers often produced double-accent structures. We will come back to probabilistic phonological marking and the prominence balance in the Conclusion. For ease of exposition in the remainder of the paper, we will use the terms *more prominent* vs. *less prominent* also for the higher vs. lower probability that an accent occurs, not just for the choice of more or less prominent accent types or for phonetic attributes that make an accent more or less prominent.

4 *Wh*-exclamatives and *wh*-questions in German: Pragmatic functions and prosodic characteristics

As laid out above, this study investigates IS in *wh*-structures in German that may express different speech acts, viz. *wh*-exclamatives and *wh*-questions. These speech acts fulfill different illocutionary functions. *Wh*-exclamatives are used to express astonishment at the degree to which a gradable property is true: they emphasize the truth of a proposition while simultaneously expressing that its truth is unexpected. The addressee is not required to provide a response; in fact, to be felicitous *wh*-exclamatives do not even require an addressee. In German, *wh*-exclamatives may come with verb-second or verb-final order. The verb-second order is more frequent in written texts (Näf, 1996; Repp, 2013), but the verb-final order is usually considered to be much more natural by native speakers (Repp, 2019). For this reason, we chose verb-final *wh*-exclamatives for the current study.

Wh-questions request an answer from the addressee. The addressee is asked to point out for which of the implicit alternatives introduced by the *wh*-phrase the questioned proposition is true (if any). Regular *wh*-questions have verb-second order in German. Verb-final *wh*-questions either are repeating questions, which are used to enquire if the interlocutor had intended to ask

that particular question (*Are you asking me, where…?*), or they are embedded in a matrix clause. In the current study, we test *wh*-questions that are embedded in polar questions (e.g., *Do you happen to know where…*). Importantly, the expected answer to such a question is one that answers the embedded question (provided the speaker knows the answer to the question), not the polar question: just answering *yes* would be pragmatically inappropriate and uncooperative. Our choice for embedding under polar questions was motivated by our goal to elicit a greater proportion of rising questions, because we also wanted to study the effect of the final contour on prosodic prominence (Section 2). Embedding polar questions are produced with a final rise very often, whereas unembedded verb-second *wh*-questions are to a much smaller extent (Repp 2020 for read speech). Overall, the choice of final falls vs. rises in questions is well known to depend on several factors, e.g., spontaneous vs. read speech, open-expectation or checking question, request for a short vs. elaborate answer. However, there is the general tendency that polar questions more often occur with rises and *wh*-questions with falls (for a discussion of final contours in questions, see e.g., Braun et al., 2019; Braun et al., 2020; Brinckmann & Benzmüller, 1999; von Essen, 1964; Kohler, 2004; Kügler 2003; Michalsky, 2017; Oppenrieder, 1988; Peters, 2018; Petrone & Niebuhr, 2014; Selting, 1991). Another advantage of the choice of (embedded) verb-final *wh*-questions is that it makes them string-identical with the verb-final *wh*-exclamatives. A disadvantage of this choice is that the illocutionary force is 'split' between matrix and embedded question, and a dependence of the embedded *wh*-questions on the embedding question might have prosodic reflexes that we are actually not interested in.

Beyond the final contour, there are many more prosodic differences between *wh*-exclamatives and *wh*-questions, both in IS- neutral contexts (all-new) and with regard to prosodic reflexes of IS, see our construction-independent review in Section 2. Regarding *wh*-exclamatives, recall that exclamations in general have been proposed to come with a constructional prosodic default (Repp & Seeliger 2020). This default comprises the presence of a highly prominent accent (the 'exclamative accent'), a falling contour (Altmann, 1993; Repp, 2015, 2020; Repp & Seeliger, 2020; Seeliger & Repp, 2020; 2023), a slower speaking rate than assertions (Altmann, 1993), and than questions (Repp, 2020; Repp & Seeliger, 2020; Seeliger & Repp, 2023). With respect to the latter comparison, we note that the slower speaking rate of exclamations might also be due to questions having a relatively faster speaking rate (Niebuhr et al., 2010). The final ingredient of the constructional prosodic default is a certain inertness for IS marking (Section 2).

Regarding the 'exclamative' accent, previous research indicates that its position towards the beginning of the clause is tied to a particular syntactic position (e.g., the C position if it hosts a

finite auxiliary), or to particular lexical items like *d*-pronouns (e.g., Altmann, 1993; Brandner, 2010; d'Avis, 2002, 2013; Oppenrieder, 1988; Repp, 2015, 2020; Repp & Seeliger 2020; Rosengren, 1992, 1997; Seeliger & Repp, 2023; Thurmair, 1989). In verb-final *wh*-exclamatives, which do not have a lexical element in the C position, the 'exclamative accent' typically occurs on a (subject) *d*-pronoun. *D*-pronouns, which are homophonous with the definite determiner, are the hallmark of exclamations in German, which means that subjects typically come in the form of a *d*-pronoun, rather than a personal pronoun or a full noun phrase. Importantly, however, *d*-pronouns are not restricted to exclamations. They occur regularly in other speech acts, including questions, for instance in casual speech (Hinterwimmer 2015).

As for the prosodic characteristics of the 'exclamative accent', it has been argued to have a higher and later pitch peak when compared to the nuclear accent in assertions (Batliner, 1988a, 1988b; Oppenrieder, 1988). This suggests that the accent might be more similar to a L+H* accent than a H* accent. However, Repp & Seeliger (2020) report for *d*-pronouns in polar exclamatives that H* accents were more frequent than L+H* accents, and Seeliger & Repp (2023) report an even distribution of the two accent types. Furthermore, utterance length seems to influence the choice of accent: L+H* accents occurred more often in short than in long polar exclamatives, which might be a sign of a more exalted speaking style (Repp & Seeliger, 2020).

In view of the fact that *d*-pronouns always refer to a given referent, it is clear that their high prosodic prominence in exclamations cannot be linked to the IS status of the referent on the given-new dimension. Neither do *d*-pronouns typically constitute contrastive information. However, according to the semantic-pragmatic theoretical literature, they may be contrastively focused if this is contextually licensed (d'Avis, 2012). This is an observation that forms the basis for our Experiment 1, which tests what prosodic reflexes the contrastiveness of a *d*-pronoun has.

Turning to embedded *wh*-questions, Repp (2020) observed that subject *d*-pronouns often are accented, but they are accented significantly less often than in verb-final *wh*-exclamatives. Accented *d*-pronouns in embedded *wh*-questions have a lower maximum f0, a higher minimum f0, a lower f0 excursion, an earlier f0 peak, are shorter and have a lower mean intensity than accented subject *d*-pronouns in the *wh*-exclamatives. These findings further corroborate the high prominence of the 'exclamative accent' on the *d*-pronoun in exclamatives. Regarding contrast, the same reasoning applies as for *d*-pronouns in exclamatives: *d*-pronouns always refer to given information, but they may be contrastive also in questions, if there is an explicit alternative in the context. We test the prosodic reflexes of this in Experiment 1.

The *wh*-structures we test are transitive and thus contain a direct object. In assertions, this object carries the default nuclear accent unless it is given. For transitive *wh*-structures, Repp (2020) observes that both in *wh*-exclamatives and in *wh*-questions, the object is accented most of the time independently of the given/new status of the object. In *wh*-exclamatives the accentuation rate is particularly high, and significantly higher than in *wh*-questions. In conjunction with the 'exclamative accent' on the subject *d*-pronoun, this means that transitive *wh*-exclamatives frequently have a double-accent structure independently of IS. For *wh*-questions, Repp (2020) reports that there sometimes is an accent on the clause-final verb, either in addition to an object accent, or alone, but independently of IS. However, there is a phonetic effect: *wh*-questions with a given accented object have higher pitch on the clause-final lexical verb and auxiliary than *wh*-questions with a new object do. Repp interprets this effect as an instance of a smaller deviation from the baseline for given than for new information described in Section 2. For the *wh*-exclamatives, Repp observes no effects. Thus, overall, transitive *wh*-structures show accentuation in the default nuclear accent position independently of the given/new status of the (non-contrastive) object, with small phonetic differences between exclamatives and questions. Experiment 2 investigates if contrast interacts with the given-new dimension, as laid out in our hypotheses in Section 3.

The following two sections present the two production experiments that we conducted to test our hypotheses developed in Section 3 for German *wh*-structures.

5 Experiment 1: Contrastive *d*-pronouns

Experiment 1 investigated if contrast is marked on subject *d*-pronouns. In *wh*-exclamatives, subject *d*-pronouns are expected to be highly prominent because they realize the requirement of the constructional prosodic default for a prominent accent. In *wh*-questions, subject *d*-pronouns do not have a speech-act marking function. As we saw in the previous section, they are accented often nevertheless, but are less prominent than the *d*-pronoun in *wh*-exclamatives. Since *d*-pronouns are always given, the given-new dimension is not part of the experimental manipulation, which means that we are not yet testing the difference between the two hypotheses presented in Section 3. We are testing if contrast is marked on given elements, which is an open question, as laid out in Sections 1 and 2, and we are testing if contrast marking interacts with speech act marking for an element that has speech-act-specific prosodic characteristcs.

In accordance with both hypotheses, *NoGivCon* and *GivPlusCon*, we predict contrast to have prosodic reflexes for the *d*-pronoun both in *wh*-exclamatives and in *wh*-questions because contrast marking has a high functional load even in non-assertive speech acts. For *wh*-

exclamatives, we expect the *d*-pronoun to always carry an accent independently of contrast due to the illocutionary function of this accent. Contrast marking should be reflected in a gradient prominence increase in terms of a higher proportion of L+H* rather than H* accents, higher $f0_{max}$, excursion and longer duration. For *wh*-questions, we expect a higher accentuation rate for the *d*-pronoun if it is contrastive. These accents might be high tone or low tone accents, depending on the subsequent prosodic contour. Post-focal reduction in rising questions – recall our expectation that *wh*-questions embedded in polar questions are predominantly rising – requires a low accent to mark a deviation from the baseline (Section 2).

In addition to these local effects, there might be non-local effects to support the positive prominence balance required by contrast. For utterances with a contrastive subject referent, we expect prominence reduction in the later part of the utterance, for instance in terms of a lower proportion of (prominent) accents on the given object noun. Still, in view of the fact that Repp (2020) found hardly any effects of givenness marking for object nouns in all-given *wh*-exclamatives, there might be no reduction on the object noun (or on the clause-final verb).

5.1 Materials

Experiment 1 had a 2×2 design with the factors SPEECH ACT (exclamative/question) and CONTRAST (non-contrastive/contrastive subject *d*-pronoun). All target structures were embedded in scripted dialogues between two speakers. The participant took the role of the second speaker. (12) illustrates the experimental conditions for one lexicalization. There were 8 lexicalizations. In addition to the experimental items, there were 16 fillers, which consisted of echo questions with different attitudinal stances.

All target utterances were transitive *wh*-clauses with a clause-initial *wh*-pronoun (corresponding to *where*, *how* and *whom* (dative)), followed by the subject *d*-pronoun, one or two adverbs, an object noun phrase (where the (underlyingly) trisyllabic object noun had lexical stress on the second syllable), and the clause-final verb complex consisting of a lexical verb participle (lexical stress on the second syllable) and the monosyllabic perfect auxiliary *hat* 'has'.

Both experimental factors were manipulated by the context, and by punctuation for the speech act. *Wh*-exclamatives were preceded by utterances preparing an amazed or surprised utterance. *Wh*-questions were preceded by utterances signaling curiosity and lack of knowledge of the speaker. For *wh*-structures with a contrastive subject, speaker 2 (i.e., the participant) acknowledged what speaker 1 had said about an alternative to the referent of the subject *d*-pronoun, and then changed the discourse topic slightly to ask or exclaim something about the target referent. In the non-contrastive conditions, there was no topic change. The referent of the

subject *d*-pronoun was thus given information in all conditions, as was the object. The lexical verb, however, was accessible. In (12) the verb *erforschen* 'investigate/research' is accessible because of the mention of a dissertation and the travel activities with the goal of finding original evidence of Germanic peoples. Thus, we expect the lexical verb to be a reasonably good attractor of prosodic prominence.

(12) **Sample item Experiment 1**

	***Wh*-exclamatives**	***Wh*-questions**
Subject not contrastive	Speaker 1: Hast du schon gehört? **Anna** hat sich in ihrer Dissertation jetzt auf Germanen spezialisiert. *'Have you heard? **Anna** has specialized in Germanic peoples for her dissertation now.'* Speaker 2 (participant): Ja, das hat sie mir neulich erzählt. Sie ist irre viel unterwegs, um an Originalquellen von Germanen heranzukommen. *'Yes, she told me about that recently. She is traveling a whole lot in order to find original evidence of Germanic peoples.'*	Speaker 1: Hast du schon gehört? **Anna** hat sich in ihrer Dissertation jetzt auf Germanen spezialisiert. *'Have you heard? **Anna** has specialized in Germanic peoples for her dissertation now.'* Speaker 2 (participant): Wirklich? Da ist sie bestimmt viel unterwegs, um an Originalquellen von Germanen heranzukommen. Weißt du zufällig, … *'Really? Then she's probably traveling a lot in order to find original evidence of Germanic peoples. Do you happen to know…'*
Subject contrastive	Speaker 1: Hast du schon gehört? **Paul** hat sich in ihrer Dissertation jetzt auf Germanen spezialisiert. *'Have you heard? **Paul** has specialized in Germanic peoples for his dissertation now.'* Speaker 2 (participant): Ja, das hat er mir neulich erzählt. Er ist irre viel unterwegs, um an Originalquellen von Germanen heranzukommen. Aber das ist nichts gegen die ganzen Reisen von **Anna**! *'Yes, he told me about that recently. He is traveling a whole lot in order to… But that's nothing compared to all the travels of **Anna**!'*	Speaker 1: Hast du schon gehört? **Paul** hat sich in ihrer Dissertation jetzt auf Germanen spezialisiert. *'Have you heard? **Paul** has specialized in Germanic peoples for her dissertation now.'* Speaker 2 (participant): Wirklich? Da ist er bestimmt viel unterwegs, um an Originalquellen von Germanen heranzukommen. Aber ich könnte mir vorstellen, dass das noch nichts gegen die Reisen von **Anna** ist. Hast du zufällig mal mitbekommen, *'Really? Then he's probably traveling a lot … But I can imagine that that's nothing compared to the travels of **Anna**. Do you happen to have heard...'*

W/wo	**die**	**schon**	**überall**	**Germanen**	**erforscht**	**hat / ?**
where	she_{DPRON}	already	everywhere	Germanic peoples	researched	has
	'The places where she has already researched Germanic peoples!'				*'where she has already researched Germanic peoples?'*	

5.2 Participants and procedure

18 native German speakers participated in the experiment (9/9 female/male, ages 18-28, mean: 23.5). They were students at Humboldt-Universität zu Berlin and were reimbursed for their participation. All participants took part in both experiments, which were run in three sessions to reduce the duration of the experiments as well as repetitiveness. Experiment 1 was run as one session. Experiment 2 was run in two sessions (see further below). The order of the sessions was balanced between participants (six different orders). The sessions were separated by at least one week.

The dialogs were presented to participants in text form, as a conversation between two cartoon characters. The contribution of the first cartoon character was also presented as pre-recorded audio via headphones. When participants had finished listening and reading, they could start the recording of their part. All participants recorded all items in all conditions.

5.3 Data processing

The 576 recordings were annotated in Praat (Boersma & Weenink, 2020) by two trained research assistants. We used a modified version of the DIMA scheme (Kügler et al., 2015, 2019) with the following tiers: syllable boundaries, GToBI tones, prominence levels, final boundary tone. After an initial round of annotation, the research assistants checked each other's annotations and reached a consensus for conflicts in the annotations.

Pitch was sampled every 10 ms. We manually inspected and corrected the pitch tracks produced by Praat in case there were octave jump errors or spurious voicing. The summarizing statistics were calculated directly in R (R Core Team, 2021), using R package rPraat (Boril & Skarnitzl, 2016). To accommodate sex-based differences in pitch without having to enter speaker sex as a factor[2] into the statistical models, we normalized absolute pitch measures within speakers, by converting Hz to semitones relative to each speaker's median pitch value. The reference level, i.e., each speaker's median pitch, was calculated as the median of all pitch values from one recording session per speaker. Relative measures such as pitch excursion are given directly in

[2] Repp (2020) found effects of speaker sex. To briefly address this matter: We replicated the findings that (i) the overall slower speaking rate for exclamatives was even slower for female speakers; (ii) only female speakers showed a larger duration and intensity of the d-pronoun in exclamatives than in questions, and there were interactions between IS and sex, usually such that female speakers make larger differences (in the same direction as in Repp, 2020). We did not replicate the findings that (i) female speakers produced more accents on the d-pronoun in exclamatives than male speakers did (the reverse was true); (ii) the later alignment for pitch peaks in d-pronouns in exclamatives vs. questions was even larger for female speakers (there were no effects of in Exp. 2, while in Exp. 1 peak alignment was generally later for male speakers). Details of the analyses can be found on OSF [tba].

semitones. We used the tonal center of gravity (TCoG; Barnes et al., 2012) as a measure of pitch alignment. For the object, we calculated TCoG across the entire object, that is including the syllable preceding, and the syllable following the accented second syllable. For the subject *d*-pronoun, we only included the preceding syllable (i.e., the *wh*-word), since the *d*-pronoun was always followed by a voiceless fricative.

For the statistical analysis, we fitted (generalized) linear mixed models using lme4 (Bates et al., 2015). For model selection, we started with the maximal model (Matuschek et al., 2017), reducing the random structure in case of convergence issues, starting with the removal of the interaction. The final models included per-item random intercepts, but none included per-item random slopes due to problems with model fit.

We conducted three types of analyses. First, we examined the overall contour. On the one hand we compared the proportion of rises vs. falls per condition. On the other hand, we investigated the size of the final rise in questions, by examining the size of the excursion from nuclear L* accents, which occurred either on the object or on the verb, to the utterance offset. Second, we conducted by-syllable analyses for the *wh*-phrase, the subject *d*-pronoun, the (second syllable of the) object noun and the (second syllable of the) lexical verb participle for a number of categorical and acoustic variables. The categorical variables were: accentuation, DIMA prominence level of accented syllables (higher-level accents (levels 2 and 3 pooled) vs. level-1 accents), and the accent type of accented syllables. For accent types we could not fit models due to convergence issues, and therefore give the results for these only in descriptive terms. The acoustic variables were: duration (log-transformed), mean intensity, TCoG and other f0-related measures separately for different accent types. For accent types with a starred high tone (H*, L+H* pooled, on *d*-pronouns in both speech acts, on objects in exclamatives), we investigated minimum and maximum f0 ($f0_{min}$, $f0_{max}$), f0 excursion ($f0_{exc}$) and TCoG. For L* accents (objects in questions) we investigated $f0_{min}$, $f0_{exc}$, and $f0_{min}$ valley alignment. Third, we carried out a descriptive analysis of combinations of accents including accent types and prominence levels to assess the clausal prominence patterns.

5.4 Results

5.4.1 Final contour

The two speech acts differed in their final contour – rising vs. falling – which was also influenced by the contrastiveness of the subject *d*-pronoun, see Table 1. The statistical model revealed a main effect of SPEECH ACT (b = -3.8, SE = 0.37, z = -10.2, $p < 0.001$), and an interaction of SPEECH ACT and CONTRAST (b = 0.85, SE = 0.2, z = 4.1, p < 0.001). Final rises were less frequent in exclamatives than in questions, as expected. Utterances with a contrastive

subject *d*-pronoun had more rises in exclamatives and fewer rises in questions. There were no significant differences for $f0_{exc}$ from L* accents to the utterance offset.

Table 1. Proportion of final rises across conditions in Experiment 1

Speech act	Contrast (*d*-pronoun)	Proportion of final rises
Exclamative	contrastive	17.3
	non-contrastive	7.8
Question	contrastive	86.0
	non-contrastive	95.7

5.4.2 By-syllable analyses

Figure 1 shows the accentuation rate, accent types and DIMA prominence levels of the accents. Figures 2-4 illustrate the acoustic measures. The abbreviation conventions for all figures are given in the caption of Figure 1. Table 2 summarizes the model parameters of all corresponding models. We only report significant differences (except for the accent types, for which we did not fit models).

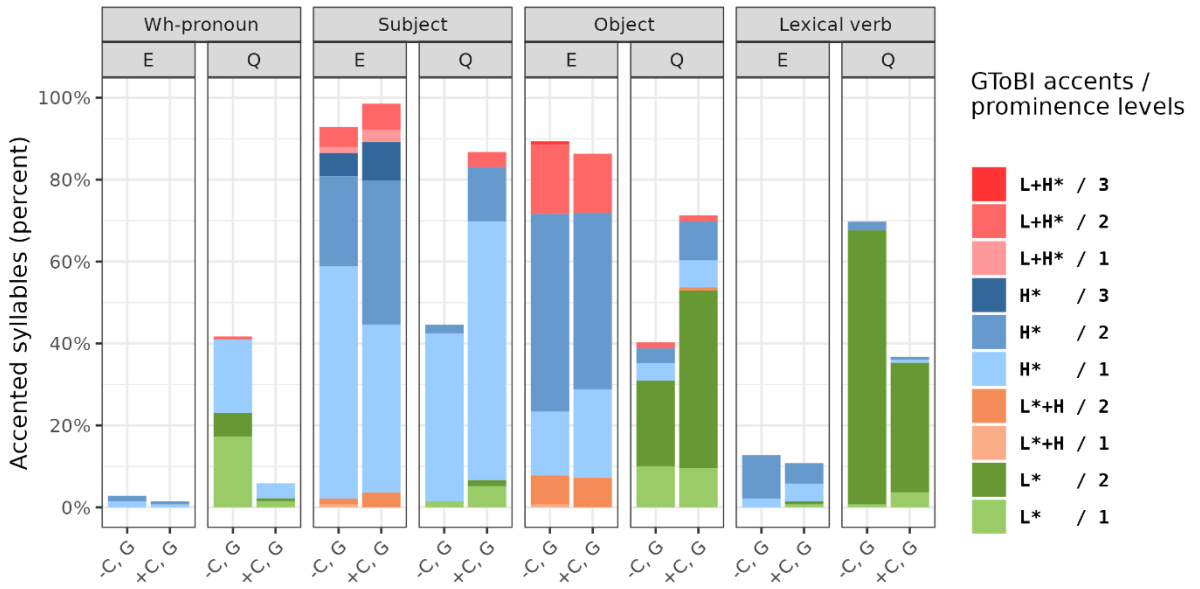

Figure 1: Accentuation rates, accent types and prominence levels in Experiment 1. Abbreviations (for all figures): E = exclamative, Q = question, -C = non-contrastive element, +C = contrastive element, G = given element, (N = new element (Exp. 2)).

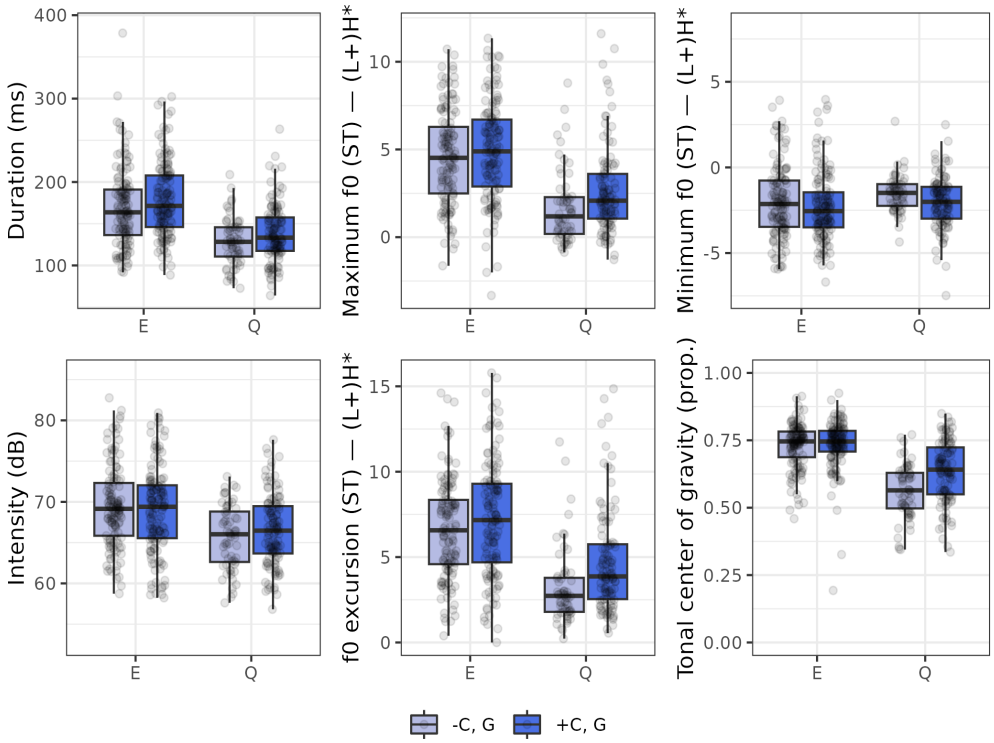

Figure 2: Acoustic properties of the subject d*-pronoun in Experiment 1. For all accents: duration (ms), mean intensity (dB). For (L+)H* accents: $f0_{max}$, $f0_{min}$ and $f0_{exc}$ (st) and TCoG. The grey dots represent individual data points (with jitter).*

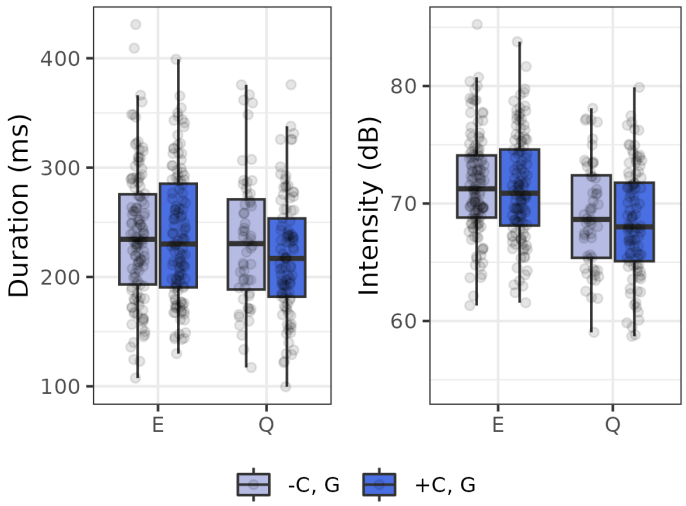

Figure 3: Acoustic properties of accented object syllables in Experiment 1: duration (ms) and mean intensity (dB). The grey dots represent individual data points (with jitter).

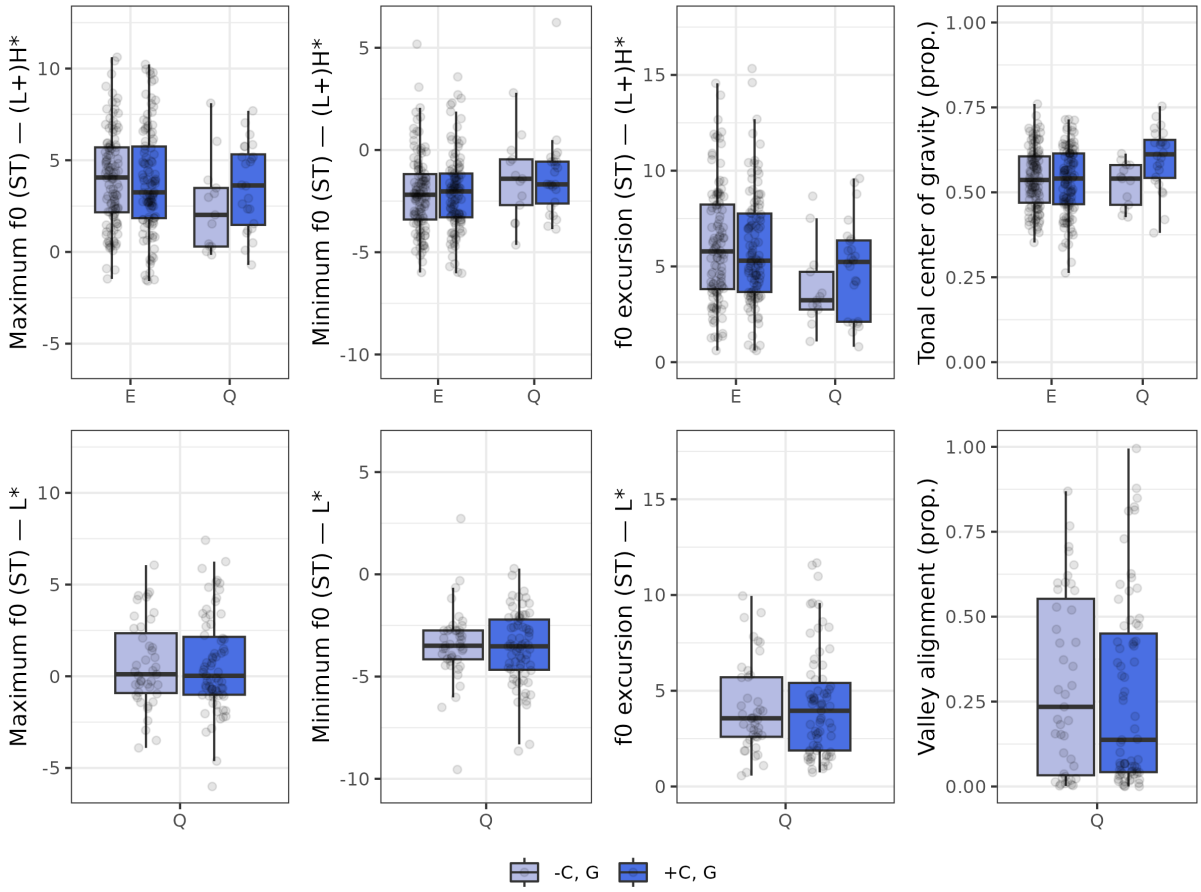

Figure 4. Acoustic properties of accented objects in Experiment 1. (L+)H accents in both speech acts (top): $f0_{max}$, $f0_{min}$ and $f0_{exc}$ (st) of the accented syllable, TCoG for entire object; L*accents in questions (bottom): $f0_{max}$, $f0_{min}$ and $f0_{exc}$ (st), and $f0_{min}$ alignment. The grey dots represent individual data points (with jitter).*

Table 2. Model parameters for syllable-level models with significant effects in Experiment 1.

Syllable	Variable	Accent type	Term	*b*	*SE*	*t/z*	*p*
Wh-pronoun	*accentuation*	pooled	*interaction*	0.72	0.27	2.7	**
Subject *d*-pronoun	*accentuation*	pooled	SPEECH ACT	1.70	0.25	6.9	***
			CONTRAST	1.27	0.48	2.7	**
	prominence	pooled	SPEECH ACT	1.14	0.29	4.0	***
			CONTRAST	0.75	0.19	4.0	***
	duration	pooled	SPEECH ACT	0.14	0.02	6.8	***
			CONTRAST	0.04	0.01	4.5	***
	intensity	pooled	SPEECH ACT	1.30	0.20	6.3	***
	$f0_{max}$ *(ST)*	(L+)H*	SPEECH ACT	1.30	0.25	5.3	***
			CONTRAST	0.32	0.11	2.9	**
	$f0_{min}$ *(ST)*	(L+)H*	CONTRAST	-0.16	0.07	-2.1	*
	$f0_{exc}$	(L+)H*	SPEECH ACT	1.50	0.26	5.8	***
			CONTRAST	0.47	0.12	3.8	***
	TCoG (percent)	(L+)H*	SPEECH ACT	7.05	0.78	9.0	***
			CONTRAST	1.94	0.41	4.8	***
			interaction	-1.61	0.40	-3.9	***
Object	*accentuation*	pooled	SPEECH ACT	-1.2	0.25	-4.9	***
			CONTRAST	-0.6	0.24	-2.3	*
			interaction	-0.5	0.15	-3.5	***
	prominence	pooled	*interaction*	-0.40	0.14	-2.75	**
	duration	pooled	SPEECH ACT	0.03	0.01	3.7	***
	intensity	pooled	SPEECH ACT	1.36	0.20	7.1	***
	TCoG (percent)	(L+)H*	*interaction*	-1.66	0.63	-2.6	**
Lexical verb	*accentuation*	pooled	SPEECH ACT	-1.5	0.25	-5.9	***
			CONTRAST	-0.6	0.14	-4.3	***
			interaction	0.45	0.14	3.2	**

Starting with the accentuation rate of the ***wh*-pronoun**, Figure 1 indicates that it was accented with a notable frequency only in questions with a contrastive subject, where the accentuation rate was 41.6%. The statistical model confirmed an interaction of the two experimental factors. Regarding the accent type, there were both H* and L* tones on the *wh*-word in questions. Most of the (few) level-2 L* accents were followed by a continuous rise to the end of the question.

The **subject *d*-pronoun** was accented in almost all exclamatives, with a small difference induced by contrast: 92.9% of the non-contrastive subject *d*-pronouns were accented, and 98.6% of the contrastive subject *d*-pronouns were. In questions, there were fewer subject accents, with a large difference induced by contrast: 44.6% of the non-contrastive subject *d*-pronouns were accented and 86.8% of the contrastive subject *d*-pronouns were. The statistical model confirmed a main effect of both experimental factors.

Regarding prominence levels, there were also two main effects. Accented *d*-pronouns had a high prominence level more often in exclamatives than in questions, and more often when they were contrastive than when they were non-contrastive. The most frequent accent type was H* in both speech acts, with a few L+H* accents. In the exclamatives, there were a couple of L*+H accents, and in the questions some L* accents.

Turning to the acoustics effects, accented subject *d*-pronouns were longer and had a higher intensity in exclamatives than in questions, and they were longer if they were contrastive rather than non-contrastive. Subject *d*-pronouns with (L+)H* accents had a higher $f0_{max}$, a larger $f0_{excursion}$ and a later TCoG in exclamatives than in questions, and higher $f0_{max}$, lower $f0_{min}$, larger $f0_{excursion}$ and later TCoG when they were contrastive than when there were non-contrastive. The contrast-induced TCoG difference was larger in questions than in exclamatives.

The **object**, which was given information in all conditions, was accented in the great majority of exclamatives: 86.3% with a contrastive subject *d*-pronoun and 89.4% with a non-contrastive subject *d*-pronoun. In questions, there were fewer accents overall, but there was a very clear effect of contrast. In questions with a contrastive subject *d*-pronoun, the object was accented more often than in questions with a non-contrastive subject *d*-pronoun (71.3% vs. 40.4%). The statistical model confirms a main effect of both experimental factors and their interaction. Thus, we find a similar accentuation pattern as for the subject *d*-pronoun: Objects were overall accented more often in exclamatives than in questions, and contrast on the subject *d*-pronoun led to a large increase in the number of object accents in questions but not in exclamatives.

Regarding prominence levels, there was an interaction of the experimental factors. When the subject *d*-pronoun was contrastive, the object accents had a higher prominence level less often in exclamatives and more often in questions. Regarding accent types, object accents in questions were mostly L* tones and less often H*. In the exclamatives, the majority were H* accents but there were also L+H* and L*+H accents. Acoustically, accented objects were longer and had a higher intensity in exclamatives than in questions. The TCoG of (L+)H* object accents in questions was later when the subject *d*-pronoun was contrastive.

The **lexical verb** in penultimate position was rarely accented in exclamatives: 10.8% if the subject *d*-pronoun was contrastive, and 12.8% if it was not. In questions, the verb was accented more often, and when the subject *d*-pronoun was contrastive, there were more verb accents than when it was not contrastive (36.8% vs. 68.8%). The statistical model confirmed a main effect of both experimental factors and an interaction: The contrast-induced accentuation difference was larger in questions than in exclamatives. In questions, accents on the lexical verb always

were L*. This is expected since questions were mostly realized with a final rise. In the few exclamatives that had an accent on the verb, this accent was H*.

5.4.3 Accent combinations

Figure 5 shows combinations of accent types, forming prosodic contours. For *wh*-exclamatives, there is one clearly preferred accentuation pattern independently of the contrastiveness of the subject *d*-pronoun. More than half of the exclamatives had a H* accent both on the subject *d*-pronoun and on the object noun. The second, much less frequent combination in exclamatives was H* on the subject *d*-pronoun and L+H* on the object pronoun, also independently of contrast.

For questions, there was no overall preferred accent combination and contrast made a difference. For questions with a contrastive subject *d*-pronoun, the most frequent combination was a H* accent on the subject *d*-pronoun plus a L* accent on the object. For questions with a non-contrastive subject pronoun, it was H* on the *d*-pronoun and L* on the lexical verb.

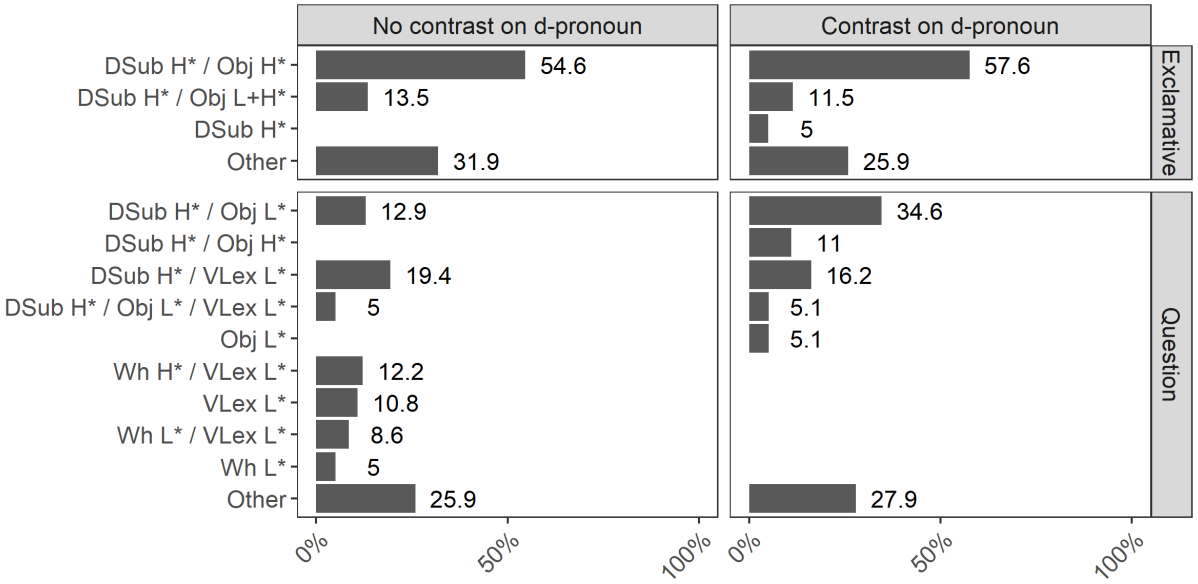

Figure 5. Proportion of accentual contours per condition in terms of GToBI accents in Experiment 1. Abbreviations (for all contour figures): Wh = wh-pronoun, DSub = subject d-pronoun, Obj = object, VLex = lexical verb participle.

Figure 6 shows the DIMA prominence level combinations across the experimental conditions. Exclamatives were quite stable in their preferred prominence pattern: Irrespective of contrast, the most frequent pattern is a combination of a pre-nuclear level-1-accent on the subject *d*-pronoun and a nuclear level-2-accent on the object. In exclamatives with a contrastive subject *d*-pronoun, the frequency of this combination reduces, and the number of combinations where the object has a lower or equally high prominence level as the subject increases.

In questions, contrast has a comparatively larger impact. In questions with a non-contrastive subject *d*-pronoun, the most frequent combinations involve a prenuclear level-1-accent on the *wh*-pronoun or the *d*-pronoun, and a level-2-accent on object or verb. In questions with a contrastive subject *d*-pronoun, there is a substantial increase of the combination of a level-1-accent on the *d*-pronoun and a level-2-accent on the object, which reflects the generally higher accentuation rate for objects in questions with a contrastive subject: when the objects were accented, they typically had level-2-accents. Otherwise, the combinations reflect the observed drop in accentuation rates for the verb in questions with a contrastive subject.

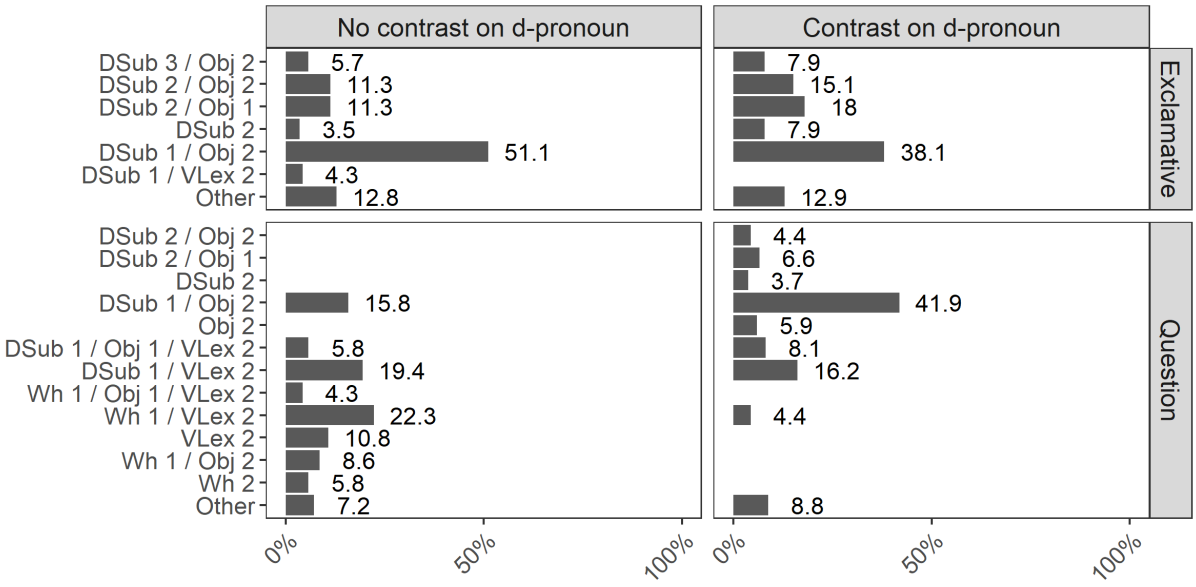

Figure 6. Proportion of combinations of levels of perceived prominence of accents per condition in Experiment 1. See caption of Figure 5 for abbreviations.

5.4.4 Interim summary and discussion

The results of Experiment 1 indicate that contrast is marked on given constituents. A contrastive subject *d*-pronoun was prosodically more prominent than a non-contrastive subject *d*-pronoun in both speech acts, as could be observed both for the categorical and for the gradient acoustic measures for the *d*-pronoun. In exclamatives the contrast-induced difference descriptively was substantially smaller than in questions, but the statistical models did not reveal an interaction. A smaller difference was predicted because the *d*-pronoun typically is highly prominent in exclamatives even in the absence of contrast due to its speech-act marking function.

Apart from local effects of prominence marking, the contrastiveness of the subject *d*-pronoun also led to non-local effects, especially in questions. There was a contrast-induced reduction of the accentuation rate for the clause-initial *wh*-pronoun, i.e., in the prenuclear region. Looking

at the accentuation rate of the *wh*-pronoun and the subject *d*-pronoun together suggests that in questions with a non-contrastive subject, the *wh*-pronoun seems to have been a viable alternative to the subject for accent placement in the clause-initial region. In the absence of contrast, the *wh*-pronoun and *d*-pronoun were roughly equally likely to attract an accent in questions. In questions with a contrastive subject the clause-initial accent almost always was placed on the subject *d*-pronoun.

There also was contrast-induced reduction of the accentuation rate for the lexical verb in the clause-final region especially in question. However, considering that the verb was adjacent to the object, which showed an unexpected contrast-induced prominence increase in the questions, the accentuation rate of the verb might be more directly related to the accentuation rate of the object rather than the *d*-pronoun. We will come back to this issue in the General Discussion. Still, looking at the accentuation of object and lexical verb together, it seems that the verb was the object's main competitor for the placement of the nuclear accent in questions and it seems that the contrastiveness of the subject *d*-pronoun influenced the location of the nuclear accent: It was mostly located on the object if the *d*-pronoun was contrastive, otherwise it was located on – i.e., shifted to – the lexical verb.

The exclamatives fairly consistently showed the double-accent pattern that Repp (2020) observed for transitive *wh*-exclamatives: in the vast majority of exlamatives, there as an accent both on the subject *d*-pronoun and on the given object. This pattern only showed a slight adaptation to the contrastiveness of the *d*-pronoun in terms of a contrast-induced reduction in prominence level of the object accent. The questions showed much greater variation in their contours, which was fed both by variation in the clause-initial region, where the *wh*-pronoun or the *d*-pronoun could be prosodically prominent, and by variation in the clause-final region, where the object or the lexical verb could be prosodically prominent. The contour variation was related to the contrast manipulation, but we highlight the unreliable deaccentuation of given objects in questions: In questions with a non-contrastive subject *d*-pronoun there was an accentuation rate of about forty percent for the given object, which increased if the subject *d*-pronoun was contrastive.

6 Experiment 2: Contrastive, given/new objects

In Experiment 2 we investigated the prosodic reflexes of contrast as well as the given-new dimension in a fully crossed design to directly test the two hypotheses presented in Section 3. We examined the same structures and lexicalizations as in Experiment 1, but we manipulated the IS of the object rather than the subject. As already mentioned, Experiment 2 was run in two

recording sessions with the same participants. We are reporting the statistics for both sessions together because our hypotheses pertained to the full design.

6.1 Materials

Experiment 2 had a 2×2×2 design with the factors SPEECH ACT (*wh*-exclamative/*wh*-question), CONTRAST (contrastive/non-contrastive) and GIVENNESS (given/new). As in Experiment 1, the experimental factors were implemented by manipulations of the context in a scripted dialogue, in which the participants took the part of Speaker 2. (13) is the English translation of one of the eight lexicalizations in all experimental conditions.

The contrastive alternative for the target object *Germanen* 'Germanic peoples' is *Etrusker* 'Etruscans'. In the conditions with a new object, the context contains the hypernym *alteuropäische Völker* 'Old European peoples'. Elements for which a hypernym is mentioned in the context have been considered to be accessible rather than new (Baumann & Riester, 2013). However, this only holds if the referents denoted by the expressions can actually be identified (Baumann et al., 2015). In a dialogue like A: *Do you like animals?* B: *I like all dogs*., *dogs* cannot be deaccented because we cannot identify dog referents on the basis of an animal referent superset. In our materials, the referents of the object noun are not identifiable on the basis of the superset (or otherwise). Therefore, we are speaking of new information focus, for which the hypernym introduces implicit alternatives.

Another aspect of the materials that we would like to point out is that although there is a difference in the number of *overall* previous mentions of the target object in the contrastive vs. non-contrastive conditions with a given object, the number of mentions by the speaker of the target utterance, is constant: it is spoken once before the target utterance. It might well be the case that the pre-target mention in the contrastive condition receives contrast marking, which, however, we did not analyze.

(13) English translation of a sample item of Experiment 2

	***Wh*-exclamatives**	***Wh*-questions**
Non-contrastive object given	Speaker 1: *'Have you heard? Anna has specialized in **Germanic peoples** for her dissertation now.'* Speaker 2 (participant): *'Yes, she told me about that recently. She is traveling a whole lot in order to find original evidence of **Germanic peoples.'***	Speaker 1: *'Have you heard? Anna has specialized in **Germanic peoples** for her dissertation now.'* Speaker 2 (participant): *'Really? Then she's probably traveling a lot in order to find original evidence of **Germanic peoples.** Do you happen to know…'*
Non-contrastive object new	Speaker 1: *'Have you heard? Anna has specialized in **Old European peoples** for her dissertation now.'* Speaker 2 (participant): *'Yes, she told me about that recently. She is traveling a whole lot in order to find original evidence of **Old European peoples.***	Speaker 1: *'Have you heard? Anna has specialized in **Old European peoples** for her dissertation now.'* Speaker 2 (participant): *'Really? Then she's probably traveling a lot in order to find original evidence of **Old European peoples.** Do you happen to know…'*
Contrastive object given	Speaker 1: *'Have you heard? Anna has specialized in **Etruscans** for her dissertation now.'* Speaker 2 (participant): *'Yes, she just travelled to Italy again in order to find original evidence of the **Etruscans.** And the rest of the time she's traveling because of her much-loved **Germanic peoples**!*	Speaker 1: *'Have you heard? Anna has specialized in **Etruscans** for her dissertation now.'* Speaker 2 (participant): *'Yes, she is always on research trips. Just recently she was in Italy because of a necropolis of the **Etruscans**. But I think she is also traveling a lot because of her much-loved **Germanic peoples**. Do you happen to know…'*
Contrastive object new	Speaker 1: *'Have you heard? Anna has specialized in **Etruscans f**or her dissertation now.'* Speaker 2 (participant): *Yes, she is always on research trips. Just recently she was in Italy because of a necropolis of the **Etruscans**. But she's not just traveling a lot because of **Etruscans**.'*	Speaker 1: *'Have you heard? Anna has specialized in **Etruscans** for her dissertation now.'* Speaker 2 (participant): *'Yes, she is always on research trips. Just recently she was in Italy because of a necropolis of the **Etruscans**. But I think she is also traveling a lot not only because of **Etruscans**. Do you happen to know…'*

W/wo	**die**	**schon**	**überall**	**Germanen**	**erforscht**	**hat / ?**
where	she_{DPRON}	already	everywhere	Germanic peoples	researched	has

6.2 Participants, procedure, data processing

As mentioned in Section 5.2, the participants of Experiments 1 and 2 were the same, with a by-participant balanced rotation of recording sessions. The experimental procedure was the same as in Experiment 1.

6.3 Results

The data processing and statistical analyses were identical to Experiment 1, except that there were three experimental factors in Experiment 2.

6.3.1 Final contour

As in Experiment 1, the two speech acts differed in their final contour in the expected direction: Final rises were less frequent in questions than in exclamatives (b = -5.7, SE = 1.2, z = -4.6, p < 0.001), see Table 3. This time, the interaction with CONTRAST was not significant but again indicated that contrast promotes the less canonical contour in either speech act. Regarding the $f0_{excursion}$ from L* accents to utterance offset in rising contours, there was a tendency for larger $f0_{excursion}$ starting on verbs with L* accents if the object was given rather than new (b = 0.54, SE = 0.26, t = 2.1, p = 0.06).

Table 3. Proportion of final rises across conditions in Experiment 2

Speech act	Given/New object	Contrast object	Proportion of final rises
Exclamative	Given	contrastive	11.8
		non-contrastive	6.5
	New	contrastive	11.4
		non-contrastive	9.4
Question	Given	contrastive	87.7
		non-contrastive	87.7
	New	contrastive	83.5
		non-contrastive	86.6

6.3.2 By-syllable analyses

Figure 7 shows the accentuation rate, accent types and DIMA prominence levels of the accents in the utterances elicited in Experiment 2. Figures 8-10 show the acoustic measures. Table 4 gives the model parameters for all models that revealed significant effects. Recall that we did not fit statistical models for accent type due to convergence issues, and only give descriptive characterizations for these.

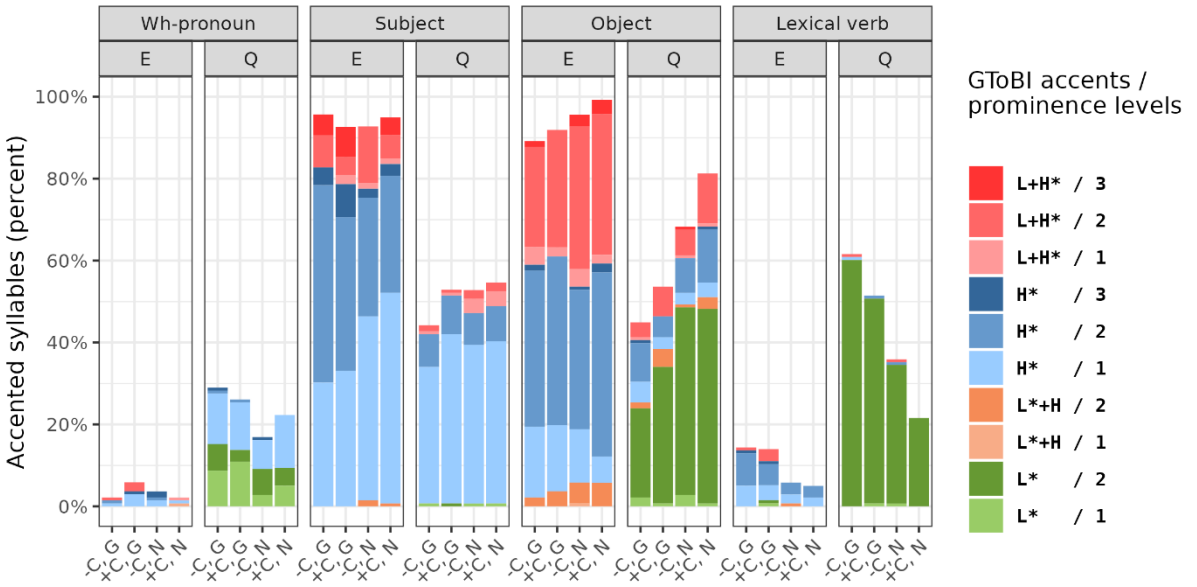

Figure 7: Accentuation rate, accent types and prominence level. See capture of Figure 1 for abbreviations.

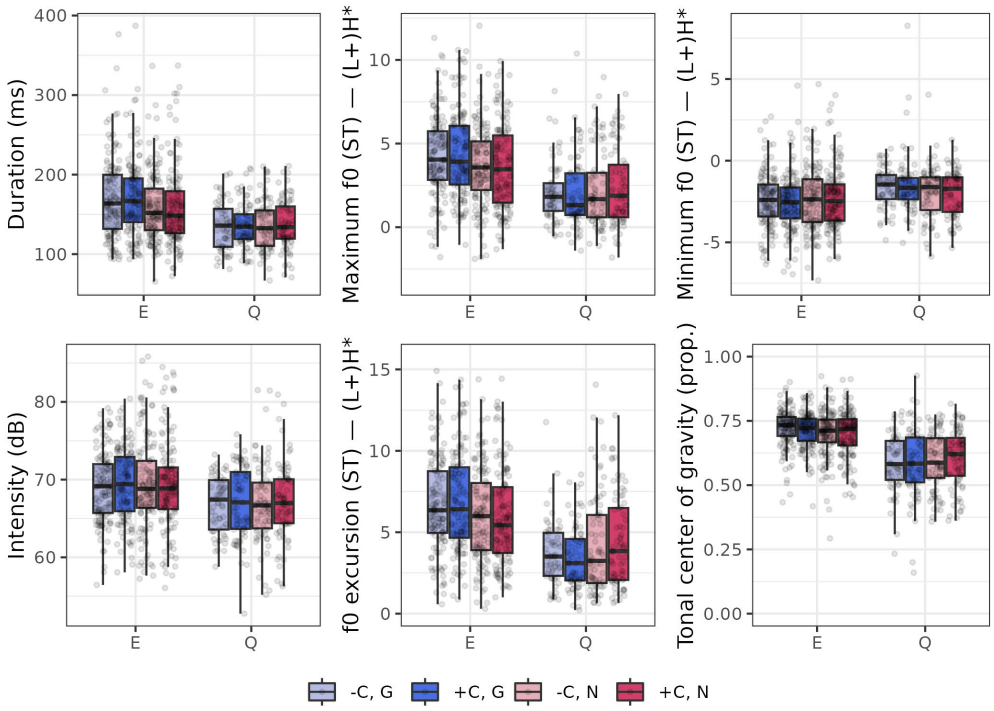

Figure 8: Acoustic properties of the subject d*-pronoun in Experiment 2: For all accents: duration (ms), mean intensity (dB). For(L+)H* accents: $f0_{max}$, $f0_{min}$, $f0_{exc}$ (st) and TCoG. Grey dots represent individual data points.*

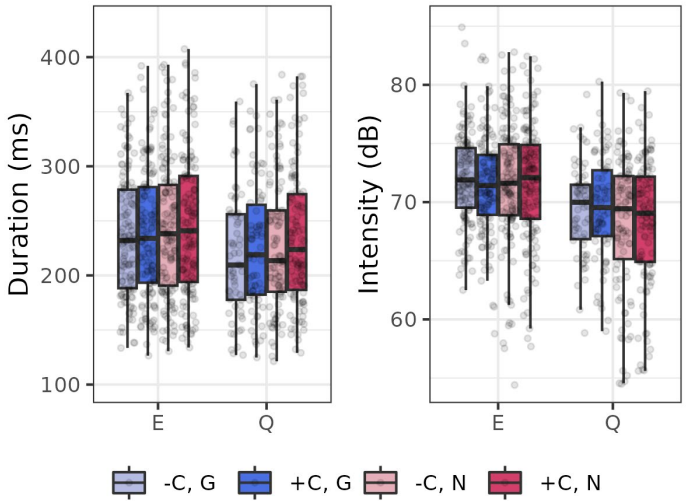

Figure 9: Acoustic properties of accented object syllables in Experiment 2: duration (ms) and mean intensity (dB). Grey dots represent individual data points.

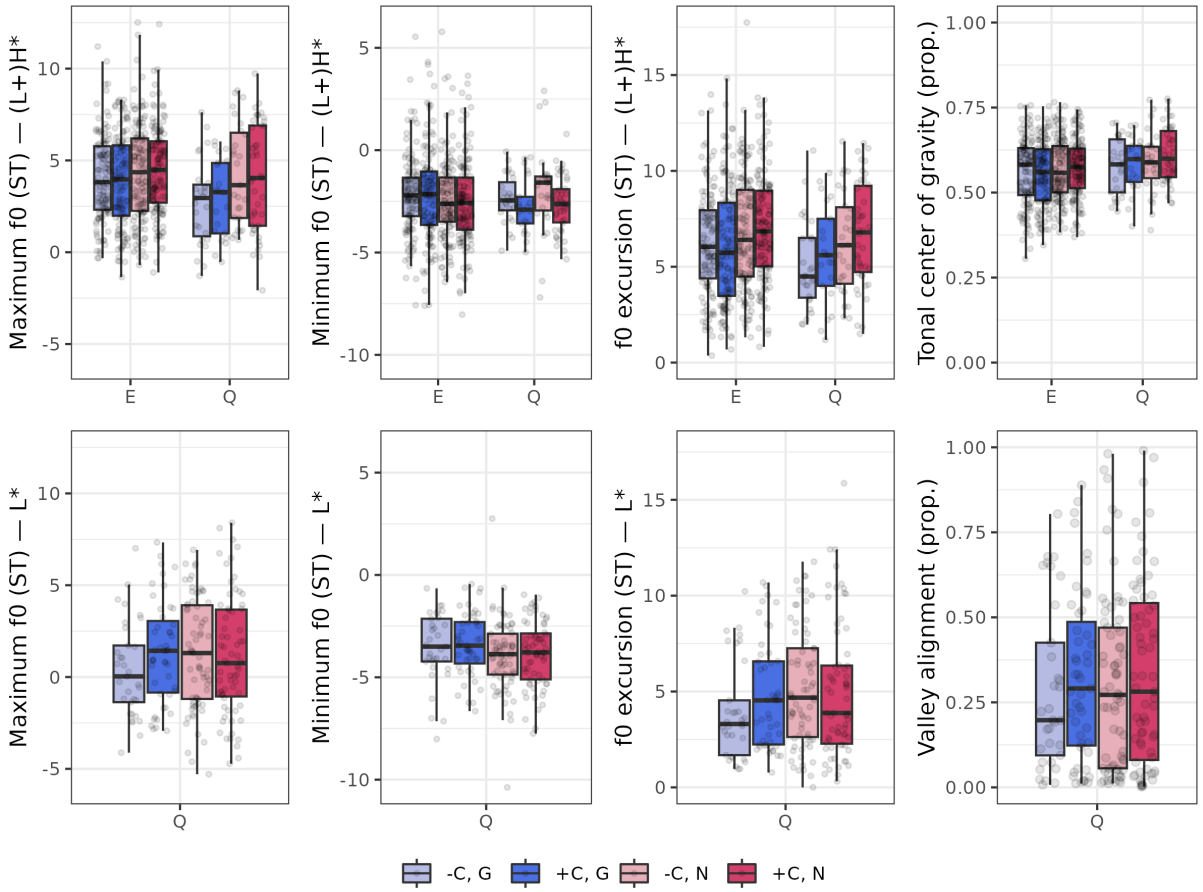

Figure 10. Acoustic properties of accented objects in Experiment 2. (L+)H accents in both speech acts (top): $f0_{max}$, $f0_{min}$ and $f0_{exc}$ (st) of the accented syllable, TCoG for entire object; L*accents in questions (bottom): $f0_{max}$, $f0_{min}$ and $f0_{exc}$ (st), and $f0_{min}$ alignment. Grey dots represent individual data points.*

Table 4. Model parameters for syllable-level models with significant effects in Experiment 2.

Syllable	Variable	Accent type	Term	*b*	*SE*	*t/z*	*p*
Wh-pronoun	*accentuation*	pooled	SPEECH ACT	-1.70	0.18	-9.6	***
			GIVENNESS	0.32	0.15	2.1	*
			3-way interaction	0.35	0.15	2.2	*
Subject *d*-pronoun	*accentuation*	pooled	SPEECH ACT	2.90	0.6	4.6	***
	prominence	pooled	SPEECH ACT	1.12	0.27	4.2	***
			GIVENNESS	0.31	0.10	3.3	**
			SPA:GIVENNESS	0.26	0.10	2.7	**
	duration (log)	pooled	SPEECH ACT	0.10	0.02	4.4	***
			GIVENNESS	0.02	0.01	2.5	*
			SPA:GIVENNESS	0.02	0.01	2.8	**
	intensity	pooled	SPEECH ACT	1.10	0.20	4.4	***
	$f0_{max}$	(L+)H*	SPEECH ACT	1.07	0.19	5.6	***
			SPA:GIVENNESS	0.19	0.07	2.8	**
	$f0_{exc}$	(L+)H*	SPEECH ACT	1.29	0.09	14.8	***
			SPA:GIVENNESS	0.39	0.08	4.7	***
	TCog (percent)	(L+)H*	SPEECH ACT	6.71	0.81	8.3	***
			SPA:GIVENNESS	0.75	0.29	2.6	*
Object	*accentuation*	pooled	SPEECH ACT	1.7	0.27	6.3	***
			CONTRAST	0.55	0.16	3.3	***
			GIVENNESS	-1.0	0.3	-3.4	***
	prominence	pooled	CONTRAST	0.39	0.12	3.3	***
			GIVENNESS	-0.34	0.12	-2.9	**
	duration (log)	pooled	SPEECH ACT	0.03	0.01	4.1	***
			GIVENNESS	-0.02	0.01	-2.4	*
	intensity	pooled	SPEECH ACT	1.40	0.24	5.8	***
	$f0_{exc}$	(L+)H*	GIVENNESS	-0.38	0.19	2.0	.056
	TCoG (percent)	(L+)H*	GIVENNESS	-1.30	0.48	-2.7	*
Lexical verb	*accentuation*	pooled	SPEECH ACT	-1.5	0.22	-6.9	***
			CONTRAST	-0.28	0.1	-2.6	**
			GIVENNESS	0.88	0.24	3.6	***

Like in Experiment 1, ***wh*-pronouns** in Experiment 2 were hardly ever accented in exclamatives. They were accented regularly in questions, but the accentuation rate was lower than in Experiment 1 (between 18% and 29% vs. up to 42%). There were small variations in the accentuation rate depending on the IS of the object. The statistical model revealed a main effect of SPEECH ACT and GIVENNESS as well as a three-way interaction of the three experimental factors. The accentuation rate in questions is higher if the object is given rather than new, and CONTRAST has opposite effects for questions with given vs. new object. Note that the differences

for the latter comparison are tiny. Like in Experiment 1, the accents in the questions were H* or L* accents.

For the **subject *d*-pronoun**, there is again a large difference between the speech acts. The subject is accented in over 90% of exclamatives regardless of the IS of the object, while in questions it is accented in only around half of the utterances. The statistical model confirms a main effect of SPEECH ACT. The prominence levels the of accented subject *d*-pronouns also differ between the speech acts. In exclamatives, accented *d*-pronouns with high prominence levels are more frequent than in questions. Furthermore, there is an interaction of SPEECH ACT and GIVENNESS. In exclamatives, the accented *d*-pronouns more often have high prominence levels when the object is new rather than given. In questions, there is no effect. In both speech acts, H* accents were most common but there were also L+H* accents.

Acoustically, accented subject *d*-pronouns were longer and had a higher mean intensity in exclamatives than in questions. Furthermore, accented subject *d*-pronouns with a (L+)H* accent had a higher $f0_{max}$, a higher $f0_{exc}$ and a later ToCG in exclamatives than in questions. $F0_{max}$ and $f0_{exc}$ were higher and ToCG was later in exclamatives with a given vs. new object, and lower/earlier in questions with a given vs. new object.

Objects were accented more often in exclamatives than in questions, contrastive objects were accented more often than non-contrastive objects, and given objects were accented less often than new objects. The statistical model confirms main effects of all predictors. Comparing the effect sizes of CONTRAST and GIVENNESS, we find that CONTRAST had a comparatively smaller effect. Furthermore, the differences between the conditions descriptively are larger within the questions than within the exclamatives. Exclamatives had a very high accentuation rate in all conditions. The finding that in questions, the accentuation rate for new contrastive objects is only 81% is a participant effect: some speakers accented the lexical verb rather than the object regardless of condition.

Regarding prominence levels, accents on contrastive objects more frequently had high prominence levels than accents on non-contrastive objects. Accents on given objects had high prominence levels less frequently than accents on new objects. The accent types in exclamatives were mostly H* or L+H* but there were also some L*+H accents. In questions, the majority of accents were L* accents, which is expected in rising contours, but there also were H* and L+H* accents.

Acoustically, the accented object syllable was longer and had a higher intensity in exclamatives than in questions. It was shorter if the object was given rather than new. $F0_{exc}$ on (L+)H* accents in exclamatives was marginally lower and TCoG was earlier if the object was given. CONTRAST had no effect on the gradient measures.

The **lexical verb** was accented more often in questions than in exclamatives, and there were IS effects. The statistical model revealed a main effect for all predictors. The lexical verb was accented less often in exclamatives than in questions, less often if the object was contrastive, and more often if the object was given. The accents were L* accents. They did not differ acoustically between the conditions.

6.3.3 Accent combinations

Figure 11 shows the combination of accent types, forming prosodic contours. As in Experiment 1, *wh*-exclamatives have one clearly preferred accentuation pattern, regardless of IS: an H* accent both on the subject *d*-pronoun and on the object noun. This is the same pattern as in Experiment 1. The second-most frequent pattern, also familiar from Experiment 1, is H* on the subject *d*-pronoun and L+H* on the object, which is more frequent for new objects than for given objects, independently of contrast.

In questions, we see a much wider variety of combinations, and IS plays a role, also as in Experiment 1. The overall most frequent contour involved a H* accent on the subject *d*-pronoun and a L* object accent, whose use increased if the object was contrastive, and also if it was new. In questions with a contrastive object, it was the most frequent contour, regardless of the given/new status of the object. In questions with non-contrastive given objects, the most common combination was a single L* accent on the lexical verb (i.e., the object was deaccented). With non-contrastive new objects, the most common combination was a single L* accent on the object.

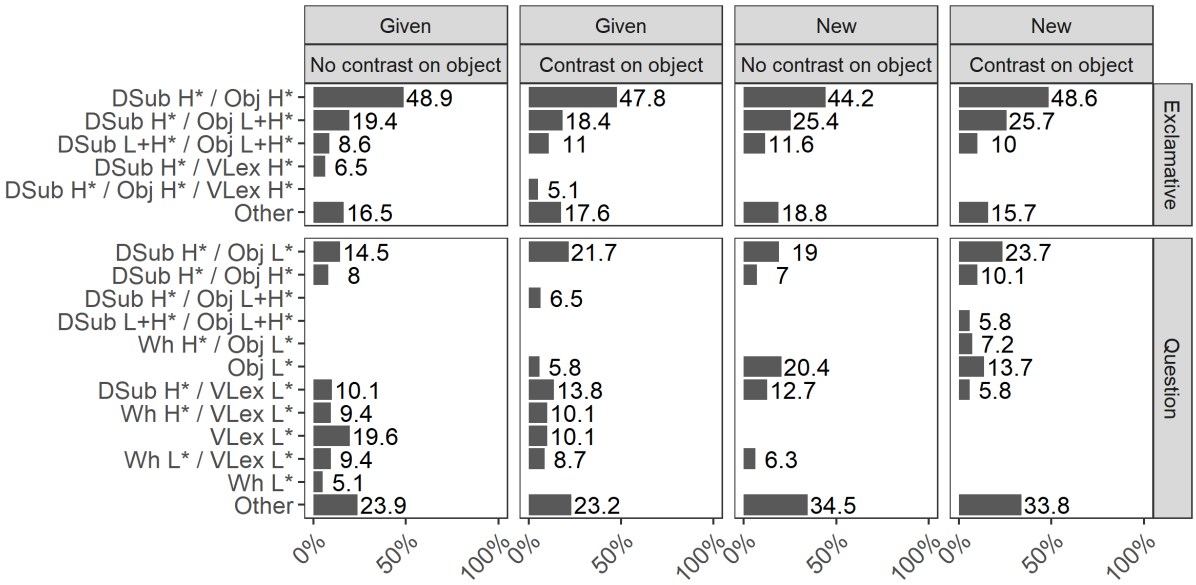

Figure 11. Proportion of accentual contours per condition in terms of GToBI accents in Experiment 2. See caption of Figure 5 for abbreviations.

Figure 12 shows the prominence level combinations. As in Experiment 1, exclamatives were comparatively stable in their prominence patterns. In the double-accent structures involving the subject *d*-pronoun and the object, the object most frequently had a prominence level that was higher than, or equal to, that of the subject (1-2 and 2-2, resp.). The proportion of combinations with a level-1 *d*-pronoun and a level-2 object accent increased in the step-like pattern that we observed for the individual accentuation rates of the object. Other than that, Figure 12 shows that there are two combinations in which the *d*-pronoun had a higher prominence level than the object (3-2 and 1-2). These combinations occurred more often in exclamatives with given rather than new objects.

In questions, the most frequent combination involves a prenuclear level-1 accent on the subject *d*-pronoun and a level-2 accent on the object, as in Experiment 1. For that combination, there is the familiar step-like pattern correlation with IS. Otherwise, we observe a fairly frequent combination of a level-1 *wh*-pronoun and a level-2 verb in questions with a given object.

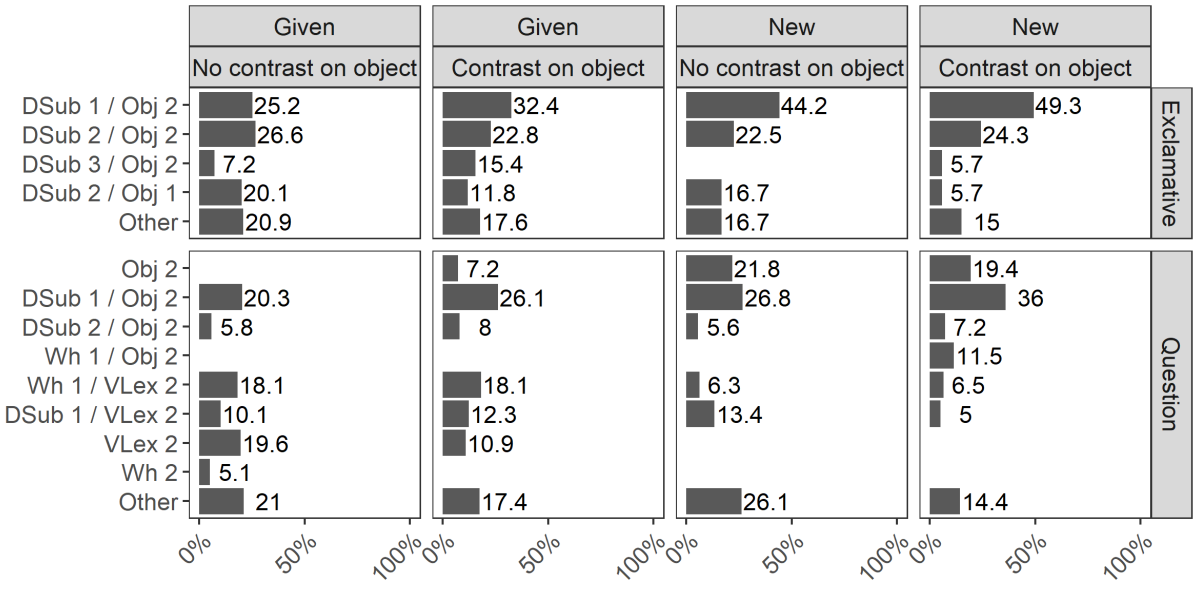

Figure 12. Proportion of combinations of levels of perceived prominence of accents per condition in Experiment 2. See caption of Figure 5 for abbreviations.

6.3.4 Interim summary and discussion

The results of Experiment 2 support hypothesis *GivPlusCon.* Differences both of the contrastiveness and of the givenness of the object led to differences in the prosodic prominence of the object in the two speech acts, with both categorical and gradient measures contributing to these local prominence differences, which were considerably smaller in exclamatives than in questions like in Experiment 1. In the exclamatives, the object overall was very prominent, i.e.,

across the IS conditions. Still, in both speech acts, the local IS effects seem to be additive: there is a prominence increase for contrast and a prominence decrease for givenness. The result is a pattern resembling successive steps: non-contrastive given objects are least prominent, contrastive new objects are most prominent, with contrastive given and non-contrastive new objects being in between.

Regarding the difference between contrastive given vs. non-contrastive new objects, we entertained two sub-hypotheses, *GivPlusCon1*$_{Focus}$ and GivPlusCon2$_{neutralization}$. According to the former, contrastive given objects should be more prominent than non-contrastive new objects because in both cases, the object is focused, and contrastive focus is marked with higher prosodic prominence than new information focus. According to the latter, non-contrastive new objects and contrastive given object should not differ prosodically because givenness marking and contrast marking cancel each other out. We found neither. We found that non-contrastive new objects are accented more often than contrastive given objects, and that the effect of givenness is larger than the effect of contrast. Having said this, recall that given non-contrastive objects in questions still are accented at a rate of about forty percent.

The IS of the object also led to non-local effects on prosodic prominence. In questions, we observed a givenness-induced prominence increase for the clause-initial *wh*-pronoun in terms of accentuation rate. In exclamatives, we observed a givenness-induced prominence increase for the subject *d*-pronoun in tems of prominence levels and gradient phonetic means. In both speech acts, we observed contrast-induced reduction and givenness-induced prominence increase effects for the lexical verb, which was adjacent to the object: there was a step-like pattern like for the local prominence marking on the object but in "reverse order" compared to the step-like effects on the object. In utterances with non-contrastive given objects the verb showed the highest prominence, in utterances with contrastive new objects, it showed the lowest prominence, with the other two IS conditions in between such that in utterances with a contrastive given object the verb was more prominent than in utterances with a non-contrastive new object. This finding is compatible with the hypothesis *GivPlusCon* but with neither of the sub-hypotheses. The effects for the exclamatives were less pronounced than for the verb, although statistically, there were no interactions.

Regarding contours, exclamatives showed the same consistent double accent contour as in Experiment 1 and in Repp (2020): an accent on the subject *d*-pronoun and the object. A double-accent contour was also most frequent in questions, although with a L* rather than a H* or L+H* accent on the object. Otherwise, questions also showed single-accent contours, with an accent on the object or on the verb, the choice being related to IS.

7 General Discussion

The current study set out to investigate two hypotheses regarding the combined prosodic reflexes of contrast and givenness in *wh*-exclamatives and *wh*-questions. Givenness and contrast are in two different IS dimensions and thus are expected to interact in the prosodic IS marking of utterances in intonation languages like German. Since earlier research on the prosodic characteristics of exclamatives and questions had shown that exclamatives are largely inert for givenness marking, and that questions also often do not show givenness marking inter alia due to their specific semantic-pragmatic characteristics, the first hypothesis, *NoGivCon*, stated that givenness marking is dispensed with on contrastive elements in the speech acts under investigation. However, since givenness marking had only ever been investigated for non-contrastive constituents, it was an open question whether contrastive constituents are marked for givenness. Therefore, the second hypothesis, *GivPlusCon*, stated that givenness is marked in addition to contrast.

To test the two hypotheses, we conducted two experiments. Experiment 1 compared the prosodic realization of utterances with a contrastive vs. non-contrastive subject *d*-pronoun. *D*-pronouns always refer to given information. In exclamatives, they are typically accented, carrying the so-called 'exclamative accent', whose presence is motivated by the illocution type. In Experiment 2, we tested the prosodic reflexes of contrast and givenness in a fully crossed design with IS manipulation of the object constituent.

Our results from both experiments support the second hypothesis, *GivPlusCon*: Givenness is marked in addition to contrast. Overall, we found both local and non-local prosodic effects, and speakers employed both categorical and phonetic gradient means to mark contrast and givenness. However, although the statistical analyses did not always indicate an interaction with the factor SPEECH ACT, descriptively the observed effects in exclamatives consistently were much smaller than in questions.

Especially in terms of accentuation, exclamatives are extremely inflexible. There is one preferred contour type irrespective of IS, which is a double-accent contour with H* on subject *d*-pronoun and object, with L+H* also occurring, especially on the object. Thus, there is a high *base-level accentuation* of exclamatives, by which we mean that in the *wh*-exclamatives in our study, at least 90 percent of the subject *d*-pronouns, and at least 85 percent of the objects were accented in every condition. This inflexibility, or rigidity, of prosodic structure, also was observed by Repp (2020), who reports rigid double-accent patterns for verb-second and verb-final transitive *wh*-exclamatives in German. We assume that the double-accent structure can be viewed as an implementation of the prosodic constructional default proposed by Repp &

Seeliger (2020). However, this default only captures the presence of *a* prominent accent in an exclamative (next to a slower speaking rate and a tendency for IS-inertness), not a double-accent pattern. Indeed, the transitive polar exclamatives studied by Seeliger & Repp (2023) often have single prominent accents. We will come back to this issue when we discuss effecdtsd of contrast further below. Overall, though, the accentual rigidity that we observed for the *wh*-exclamatives in the current study raises the issue of the functional contribution of more fine-grained differences between exclamative types.

In addition to the accentual rigidity that sets exclamatives apart from questions, the *wh*-exclamatives and the (embedded) *wh*-questions that we tested differed in their final contour, as we had predicted. The exclamatives mostly ended in a fall, the questions in a rise. There were some exceptions in both speech acts. The occurrence of exclamatives with a rising contour is unexpected. Earlier literature agrees that exclamatives end in a fall. However, Seeliger & Kaland (2023), who performed a cluster analysis of a subset of our data, suggest that some of the rises are medium-high plateaus, rather than H-^H% boundary tones. Medium-high plateaus have been connected to concepts such as repetition and routine by earlier studies (Ladd, 1978; Selting, 2001). The target sentences in the current study mostly contained propositions compatible with a habitual reading, for instance exclaiming about a person regularly going on research trips. This was not the case for the target sentences in Repp & Seeliger (2020) and Seeliger & Repp (2023), which were about single events. So, habitual readings might be a partial explanation for the higher number of rising exclamatives compared to the earlier studies. However, we cannot account for the sensitivity to contrast. Regarding falling questions, which per se are not unexpected but which show an effect of contrast in Experiment 1, we offer an explanation in the next subsection, when we discuss prosodic reflexes of contrast.

Generally, we observed that prosodic prominence within falling contours was marked by high-tone pitch accents (H*, L+H*), whereas prominence within rising contours was marked by a low-tone pitch accent (L*). This corroborates earlier findings and supports the assumption that deviations from the pitch baseline are opposite to the general direction of the baseline (Kügler & Genzel, 2012; Repp, 2020). In the following we will collapse high-tone accents in falling contours and low-tone accents in rising contours in our discussion of the prosodic prominence relations in *wh*-questions and *wh*-exclamatives as influenced by contrast and givenness. We will start our discussion with the prosodic reflexes of contrast, which was tested in both experiments, and then move on to the interaction of contrast and givenness marking.

7.1 Contrast

Contrast was marked both locally, on the contrastive element, and non-locally in other parts of the clause. There were both pre- and postnuclear effects. Starting with local effects of contrast, we found that contrastive subject *d*-pronouns (Exp. 1) and contrastive objects (Exp. 2) were accented more often, and the accents more often had higher prominence levels than non-contrastive subject *d*-pronouns and objects, respectively. Contrastive subject *d*-pronouns furthermore had a longer duration and a higher intensity, and (L+)H* subject accents showed a larger f0 excursion, which was driven by both a higher maximum and a lower minimum f0, and the TCoG was later. The contrast-induced TCoG effect was larger in questions than in exclamatives, where the alignment was later than in questions in general. We did not observe differences in the choice of accent for high tone pitch accents (H* vs. L+H*), that is contrast did not show a probabilistic association with accent type, contrary to earlier findings for polar exclamatives (Seeliger & Repp, 2020; 2023).

Regarding non-local prosodic reflexes of contrast, our study yielded the expected effect of prominence reduction in other parts of the clause. We found that in questions with a contrastive subject *d*-pronoun, the *wh*-pronoun preceding the verb was accented less often than in questions with a non-contrastive subject *d*-pronoun (Exp. 1). Furthermore, when the object was contrastive, the lexical verb following the object was accented less often when the object was non-contrastive (Exp. 2).

These findings indicate that contrast marking proceeds in the way suggested by Seeliger & Repp (2023), i.e., the positive prominence balance required by contrast is increased by locally higher, and by non-locally lower prosodic prominence. Non-local prominence reduction occurs both in the prenuclear and in the post-nuclear region. Note, however, that the contrastiveness of the object did not have reduction effects in the prenuclear region, which is different from the findings for polar exclamatives (Seeliger & Repp 2023). In polar exclamatives, object contrast led to a substantial reduction of the accentuation rate of the subject *d*-pronoun, and the prominent accent required by the prosodic constructional default was realized on the object. We can only offer a tentative explanation for this difference between the two studies, which is unpredicted because prima facie there is no reason why *wh*-exclamatives and polar exclamatives with a transitive structure should display different prominence relations between object and subject *d*-pronoun. One difference between the current study and the earlier study on polar exclamatives concerns the amount of material occurring between *d*-pronoun and object. In the polar exclamatives there always was a bisyllabic adjective between *d*-pronoun and object, whereas in the current study six of the eight lexicalizations had three or more syllables between the two elements so that the distance between the two potential accent

positions mostly was larger. If the distance is larger, non-local prominence reduction of the *d*-pronoun might be less effective for increasing the positive prominence balance for the contrastive object. Another difference between the two studies is that the base accentuation rate of the *d*-pronoun was lower in the polar exclamatives (around 80% vs. 90% in the current study). Maybe polar exclamatives are less rigid in their double-accent structure, as already hinted at above, so that prenuclear deaccentuation is more readily available as a means for contributing to the positive prominence balance of the object.

There was one effect of non-local contrast marking in the *wh*-questions in Experiment 1 that was truly unexpected: When the subject *d*-pronoun was contrastive the object was more prominent than when the subject *d*-pronoun was non-contrastive. In other words, there was a non-local prominence increase rather than the predicted non-local prominence decrease. The lexical verb following the object did show the predicted prominence decrease. However, in view of the fact that the verb and the object are adjacent, and the subject *d*-pronoun in comparison is 'far away', the verb effect more likely is the result of a prominence interaction of verb and object rather than of verb and *d*-pronoun. In other words, the effect for the verb is indirect.

We think that the non-local contrast-induced prominence increase on the object might have two sources. The first is an information-structural one, the second one is illocutionary. Starting with the IS source, compare (14) and (15), which are English translations of the non-contrastive question condition, (14), and the contrastive question condition, (15):

(14) A: Have you heard? Anna has specialized in Germanic peoples for her dissertation now.

B: Really? Then she's probably traveling a lot in order to find original evidence of Germanic peoples. Do you happen to have heard *where she has already researched Germanic peoples?*

(15) A: Have you heard? Paul has specialized in Germanic peoples for his dissertation now.

B: Really? Then he's probably traveling a lot in order to find original evidence of Germanic peoples. But I can imagine that that's nothing compared to the travels of Anna. Do you happen to have heard *where she has already researched Germanic peoples?*

In the contrastive condition, (15), there is a topic shift in the sentence preceding the target sentence, which introduces the intended contrastiveness of the subject *d*-pronoun. We propose that this topic shift opens up the possibility of an *IS reset* for the object: Due to the topic shift, the given object can be interpreted as new *in relation to the subject of the question*. Concretely, speaker B in (15) acknowledges that Paul travels a lot in order to research Germanic peoples, and then changes the topic to Anna and her travels. Whether these travels also relate to

Germanic peoples or to, e.g., Etruscans, is not specified in the context. The speaker of the question is essentially free to treat *Germanic peoples* as (still) given or to treat it as new within the context of Anna's travels. If the object is treated as new, it is accented. If it is given, the nuclear accent must be placed elsewhere, a good location being the information-structurally accessible adjacent verb.

The second potential, illocutionary source for the non-local prominence increase is lexicalization specific. In three of the eight experimental items, the verb in the embedding question in the contrastive condition was *mitbekommen* 'notice, observe', which allows embedding of a question or of an exclamative (see Grimshaw, 1979, for embedded exclamatives vs. questions). An exclamative interpretation in principle is coherent in the contrastive contexts because speaker B compares the subject of the *wh*-structure, Anna in (15), with the alternative, Paul, airing the suspicion that Anna surpasses the alternative Paul in the relevant action, viz. in the amount of traveling in (15). In the productions of the three lexicalizations with *mitbekommen*, the proportion of object accents in the contrastive condition is substantially higher than in the other items. Furthermore, there are more final falls. Thus, we assume that there (also) is an exclamatory component which contributes to the frequent accentuation of the object in the contrastive condition in the questions.

7.2 The interplay of contrast and givenness

We already discussed the fact that in exclamatives, *d*-pronouns, which always refer to given information, are typically accented for illocutionary reasons: they carry the so-called 'exclamative accent'. This is also what we found in the current study. We also already discussed the observation that the object in transitive exclamatives typically is accented irrespective of IS, resulting in the rigid double-accent structure that we observed for *wh*-exclamatives. Surprisingly, the *wh*-questions in our study also showed high accentuation rates for non-contrastive subject *d*-pronouns and non-contrastive given objects: about forty percent of the questions in both experiments. Still, there is a notable difference between subject and object accents. Subject accents overwhelmingly were level-1 prominences. Therefore, we propose that they are prenuclear rhythmic accents. Since *d*-pronouns in German are strong pronouns (the personal pronouns being weak(er)), we assume that *d*-pronouns can easily carry a rhythmic accent. Regarding the high accentuation rate of non-contrastive given objects, which mostly have level-2 accents, we assume that we are dealing with the typical unreliability of givenness marking that previous research on questions has observed. Recall that Repp & Seeliger (2023) found for declarative questions that in the presence of a contrastive verb, preceding objects are only rarely deaccented. From this perspective it is not surprising that an accessible verb, i.e.,

one that requires less prominence than a contrastive verb, cannot reliably "prevent" deaccentuation of the preceding object. Still, in our study the verb itself is accented quite regularly if the object is non-contrastive: between 60 percent (Exp. 2) and 70 percent (Exp. 1) of the questions with a non-contrastive object. Thus, abstracting away from the overall high accentuation rate for non-contrastive given objects, we observe a regular accent shift to the accessible verb for those utterances where the non-contrastive object is not accented.

Turning now to the interaction of givenness and contrast in their opposing requirements for prosodic prominence marking, we already mentioned at the beginning of the General Discussion that our results support the *GivPlusCon* hypothesis: Givenness is marked in addition to contrast. Our results do not support either of the two sub-hypotheses. According to hypothesis $GivPlusCon1_{focus}$ contrastive given objects should have been more prominent than non-contrastive new objects. This hypothesis was based on the assumption that contrast, which is a sub-type of focus – contrastive focus –, is marked more prominently than new information focus. This is not what we found. According to hypothesis $GivPlusCon2_{neutralization}$ contrastive given objects should have been as prominent as non-contrastive new objects. This hypothesis was based on the assumption that contrast and givenness cancel each other out. This is not what we found either.

What we found was that both locally and non-locally, givenness had a greater impact on the prominence relations than contrast did. Locally, we found a larger effect size of givenness than of contrast for the accentuation rate of objects. Consequently, contrastive given objects were less often accented than non-contrastive new objects. For the prominence level of the object, the effects of contrast and givenness were about the same. The acoustic measures that showed significant differences – duration, f0 excursion and TCoG of (L+)H* accents – only showed effects of givenness: the expected prominence decrease. Regarding non-local effects, we found that the prominence-increasing effect of the givenness of the object was larger than the prominence-decreasing effect of the object's contrastiveness for the accentuation of the lexical verb. Verbs following contrastive given objects were more often accented than verbs following non-contrastive new objects. In the pre-nuclear region of the *wh*-questions, only object givenness had a prominence-increasing effect for the *d*-pronoun in terms of high prominence levels, duration, maximum f0 and f0 excursion. Finally, the questions showed a prenuclear effect of object givenness for the accentuation rate of the *wh*-pronoun, which was higher in questions with given vs. new objects – an effect which was not found in Repp's (2020) earlier study of *wh*-questions.

These results seem to pose a bit of a paradox. On the one hand, we observe a considerable reluctance to deaccent given objects not only in exclamatives: recall that given objects are accented in around forty percent of the questions. On the other hand, our findings suggest that givenness has larger effects when compared to contrast. Furthermore, our study has revealed larger effects of givenness than the one conducted for *wh*-questions by Repp (2020). To approach the relative difference between effects of givenness and of contrast, we suggest that it is instructive to compare the effects of object contrast (Exp. 2) to those of subject contrast (Exp. 1), zooming in on given constituents in the questions. Subject contrast on given constituents in questions has substantial local and non-local effects. This can be seen in the local and non-local accentuation rate, prominence levels, and phonetic measures. When we compare subject contrast with object contrast by visually inspecting the extent of the effects in the figures in Sections 5 and 6, and comparing the effect sizes (which includes new objects for Exp. 2), we find that object contrast seems to have smaller effects than subject contrast. The reasons for this are presently unclear. Importantly, the comparatively small effects of object contrast might produce the impression that the prosodic effects of givenness on the object are comparatively large.

Another factor that might have contributed to the seemingly small effect of object contrast is the IS of the lexical verb, which was accessible and not lexically given. Recall that for new contrastive objects we found a surprisingly low accentuation rate of around 80 percent, the verb carrying an accent in around 20 percent of these utterances. It is possible that speakers were reluctant to deaccent the accessible verb and due to the adjacency of object and verb they made a choice for one or the other.

Turning to the fact that we found more substantial effects of object givenness in the *wh*-questions than Repp (2020) did, we note that we implemented givenness in a slightly different way in the present study. In utterances with given contrastive objects, the contrastive target object was mentioned by the participant themselves before they uttered the target sentence (e.g., *Yes, she is always on research trips. Just recently she was in Italy because of a necropolis of the Etruscans. But I think she is also traveling a lot because of her much-loved Germanic peoples. Do you happen to know where she studied Germanic peoples?*). Hence, the critical constituent was a second mention by the same speaker, which was not the case in the experiment reported by Repp (2020). Arguably, this difference resulted in the larger prosodic prominence reduction in the current study.

Thus, we would like to argue that there are many factors that contribute to the relative prominence-reducing capacity of givenness and the relative prominence-lending capacity of

contrast. There is a multitude of details that are relevant, such as metrical structuring, concrete implementations of constituent contrast and givenness, the precise discourse conditions, and – of course – the type of speech act.

8 Conclusion

The current study makes a contribution to disentangling dimensions of IS in their impact on prosodic prominence. We could show that the given-new dimension and the focus-background dimension in the shape of contrast impose independent, additive requirements on the prosodic realization of two non-assertive speech acts: *wh*-questions and *wh*-exclamatives. By crossing constituent contrast with the given-new dimension, we could show that contrast is marked both on new and on given constituents, and that givenness is marked both on non-contrastive and on contrastive constituents.

Importantly, both contrast and givenness have not only local but also non-local effects, both in the prenuclear and in the post-nuclear regions, contributing to the literature highlighting the relevance of the prenuclear region for IS marking in German (Baumann, Grice, Steindamm, 2006; Roessig, 2023; Seeliger & Repp 2020, 2023). Our findings corroborate the assumption that IS marking is a global affair. They support the suggestion by Seeliger & Repp (2023) that the phonological category that is central for IS marking is *prominence balance*, i.e., a characteristic of a larger prosodic constituent (the intonation phrase), rather than a characteristic of individual constituents. Reducing the prosodic prominence of pre- and postnuclear parts of the utterance maximizes the prosodic distinctiveness of constituents whose IS status requires a high positive prosody balance. For constituents whose IS status does not require a high but rather a level balance, increasing the prosodic prominence of pre- and postnuclear parts of the utterance contributes to the required level balance. For constituents where IS requirements combine, compromises are called for, where *compromise* is a different conceptualization of the additivity of effects of contrast and givenness: speakers make compromises for the prosodic realization of objects whose IS varies along the two dimensions given/new and contrastive/non-contrastive.

In their discussion of competing requirements from IS and illocution, Seeliger & Repp (2023), speak of a ‘wish-list’ for prosodic realization. They show for polar exclamatives with contrastive objects that contrast marking can overwrite the *typical* speech act marking in polar exclamatives (accent on the subject *d*-pronoun), if a *non-typical* contour which is compatible both with contrast and with speech-act marking can be produced (no accent on the subject *d*-pronoun but only on the object). As a result, both the ‘wish’ (requirement) for a positive prosody balance for contrast and the ‘wish’ (requirement) for the realization of the (flexible)

constructional prosodic default for exclamatives are fulfilled. In the current study, the result of combining illocutionary and IS requirements differs from that for the polar exclamatives investigated by Seeliger & Repp (2023). Contrast marking in *wh*-exclamatives is present, but it conflicts with the double-accent structure that seems to be typical for transitive *wh*-exclamatives. We did not observe deaccentuation or any other contrast-related prosodic effects in the prenuclear region in *wh*-exclamatives. As already speculated in the General Discussion, the constructional prosodic default seems to be different for *wh*-exclamatives than for polar exclamatives. Because of this different constructional default, the positive prominence balance for contrast is smaller in *wh*-exclamatives than in polar exclamatives. In *wh*-exclamatives, the constructional default is the 'winner' in the competition of the different prosodic requirements – contrast, givenness, illocution – in terms of accentuation. IS only has small, acoustic effects.

For *wh*-questions, the combination of prosodic requirements from the three prominence-impacting sources – contrast, givenness, illocution – results in a compromise both in terms of accentuation and in terms of acoustic measures. As a result, the requirements of all sources are partially met: They are met *to some extent* and *at the expense of the other requirements*. This is a true compromise.

An important finding regarding questions, which we can now consider as fairly stable across a number of studies, is that a positive prominence balance in rising contours is signaled by low pitch, i.e., a L* accent. Thus, we think that it is safe to say that contrast is not signaled by a particular type of accent as was often assumed in previous literature, notably L+H* (Baumann et al., 2007; Grice et al., 2005; Kohler, 1991; 2005; Ritter & Grice, 2015; also cp. Pierrehumbert & Hirschberg, 1990). Rather, as we argued throughout, contrast is signalled by a large positive prominence balance, which means a large deviation from the pitch baseline. Whatever accent is considered to be prominent by speakers (and by speakers) can be used. Thus, in falling contours, L+H* often is used to implement high prosodic prominence, but H* also is used and the pitch peak can be aligned later within the accent type (Grice, Ritter, Niemann & Roettgoer, 2017). In rising contours, L* is prominent, as we have seen. Level prominence balance similarly need not be associated with low pitch. It can involve high pitch, if the base pitch is rising (high), as observed by Repp (2020).

In conclusion, our research has shown that givenness and contrast have combined effects on the prosodic realization of *wh*-questions and *wh*-exclamatives, and that the effects they make depend on the speech act, thus corroborating findings from earlier research on non-assertive speech acts. Our study has shown that it is important to study different sources regarding the requirements on prosodic prominence, and to carefully disentangle their different contributions.

We saw that the solutions that speakers choose to meet the different requirements sometimes show clear prioritizations – as choosing a double-accent structure for *wh*-exlamatives but not for polar exclamatives – and sometimes seem to result in more even compromises.

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