The prosody of rhetorical questions

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1. Introduction

The present paper deals with the prosody of rhetorical questions as compared to information-seeking questions in three related languages: English, German and Icelandic. The study includes two question types: polar questions (Does anyone like liver?) and wh-questions (Who likes liver?). The focus of the prosodic analysis is on their intonational characteristics, as well as on the phonetic parameter of duration.

1.1 Information-seeking and rhetorical questions

Prototypical questions (i.e., information-seeking questions, henceforth ISQs) perform the directive speech act of requesting information. Polar questions "request an answer that specifies whether the proposition expressed by their sentence radical holds or does not hold" (Krifka 2011:1747), i.e., the expected answer may be "yes" or "no" (Groenendijk and Stokhof 1984, Karttunen 1977). Semantically, polar questions hence denote the set of possible answers (or resolutions) \{p, ¬p\}; but see Biezma and Rawlins (2012). Wh-questions, on the other hand, "create an open proposition by leaving parts of the description of the proposition unspecified" (Krifka 2011:1744). In English, the open parameter is represented by a wh-pronoun (e.g., who), correspondingly in German by a w-pronoun (e.g., wer 'who') and in Icelandic by a he-pronoun (e.g., hvir 'who'). The expected answer is one that provides information about the open parameter. Semantically, a wh-question is either represented as a set of propositions that would constitute felicitous answers (Groenendijk

*The research presented here is the result of highly collaborative work. Bettina Braun and Nicole Dehé are co-PIs of a research project on "The production and perception of rhetorical questions in German" funded by the German Research Foundation (DFG) as part of the research unit "Questions at the Interfaces" (FOR 2111; project P6, grant numbers BR 3428/4-1 and DE 876/1-1; University of Konstanz). Jana Nitsch, Daniela Wochner and Katharina Zahner are PhD students working on the project. I am grateful to all project members, especially Bettina Braun, for the fruitful collaboration. I would also like to thank Anja Arnold, Tolló Eyþórsson, Ári Kristjánsson, Margrét Pálldóttir, Jörgen Pind, Sigríður Sigurjonsdóttir, Sigríður Sárunn Sigurðardóttir, and Christiane Ulbrich for contributing in various indispensable ways to the successful realization of the English and Icelandic experiments.

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Moreover, the high rise (H-H-H%) frequently occurs with polar ISQs in English (e.g., Bartels 1999, Hedberg et al., 2017). Polarity ISQs in German have also been described as ending in a final rise by von Essen (1964) and Fery (1993), but falling polar questions have also been reported in the literature; see e.g. Setting (1995) for North-West German speakers, and Kügler (2003) for Upper Saxon German speakers. Analyzing the intonational terminus in questions in German, appointment-making dialogues, Kügler (2004) found that polar questions were predominantly rising (70%; high rise: 40%; low rise: 30%), but also that a considerable proportion (21% of the polar questions) was falling. Kügler (2003) considers the possibility that falling polar questions are more frequent in spontaneous than in read speech.

Unlike in English and German, the default intonational contour of polar questions in Icelandic ends in a low boundary tone L% (Arason 1998, 2005, 2011, Dehé 2018). The typical nuclear pitch accent in Icelandic polar questions is a rise from a low target on the accented syllable (late rise: L*-H%), the peak being reached after the end of the nuclear syllable (Arason 2011). Combined with the low boundary tone, the typical nuclear contour is thus a rising-falling one (L*-H L%).

Wh-ISQs are generally assumed to be falling to L% in all three languages. In English, they are typically assumed to be produced with a nuclear high fall, i.e. H* L-L%. In German, wh-ISQs are also typically produced with a nuclear high fall (H-L%), whereas in Icelandic, high falls (H-H%) are commonly produced.

The present paper presents a study that investigates the prosodic characteristics of polar and wh-RQs and ISQs in English, German, and Icelandic, and discusses theoretical implications of the results. The remainder of this section introduces the reader to the intonation of ISQs and RQs as described in previous literature, followed by hypotheses for the current study. Section 2 reports on a production experiment carried out with parallel materials in the three languages. Section 3 discusses the results, making an important contribution to our knowledge about question intonation and the prosodic means to mark illocutionary type in interrogatives (ISQ vs. RQ). Section 4 is a conclusion.

1.2 The intonation of information-seeking and rhetorical questions

1.2.1 The intonation of Information-seeking questions

According to previous studies, English polar ISQs are predominantly realized with a low rise, i.e. L* H-H% in autosegmental-metrical phonology (Bartels 1999, Hedberg and Sosa 2002, Hedberg et al., 2010, Pierrehumbert and Hirschberg 1990, Schubiger 1958).
assertion, and are thus realized with falling intonation, like declaratives expressing assertions, but unlike polar ISQs. Bananazizi and Creswell (1999) investigated the intonation of polar questions based on data taken from the Switchboard corpus of telephone conversations. They analyzed a total of 102 polar RQs and 2106 polar ISQs. Of the 102 RQs, 45 (44.1%) were falls and 57 (55.9%) were rises, compared with 89.7% of rises for polar ISQs. Bananazizi and Creswell (1999) link the default intonational rise in "genuine" polar questions to the sincerity conditions that they must meet. RQs, they argue, violate these conditions. In particular, in the speaker's mind, the answer to an RQ is "either perfectly obvious or perfectly obviously knowable". An answer is therefore not required or expected to an RQ, and there is therefore no need for an intonational rise. This explains the higher frequency of final falls with polar RQs than with polar ISQs in their corpus data (44.1% vs. 10.3%), but it does not explain the high percentage of rises found in RQs (55.9%). According to Barbets (1999:ch. 8.2), whose study is mostly based on fictive data, polar RQs may be rising or falling, depending on polarity (positive vs. negative sentence radical) and speaker commitment to the proposition. Specifically, in her examples, H-H% cues "the speaker's commitment to the polar opposite of [the surface] proposition" (Bartels 1999:255), whereas L-L% cues assertiveness.

Rhetorical w-h-RQs have been claimed to be realized with a rise-fall, "less commonly a simple falling tone" (Quirk et al. 1985:826). In her theoretical study, Han (2002) assumes for w-questions "that the intonational contour serves as a cue that a w-question is a rhetorical question that expresses an assertion" (Han 2002:217), but does not specify exactly how this is done. Since assertions typically have falling intonation, we may infer that Han assumes w-h-RQs to have falling intonation, too. However, since w-h-ISQs are also falling, this would not distinguish w-h-ISQs from w-h-RQs. So while Han seems to advocate an intonational distinction between (assertive) RQs and (non-assertive) ISQs, for w-questions it is not clear what this difference would be. According to Barbets (1999:ch. 8.2), w-h-RQs, like polar RQs, may have either rising or falling intonation, but the reasoning is different for the two question types. For w-questions, she argues, non-tonal cues (e.g., the context) are responsible for interrogative utterances to be interpreted as questions or statements, i.e. in w-questions (unlike in polar questions) "L does not necessarily indicate non-assertionness" (Bartels 1999:257; italics in original). Factors affecting the intonation of wh-questions according to Barbets include politeness strategies (see also Bananazizi and Creswell 1999) and didactic stratagems.

1.2.3 Intonation: Summary
The intonational patterns of ISQs and RQs as outlined above are summarized in (1) for all three languages. Note that the contours provided for ISQs are based on experimental and corpus work, whereas the contours for RQs are mostly based on theoretical work and introspective data, i.e. they do not rest on actual prosodic evidence. Stylized intonation contours are provided for illustration.

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>German</th>
<th>Icelandic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISQ</td>
<td>L* H-H%</td>
<td>L* H-H%</td>
<td>L* H-H%</td>
</tr>
<tr>
<td>RQ</td>
<td>Rise</td>
<td>Rise-fall</td>
<td>Rise-fall</td>
</tr>
<tr>
<td>Wh</td>
<td>Fall: H%L%</td>
<td>Fall: H%L%</td>
<td>Fall: H%L%</td>
</tr>
<tr>
<td>RQ</td>
<td>Rise-fall, rise-fall</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1.3 Hypotheses
Hypothesis H1 follows directly from the literature survey in Section 1.2. Several authors assume intonational differences between ISQs and RQs, although the specific parameters contributing to these differences have not previously been approached experimentally and remain unclear in previous literature. Hypothesis H2 goes beyond the assumptions in most of the literature. While some authors limit their discussion to final edge tones (e.g. Barbets 1999, Han 2002), the current study takes into account further intonational categories in earlier parts of the intonational contour, specifically prenuclear and nuclear pitch accents, to investigate the intonational differences between illocution types. Hypothesis H3 adds one phonetic parameter – duration – to the intonational ones. Hypothesis H4 relates to the assumption that certain differences between ISQs and RQs may be language-specific.

- H1. In production, ISQs and RQs generally differ in their intonational realization.
- H2. Intonational, boundary tones, nuclear and prenuclear pitch accents contribute to the overall different prosodic realization of ISQs and RQs.
- H3. Along with intonational parameters, phonetic parameters (e.g. duration) are responsible for the overall different prosodic realization of ISQs and RQs.
- H4. All languages investigated here make use of intonational categories to signal illocution type. The exact way of doing this may be language-specific.

2. Production experiment
A production experiment was designed and carried out in English, German and Icelandic to test hypotheses H1 through H4.

2.1 Method
2.1.1 Materials
Eleven pairs of wh- and 11 pairs of polar interrogatives and accompanying contexts were constructed. Target interrogatives and contexts were originally constructed in German and
were translated into English and Icelandic as closely as possible by native speakers of the respective language. All German target interrogatives included the particle *denn*, which is known to appear in both polar and *wh*-questions (Thurmair 1991). The particle was removed in the translations. One question pair was removed in the English and Icelandic versions, leaving 21 pairs in these two languages. Each question was felicitous in an information-seeking context as well as a rhetorical one, resulting in 22/21 quadruples (examples in (2)-(3); German and Icelandic targets in (4) and (5), respectively). In contexts triggering an *ISQ* reading of the target interrogative, the answer was obviously not known to the speaker and would thus have been highly informative. The description of the context situation was therefore followed by a sentence starting "You would like to know" or similar (see left-hand columns in (2) and (3)). In contexts triggering an *RQ* reading of the target interrogative, there was no uncertainty about the answer. Instead, the answer to the *RQ* was obvious from the context, i.e. common ground in the given situation. This was achieved by the string *It is well known that* or similar (see right-hand columns in (2) and (3)).

<table>
<thead>
<tr>
<th>Context for ISQ</th>
<th>Context for RQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>At a garden party, you offer canapés with Limburger cheese. You would like to know which of the guests eat this and whether they want some of it or not. You say to the guests:</td>
<td>Your friend offers his guests a cheese tray, including Limburger. However, it is well known that none of your friends like stinky cheese and therefore, nobody will touch it. You say to your friend:</td>
</tr>
<tr>
<td><strong>Target:</strong> Does anyone eat Limburger?</td>
<td></td>
</tr>
</tbody>
</table>

**Contexts and target wh-interrogatives**

<table>
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<th>Context for ISQ</th>
<th>Context for RQ</th>
</tr>
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<tbody>
<tr>
<td>At a garden party, you offer canapés with Limburger cheese. You would like to know which of the guests eat this and want some of it. You say to the guests:</td>
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</tr>
<tr>
<td><strong>Target:</strong> Who eats Limburger?</td>
<td></td>
</tr>
</tbody>
</table>

**German target interrogatives**

<table>
<thead>
<tr>
<th>a. Mag denn jemand <strong>Sellerie</strong>?</th>
<th>b. Wer mag denn <strong>Sellerie</strong>?</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>LikesPART anyone celery</em></td>
<td><em>Who likes <strong>PART</strong> celery</em></td>
</tr>
</tbody>
</table>
| *Does anyone like celery?*             | *

**Icelandic target interrogatives**

<table>
<thead>
<tr>
<th>a. Borðar einhver <strong>limónr</strong>?</th>
<th>b. Hver <strong>borðar limónur?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Eats anyone limes</em></td>
<td><em>Who eats limes</em></td>
</tr>
<tr>
<td><em>Does anyone eat limes?</em></td>
<td><em>Who eats limes?</em></td>
</tr>
</tbody>
</table>

1 Note that unlike English, German and Icelandic do not have do-support in polar questions, thus the lexical verb is in initial position in German and Icelandic polar questions.

2.1.2 Procedure

Two basic experimental lists were constructed. Each list contained both questions types (polar and *wh*), and both illocution types (*ISQ* and *RQ*). In the English and Icelandic versions, the members of the quadruples were distributed across the two lists such that one list contained 11 polar and 10 *wh*-questions, the other list contained 10 polar and 11 *wh*-questions. In the German version, each list contained the polar question for half of the question-pairs and the *wh*-question for the other half. Illocution type was thus manipulated within-subjects. The same polar or *wh*-question occurred twice in each list, one in an *ISQ* context, the other in an *RQ* context. For example, the items in (2) were members of list 1, the items in (3) appeared in list 2. The filler items were added to both lists. The participants were randomly assigned to one of the two lists. The lists were randomized for each participant separately in such a way that the two readings of a question were separated by at least four other trials. Each experiment started with four familiarization trials (three in the Icelandic version). These were followed by a short break, during which the participants were allowed to ask questions. The experiment was controlled using the experimental software Presentation (Neurobehavioural-Systems, 2000). Each trial started with the visual display of the context, which the participant had to read silently. After a button press, the target interrogative appeared on the same screen. The participants were instructed to read each context carefully and to utter the target and filler sentences as naturally as possible and in such a way that they were suitable in the given context. The recording started with the appearance of the target interrogative on the screen. The participants pressed a button to proceed to the next trial. The recording was stopped at this point. Participants were allowed to repeat the target in case of mistakes. The experiment was self-paced and lasted about 25 to 30 minutes. No feedback was provided during the experiment. The contexts were presented in black Calibri 40 font and the target sentences in blue Calibri 40 font, all on white background. Productions were recorded using a head-set-microphone (Shure SM10A) and digitized directly onto a PC (44.1 kHz, 16Bit, stereo).

2.1.3 Participants

The participants entering the analysis were 21 native speakers of North American English from Canada (7 male, 14 female; average age = 22.5 years), 20 monolingual native speakers of German (15 female, 5 male; average age = 21.7 years) and 17 native speakers of Icelandic (6 male, 11 female, average age = 26.9 years). They were tested in sound-attenuated rooms at the University of Alberta, Canada, the University of Konstanz, Germany, and the University of Iceland, respectively. The participants were unaware of the purpose of the experiment. None of them reported any speaking or hearing disorders.

2.1.4 Data treatment and analysis

Overall, 918 English, 880 German, and 714 Icelandic target interrogatives were produced. Of these, all target interrogatives containing slips of the tongue, speech errors, omissions or inclusions of lexical material, or stammering or laughter on the part of the speaker were
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2002. For the statistical analysis of duration, linear mixed effect regression models were run with the same specifications and model fitting as described above. P-values were calculated using the Satterthwaite approximation of degrees-of-freedom. To avoid Type I errors, p-values were adjusted by means of the Benjamini-Hochberg correction (Benjamini and Hochberg 1995).

2.2 Results

This section reports the results of the phonological (intonational) and phonetic analyses, i.e. for boundary tones, nuclear and prenuclear accents, and duration. Within parameters, results are first reported for polar questions, followed by wh-questions. The focus is on the relevant differences between illocution types (ISQs vs. RQs) and languages (English, German, Icelandic).

2.2.1 Boundary tones

The results for boundary tones are summarized in (7) for the three languages. They show that in polar questions, English and German make use of the boundary tone to distinguish between ISQs and RQs, but Icelandic does not. In wh-questions, the boundary tone is relevant in German only.

(7) Distribution of final boundary tones across question types and illocution types: statistically significant differences are marked by asterisks; n.s.: not significant

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>German</th>
<th>Icelandic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>polar questions</strong> ISQ</td>
<td>82% H-H%</td>
<td>83% H-H%</td>
<td>95.5% L-% n.s.</td>
</tr>
<tr>
<td>RQ</td>
<td>46% H-H%</td>
<td>27% H-H%</td>
<td>100% L-%</td>
</tr>
<tr>
<td><strong>wh-questions</strong> ISQ</td>
<td>89% L-L%</td>
<td>48% L-%</td>
<td>88% L-% n.s.</td>
</tr>
<tr>
<td>RQ</td>
<td>87% L-L%</td>
<td>28% L-H%</td>
<td>100% L-%</td>
</tr>
</tbody>
</table>

In English polar questions, the steep rise to a high terminal (H-H%) was overall very frequent in both ISQs and RQs. However, it was significantly more frequent in polar ISQs than in polar RQs (B=2.7, SE=0.8, z=3.4, p<0.0001, p_{adj}=0.0006). At the same time, RQs were comparatively more often realized with a mid-high final plateau (H-L%) in polar RQs than in polar ISQs (B=5.0, SE=2.0, z=2.4, p<0.01, p_{adj}<0.02), i.e. RQs did not have as many steep rises as ISQs. A similar difference was found for German polar questions. High rises (H-H%) were significantly more frequent in ISQs (B=2.8, SE=0.3, z=10.1, p_{adj}<0.0001), while high plateaus (H-L%) were significantly more frequent in RQs (B=5.5, SE=1.5, z=3.8, p<0.0002, p_{adj}<0.0004). In Icelandic polar questions, however, L-% was found in almost all ISQs and in all RQs. In English wh-questions, the most frequent edge tone was L-L% in both ISQs and RQs, i.e. wh-questions were predominantly falling regardless of illocution type, thus there was no effect of illocution type on edge tone. The results are very similar for Icelandic wh-questions. For Icelandic, it was impossible to compare the distribution of L%-boundary

Note some relevant notational differences between Tobi and GToBI. For example, * in Tobi marks the upstep of a tone in accents and at boundaries, i.e. *H% marks a high boundary, which is higher than preceding peaks in the same utterance. H*-H%, H-% and L-% are labels according to GToBI, which are not identical to the original Tobi for English. H*-H% in GToBI corresponds to H-H% in Tobi, L-% in GToBI corresponds to L-L% in Tobi. Since a Tobi framework does not yet exist for Icelandic, the annotation of the Icelandic data generally follows the original Tobi, and borrows * for upstep from GToBI.

The duration of the relevant constituents was automatically extracted from the annotation. For the statistical analysis of accent types and boundary tones, logistic mixed effect regression models were run with illocution type (ISQ vs. RQ) as fixed factor and participants and items as crossed random factors (adjustment of intercepts). For dependent variables with more than two levels, one level was coded 1 and all other levels 0 (Agresti, 2002).
In Icelandic polar questions, the nuclear accent was realized on the object noun throughout. Both polar ISQs and polar RQs were typically realized with a rising binatal nuclear pitch accent (L+H), but the rises in the two illocution types differed in timing. The most frequent nuclear pitch accent in polar ISQs was the late rise (L*+H and L*+H*, together 55.8%), followed in frequency by the early rise (L+H* and L*+H*, together 41%). In Icelandic polar RQs, the most frequent accent type was the early rise (L+H*, L+HH* and L+*H*), adding up to 68.2%. This was followed in frequency by late rises (L*+HH, L*+H, and L*+H*, together 28%). Late rises were significantly more frequent in ISQs than in RQs (p=0.1, SE=0.3, z=5.6, p<0.0001), while early rises were significantly more frequent in RQs than in ISQs (p<2.8, SE=0.5, z=6.3, p<0.0001).

The timing of the nuclear rise is illustrated in (9), using the Icelandic polar question Les einkvar novella? "Does anyone read novels?". The polar ISQ (left) is realized with a late rise (L*+H), i.e. the low target is located in the vowel of the accented syllable, and the peak is reached outside the nuclear syllable, here within the median consonant /l/ at the boundary of the second and third syllables of the object noun novellur. The polar RQ (right) is realized with an early rise (L+H*). Both L and H are aligned in the nuclear syllable. The peak is reached within the vowel of the nuclear syllable (interval 9c to 11c).

(9) Timing of the rise: Late rise (ISQ: left) vs. early rise (RQ: right) in polar questions, zooming in to nuclear area; nuclear syllable <nd> marked by rectangle
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particularly relevant, with generally more prenuclear accents in RQs than in ISQs. In wh-
questions, the type of accent matters most in English, and both features matter in Icelandic.
In German polar questions, the accent type also plays a role. Unlike in English and
Icelandic, the distribution of prenuclear accents contributes to the distinction between ISQs
and RQs in German wh-questions, with more unaccented wh-pronouns but more accented
verbs in RQs than in ISQs. The results are reported in more detail immediately below.

In English polar questions, the sentence-initial auxiliary (does) was unaccented almost
across the board in both ISQs (98%) and RQs (99%). The lexical verb was mostly
unaccented, but there were more unaccented verbs in ISQs (74.8%) than in RQs (55.8%),
and the difference was statistically significant ($\beta=2.0, SE=0.5, z=4.1, p=0.001$).
In Icelandic polar questions, the sentence-initial verb was mostly unaccented
in ISQs (65.6%), but mostly accented in RQs (67.5%). The difference was statistically
significant ($\beta=2.0, SE=0.5, z=4.1, p=0.001$). Within accented verbs in RQs, the
most frequent accent type was *L*-H+, which occurred significantly more frequently in RQs
than in ISQs ($\beta=3.5, SE=1.1, z=3.3, p=0.001$). The subject in Icelandic polar questions
was mostly unaccented in both illocution types, but significantly more so in ISQs than in RQs
($\beta=2.9, SE=0.6, z=4.6, p=0.001$). In German polar questions, both the modal particle denn
and the subject jemand 'anyone' were typically unaccented. The verb was more often
accented than unaccented, and if it was accented, it was most often realized with H+ in
both illocution types (ISQs: 52.1%; RQs: 45.7%). However, there were significantly more
L*-H+ in RQs (30.0%) than in ISQs (20.7%) ($\beta=0.8, SE=0.3, z=2.8, p=0.005$,
$p_{\text{adj.}}=0.008$).

In English wh-questions, there was no difference in frequency of prenuclear accent
placement on the wh-word or the verb between ISQ and RQ. However, there was a
difference in accent type. If accented, the wh-word was more often realized with an L*-H+
accent in RQs (70.4%) than in ISQs (46.9%), a difference that was statistically significant
($\beta=1.3, SE=0.2, z=5.4, p<0.0001, p_{\text{adj.}}=0.0009$). Conversely, there were significantly more
H+ accents in ISQs (34.7%) than in RQs (14.8%) ($\beta=1.4, SE=0.27, z=5.1, p=0.0001$,
$p_{\text{adj.}}=0.0009$). This difference can be observed in (10) above. The wh-pronoun has
a prenuclear mononuclear peak accent (H) in the ISQ (left), but it has a prenuclear
bitalon L*-H+ accent in the RQ (right). In Icelandic wh-questions, approximately a third of the
wh-words was unaccented (ISQ: 34.3%, RQ: 36.7%, difference not significant). Among
the accented wh-words, L*-H+ was most frequent in RQs, and it was significantly more
frequent in RQs than in ISQs ($\beta=2.6, SE=0.4, z=5.9, p<0.0001$). Among the accented
wh-words in ISQs, L*-H+ was most frequent (57.9%), and it was significantly more frequent
in ISQs than in RQs ($\beta=1.0, SE=0.3, z=3.5, p=0.0004$). Within accented wh-words, there
were generally mostly mononuclear accents in ISQs (H+ and L* together 91.7%), while in RQs
there were slightly more bitonal accents (53.3%). This effect of illocution type was
significant such that there were more mononuclear prenuclear accents on wh-words in ISQs
than in RQs ($\beta=3.1, SE=0.5, z=5.9, p<0.0001$). Also for Icelandic wh-questions, verbs
were mostly unaccented (96.4%, RQ: 62.7%), although there were significantly more
unaccented verbs in ISQs than in RQs ($\beta=3.1, SE=0.5, z=6.4, p<0.0001$). The most
frequent prenuclear accent on the verb in wh-RQs was H*.

In German wh-questions, the wh-pronoun was mostly unaccented in both illocution
types, but significantly more so in RQs (ISQs: 61.9%; RQs: 75.1%; $\beta=0.8, SE=0.3, z=2.7$,
$p=0.007, p_{\text{adj.}}=0.008$). There were significantly more unaccented verbs in ISQs (45.1%)
than in RQs (31.5%) (t=0.9, SE=0.3, z=2.7, p=0.006, p(adj)mul=0.009). The most frequent accent type on verbs in RQs was the monotonal H* (47.4%), which was significantly more frequent in RQs than in ISQs (38.6%) (t=0.5, SE=0.2, z=2.0, p=p(adj)mul=0.05). Finally, the particle denn was typically unaccented throughout.

2.2.4 Duration

The results for duration show that in all three languages, utterance duration and the duration of individual constituents is generally longer in RQs than in ISQs. For reasons of space, examples are presented here only from English and Icelandic (but see Section 3 for German). The results reported on here are plotted in (11) and (12) for English and Icelandic, respectively. In English, we find longer durations for major syntactic constituents in both polar and wh-RQs. In polar questions, the subject (anyone) was on average 50 ms longer in RQs than in ISQs (t=50.0, SE=8.1, t=21.0, p<0.01, p(adj)mul=0.02). Likewise, the object was 57 ms longer in RQs than in ISQs (t=56.9, SE=9.3, t=20.6, p<0.02, p(adj)mul=0.03). In English wh-questions, the duration measures showed longer absolute durations of the wh-word and the object in RQs compared to ISQs. The wh-word was on average 28 ms longer in RQs than in ISQs (t=28.4, SE=6.8, t=20.9, p<0.004, p(adj)mul<0.007). The duration of the syntactic object was 104 ms longer in RQs than in ISQs (t=104.2, SE=12.7, t=8.2, p<0.001, p(adj)mul≤0.002).

In Icelandic polar questions, the sentence-initial verb was on average 66.7 ms longer in RQs than in ISQs (t=66.9, SE=0.1, t=16.7, p=6.4, p<0.01). In wh-questions, the wh-word was on average 58.4 ms longer in RQs than in ISQs (t=60.7, SE=0.01, t=18.8, p=4.6, p<0.0005). There was also a significant effect of illocution-type on the duration of the nuclear syllable in both question types. The accented syllable was on average 62.9 ms longer in polar RQs than in polar ISQs (t=62.7, SE=0.007, t=14.0, p=8.2, p<0.0001). In wh-questions, the accented syllable was on average 90.7 ms longer in RQs than in ISQs (t=90.2, SE=0.008, t=18.3, p=11.4, p<0.0001). Within the nuclear syllable, the effect was due to lengthening of both the onset and the rhyme of the syllable; see (12). The onset consonant was on average 29.7 ms longer in polar RQs than in polar ISQs (t=30.3, SE=0.003, t=14.8, t=9.9, p=0.0001), and 44.9 ms longer in wh-RQs than in wh-ISQs (t=43.3, SE=0.004, t=26.4, t=10.7, p<0.0001). The rhyme was on average 32.6 ms longer in polar RQs than in polar ISQs (t=32.9, SE=0.005, t=19.4, t=7.3, p<0.001), and it was 50.2 ms longer in wh-RQs than in wh-ISQs (t=50.6, SE=0.007, t=19.4, t=7.0, p<0.001).

3. Discussion

This paper set out to identify prosodic differences between ISQs and RQs in three languages: English, German and Icelandic. Intonational and phonetic parameters were tested (boundary tones, nuclear and prenuclear pitch accents, duration). This section discusses the results and their implications. The hypotheses are repeated directly below.

H1. In production, ISQs and RQs generally differ in their intonational realization.

H2. In intonation, boundary tones, nuclear and prenuclear pitch accents contribute to the overall different prosodic realization of ISQs and RQs.

H3. Along with intonational parameters, phonetic parameters (e.g. duration) are responsible for the overall different prosodic realization of ISQs and RQs.

H4. All languages investigated here make use of intonational categories to signal illocution type. The exact way of doing this may be language-specific.

ISQs and RQs differ in their intonational realization in all three languages, confirming H1 as well as general assumptions in the literature. In line with H2, boundary tones, nuclear
and prenuclear pitch accents all contribute to the overall different prosodic realization of ISQs and RQs. Effects of illocution type were found for all intonational parameters. Along with intonation, duration is also used to convey illocution type, confirming H3. There were overall longer durations in RQs than in ISQs. Duration was reported in Section 2 for English and Icelandic only, but similar effects have been found for German. They were first reported in Wochner et al. (2015), who found overall longer utterance durations for RQs than for ISQs in both polar and wh-questions, as well as longer durations of the object noun, wh-word and verb in wh-RQs than wh-ISQs. The Icelandic duration results are interesting from a phonological perspective, because in the literature on Icelandic syllable structure, lengthening of a stressed syllable, e.g. due to emphasis, has been described as lengthening of the rhyme (V in open syllables, coda C in closed syllables; see Arnason 2011 and references given there). The current study shows that speakers lengthen the onset consonant, too, at least to indicate illocution type. In line with H4, all three languages make use of intonational categories to signal illocution type, but the exact way of doing so is indeed language-specific. In particular, the boundary tone has more impact in German than it has in English, and in English, it has in turn more impact than in Icelandic. In German the boundary tone contributes to the distinction between ISQs and RQs in both polar and wh-questions. In polar questions, the difference is between a frequent rise in ISQs and a frequent plateau in RQs. Within German wh-questions, RQs are mostly falling, but the boundary tone in ISQs is more varied. In English, on the other hand, the boundary tone contributes to the difference between illocution types only in polar questions, such that ISQs mostly ended in steep rises, while RQs ended in plateau (H-L%) in more than 50% of the cases. In English wh-questions, however, a fall of the intonational contour to L-L% is frequent both in ISQs and RQs. In Icelandic, the boundary tone does not mark illocution type at all, because the contour falls to L% almost throughout. Note that the Icelandic tonal inventory does have H%, but L% seems reserved for special connotations and continuation rises (Arnason 1998, 2005, 2011, Dehé 2009).

It is particularly noteworthy that boundary tones do not distinguish between illocution types in all languages or question types. In previous literature, the intonational distinction has sometimes been put down to edge tones alone (Bartels 1999, Han 2002; see Section 2) without taking into account the rest of the utterance, i.e. without considering the intonational contour up to the terminus. The current study clearly shows that this is not enough to focus on the boundary tone, because nuclear and prenuclear pitch accents contribute to the distinction between illocution types, too. Moreover, the present study shows that in cases in which the boundary tone does play a role (German polar and wh-questions, English wh-questions), it is not enough to distinguish between falls and rises. Instead, a (mid-) high plateau is frequent in English and German polar RQs. One crucial difference between polar ISQs and polar RQs in both English and German is that a steep rise is typical of ISQs (English H-H%, German H-H%), while we find more than 50% plateau in RQs (English H-L%, German H-H%). Roughly speaking, the result is then a threelfold distinction between steep rise in polar ISQs, (mid-) high plateau in polar RQs, and fall (English L-L%, German L-%) in wh-questions and declaratives. It almost seems as if the plateau were ideal to terminate an RQ, i.e. an utterance that is interrogative in syntactic form, but which has the feel of an assertion. Crucially, a fall to L% is not typical of English polar RQs, against Han (2002). The fact that Icelandic does not make use of the boundary tone to mark illocution type is in line with previous findings in the


All three languages investigated here make use of the nuclear pitch accent to distinguish between ISQs and RQs in both polar and wh-questions. It is interesting to note that the same characteristics of pitch accents play a role in different languages, but not in the same way. All three languages make use of the distinction between monotonal and bitonal pitch accents in signaling illocution type, but while German does so in polar questions, English and Icelandic do so in wh-questions. The timing of the rise in bitonal nuclear accents is relevant in Icelandic polar questions and in German wh-questions, but not in English. While Icelandic polar questions use mostly late rises in ISQs and mostly early rises in RQs, in German wh-questions we find the opposite. The position of the nuclear accent (placed on syntactic subject vs. object) contributes to the distinction between polar ISQs and polar RQs in English, but not in German or Icelandic.

Along with the nuclear accent, the prenuclear region contributes to the distinction between ISQs and RQs in all three languages in some way. Both the presence of a prenuclear accent on a particular item and the type of pitch accent play a role. It seems that in English and Icelandic polar questions, it is the presence vs. absence of a prenuclear accent that is particularly relevant, while in wh-questions it is the type of accent that matters in English and German, and both the presence vs. absence and the type of accent in Icelandic. We find similarities between Icelandic and English such that more and stronger (i.e., bitonal) prenuclear accents are found in RQs than in ISQs. It follows from all this that the intonational parameters used to signal illocution type may be the same in different languages, but the way they are employed are language-specific. Notice that the phonetic, the manner of duration goes in the same direction in all three languages: RQs have longer durations than ISQs throughout. At the prosodie pragmatics interface, this study shows that intonation as well as duration are used by speakers to distinguish between illocution types, i.e. the results add to the evidence suggesting that prosody, along with other factors (such as the context), helps to distinguish between possible meanings of an utterance. Unlike other studies focusing on RQs, this study identifies a number of actual prosodic means speakers use to mark illocution type. Crucially, speakers employ a range of prosodic parameters, rather than the boundary tone, or the distinction between utterance-final rise or fall, alone, thus the course of the whole intonational contour, as well as its phonetic properties, is relevant, not just the terminus.

4. Conclusion

The paper contributes to our knowledge about prosodic differences between ISQs and RQs in three Germanic languages: English, German and Icelandic. Crucially, all languages make use of intonational means to signal illocution type, but not all three of them do so in the same way. Given the focus on the terminus of the intonational contour (boundary tone, rise to H% vs. fall to L%) in previous literature, it is important to emphasize that the boundary tone does not contribute to the pragmatic meaning of an interrogative in all languages (here: not in Icelandic) and not in all question types (English: polar questions only). Moreover, three rather than two ways of terminating the contour seem relevant (rise, fall, plateau). Along with intonation, duration signals illocution type. Finally, while there is undoubtedly some variation in the intonational realization of both ISQs and RQs, there
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