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Abstract

The present accent rating study investigates the interaction between accent strength and grammatical correctness on perceived accentedness. German native (L1) listeners rated German sentences produced by L1 and non-native (L2) speakers. Sentences either contained a grammatical error or were grammatically correct. Results showed that grammatical correctness affected the accent rating of sentences produced by L1 speakers, but not of those by L2 speakers. The inverse influence of grammatical errors on sentences spoken with stronger accents suggests that phonological information plays a more important role for global perception of speech accentedness than grammatical correctness does, revealing a hierarchical importance of factors that form an L2 accent. This finding is in line with recent findings from an online processing ERP study (Hanulíková, van Alphen, van Goch, & Weber, 2012) in which L1 listeners were tolerant towards grammatical errors made by L2 speakers, i.e. showed no P600 effect for grammatically incorrect sentences.

Keywords: perceived accent strength; grammatical error

Introduction

Spoken language is notoriously variable. The auditory signal produced by a speaker can vary due to differences in voice, stress, intonation, and speaking rate, among other factors. Additionally, phonological processes of assimilation or deletion, as well as dialects and foreign accents, can lead to deviations in form from the standard of a target language. Yet, despite these deviations, listeners usually understand spoken language quite easily, suggesting that the human speech processing system is flexible and able to adapt to varying input quickly. Previous studies have shown that listeners are, for example, able to adapt to foreign-accented speech within a few minutes (Bradlow & Bent, 2008; Weber & Pöllmann, 2010). It has also been found that listeners adjust their interpretation of the speech signal so that it is in line with information about the identity of the speaker. As a consequence, sentences like "I am pregnant." are perceived to be anomalous when produced by a male speaker, because listeners are aware of semantic and pragmatic constraints which restrict the use of the adjective pregnant to females (Van Berkum, van der Brink, Tesnik, Kos, & Hagoort, 2008).

In the vein of speaker-specific adjustments in comprehension, Hanulíková et al. (2012) found in a recent ERP study that listeners are surprisingly tolerant towards grammatical errors in foreign-accented speech. When a Turkish L2 speaker of Dutch produced sentences containing a gender-agreement error, L1 Dutch listeners did not show the P600 effect typically observed for this type of syntactic error (Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005). When the same sentences were produced by an L1 speaker of Dutch, however, there was a clear P600 effect visible in the ERP response of the Dutch listeners. It is possible that Dutch listeners were so habituated to gender-agreement errors in Turkish-accented Dutch that the brain no longer marked them as errors. Interestingly, a comparable and very fast habituation was also visible for accent-free sentences in the experiment. When the study was split into two blocks, the P600 effect observed for L1 speech vanished in the second half of the experiment. This suggests that listeners adjust their model regarding the occurrence of errors even in L1 speech. This finding was in accordance with previous studies (e.g., Hahne & Friederici, 1999). Furthermore, the P600 is sometimes interpreted as an indicator of unexpectedness (e.g., Gouvea, Philipps, Kazanina, & Poeppel, 2010). In this sense, the P600 effect found for L1 speech with grammatical errors can also be interpreted as a surprisal effect.

The question that arises from the study of Hanulíková et al. (2012) is whether grammatical errors have an effect on perceived accent strength, even though they do not disrupt online processing of foreign-accented speech. Previous studies on accentedness mainly employed rating tasks that either focused on effects of speaker background or phonological deviations. One of the decisive factors for speaker background is, for example, age of acquisition (AOA). Flege, Munro, and Mackay (1995) found in a rating experiment with Italian L2 speakers of English that speakers who learned their L2 after the age of 15 hardly ever receive ratings that fall within the L1 English range. Another factor that has been found to affect a speaker's accent in L2 is length of residence (LOR), where LOR means the amount of time spent in a country in which the speaker's L2 is the dominant language. Flege and Fletcher (1992) found that LOR has effects on degree of foreign accent, although this seems to be a slow process and significant effects only showed after roughly 14 years of residence. Adding to that, gender also affects the degree of perceived accentedness. Flege et al. (1995) found that female subjects who did not learn English as their L1, but started learning it as L2 as children received higher pronunciation scores than their male peers. However, in late adolescence this picture reverses, and male subjects begin to receive higher scores when AOA increases. It is unclear, however, whether this is motivated by biological or social factors (Edwards, 2008). A second main strand in previous foreign accent rating studies investigated phonological deviations. For example, Magen (1998) showed that L1 English speakers are sensitive to syllable structure factors, consonant manner, and lexical and phrasal stress in utterances produced by L2 speakers of English with a Spanish background. More generally, it can be said that previous studies have shown a high sensitivity of L1 listeners towards non-nativeness in speech. Non-nativeness is noticed reliably in very short stretches of speech (e.g., the

release burst of stop consonants, see Flege, 1984) and even in a strongly distorted speech signal (e.g., Munro, Derwing, & Burgess, 2010).

L2 speakers typically deviate not only in the phonological form but also in grammar from the target language. How far grammatical correctness of sentences produced by L2 speakers contributes to overall perceived accentedness is still an open question. L1 speech usually manifests itself with an absence of grammatical errors, as is reflected in the strong P600 effect when errors do occur (Hanulíková et al., 2012); in foreign-accented speech, however, grammatical errors, in addition to myriad phonological and phonetic cues can be considered yet another indicator of a speaker's non-nativeness. The current study investigates this matter in a German accent rating study by incorporating grammatical errors into sentences spoken by L1 and L2 speakers of German. The L2 speakers had different L1 backgrounds in order to add variation to the study; the authors judged the L2 speakers to all have noticeable accents in German but with varying accent strength. Following the results of Hanulíková et al. (2012), two outcomes are possible: First, grammatical errors might not influence accent ratings because listeners are familiar with them, and they do not noticeably disrupt online processing. Second, it is also possible that grammatical errors do influence accent ratings, as we know that L1 listeners can reliably detect grammatical errors in foreign-accented speech reliably when asked to do so (Hanulíková et al., 2012) and are generally very sensitive towards nonnativeness in speech (Flege, 1984). Hence, it could be assumed that grammatical errors count as yet another cue towards the perceived foreignness of the speaker.

Accent Rating

Method

Participants Thirty-five monolingual L1 speakers of German (mean age = 24.4; 23 = female, 12 = male) took part in the study.

Materials Fifteen German sentences with varying syntactic structures were constructed as materials. Care was taken to avoid low frequency words that L2 speakers of German might not know. Furthermore, the entire breadth of the German sound inventory was represented in the sentences. Each sentence was prepared both with and without grammatical errors. For the incorrect versions, we used three different kinds of grammatical errors that were conside to be typical of various L2 speakers of German (see also Schwartz & Sprouse, 1994). Three typical error types in L2 German (Heringer, 2001) were chosen to disguise the grammatical error manipulation. The error types were preposition errors, case errors, and verb-agreement errors. Five of the sentences contained a preposition error of the kind given in (1a/b), where (1a) is correct and (1b) incorrect (the relevant preposition is marked in italics). The verb *kommen* 'to come' in combination with *Hause* 'home' requires the preposition *nach* 'to'.

(1a) Du musst schnell *nach* Hause kommen.
(1b) *Du musst schnell *zu* Hause kommen.
(Engl. You need to come home quickly.)

Another five sentences contained a case-error that could either be realized on the determiner or on an adjective preceding a noun, because both determiners and attributive adjectives are inflected for case in German. An example can be found in (2a/b) (a = correct, b = incorrect). The German preposition *hinter* 'behind' selects a dative NP that is marked with the dative definite article; in the case of a masculine noun like *Schuppen* 'shed', the correct form is *dem* (2a).

(2a) Hinter *dem* Schuppen steht ein altes Fahrrad.
(2b) *Hinter *der* Schuppen steht ein altes Fahrrad.
(Engl. Behind the shed, there is an old bicycle.)

Five additional sentences contained an agreement error between the main verb and the subject. An example can be found in (3a/b). Agreement takes place between the subject *du* 'you' (second person singular) and the main verb *spielen* 'to play'. The correct verb form for second person singular is *spielst*. The verb in (3b) is, on the other hand, is ambiguous between first person plural, third person plural, and the infinitive.

(3a) Du *spielst* sehr gut Fußball.
(3b) *Du *spielen* sehr gut Fußball.
(Engl. You play football very well.)

All sentences were recorded with a mobile Zoom H2N recorder in a quiet room in .wav format (24Bit/96kHz). There were two speaker groups. The L1 speaker group consisted of five female students of the University of Würzburg (Germany) whose L1 was German (age range 23-26, mean age = 24.2). The L2 speaker group consisted of five female speakers with a mixed L1 language background (Polish (1x), Kirghiz (1x), Russian (1x), Persian (2x)) of moderate to high proficiency in German with a noticeable accent in their pronunciation. At the time of recording, all L2 speakers studied at the University of Tübingen (in Germany) in various degree programs. All 10 speakers produced each of the 15 sentences in both the correct and incorrect versions (i.e., 30 sentence recordings per speaker). Speakers were asked to read all of the sentences carefully before recording them in order to avoid hesitations and uncertainties. Speakers always recorded the correct and incorrect versions of each sentence in consecutive trials, and the examiner paid attention that both versions were, apart form the grammatical error, comparable in pronunciation and fluency. Multiple tokens of each sentence were recorded, and the best tokens (i.e., recordings with no hesitations or unintentional grammatical errors) were chosen

for presentation in the study. The chosen sentences were normalized for loudness using Samplitude Music Studio 2013.

Procedure The experiment was carried out as an online rating study using the OnExp software (http://www.lingexp.uni-tuebingen.de /OnExp/). A link to the experiment was emailed to the participants, all of who were naive to the purpose of the study. Participants first had to indicate their age and language background (including L1 and dialects) in a short questionnaire. Then, they were informed that they would hear short sentences spoken by L1 and L2 speakers of German and that their task would be to rate these sentences for degree of foreign accent. The instructions did not specify that some of the sentences contained grammatical errors. Participants were asked to wear headphones to minimize background noise and distraction during the experiment. They were told that they would have to rate "accentedness" on a 9-point scale where 1 designates "no accent" and 9 "strong foreign accent" (see Southwood & Flege, 1999, for a discussion of rating scales in accent studies). The instructions and the explanation of the rating scale were visible throughout the experiment to prevent subjects from accidentally mixing up the two ends of the scale. The instructions also indicated that they should listen to each sound file only once. Participants were randomly assigned to one of five experimental lists. Each list contained 60 sentences, cross-balanced in a Latin-Square Design for *sentence* (N = 15), *language background of the speaker* (L1 and L2), and *grammatical correctness* (correct and error).

Results

In total, 2100 data points were recorded (35 participants x 60 trials). From these, 5 data points had to be discarded due to the lack of a response. Average rating scores in each *speaker group*, *grammatical correctness* and *type or error* are shown in Table 1.

Table 1: Mean rating scores and standard deviations for each condition.

speaker group	type of error	grammatical correctness	
		correct	error
	preposition	1.57 (0.89)	2.81 (1.90)
L1	case	1.37 (0.81)	2.46 (1.60)
	agreement	1.40 (0.79)	2.43 (1.79)
	preposition	5.99 (2.18)	6.69 (2.04)
L2	case	6.15 (2.11)	6.77 (1.78)
	agreement	6.24 (2.11)	6.63 (2.10)

In the following analyses, we provide statistical results from linear mixed-effects regression (LMER) models providing p-values that are based on null-hypothesis significance testing, as well as from descriptive statistics providing 95% CI error bars as a complementary data analysis, since the use of a statistical significance referring only to p-values has recently been critically discussed due to the low reliability of the obtained p-values (Cohen, 1994; Cumming, 2011, 2013; Loftus, 1993). Cumming (2013) showed *a dance of the p-values* (p. 6) to point out an enormous variation in p-values from less than .001 to 0.75 when replicating an experiment 25 times with two independent groups, each group having an N of 32. CI error bars are informative because they indicate the possible variations of p-values shown in the dance of the p-values, while a single p-value gives virtually no information about the variation among the infinite possible p-values. The LMER-analysis included *accent rating* as dependent measure, *speaker group* (L1 vs. L2), *grammatical correctness* (correct vs. error) and *type of error* (preposition vs. case vs. agreement) as fixed factors and *participant* and *sentence* as random factors including random slopes (Cumming, 2013; Barr, Levy, Scheepers, & Tily, 2013). The analysis showed a significant main effect of *speaker group* (rating scores for L2 speakers were higher than those for L1 speakers, ß= 4.61, SE = 0.10, t = 45.6, p < 0.001) and of *grammatical correctness* (rating scores for grammatically incorrect sentences were higher than those for correct sentences, ß= 1.15, SE = 0.10, t = 11.3, p < 0.001). Moreover, there was an interaction between *speaker group* and *grammatical correctness* (the difference between the scores of correct and incorrect sentences were greater for L1 speakers than that for L2 speakers, ß= 0.51, SE = 0.14, t = 3.6, p < 0.001). No effect of *type of error* was found, see Figure 1.

Figure 1: Raw rating scores and 95% CI bars by L1 speakers (left) and by L2 speakers (right). Within-subject CIs were calculated with summarySEwithin function in R-package Rmisc.
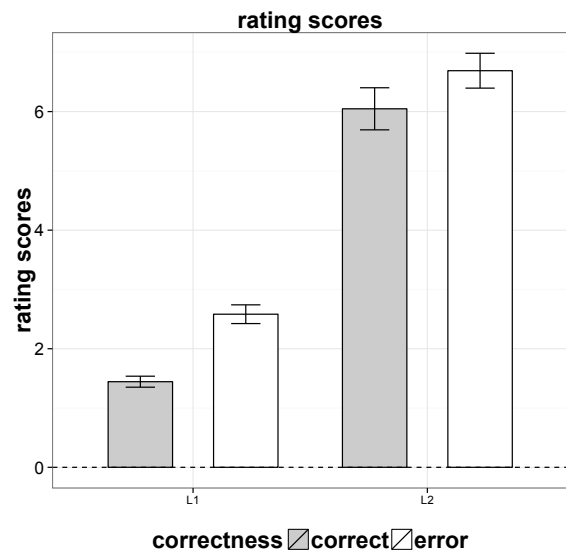
The box plots confirm the interaction found in the LMER-analysis. Additionally, they illustrate that the rating scores of L2 speakers exhibit a larger range than those of L1 speakers.

Importantly, however, we did not find a ceiling effect in the L2 speaker data. Both in the *correct* and *error* conditions, the upper CIs did not reach the maximum score (=9).

Next, in order to corroborate the interaction found in the LMER-analysis, the rating scores were normalized by subtracting the average scores of grammatically incorrect sentences from those of correct sentences for each speaker, see Figure 2.

Figure 2: Mean normalized rating scores (*correct - error*) and 95% CI bars by L1 speakers (left) and by L2 speakers (right). Within-subject CIs were calculated with `summarySEwithin` function in R-package `Rmisc`.
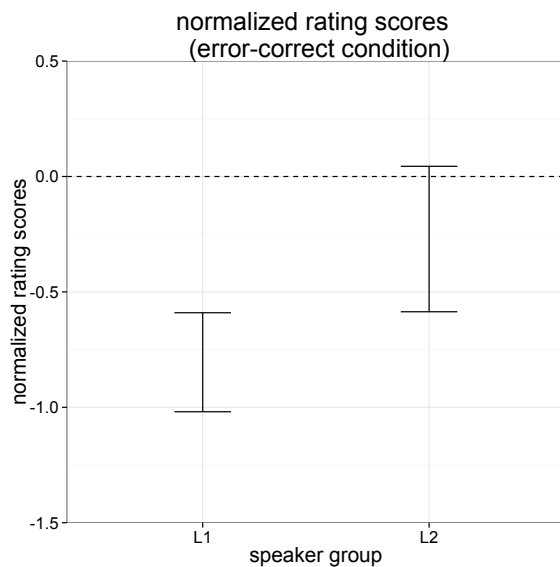

Figure 2 shows that only the CI bars of L1 speakers were placed in the negative area, suggesting that the accent rating scores for grammatically incorrect sentences were higher than those for grammatically correct sentences. The CI bars of L2 speakers crossed 0 and did not overlap with those of L1 speakers, suggesting that the rating scores for grammatically correct and incorrect sentences did not differ from each other and that the normalized scores of L1 and L2 speakers differed significantly from each other. The results from the LMER-analysis and from the CI bars were thus congruent.

Discussion

The results of the present rating study add to our understanding of perceived accent strength. Sentences with grammatical errors were rated as more strongly accented than the same sentences without grammatical errors, but this was true only when the sentences were spoken by L1 speakers. Thus, in the presence of grammatical errors, L1 speech was perceived as more accented. When sentences were spoken by L2 speakers, however, additional grammatical errors did not significantly affect the perceived accent strength. This suggests that phonological and phonetic information is more decisive for

perceived accentedness than grammatical correctness is. It is important to note that we did not find a ceiling effect in the L2 speaker data. Therefore, the lack of the *grammatical correctness* effect on L2 speakers' scores cannot be explained by claiming that L2 speakers would have produced grammatically correct sentences with accents so strong that participants would have not been able to give higher scores. Our finding is in line with recent findings from an ERP study (Hanulíková et al., 2012) in which L1 listeners were tolerant towards grammatical errors made by L2 speakers, i.e. showed no P600 effect for grammatically incorrect sentences. We see at least three possible explanations for this interaction between accent strength and grammatical correctness. First, it is possible that in strongly accented sentences, the grammatical error was pronounced less clearly, and therefore the error was less strongly noted, (see, however, Hanulíková et al., 2012). Second, listening to foreign accented speech may require higher demand on attention control (Baddeley & Hitch, 1974; Bialystock, 1992) than listening to L1 speech. This attention mechanism controls the limited cognitive resources in all forms of information processing through shifting efficient attention between foregrounding and backgrounding of task-relevant and -irrelevant information (Isaacs & Trofimovich, 2011; Rosen & Engle, 1998). While paying attention to phonologically deviant forms in L2 speech, listeners' attention capacity for grammatical errors is possibly reduced. In this case, the result suggests that phonological information is perceptually more dominant in global rating of foreign accents than grammatical information is. This knowledge contributes both to empirically defining a hierarchical importance of factors that form foreign accented speech as well as to revealing which of the factors is most dominant in the global perception of accents. However, it is questionable whether an attention effect would emerge in our experimental setting alternating nativeness of the speakers.

Alternatively, experience with grammatical errors in L2 speech led to a reduced surprisal effect and hence weaker adverse influence on the ratings. Based on the mechanism of statistical learning (e.g. Romberg & Saffran, 2010), exposure to foreign accented speech accommodated the listener's sensitivity to processing grammatical errors in L2 speech. This accommodation is advantageous in processing a specific kind of speech effectively (e.g. Eisner & McQueen, 2005; Kraljic & Samuel, 2005; Norris & Cutler, 2003). In order to support this claim, we need to test whether listeners with little experience with the foreign-accented speech or grammatical errors atypical of L2 speakers would fail to show the effect found in the present study. Importantly, our speakers had different L1s, so accent-specific perceptual accommodation cannot explain our result.

Note that in our study we only used three types of grammatical errors that did not necessarily affect the sentence meaning, i.e. sentence meaning could still be inferred. The three types of errors were comparable in their results. We believe that in most cases it was still possible to correctly

interpret the message of the incorrect sentences. However, grammatical errors can also affect the interpretability of a sentence more strongly. If a speaker, for example, uses the wrong gender in an anaphoric pronoun, this would make processing for this sentence more difficult because the correct referent of the pronoun can no longer be assigned as a result of the grammatical error. It is of further interest to investigate the relationship between the impairment of sentence meaning and accent rating performance. Further research in this area could focus on perception differences between other possible grammatical errors. This was not possible in the study presented in this article because of the small number of items that were used to keep the length of the experiment manageable. It could, however, be the case that frequent errors are handled differently by L1 listeners than errors that occur relatively infrequently in L2 speech. Hahne and Friederici (1999) have shown in an EEG-study that listeners seem to adjust their response to errors in L1 as a function of error probability. It would be interesting to see whether this carries over into the perceived accentedness of speech produced with a foreign accent. In this respect, corpora could help determine frequently produced grammatical errors in foreign-accented speech for a certain well-known accent, and these errors could then be compared to errors that are demonstrably infrequent. Apart from overall error frequency, further research could also investigate error frequency within a sentence. Is the reaction of L1 listeners when there is only one grammatical error in a sentence different from a sentence with more than one error? Hence, is there a point at which L1 listeners just put an L2 speaker into a category that tells the parsing system to ignore grammatical errors for the sake of semantic content? Previous research suggests that L1 listeners may develop a focus on meaning in L2 speech (Galloway, 1980), which makes it interesting to see whether there is a threshold for error occurrence after which additional errors are simply ignored by the parser.

Conclusions

The present accent rating study revealed an interaction between accent strength and grammatical correctness which had not been investigated in previous studies. Only in ratings for sentences spoken by L1 speakers we found an effect of grammatical errors. When it comes to L2 speech, which was phonologically accented, grammatical errors did not influence the global perception of accentedness. Thus, in L2 speech, phonological information was more decisive than grammatical information for global perception of accentedness. We discussed this result as a piece of empirical evidence that 1) L1 listeners paid attention to a perceptually more decisive factor than to a less decisive one because the listeners' capacity of attention control is limited in online speech perception and that 2) listeners accommodated their perception to a specific kind of speech in order to effectively process it.

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