The influence of alcohol on L1 vs. L2 pronunciation

Martijn Wieling[1,2], Christiaan Blankevoort[3], Vera Hukker[1], Jidde Jacobi[1,4], Lisanne de Jong[1], Stefanie Keulen[5], Masha Medvedeva[1], Mara van der Ploeg[1], Anna Pot[6], Teja Rebernik[1], Pauline Veenstra[1] and Aude Noiray[2,7]

[1]University of Groningen, [2]Haskins Laboratories, [3]Lentis Mental Health Institution, [4]Macquarie University, [5]Vrije Universiteit Brussel, [6]University of Amsterdam [7]University of Potsdam
wieling@gmail.com, g.blankevoort@lentis.nl, v.hukker@rug.nl, j.jacobi@rug.nl, l.m.de.jong.4@student.rug.nl, stefanie.keulen@vub.be, m.medvedeva@rug.nl, a.m.van.der.ploeg@rug.nl, a.pot@uva.nl, t.rebernik@rug.nl, pauline.veenstra@gmail.com, anoiray@uni-potsdam.de

ABSTRACT

In this study, we investigated the influence of alcohol intake on pronunciation in both a native and a non-native language. At a Dutch music festival, we recorded the speech of 87 participants in Dutch (native language) and English (non-native language) when reading a few sentences in both languages. The recorded audio samples were judged by 108 sober native Dutch speakers in a perception experiment at the same festival. Participants were asked to judge how clear the Dutch pronunciations of a random selection of speakers were and how native-like the English pronunciations were. The results, analysed using generalized additive modelling (which is able to identify non-linear relationships), indicated a small linear negative relationship between alcohol intake and clarity of Dutch speech. For English there was no effect of alcohol intake on the native-likeness of the English pronunciations.

Keywords: L1 pronunciation, L2 pronunciation, Alcohol intake.

1. INTRODUCTION

Alcohol intake negatively affects speech. For example, vowels and consonants are often elongated and fricatives such as /s/ may be distorted [5]. While there has been a substantial amount of research focusing on the influence of alcohol on speech, these studies have mostly focused on speech in a native language (L1). For example, Chin and Pisoni [1] report on dozens of studies investigating the influence of alcohol on speech, and clearly show that alcohol negatively affects speech. Among other aspects, they mention that the intake of alcohol results in an increased number of speech errors, lengthening of vowels and consonants, and frication of stop consonants ([1]: Ch. 9). In addition, perceptual studies (e.g., [5]) show that both experienced and naïve listeners are able to detect whether speakers were under the influence of alcohol.

Despite the overwhelming evidence that alcohol *negatively* affects speech in a native language, a popular belief is that alcohol *positively* affects speech in a non-native language (L2). However, only a few studies have specifically investigated this relationship.

Guiora et al. [2] recorded 87 native American English students repeating auditorily presented Thai words and phrases. Their observation was that "the ingestion of small amounts of alcohol, under certain circumstances, does lead to increased ability to authentically pronounce a second language" (p. 426).

In another study, Tsilják-Szabó et al. [7] investigated tongue-twisters pronounced by 15 adult speakers of Hungarian. Their results showed that "subjects made more speech errors in alcohol influenced than in sober states in all types of the tongue-twisters *except for those using foreign words*" (p. 737; emphasis added).

The final, most recent, study considering non-native speech was conducted by Renner et al. [6]. They recorded dialogues between German speakers when arguing in Dutch (their L2) about animal testing, who either drank alcohol (to an approximate blood alcohol concentration, BAC, of 0.04%) or not. Subsequently, the language skills of the speakers were rated on nine aspects of language proficiency by two native Dutch judges who were blind to the experimental condition. The nine aspects of language proficiency included, for example, word selection, grammar, and pronunciation. The results of Renner et al. [6] indicated that the language skills of speakers in the alcohol condition were judged significantly *better* than those in the sober condition. Importantly, this difference was caused by the *pronunciation* of the speakers in the alcohol condition being rated more favourably than that of the speakers in the sober condition. Renner et al. [6] hypothesized that one of the reasons for this finding may have been related to speakers' potentially reduced language anxiety in the alcohol condition as compared to the sober condition. However, this hypothesis could not be tested since language anxiety was not measured in their study.

In the present study, we aim to replicate and expand on the results of Renner et al. [6] in different experimental conditions. While Renner et al. [6] recorded spontaneous speech to assess general foreign language skills, the present study focuses on *pronunciation* by using read speech stimuli. In line with Renner et al.'s findings [6], we hypothesize that L2 pronunciation (in our case, English) improves for speakers with higher BAC levels. If this hypothesis is indeed supported, we expect (in line with the hypothesis put forward in [6]) that this is due to lower foreign language anxiety for speakers with higher BAC levels. Furthermore, we expect that the speakers' native (Dutch) pronunciations are negatively influenced by higher BAC levels.

2. DATA COLLECTION

Data was collected in August 2018 at *Lowlands Science*, a science event at the three-day music festival *Lowlands* with 55,000 visitors held in Biddinghuizen, the Netherlands. Before the study, ethical approval was obtained via the Faculty of Arts Research Ethics Review Committee of the University of Groningen. Given the setting, each individual part of the data collection procedure (intake, production experiment, perception experiment) was set up in such a way that it took at most seven minutes. By having a team of 12 researchers involved in data collection, waiting time was reduced to a minimum and participating in all phases of the complete procedure took 20 minutes at most. In order to allow the first participants at *Lowlands Science* to participate in the perception experiment, we also collected some speech production data beforehand. We did this for a total of nine speakers (in line with the approach discussed in Sections 2.1 and 2.2) who had varying BAC levels. This data is included in the analysis as well.

2.1. Intake and questionnaire

After signing an informed consent form and being informed about the purpose of the experiment, each participant had to fill out an intake questionnaire that was used to obtain general information about the participant (such as age, gender, province of birth, and education level), the participant's language background (e.g., native language, and self-rated English language proficiency), and finally the participant's foreign language anxiety. To assess general foreign language anxiety, we adapted seven questions (questions 1, 9, 14, 18, 24, 27 and 30) from the communication apprehension subscale of the foreign language classroom anxiety scale (FLCAS; [3]). The original subscale consisted of 11 questions, but we excluded four questions (questions 4, 15, 29, 32) focusing on listening rather than speaking. We translated the questions into Dutch and adapted them in such a way that references to "language class" were replaced with explicit references about "speaking English". For example, two of the questions were: "I would not be nervous speaking English with native speakers" and "I start to panic when I have to speak English without preparation". Participants had to rate their agreement with each statement on a five-point-scale (1: strongly agree, 5: strongly disagree). Cronbach's alpha for the seven questions was 0.76, indicating a reliable scale and therefore a single measure was constructed by taking the average score of all seven questions (questions where higher scores indicated less anxiety were inverted).

After entering the data from the questionnaire into a spreadsheet, the experimenter used a certified professional breathalyser (AlcoTrue P) to obtain the blood alcohol concentration of the participant. The intake process lasted about 5 minutes per participant.

Having finished the intake, the participant either participated in the production experiment immediately followed by the perception experiment, or only in the perception experiment. Hence, the anxiety questionnaire and other information were directly linked to the individual's participation in the experiment(s).

2.2. Production experiment

During the production experiment, the participants were sitting approximately 1 meter from a 27-inch-computer screen on which the words and sentences were displayed which they had to read out loud. Besides the acoustic recordings, we also collected simultaneous ultrasound tongue imaging data. This data, however, is still in the process of being analysed and will not be discussed in the remainder of this paper. We used the AAA software package (Articulate Instruments Ltd) to record the acoustic speech signal at 22.05 kHz using a Shure WH20 XLR headset microphone. By using a headset microphone and collecting data in a separate room, the background noise was hardly perceptible in the resulting recordings.

After positioning the microphone close to the mouth, participants read several words and phrases, and conducted a few diadochokinetic (DDK) tasks. For the purpose of this study, we only focus on the Dutch and English sentences which were judged by other listeners during the perception experiment. The target Dutch sentence was: "Het was voorjaar en de zon scheen, iepen waren in bloei, water liep uit fonteinen, roeken vlogen rond en goudvissen, zo groot als dolfijnen schoten door het glinsterende water.” (English translation: “It was spring and the sun was shining, elms were in bloom, water came from fountains, rooks flew around and goldfish, as big as dolphins were shooting through the glistening water.”) The English phrase consisted of the first part of the elicitation paragraph used in the Speech Accent Archive [9]: “Please call Stella. Ask her to bring these things with her from the store: Six spoons of fresh snow peas, five thick slabs of blue cheese, and maybe a snack for her brother Bob.” While the alcohol level of the speaker may have affected reading ability, each recording with a mispronunciation was recorded anew.

2.3. Perception experiment

Recordings made during the production experiment were automatically uploaded to a network attached storage drive. In the perception experiment, implemented in PsychoPy [4], the recordings of the Dutch and English sentence indicated in the previous section were used as stimuli. The perception experiment had two parts of equal duration and took five minutes in total to complete.

During the first half of the experiment, the participants were presented with the English pronunciations of *other* speakers through a pair of Sennheiser HD 280 headphones. The speakers from whom the corresponding English audio sample was selected were randomly chosen and the audio samples were presented in random order. For each audio sample, the listener was asked to judge how well the English pronunciation of the speaker was on a scale from 1 (bad) to 5 (not distinguishable from a native English speaker). Listeners were not required to listen to the complete audio sample before making a judgment. As each half was time-limited to 2.5 minutes, the number of speech samples rated by the participants differed depending on their speed. Those who listened to the entire audio sample rated fewer samples than those who only listened to the first part of the audio sample before making their judgment.

The second half of the experiment was similar to the first, with the only difference that speakers were now presented with the Dutch audio samples (of a new random selection of speakers, randomly ordered). In this case the speakers were asked to indicate how clear the Dutch pronunciation was on a scale from 1 (very unclear) to 5 (very clear). As before, listeners were not required to listen fully to each audio sample, and the second half of the experiment also ended after 2.5 minutes.

3. ANALYSIS

Before analysing the data, we first determined which participants had to be excluded (see below). Note, however, that the results were comparable when including all data (thereby including the acoustic data from all 154 recording sessions and the associated ratings from all 257 participants who rated the Dutch and English pronunciations).

3.1. Pre-processing and data selection

In the analysis, we only included audio samples for native Dutch monolingual speakers who were born and still living in the Netherlands, who did not have any self-reported reading, hearing or speaking problems, and who had not used drugs. Because the majority of BAC measurements (87 out of 94) was 0.8 or lower, and there was a comparatively large gap following a BAC of 0.8 (i.e. a BAC of 0.97), we excluded the speech samples from 7 speakers with a BAC > 0.8 and therefore retained the speech samples for a total of 87 speakers (39 male, 48 female; M age: 21, SD age: 9.

While all interested people were allowed to participate in the perception experiment, we only included the ratings given by 108 native Dutch speakers (40 males, 68 females; M age: 20, SD age: 8) adhering to the same criteria as for the production experiment (see previous paragraph) in addition to no alcohol intake (i.e. with a BAC of 0). The total number of ratings for the data obtained during the 87 production experiments was 1,449. On average, each English speech sample received almost 10 ratings, whereas each Dutch speech sample (which lasted slightly longer) received on average almost 8 ratings. As individual raters may differ in their interpretation of the rating scales, we *z*-transformed the scores for each rater per language separately. Consequently, the average rating per language (English and Dutch) for each individual rater was 0.

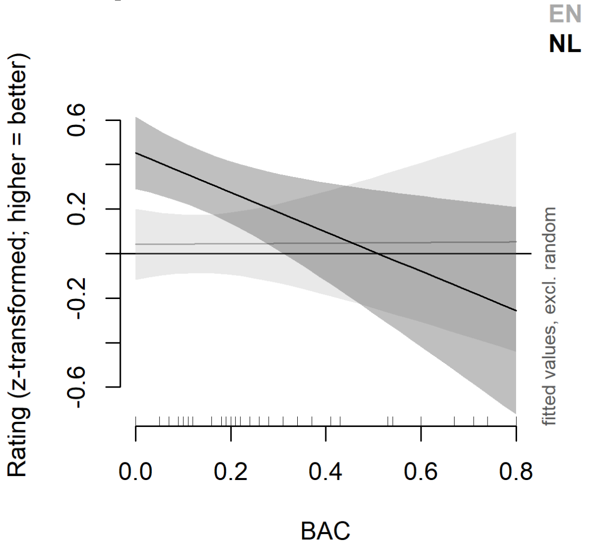
3.2. Statistical analysis

After pre-processing the data, we fitted a generalized additive model where we estimated the (potentially non-linear) effect of the numerical variable BAC on the given ratings for English and Dutch separately. We used the *mgcv* R package [11] for fitting the generalized additive model and the *itsadug* R package [8] for visualization. To account for individual variability in both speakers and listeners, we assessed the inclusion of by-speaker and by-listener random intercepts as well as by-speaker and by-listener random slopes for the influence of the language (Dutch or English). After fitting the model, we ascertained that the residuals of the model were normally distributed and homoscedastic. An overview and tutorial of the generalized additive modelling technique can be found in [10].

4. RESULTS

In contrast to our hypothesis, the generalized additive model revealed a non-significant effect (close to being exactly 0) of speakers' BAC on the ratings of the English speech samples. In line with our hypothesis, however, the ratings of the Dutch speech samples significantly decreased ($p = 0.01$) for higher BAC levels. Figure 1 provides a visualization of the effects for both languages. It is clear that the effect of BAC on the English pronunciation ratings is not distinguishable from 0. Note that the difference in patterns between the two languages significantly differs at $p = 0.03$. Including English language anxiety and/or self-rated English language proficiency (which were also not significant by themselves; all p's > *.15*) did not affect this relationship.

Figure 1: BAC's influence on native Dutch listener's ratings of English (light; n.s. with $p = 0.97$) and Dutch (dark; significant with $p = 0.01$) pronunciations by native Dutch speakers.



5. DISCUSSION

In this study, we have investigated the effect of alcohol on pronunciation in a native and non-native language. Whereas a recent study [6] reported a positive influence of alcohol on L2 pronunciation, we were not able to corroborate this finding in our study. We did, however, find a clear difference in the effect of alcohol on the L1 (Dutch) vs. the L2 (English) pronunciation, as judged by native Dutch listeners. Alcohol negatively affected the pronunciation of the native language, whereas it did not affect the pronunciation of the L2. However, these results were based on a sample where almost all speakers only participated once (i.e. with one BAC level). Our results expand on Tsiljár-Szabó et al.'s findings [7] from Hungarian to Dutch, with a much larger sample size than previously recorded (87 versus 15). However, our results did not support Renner et al.'s hypothesis [6] that speakers with a higher BAC might have lower foreign language anxiety.

There are several differences between our study and past studies investigating the influence of alcohol on a non-native language. First, our participants read phrases aloud, whereas Renner et al. [6] investigated spontaneous speech and participants of Tsiljár-Szabó et al. [7] repeated (previously heard) tongue-twisters. There are two main benefits of using a reading task as compared to the other two alternatives: 1) the speech samples in both the L1 and L2 are comparable to each other, and 2) the pronunciation of a participant is not influenced by that of a model speaker. Nevertheless, our findings cannot be seen as representative of spontaneous conversation (as in [6]) and further research is necessary to determine the differential effects of alcohol on spontaneous versus read speech.

The setting of our experiment (at a music festival) allowed us to treat the BAC level as a continuous variable, by simply measuring the participant's actual BAC level. This is a clear advantage compared to other studies which only used a binary distinction (alcohol vs. no alcohol). Another advantage was the ability to recruit a large number of interested speakers and raters.

Our data collection procedure also has some disadvantages. First, participants were native Dutch speakers, and having native English speakers rate the English pronunciation of Dutch speakers would likely have provided a finer-grained assessment of the English speech samples collected. Nevertheless, Dutch people are generally quite proficient in English (88 of the 108 raters gave themselves an English proficiency rating between 7 and 9, on a scale from 1 to 10, with 10 being the highest score), and due to high exposure to native English speech (e.g., via TV) likely able to judge the native-likeness of English speech adequately. Collecting data at a festival may have had other disadvantages, such as participants being more tired than usual or having had drugs without reporting this. Nevertheless, given that the results were comparable when no participants were filtered out (e.g., also including participants who had used drugs), we believe our results to be robust.

6. REFERENCES

[1] Chin, S. B., Pisoni, D. B. 1997. *Alcohol and Speech*. San Diego: Academic Press.

[2] Guiora, A. Z., Beit-Hallahmi, B., Brannon, R. C., Dull, C. Y., Scovel, T. 1972. The effects of experimentally induced changes in ego states on pronunciation ability in a second language: An exploratory study. *Compr Psychiatry* 18, 409–417.

[3] Horwitz, E. K., Horwitz, M. B., Cope, J. 1986. Foreign language classroom anxiety. *Mod. Lang. J.* 70, 125-132.

[4] Peirce, J. W., 2007. Psychopy – Psychophysics software in Python. *J. Neurosci Methods* 162, 8–13.

[5] Pisoni, D. B., Martin, C. S. 1989. Effects of alcohol on the acoustic-phonetic properties of speech: Perceptual and acoustic analyses. *Alcohol Clin. Exp. Res*. 13, 577–587.

[6] Renner, F., Kersbergen, I., Field, M., Werthmann, J. 2018. Dutch courage? Effects of acute alcohol consumption on self-ratings and observer ratings of foreign language skills. *J. Psychopharmacology* 32, 116–122.

[7] Tsiljár-Szabó, E., Rossu, R., Varga, V., Pléh, C. 2014. The effect of alcohol on speech production. *J. Psycholinguist. Res*, 43, 737–748.

[8] Van Rij, J., Wieling, M., Baayen, R. H., van Rijn, H. 2017. itsadug: Interpreting Time Series and Autocorrelated Data Using GAMMs. R package version 2.3.

[9] Weinberger, S. 2015. *Speech Accent Archive.* George Masun University. Retrieved from http://accent.gmu.edu.

[10] Wieling, M. 2018. Analyzing dynamic phonetic data using generalized additive mixed modeling: a tutorial focusing on articulatory differences between L1 and L2 speakers of English. *J. Phon.* 70, 86–116.

[11] Wood, S. N. 2017. *Generalized additive models: an introduction with R*. Chapman and Hall/CRC.