Effects of perceived gender on the perceived social function of laughter

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Abstract

Previously, the sex of the speaker has been found to play an important role in how we perceive human and artificial voices. It was found, for example, that sex mediates in how we perceive the social function of laughter. We, however, are interested in how socially-formed concepts of gender influence how laughter is perceived. To investigate this, we carried out a within-subjects study of listeners who judged social functions of the same laugh stimulus twice, which was framed as produced by either a man or woman. Mixed-effects ordinal regression modelling showed no statistically significant relations between the perceived gender of a laugh and its perceived social functions.
Index Terms: laughter, gender, perception

1. Introduction

Laughter is an integral part of human communication. The most well-established reason for laughter is humor, but laughter also plays a large role in conveying emotions and other social functions (such as showing affiliation or conveying dominance) [1, 2, 3, 4, 5]. Because laughter is nonverbal, communication through laughter is entirely reliant on factors such as acoustics and context, topic of the conversation, facial cues, and social norms [6]. Researchers have found, for example, that the sex of the person laughing strongly moderates relations between acoustics and judgements of laughter's social functions [7]. In contrast, we are interested in knowing how *perceived gender* and listeners' beliefs and expectations of how men and women "should" sound when they are expressing different social intentions, play a role in how social functions are perceived. While there is evidence that gender norms and stereotypes in society influence speech perception, we aim to investigate whether this extends to the perception of laughter. Laughter is a non-verbal vocalization that, while being independent of language, serves important affective and social signaling functions in interaction, and can hence be susceptible to gender norms.

In this paper, we aim to study whether sex (of the laughing person) differences in the perception of social functions of laughter, as found in studies such as [7], can be attributed to differences in mental models that people have of men and women. We do this by presenting the exact same laugh to listeners using two different framings: the same laugh is framed once as produced by a woman and once as produced by a man. Differences we find in the perception can thus be attributed to the mental models listeners have of men and women. In order to find laughter samples that are, without being labelled as a certain gender, perceived by people as gender-ambiguous or as being undecisive with respect to the gender of the laughing person, a **pre-study** was carried out, see Section 3. In the **main study** (Section 4), we subsequently present these gender-ambiguous

laughter stimuli to listeners twice in a within-subjects study, i.e., the same stimulus is presented once framed as produced by a man and once framed as produced by a woman, and ask them to rate these laughter stimuli on perceived reward, affiliation, dominance, and spontaneity (following [7]). Using mixed-effects ordinal regression modelling, we modelled the effect of the manipulated gender on the ratings of the perceived social functions of laughter. We discuss the results in Section 5.

2. Related work

2.1. Gender vs. sex

The human voice is influenced by various biological and psychological traits, which together determine how we express ourselves [8]. Sex, for instance, plays a role in how laughter is produced through the sexually dimorphic nature of vocal mechanisms [7, 9, 10], but gender also plays a role in this process, as supported by the field of sociophonetics, which states that our socially-formed concepts of gender impact how we use and perceive voices [11, 12, 13]. Socially constructed beliefs or expectations about how a speaker "should" sound can influence listeners' perception of the speech signal; bottom-up processing of acoustic information directly interacts with higher-level information related to these social constructs about gender [13]. This interconnected nature means that if the factors are not addressed separately, research investigating the role of voice in any phenomenon will not have a clear conclusion about which effects can be attributed to sex versus gender. There are several reasons why these might need to be studied separately. In order to represent humans beyond the majority groups in research, we need to consider that gender and sex do not align for everyone, and additionally, that unintentional perpetuation of gender expectations towards humans and Artificial Intelligence (AI) technology can lead to harmful stereotyping overall.

Under the expectation that gender stereotypes that are known to be pervasive in human psychology also extends to machines [14, 15], some studies have addressed the perception of (non-)gendered artificial voices [16, 17]. Studies using gender-ambiguous (artificial) voices are still scarce and results are mixed; there is no consistent evidence that gender influences the perception of artificial voices due to stereotypical thinking.

Within this paper, the use of the word sex refers to the biological characteristics of a person (such as hormones, reproductive organs, and chromosomes), while the term gender refers to a person's self-identification, and perceived gender refers to other people's interpretation of one's gender. It is important to note that many of the referenced studies, including the current one, limit the descriptors of the people producing the laughter to "man" or "woman" (which are terms use to refer to gender, while "female" and "male" are used to refer to sex). We ac-

knowledge that gender is a social categorization and can thus exist outside this binary, but choose to study only the stereotypes surrounding these two genders given their current predominance in our society. This is done because, by nature of studying gender stereotypes, we can only look at those which participants will have existing mental models of. It is also worth noting that we do not know if the studies we reference here use gendered/sex-related terms as self reported by participants or as labelled by researchers.

2.2. Gender, sex, and laughter

Gender plays an important role in the perception and production of laughter. For example, research shows that females in general laugh more often than males [18, 19], and they also produce voiced laughs more often [20]. In mixed-gender dyads, females tend to share laughter with the interlocutor more often than males [21]. In a study by [22], it appears that both females and males are able to discriminate between simulated and spontaneous signals (laughter and smiles) produced by males, but not when produced by females. Bachorowski & Owren [23] find that participants preferred female voiced laughter over male voiced laughter, while consistently disliking unvoiced laughter, especially those produced by female laughers. In a study by [7], it was found that the sex of the laughing person moderated the relation between acoustics and participants' judgements of social functions of laughter, including reward, affiliation, dominance and spontaneity. To give an example, males were judged as conveying more affiliation when their laughter was louder, while female laughter was perceived as more affiliative when it was quieter. As a possible explanation, the authors mention that if women are expected to be generally more restrained, then female-sounding people might be perceived as friendlier with quieter laughter, whereas it might be more acceptable for men to be louder [7]. Thus, various studies have identified how gender or sex influences perception or production of laughter. However, it remains unclear to what extent socially constructed beliefs/expectations of how females or males should sound play a role in these influences.

3. Pre-study: gender-ambiguous laughter

The goal of this pre-study is to collect gender-ambiguous laughter to be used in the subsequent main study. Participants were presented with laughter stimuli in an online survey and were asked to rate what they believed the gender of the laughing person was. The pre-study was reviewed and approved by the EEMCS Ethics Committee Computer & Information Science (EC-CIS) RP2022-40 of the University of Twente.

3.1. Method

Participants Participants were recruited via the researchers' networks through email and WhatsApp. Participants were all over the age of consent (16 years), were thoroughly briefed on the nature of the study and completed a consent form. Out of the 18 participants, the youngest participant was 17 and the oldest was 58 years old (mean of 31.5y, sd of 16y; 10 women, 7 men, 1 non-binary). All were living in the Netherlands and the large majority (89%) identified as Dutch.

Stimuli The audio clips of laughter, originally obtained from Soundsnap.com (a professional online sound library), used for this study were taken from the database compiled in the study by Wood et al. [7]. Soundsnap.com is a resource for videogame

and movie sound editors and was selected by [7] under the assumption that the vocalizations in that library would convey a wide range of social intentions. A preselection was created of the laughter stimuli by removing the laughter that the researchers and three trial participants felt played heavily into stereotypes of men and women. This left 61 laughter samples (from 38 males and 23 females) that were presented to the participants in the online survey. Qualtrics XM was used to host the survey.

Procedure Participants were each presented with 61 laughs, one per page of the survey, each accompanied by a 5-point Likert scale asking for the "gender of the laughing person" with the possible labels "Certainly a woman", "Possibly a woman", "Neutral/I don't know", "Possibly a man", and "Certainly a man". At the end of the study, participants were asked to report their age, gender, country of residence, and what countries or cultures were a part of their background. They were then debriefed on the role of the survey within the research and asked not to speak to others about the nature of the study.

3.2. Results

The results of the survey are presented in the stacked bar chart in Fig. 1. There, we can observe that some of the laughter stimuli are predominantly perceived as being produced by a man (the bars with proportionally large black-filled bars, rating "5 = Certainly a man") and some are predominantly perceived as being produced by a woman (the bars with proportionally large white-filled bars, rating "1 = Certainly a woman"). For the main study though, we are looking for laughs that are predominantly rated close to "3 = Neutral/I don't know", and included laughs that had an average rating between 2.5 and 3.5.
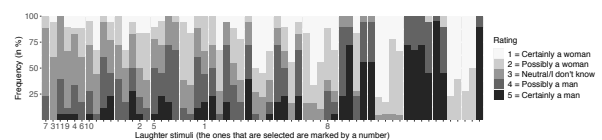

Figure 1: *Stacked bar chart showing the distribution of the participants' ratings per laughter stimulus (x-axis sorted by the frequency of category 3 (Neutral/I don't know). The numbers on the x-axis indicate the selected laughs for the main study.*

However, this included laughs that had average ratings near 3, but still had a lot of ratings under "Certainly a woman" (rating of 1) or "Certainly a man" (rating of 5). Hence, laughs that had 20% or more ratings of either value 1 or 5 were excluded. One other laugh was removed due to being very short (< 1 second long), likely having received so many ratings of 3 because participants did not have enough acoustics to even attempt to identify the gender of the laughing person. Finally, one laugh was removed as it was created by an actor who was represented 3 times in the laughs presented, and all three of these laughs were rather similar sounding. This left 11 gender-ambiguous laughs for use in the main study (see Fig. 1).

4. Main study: Effects of perceived gender on perceived social function of laughter

The goal of the main study was to investigate whether the collected gender-ambiguous laughter samples would be judged differently by listeners when presented to them twice, once framed

Table 1: *Definitions of social functions (and spontaneity) of laughter, drawn from [7].*
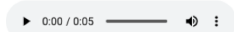
Aff(iliation)	Laughter can sometimes be reassuring. You could feel that someone's laughter means they are acknowledging you and want you to know they are not threatening
Rew(ard)	Laughter can sometimes be rewarding. You could feel that someone's laughter means they like something that you did or said.
Dom(inance)	Laughter can sometimes be mocking. You could feel that someone's laughter means at this moment they feel superior to or dominant over you.
Spon(taneity)	Laughter can sometimes be spontaneous. You could feel that someone's laughter is unintentional and is occurring outside of their control.

as produced by a woman and once framed as produced by a man. The main study was reviewed and approved by the EEMCS Ethics Committee Computer & Information Science (EC-CIS) RP2022-40 of the University of Twente.

4.1. Method

Partcipants Participants for this survey were recruited via the researchers' networks through email and WhatsApp. Participants were all over the age of consent (16 years), completed a consent form, were thoroughly debriefed after answering all questions, and given the opportunity to withdraw before submitting their results. Out of the 34 participants, the youngest was 18 and the oldest was 86 (mean of 37.8y, sd of 21.8y; 15 women, 17 men, 2 non-binary). All were living in the Netherlands and the large majority (88%) identified as Dutch.

Figure 2: *Screenshot of how the stimuli are presented in Qualtrics XM along with the gender framing that could be either "woman/her" or "man/his" (see the red rectangles).*

Stimuli The 11 laughter stimuli (from 7 males and 4 females) used were decided upon in the pre-study (Section 3). As part of the gender manipulation (framing), these were coupled with the gender labels "woman" and "man", resulting in a total of 22 stimuli that were presented to each participant. Durations of the laughter stimuli varied from being 0.2s to 5.3s long ($\mu = 1.4s$, $\sigma = 1.5s$). Qualtrics XM was used to host the online survey.

Procedure The study had a within-subjects design. Participants were all presented with 22 stimuli, one per page. These stimuli consisted of 11 laughs, each paired once with a text consistent with the gender "woman" and once with "man", see Fig. 2. The stimuli were shuffled in such a way that the same laugh would not be shown within 5 stimuli of its earlier presentation. On each page, participants were prompted with the sentence "Please listen to this audio clip of a [woman OR man] laughing.", with the audio clip positioned underneath this, see Fig. 2.

Below this, participants were asked to indicate their agreement with five statements about the laughter, with the response options "Yes" or "No". The goal of this section was to conduct a manipulation check, to see whether participants believed the gender assigned to the laugh. The first four questions posed were included to draw the focus away from the topic of gender, to minimize the effect that asking about gender had on the participants. These statements prompted participants to indicate whether they agreed that the laugh was warm, nervous, young, or old. The fifth and final statement prompted them to indicate whether they agreed that the laugh was produced by a woman/man (this label matched the one at the top of the page) - agreeing with this statement meant that the manipulation of perceived gender was successful. All five prompts used either the pronouns "she/her" or "he/him" to match the label at the top of the page, to assist in the manipulation.

At the bottom of the page, participants were asked to rate the laughter in terms of how much it communicated affiliation, reward, dominance, and spontaneity of laughter. These were presented to participants along with the definitions (Table 1) and accompanied with a 10-point Likert scale, labelled for values 1 ("Not at all") and 10 ("Very much"). These definitions and scale of ratings for the perceived social functions were drawn from Wood et al.'s study [7].

At the end of the study, participants were asked to report their age, gender, country of residence, and what countries or cultures were a part of their background. They were then debriefed on the true nature of the study and asked not to speak to others about this. After the debriefing, participants were given a chance to withdraw before submitting their responses.

Analysis Due to the ordinal nature of the Likert scales used for the social function ratings (from 1 to 10), we carried out paired ordinal mixed-effects regression analyses for each social function rating (4 in total) as dependent variable. Since we have multiple responses from the same subjects, we need to account for by-subject and by-item variation. We used the function *clmm* from the *ordinal* package [24] in R to analyse the relation between a social function rating and the manipulated gender of the laugh. As fixed effect, we entered the manipulated gender of the laugh (woman/man). Since the rater's gender (woman/man/non-binary) could also play a role, we entered this as a fixed effect as well (without interaction). As random effects, we had intercepts for subjects and items, as well as by-subject and by-item random slopes for the effect of manipulated gender.

4.2. Results

4.2.1. Manipulation check

To analyse the effect of perceived gender on social function ratings, the manipulation of perceived gender, i.e., the gender

Table 2: *Estimates of the fixed effects (g_cond=gender of framing condition, W=woman, NB=non-binary).*

rating	variable	β	SE	CI	p
Aff.	g_condW	-0.046	0.232	-0.501–0.409	0.844
	g_raterNB	0.284	1.655	-2.960–3.529	0.864
	g_raterW	-0.033	0.571	-1.152–1.085	0.953
Rew.	g_condW	0.233	0.233	-0.224–0.689	0.317
	g_raterNB	-0.242	1.398	-2.983–2.499	0.862
	g_raterW	-0.329	0.477	-1.265–0.606	0.490
Dom.	g_condW	0.137	0.259	-0.371–0.645	0.596
	g_raterNB	0.757	1.353	-1.896–3.409	0.576
	g_raterW	-0.279	0.477	-1.213–0.655	0.558
Spon.	g_condW	0.024	0.216	-0.400–0.447	0.912
	g_raterNB	-0.463	1.317	-3.043–2.118	0.725
	g_raterW	0.120	0.464	-0.790–1.030	0.796

framing, for that gender label must pass: if participants agreed with the fifth statement "I think this is a [woman OR man]" (Fig. 2), the manipulation for this laugh stimulus was successful. In total, the survey yielded 11 laughs × 2 gender framings × 36 participants = 792 responses for the manipulation check. Out of these 792, we found that 518 successfully passed the manipulation check. However, the within-subjects design of the study considers pairs of stimuli, hence, both gendered versions of the same laugh stimulus needed to pass their manipulation checks in order to be included in the analysis. This is required in order to ensure people are manipulated by the social aspect of viewing the laughing person as a man or woman, and not the sex-linked characteristics which may be present in the laughter itself. Out of the 396 paired laughter manipulation checks, 149 were found to be valid, i.e., 37.6% of all paired laughs passed both the "woman" and "man" manipulation.

4.2.2. Effects of manipulated gender and gender of the rater

To recapitulate, for each social function rating, a paired mixed-effect ordinal regression analysis was carried out with manipulated gender and gender of the rater as fixed effects (without interaction), and subject and item as random effects. As we can observe in Table 2, the effects of manipulated gender and gender of the rater are not significant for all four social function ratings. Fig. 3 shows the frequency distribution (in percentages) of all ratings per manipulated gender and social function: there indeed seem to be no observable differences in the way participants rate the social functions of laughter when perceived as produced by a woman or a man.
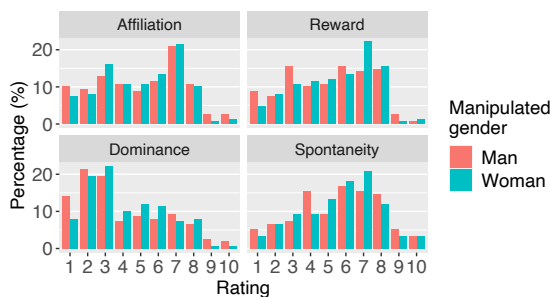

Figure 3: *Bar charts with percentages of frequency of rating for each social function and manipulated gender*

5. Discussion

The current study did not find any statistically significant effect of perceived gender and gender of the rater on ratings of social functions (i.e., affiliation, reward, dominance, and spontaneity) of laughter. It was found that when sex- and gender-linked characteristics of a laugh are mostly removed (the current study used perceived gender-ambiguous laughter, but not sex-neutral laughter), but a gender label is applied, participants rated the social function of the laughter largely the same across gender labels. This finding is in contrast with previous studies such as [16, 17] that found that gender markers (as manipulated by using different names) in the absence of sex- or other gender-linked characteristics lead to differences in participant evaluations of emotional intelligence [16] and warmth and competence [17]. Possible reasons for not finding similar results can lie in the facts that the current study uses laughter as stimuli, focuses on ratings of specific social functions, and manipulates perceived gender by changing the pronouns in the text of the questionnaire items: all of which differ from previous studies. On the other hand, it is too early to draw strong conclusions given the lack of related work.

Another factor that can be part of the explanation of our results lies in the specific acoustic nature of laughter. Speaker sex perception is more difficult for laughter than for vowels (as encountered in speech) - this was true for laughter produced by males [25]. It is also known that F0 information is the more salient acoustic cue to speaker sex perception [26] and that when missing, such as in whispered speech, judgements of speaker sex decreases drastically [27]. F0 is not always as sustainedly present in laughter as in speech (we did check whether all laugh stimuli used in the main study were partly voiced and this was the case), which might have also affected the ability to judge gender in the current study.

A limitation of the current study that could have contributed to these results lies in the design and task of the study which could have been too difficult (although a similar task with the same stimuli was used in [7]). Relatively few pairs of laughter stimuli passed the manipulation check. Additionally, participants commented that the short duration of the laughter stimuli made it difficult to judge the social functions. An improved design of the study in which the influence of listeners' gender beliefs and expectations on the perception of laughter should be investigated for future research.

6. Conclusion

Based on the findings in earlier research that speaker sex plays a moderating role in the social function of laughter, the current study researched whether, for acoustically gender-ambiguous laughter, perceived gender affects the perceived social functions of laughter. It is found that in the scope of this study, perceived gender does not play a detectable role in the perception of affiliation, reward, dominance, or spontaneity of laughter. In human-machine interaction, the use of gender-ambiguous laughter (likely paired with a gender-ambiguous voice) could help avoid the perpetuation of gender stereotypes that comes with using a gendered voice for machines.

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