Peer audience effects on children's vocal masculinity and femininity

Article (Accepted Version)

Peer audience effects on children's vocal masculinity and femininity

Abstract

Existing evidence suggests that children from around age 8 strategically alter their public image in accordance with known values and preferences of peers, through the self-descriptive information they convey. However, an important but neglected aspect of this 'self-presentation' is the medium through which such information is communicated: the voice itself. The present study explored peer audience effects on children's vocal productions. Fifty-six children (26 females, aged 8 to 10) were presented with vignettes where a fictional child, matched to the participant's age and sex, is trying to make friends with a group of same-sex peers with stereotypically masculine or feminine interests (rugby and ballet, respectively). Participants were asked to impersonate the child in that situation and, as the child, to read out loud masculine, feminine and gender-neutral self-descriptive statements to these hypothetical audiences. They also had to decide which of those self-descriptive statements would be most helpful for making friends. In line with previous research, boys and girls preferentially selected masculine or feminine self-descriptive statements depending on the audience interests. Crucially, acoustic analyses of fundamental frequency and formant frequency spacing revealed that children also spontaneously altered their vocal productions: they feminised their voices when speaking to members of the ballet club, while they masculinised their voices when speaking to members of the rugby club. Both sexes also feminised their voices when uttering feminine sentences, compared to when uttering masculine and gender-neutral sentences. Implications for the hitherto neglected role of acoustic qualities of children's vocal behaviour in peer interactions are discussed.

Keywords: acoustics, voice gender, voice pitch, vocal tract resonances, vocal masculinity, audience effects

Introduction

Children's peer relationships have received considerable attention over the past thirty years as a key socialisation context for children's gendered behaviour. By 3 years of age, children spontaneously segregate into same-sex peer groups [1] and continue to do so throughout the school years [2]. As children value their ingroup

membership, they become increasingly concerned about peer group norms on gender [3-5], and the negative consequences associated with not complying with them such as being teased, shunned or referred to as “tomboys” or “sissies” [6,7]. For example, toddlers play less with counter-stereotypical toys in the presence of peers than when alone [8]. Primary school children are also more likely to show a preference for own-sex typed toys and activities when peers are present than when alone, particularly young boys who hold the most rigid stereotypes [9]. Building on such evidence that children display or inhibit particular behaviours in line with external or internal rules and standards (e.g., [10, 11]) researchers have shown that children increasingly engage in diverse forms of self-presentational behaviour – behaviour specifically intended to control others’ impressions of the self – in accordance with known values and preferences of peers. For instance, using self-presentational stories involving emotion-masking displays, Banerjee and Yuill [12] have shown children as young as 6 assign to protagonists facial expressions which are incongruent with their real emotions if the latter were likely to attract negative evaluations by the story audience (e.g. the protagonist being judged as stupid, a cry-baby or greedy).

By the end of primary school self-presentation motives become increasingly salient and children increasingly adapt self-presentation strategies to specific goals. For instance, in a study of 6- to 10-year-olds, Aloise-Young [13] found that older children (especially from age 8 onwards) spontaneously tailored their self-descriptions in order to promote themselves to and ingratiate themselves with a peer audience (specifically to convince other children to pick them as partner for a game). Similarly, in a series of three experiments with the same age range, Banerjee [14] reported that even children in the youngest age group (age 6-7) were able to acknowledge the evaluative preferences of a given audience and to alter their choices of self-descriptive options to match those preferences, and that the tendency to do so increased with age.

However, while this literature demonstrates children’s ability to engage in verbal self-presentation, we know little about children’s self-presentational control of the medium through which such verbal information is communicated: the voice itself. Interestingly, converging evidence from acoustic [15, 16] and anatomical [17] studies indicates that differences between pre-pubertal boys’ and girls’ voices are largely behavioural. Consistent with the absence of appreciable sex differences in the vocal apparatus before puberty, boys and girls speak with a similar mean fundamental

frequency (F0, the correlate of voice pitch). However, boys speak with lower formants (the resonances produced by the vocal tract) and narrower formant spacing (ΔF, the distance amongst adjacent formants) than girls, giving them a deeper, more masculine voice. Boys and girls with more masculine voices (lower ΔF) are also rated, by both child and adult listeners, as having more stereotypical masculine profiles (e.g., in preferences for toys, playmates, activities) than children with less masculine voices [18]. As well as variation in sex-related voice cues affecting listeners' perception of children's masculinity and femininity, children appear to volitionally manipulate F0 and ΔF when giving voice to stereotypically masculine or feminine child characters of the same age and sex as themselves [19].

Integrating these findings, it is theoretically plausible that children's self-presentational motivations will extend to their ability to masculinise and feminise their voices in accordance with gender-stereotyped perceptions of peer audiences. The present study tests this hypothesis by investigating whether children vary their F0 and ΔF when impersonating a child of the same age and sex as themselves who is trying to ingratiate themself with a group of same-sex peers engaging in stereotypically masculine or feminine interests (e.g., rugby players vs. ballet dancers). This "making friends" scenario is often used in the peer relations literature (e.g., [20-22]) as this type of situation is common in children's (and adults') social interactions and can prime behavioural appropriateness according to social norms and expectations [23, 24]. Specifically, the present study examined hypothetical interactions with same-sex peers, given that preferences for same-sex friends dominate social interactions and friendships throughout childhood [2].

We hypothesised that (H1) children would feminise their voice (by raising F0 and increasing ΔF) when imagining they were addressing the ballet club, and masculinise their voice (by lowering F0 and narrowing ΔF) when addressing the rugby club. In line with previous research, we also expected (H2) children to preferentially select stereotypically masculine or feminine self-descriptive statements when playing the role of a child character who is seeking to ingratiate themselves with peers known to have masculine or feminine interests (rugby or ballet). Given that previous research has found that children with the most rigid stereotypes are more likely to present themselves as sex-typed in front of a peer audience [9], we also expected that (H3) children who stereotype more strongly in terms of choice of statements would also exhibit greater voice variation between the two audiences.

audience effects on children's voice

The present study included children aged 8 to 10 years old to ensure that the participants had the literacy skills needed for completing the tasks. This age group also allowed us to test our hypotheses before the onset of pubertal changes to the vocal apparatus [25]. Moreover, previous research has shown that from around 8 years of age, children exhibit verbal self-presentation in response to audience characteristics [13, 24, 26]. It is also from about this age that children rely on gender individuating information from multiple dimensions (e.g., physical appearance, interests), as well as gender labelling, when making social judgements [27].

Methods

Participants

Participants were 56 children (30 males, 26 females) recruited from UK school years 4 and 5, aged 8 to 10 years (mean age = 8.7, SD =.84) in three local primary schools (one from a city and two from two small towns). Children represented different socioeconomic status groups (proportion eligible for free school meals: 2.2%, 14.8%, 33.3%) and were mostly of white ethnicity (96.5%, 87%, 74.1% children). Children were recruited through an advertisement in the school newsletters. School leaders provided informed consent, and parents were additionally provided with information letters and an opportunity to withdraw their children from participation (<30% did so in any school). All children were native English-speakers and had no history of speech or hearing impairments. Children were tested individually on the school premises. The procedure was granted ethics approval by the Sciences & Technology Cross-Schools Research Ethics Committee (C-REC) at the University of Sussex (Certificate: ER/VC44/8).

Procedure

Participants sat in a comfortable chair and were audio recorded with a Zoom H1 handheld recorder, which was positioned at approximately 30 cm from the participant, with a Marantz shield around it. Next, children were presented with two short vignettes via a PowerPoint presentation with pre-recorded narration. Each vignette involved a fictional protagonist of the same age and sex as the participants (Appendix 1). Participants were told to imagine that this child had joined a new school and on

their first day he or she had met with some new peers of the same age and sex as themselves. These peers belonged to either a rugby club (peer audience engaging in a stereotypically masculine activity) or a ballet club (peer audience engaging in stereotypically feminine activity). Children were told in each story that the protagonist wanted to make friends with the given peer audience. They were presented with a set of three self-descriptive statements (masculine, feminine, or neutral), chosen pseudo-randomly from a set of twelve (Appendix 2). Children were then asked to read out all three statements in the order presented as if they were the character speaking to that audience and as if they were true of the child character. Next, children were asked to select the statement which in their opinion the protagonist should say to the peer audience in order to be liked by them. This procedure was repeated twice more for each audience, with a new set of three (masculine, feminine, and neutral) sentences each time. Therefore, each child read out nine self-descriptive statements (three stereotypically masculine, three stereotypically feminine, and three neutral) as a child character speaking to the ballet club, and nine as a child character speaking to the rugby club. The choice of statements, the order of the statements within each set, and the order of the two imagined audiences (ballet club, rugby club) were counterbalanced across groups of children. The vignettes and questions were presented in PowerPoint on a MacBook Air, placed behind, but above the recorder, so that the screen was in full view.

Acoustic analyses

For each sentence spoken by the child, we extracted the mean fundamental frequency (F0) and the centre frequencies of the first four formants (F1-F4) using a custom batch-processing script (see electronic supplementary material 1) that was written using PRAAT software [28]. For each recording, the script overlaid the computed F0 and formant values on narrow band spectrograms, which allowed the researcher to manually correct for erroneous estimates (values departing from visually estimated fundamental and formant frequencies). The parameters for F0 were set as: pitch floor 100Hz, pitch ceiling 450Hz, time step 0.01s. The parameters for formant analysis were set as: number of formants 6, max formant 8000, and dynamic range 30 dB. Given that the frequency of each individual formant is related to formant spacing (ΔF) by equation (1):

$$Fi = \frac{(2i-1)}{2}\,\Delta F$$

We derived ΔF by plotting mean formant frequencies for sentence against the expected increments of formant spacing [(2i−1)/2], where ΔF is equal to the slope of the linear regression line with an intercept set to 0, as in [29]. This acoustic analysis procedure has been applied successfully in previous studies to estimate ΔF from children's speech (e.g., [18, 30]).

Statistical analyses

Linear mixed models (LMMs) fitted using maximum-likelihood estimation were used to examine the main and interaction effects of speaker sex (between participants), audience (ballet club, rugby club) and sentence type (masculine, neutral, feminine) and order presentation of the sets (1,2 or 3) (within participants), on each acoustic parameter (F0 and ΔF) separately (H1). Sentence number within sentence type (allowing the intercept to vary between sentences) and participant identity (allowing the intercept to vary between participants), were included as random factors. The main effects of within-participant factors audience, sentence type and set number were included as random slopes. For all LMMs we checked the residuals for normality with a Q-Q Plot and histogram (electronic supplementary material 2), and there was no indication of this assumption being violated.

In order to establish whether children preferentially selected gender-stereotypical statements when speaking to the ballet or rugby club (H2) we first coded the choice of sentence in each set as 1 or 0. These codes represented, respectively, whether children chose self-descriptive statements in accordance with the stereotyped interests of the peer audience, or not (i.e., participants scored 1 if the feminine / masculine sentence was chosen when speaking to the ballet / rugby club, and 0 otherwise). We then ran a Generalised Linear Mixed Model (GLMM) on the stereotype-matching sentence choice (0 or 1) with speaker sex, audience, set number and their interactions as fixed factors, sentence number within sentence type, and participant identity as a random factors. For the LMM and GLMM pairwise comparisons with Bonferroni corrections were used for fixed factors with more than two levels. Confidence intervals on the means for the Bonferroni-corrected pairwise comparisons were determined by bootstrap resampling 1000 times [31]. LMMs and GLMMs were run in R Studio (analysis script as electronic supplementary materials 3, 4) [32].

Finally, we investigated whether frequency shifts in F0 and ΔF between the two audience groups were significantly associated with the choice of sentences that would most ingratiate them to the given audience (H3), using SPSS v.24 [33]. For each speaker, we first calculated the average difference in F0 and ΔF between the sentences spoken to the ballet and rugby clubs, by averaging, respectively, F0 and ΔF across all sentences addressed to the ballet club and subtracting the averaged F0 and ΔF across all sentences addressed to the rugby club. We then correlated, for boys and girls separately, the F0 and ΔF difference scores with the average number of stereotype-matching sentence choices made for each audience (i.e., masculine self-descriptions for the rugby club; feminine self-descriptions for the ballet club), and also with the average total number of stereotyping-matching choices across the two audiences.

Results

Audience effects on voice manipulations (H1)

The results of our LMMs are reported in Table I. There was a significant main effect of audience on children's F0 and ΔF. Simultaneous pairwise comparisons using Bonferroni correction indicated that the children spoke with a significantly higher mean F0 when addressing the imagined same-sex feminine (ballet) audience (M=233Hz, 95%CI [227, 240]), compared to when addressing the imagined same-sex masculine (rugby) audience (M=225Hz, 95%CI [219, 231]), $p<.001$. They also spoke with a significantly higher ΔF when addressing the feminine audience (M=1374Hz, 95%CI [1363,1386]), compared to when addressing the masculine audience (M=1259Hz, 95%CI [1247,1270]). As expected, the LLM also confirmed a significant main effect of sex on ΔF, as on average boys spoke with lower ΔF (M=1296Hz, 95%CI [1283,1308]) than girls (M=1337, 95%CI[1323,1350]) across both conditions.

There was a significant interaction effect of sex and audience type on both F0 and ΔF (Figure 1). Both boys and girls raised their F0 when addressing the feminine audience (girls: M=230Hz, 95% CI[220,238]; boys: M=237Hz, 95% CI[228,245]) relative to the masculine audience (girls: M=227Hz, 95% CI[217,234]; boys: M=225Hz, 95% CI[217,233]), but this shift was significant in boys only, $p<.001$. Additionally, while both boys and girls raised their ΔF when addressing the feminine

audience relative to the masculine audience, this shift was larger in girls than in boys, p <.001. There was a significant main effect of sentence type on children's F0 and ΔF. Stereotypically feminine self-descriptions were spoken with a significantly higher F0 (M=234Hz, 95%CI[227,240]) and higher ΔF (M=1327Hz, 95%CI[1315,1342]) than the neutral sentences (F0: M=227Hz, 95%CI[221,233]; ΔF :M=1301Hz, 95%CI[1289,1316]) , p<.05, and a non-significant trend was also observed in comparison with the masculine sentences (F0: M=234Hz, 95%CI[220,235]); ΔF:M=1319Hz, 95%CI[1307,1331]), ps<.15. Additionally, there was a significant interaction effect of sentence type with audience type on F0 and ΔF, in that the difference between feminine sentences and the other two sentence types was larger when addressing the feminine audience relative to the masculine audience, while both boys and girls uttered the gender-neutral sentences with a significantly lower ΔF compared to the masculine sentences, p<.05.

There was a significant main effect of set number on children's F0: F0 decreased overall with the sets, and was significantly lower in the last set (M=226Hz, 95%CI [220, 232]), compared to the first (M=231Hz, 95%[225, 238]), p=.006. Additionally, there was a significant interaction effect of sex and set number on children's ΔF. Boys' ΔF was significantly lower in the last set (M=1300Hz, 95%CI [1288, 1312]), compared to the first (M=1291Hz, 95%[1278,1304]), p=.04, while girls' ΔF did not significantly change with set number.

Table I. LMMs testing the effects of the experimental factors on F0 and ΔF.
Figure 1. Girls' and boys' F0 (Hz) (a) and ΔF (b) when addressing the ballet and rugby clubs.

Sentence choice (H2)

As expected, the GLMM revealed that all children preferentially selected stereotypically feminine sentences (boys: M=0.70, 95%CI[0.65, 0.76]; girls: M=0.67, 95%CI[0.62, 0.74]) when speaking to the ballet audience, and stereotypically masculine sentences when speaking to the rugby (boys: M=0.75, 95%CI[0.69, 0.80]; girls: M=0.69, 95%CI[0.62, 0.75]), with no significant difference being found in the degree of stereotyping for the two audiences, p>.05. Moreover, stereotypical choices by boys and girls in both conditions (calculated by taking the mean score across the

three sets in each audience condition) were consistently significantly above chance (one-tailed t-tests ps<.001, comparing against a chance value of .33).

Is there a relation between sentence choice and degree of voice adjustments? (H3)

Correlations of the F0 and ΔF differences between the two audience conditions with the average number of stereotype-matching sentence choices made for each condition (i.e., masculine self-descriptions for the rugby audience; feminine self-descriptions for the ballet audience), and with total number of stereotype-matching choices across both stories together, were non-significant, rs between -.31 and .07, all ps > .10. Thus, differentiating between audiences in terms of spontaneous changes to vocal pitch and resonance was not associated with explicit choices of stereotyped self-descriptions to match audience characteristics (Table S1 in Appendix 3).

Discussion

In line with our hypotheses this study reveals that the presence of an imagined same-sex peer audience with masculine or feminine interests affects children's self-presentations. Effects emerged not just in their choice of self-descriptive statements but also in the modulation of vocal characteristics associated with masculinity and femininity. More specifically, when impersonating a fictional child trying to make friends with same-sex peers engaging in a stereotypically feminine activity (ballet club), children overall systematically feminised their voices (by raising their F0 and ΔF). However, they masculinised their voices (by lowering their F0 and ΔF) when speaking to same-sex peers engaging in a stereotypically masculine activity (rugby club).

The role of nonverbal vocal behaviour in children's self-presentation has hitherto been unexplored. However, our results add to a long-established line of research showing that children's nonverbal displays in other dimensions often accompany verbal strategies for producing desired self-presentational outcomes. These include the strategic use of crying in help-seeking scenarios [34], the use of smiling in conflict situations [35,36] and "looking down one's nose" where children try to convey an impression of competence [37] as well as the deliberate suppression of expressions of anger or hurt feelings in response to provocation [38].

Our results are also consistent with the view that children's gender schemas – the networks of cognitive associations that organise and guide perceptions and understanding of the world on the basis of gender (see [39]) – include correspondences between sexually dimorphic voice cues (lower ΔF in pre-pubertal boys than girls, and lower F0 and ΔF in men than women) and gender-related characteristics (lower frequencies being associated with greater masculinity). Previous voice production studies have shown that children's gender schemas include a vocal component. Children manipulate fundamental and formant frequency values towards those expected from the sex dimorphism in adult voices when asked to sound like a boy or a girl [30], when giving voice to peers with masculine or feminine interests [19], and when asked to impersonate adults in stereotypically masculine and feminine occupations [40]. Our study extends previous findings by showing that children are not only capable of manipulating their voice masculinity and femininity in response to an explicit request, but that they also spontaneously modulate them in a stereotypical way in the presence of peers, in line with the audience's masculine or feminine interests.

Verbal vs. non-verbal displays of self-presentation

In line with previous studies [9, 12-14] we also found that when children were trying to ingratiate themselves with their audience, they selected statements that matched the peers' choice of gender-typed activity. They preferentially selected stereotypically masculine self-descriptions when addressing the rugby club, and stereotypically feminine self-descriptions when addressing the ballet club. However, we did not find a relation between the extent of voice manipulations and how strongly children were inclined to choose stereotypical statements. Although Banerjee and Lintern [9] previously reported higher levels of sex-typed self-descriptive statements in children with more rigid gender stereotypes, this kind of explicit choice of verbal self-description may be independent of the spontaneous stereotype processes manifested in children's vocal productions. In support of this explanation, several studies have reported only a weak relation between implicit and explicit measures of gender stereotyping (e.g., [40-42]).

We also observed an interaction between nonverbal vocal strategies and the content of the sentences spoken by children. Children feminised their voices when uttering the feminine sentences, by raising both F0 and ΔF compared to the other two

sentence types, whilst they did not masculinise their voices when uttering the masculine sentences. Psychoacoustic studies with adult listeners have shown that compared to lower frequency voices, higher vocal frequency voices evoke an attribution of greater friendliness and cooperativeness [43,44], which would be a valued attribute in our hypothetical scenario of making friends. Thus, the strategy of lowering one's voice to express masculinity may have been constrained by the risk of sounding unfriendly. On the other hand, raising one's voice to express femininity may have converged with children's desire to signal friendliness.

Sex differences in nonverbal vocal self-presentation

While our analyses revealed that both sexes shifted the sex-related cues of their voice in line with adult sex dimorphism, the role of F0 and ΔF in the expression of masculinity and femininity appears to vary between the two sexes. This pattern of results is likely to be driven by sex-specific differences in articulatory behaviour, given the absence of overall differences in the vocal apparatus between the two sexes prior to puberty. Specifically, we found that that girls' ΔF was 60Hz higher than boys' when addressing the feminine audience. It is possible that girls spread their lips more than boys when addressing the feminine audience, which would cause a shortening of the vocal tract and therefore a wider ΔF [45]. Interestingly, a recent meta-analysis [46] reveals that women smile (thus spreading their lips) more than men, particularly when gender-appropriate norms are emphasised, and this difference appears to be already present by age 9 [47]. In terms of F0, boys differentiated between audiences more than girls did, with boys speaking with a 7Hz higher and 2Hz lower F0 than girls when speaking to the feminine and masculine audience, respectively. While the difference in girls' F0 between the two audiences was in the expected direction, it was not statistically significant. This suggests that boys increased/decreased the rate of vocal fold vibration to a greater extent than girls, resulting in the observed higher/lower mean F0 when addressing the feminine and masculine audience, respectively. Although small, these differences are in line with a previous study showing that boys manipulate their F0 to a greater extent than their ΔF when giving voice to a boy with feminine versus a boy with masculine interests [19].

Limitations and future research

A number of suggestions for future research emerge from the findings of the present study. Firstly, we reported a slight decrease in F0 (both sexes) and ΔF (boys only) with number of task repetitions (sets). This result was also found in a study with children of this age group [48] and may be at least partly influenced by laryngeal fatigue and practice effects [49]. A further methodological refinement would therefore be to assess the optimal number of trials required to reach representative speaking F0 values. Secondly, our study included a relatively small and mainly white sample from a relatively narrow socioeconomic status (SES) range. Cross-cultural comparisons using larger samples should establish the extent to which our findings can be generalised to diverse cultural contexts, outside that of Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies [50].
Thirdly, our paradigm could be implemented with children spanning a wider age range, as developmental changes in vocal self-presentational behaviour are likely to reflect the combined development of social experience (e.g., amount of peer interaction), cognitive processes (e.g., perspective-taking abilities), gender stereotyping, as well as vocal morphology and control. A particular developmental period of interest would be between late childhood and into early adolescence, given that social evaluation concerns increase during this period [51], though emerging anatomical differences between females and males would also need to be taken into account [17]. It would also be worth investigating to what extent the observed vocal modulation for self-presentational purposes occurs in the early years, given that 5- to 6-year-olds show a relatively limited cognitive capacity for understanding self-presentational motives [12], though they do have the ability to control their voice to alter the expression of their gender [30].

Another goal for future research would be to explore whether children differ in the degree of voice manipulation according to other characteristics of the audience and the nature of the interaction taking place, beyond the current focus on making friends with a hypothetical peer audience. Responses to vignettes are clearly valuable for gaining an insight into children's self-presentational motivations [i.e., 52]. However, when making friends in real life aspects of individuals' vocal productions may not be under voluntary control. For example, an increase in anxiety is associated with higher F0 [53]. Thus, future research could use naturalistic or structured observation of children's behaviour to increase the ecological validity of its findings.

Moreover, we already know that that different social agents (e.g., parents: [54]; teachers: [55]; peers: [56]) influence children's conformity to gender norms. So it is possible that children will respond differently to more narrowly specified categories of audience (e.g., friends vs. nonfriends; familiar vs. unfamiliar; teachers vs. parents). The development of children's self-presentation is also known to vary systematically in relation to contextual factors. Such factors include reputation management following rule violations and acceptance and self-enhancement with members of one's social group vs out-group members [26], as well as children's perceptions of themselves (e.g., social influence and status) and of others [57]. It would be instructive to evaluate the extent to which spontaneous manipulations of vocal qualities take place in these different kinds of social interactions with both peer and adult audiences.

To understand how the voice manipulations we observed map onto listeners' perceptions, studies could evaluate the success of these self-presentational efforts in terms of audience responses (e.g. peer behavioural attributions and friendship choices), particularly given that we already have evidence that child listeners attribute masculinity and femininity on the basis of shifts in voice frequency cues [18]. As well as cues to masculinity and femininity, psychoacoustic research with adults suggests that F0 and ΔF can affect perception of other social traits, including dominance and trustworthiness [58-60], which are also important in attempts to establish friendship. Future research could therefore investigate whether children's variation in vocal masculinity and femininity could also have broader effects on audience attributions along a range of different personal dimensions, and their possible impact on children's popularity and likeability in peer contexts.

References

1. Maccoby E. 1990 Gender and relationships: A developmental account. *American Psychologist*, 45,4, 513-520 (doi: 10.1037/0003-066X.45.4.513)

2. Mehta C., Strough J. 2009 Sex segregation in friendships and normative contexts across the life span. *Developmental Review*, 29,3, 201-220 (doi: 10.1016/j.dr.2009.06.001)

3. Erwin P. 1993. *Friendship and peer relations in children*. Chichester: John Wiley & Sons.

4. Gottman JM, Parker JG. 1986 *Conversations of friends: Speculations on affective development*. Cambridge: Cambridge University Press.
5. Martin C, Kornienko O, Schaefer D, Hanish L, Fabes R, Goble P. 2012 The Role of Sex of Peers and Gender-Typed Activities in Young Children's Peer Affiliative Networks: A Longitudinal Analysis of Selection and Influence. *Child Development*, 84(3), pp.921-937 (doi: 10.1111/cdev.12032)
6. Thorne B. 1993 *Gender play: girls and boys in school*. New Brunswick, NJ: Rutgers University Press.
7. Skočajić MM, Radosavljević JG, Okičić MG, Janković IO, Žeželj, IL. 2020 Boys just don't! Gender stereotyping and sanctioning of counter-stereotypical behavior in preschoolers. *Sex Roles*, 82,3, 163-172 (doi: 10.1007/s11199-019-01051-x)
8. Serbin LA, Connor JM. 1979 Sex-typing of children's play preferences and patterns of cognitive performance. *The Journal of Genetic Psychology: Research and Theory on Human Development,* 134, 2, 315–316 (doi: 10.1080/00221325.1979.10534065)
9. Banerjee R, Lintern, V. 2000 Boys will be boys: The effect of social evaluation concerns on gender-typing. *Social Development*, 9, 3, pp.397-408 (doi: 10.1111/1467-9507.00133)
10. Bandura A, Bussey K. 2004 On broadening the cognitive, motivational, and sociostructural scope of theorizing about gender development and functioning: comment on Martin, Ruble, and Szkrybalo (2002). *Psychol. Bull.*, 130, 5, 691-701. (doi: 10.1037/0033-2909.130.5.691)
11. Vaughn BE, Kopp CB, Krakow JB. 1984 he emergence and consolidation of self-control from eighteen to thirty months of age: Normative trends and individual differences. *Child Development,* 55,3, 990–1004 (doi:10.2307/1130151)
12. Banerjee R, Yuill N .1999 Children's understanding of self-presentational display rules: Associations with mental-state understanding. *British Journal of Developmental Psychology*, 17, 111–124 (doi: 10.1348/026151099165186)
13. Aloise-Young PA. 1993 The development of self-presentation: Self-promotion in 6-to 10-year-old children. *Social Cognition*, 11, 2, 201-222 (doi: 10.1521/soco.1993.11.2.201)
14. Banerjee R. 2002 Audience effects on self-presentation in childhood. *Social Development*, 11,4, 487-507 (doi: 10.1111/1467-9507.00212)

15. Lee S, Potamianos A, Narayanan S. 1999 Acoustics of children's speech: Developmental changes of temporal and spectral parameters. *The Journal of the Acoustical Society of America*, 105, 3, 1455-1468 (doi: 10.1121/1.426686)
16. Perry TL, Ohde RN, Ashmead DH. 2001 The acoustic bases for gender identification from children's voices. *The Journal of the Acoustical Society of America*, 109, 6, 2988-2998 (doi: 10.1121/1.1370525)
17. Vorperian HK, Kent RD. 2007. Vowel acoustic space development in children: A synthesis of acoustic and anatomic data. *Journal of Speech, Language, and Hearing Research*, 50, 6, 1510-1545 (doi:10.1044/1092-4388(2007/104)
18. Cartei V, Banerjee R, Hardouin L, Reby D. 2019 The role of sex-related voice variation in children's gender-role stereotype attributions. *British Journal of Developmental Psychology*, 37, 3, 396-409 (doi: 10.1111/bjdp.12281)
19. Cartei V, Garnham A, Oakhill J, Banerjee R, Roberts L, Reby D. 2019 Children can control the expression of masculinity and femininity through the voice. *Royal Society open science*, 6, 7, 190656 (doi: 10.1098/rsos.190656)
20. MacEvoy JP, Asher SR. 2012 When friends disappoint: Boys' and girls' responses to transgressions of friendship expectations. Child development, 83, 1, 104-119 (doi: 10.1111/j.1467-8624.2011.01685.x)
21. Coplan RJ, Girardi A, Findlay LC, & Frohlick SL. 2007 Understanding solitude: Young children's attitudes and responses toward hypothetical socially withdrawn peers. *Social Development*, 16, 3, 390-409 (doi: 10.1111/j.1467-9507.2007.00390.x)
22. Felmlee DH. 1999 Social norms in same-and cross-gender friendships. *Social Psychology Quarterly*, 53-67 (doi: 10.2307/2695825)
23. Deaux K, Major B. 1987 Putting gender into context: An interactive model of gender-related behavior. *Psychological review*, 94, 3, 369 (doi: 10.1037/0033-295X.94.3.369)
24. Banerjee R. 2002 Audience effects on self-presentation in childhood. *Social Development*, 11,4, 487-507 (doi: 10.1111/1467-9507.00212)
25. Vorperian HK, Wang S, Schimek EM, Durtschi RB, Kent RD, Gentry LR, & Chung MK. 2011 Developmental sexual dimorphism of the oral and pharyngeal portions of the vocal tract: An imaging study. *Journal of Speech, Language, and Hearing Research*. (10.1044/1092-4388(2010/10-0097)

26. Banerjee R, Heyman GD, & Lee K. 2020 The development of moral self-presentation. In L. A. Jensen (ed.), *The Oxford handbook of moral development: An interdisciplinary perspective* (pp. 92-109). New York, NY: Oxford University Press.
27. Martin CL, Wood CH, Little LK, 1990 The development of gender stereotype components. *Child development*, 61, 6, 1891-1904 (doi: 10.1111/j.1467-8624.1990.tb03573.x)
28. Boersma P, Weenink D. 2014 Praat: Doing Phonetics by Computer. Available at: http://www.praat.org (accessed 2019).
29. Reby D, McComb K. 2003 Anatomical constraints generate honesty: acoustic cues to age and weight in the roars of red deer stags. *Animal behaviour*, 65, 519–530 (doi: 10.1006/anbe.2003.2078)
30. Cartei V, Cowles W, Banerjee R, Reby D. 2014 Control of voice gender in pre-pubertal children. *British Journal of Developmental Psychology*, 32, 1, 100-106 (doi: 10.1111/bjdp.12027)
31. Fox, J. 2016 Bootstrapping Regression Models. In J. Fox (3rd ed.), *Applied Regression Analysis and Generalized Linear Models* (pp. 587-606). Thousand Oaks, CA: Sage
32. RStudio Team. 2020 RStudio: integratrd Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/
33. IBM Corp. 2016 IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.
34. Saarni C. 1979 Children's understanding of the display rules for expressive behavior. *Developmental Psychology*, 15, 424-429 (doi: 10.1037/0012-1649.15.4.424)
35. Camras LA. 1984 Children's verbal and nonverbal communication in a conflict situation. *Ethology and Sociobiology*, 5, 4, 257-268 (doi: 10.1016/0162-3095(84)90005-0)
36. Davis TL. 1995 Gender differences in masking negative emotions: Ability or motivation?. *Developmental Psychology*, 3, 4, 660 (doi: 10.1037/0012-1649.31.4.660)
37. Zivin G. 1982 Watching the sands shift: Conceptualizing development of nonverbal mastery. In *Development of nonverbal behavior in children*, 63-98. New York, NY: Springer.
38. Underwood MK, Coie JD, Herbsman CR. 1992. Display rules for anger and aggression in school-age children. *Child development*, 63, 2, 366-380 (doi: 10.2307/1131485)

39. Leaper C. 2011 More similarities than differences in contemporary theories of social development? A plea for theory bridging. *Advances in Child Development and Behaviour*, 40, 337-378 (doi: 10.1016/B978-0-12-386491-8.00009-8)
40. Cartei V, Oakhill J, Garnham A, Banerjee R., Reby D. 2020 "This Is What a Mechanic Sounds Like": Children's Vocal Control Reveals Implicit Occupational Stereotypes. *Psychological science*, 31, 8, 957-967 (doi: 10.1177/0956797620929297)
41. Cvencek D, Meltzoff AN, Greenwald AG. 2011 Math–gender stereotypes in elementary school children. *Child development*, 82, 3, 766-779 (doi: 10.1111/j.1467-8624.2010.01529.x)
42. White MJ, WhiteGB. 2006 Implicit and explicit occupational gender stereotypes. *Sex roles*, 55, 3, 259-266 (doi: 10.1007/s11199-006-9078-z)
43. Sityaev D, Webster G, Braunschweiler N, Buchholz S, & Knill K. 2007 Some aspects of prosody of friendly formal and friendly informal speaking styles. In *XVI International Conference on Phonetics Sciences, Saarbrücken* (pp. 6-10).
44. Knowles KK., Little AC. 2016 Vocal fundamental and formant frequencies affect perceptions of speaker cooperativeness. *Quarterly Journal of Experimental Psychology*, 69, 9, 1657-1675 (doi: 10.1080/17470218.2015.1091484)
45. Sachs J, Lieberman P, Erickson D. 1973 Anatomical and cultural determinants of male and female speech. In R. W. Shuy & R. W. Fasold (Eds.). *Language attitudes: Current trends and prospects* (pp. 74– 84). Washington, DC: Georgetown University Press (doi: 10.1250/ast.33.215)
46. LaFrance M, Hecht MA, Paluck EL. 2003 The contingent smile: a meta-analysis of sex differences in smiling. *Psychological bulletin*, 129, 2, 305 (doi: 10.1037/0033-2909.129.2.305)
47. Dodd DK, Russell BL, Jenkins C. 1999 Smiling in school yearbook photos: gender differences from kindergarten to adulthood. *Psychol. Rec.* 49, 543-553.
48. Ma EPM, Lam NLN. 2015 Speech task effects on acoustic measure of fundamental frequency in Cantonese-speaking children. *International journal of pediatric otorhinolaryngology*, 79, 12, 2260-2264 (doi: 10.1016/j.ijporl.2015.10.018)
49. Vogel AP, Fletcher J, Snyder PJ, Fredrickson A, & Maruff P. 2011. Reliability, stability, and sensitivity to change and impairment in acoustic measures of timing and frequency. *Journal of Voice*, 25, 2, 137-149 (doi: 10.1016/j.jvoice.2009.09.003)
50. Henrich J, Heine SJ, & Norenzayan A. 2010 Most people are not WEIRD. *Nature*, 466, 7302, 29-29

51. Westenberg PM, Drewes MJ, Goedhart AW, Siebelink BM, Treffers PDA. 2004 A developmental analysis of self-reported fears in late childhood through mid-adolescence: social-evaluative fears on the rise? *Journal of Child Psychology and Psychiatry.* ;45, 3, 481–495 (doi: 10.1111/j.1469-7610.2004.00239.x)
52. Banerjee, R, & Dittmar, H 2008. Individual differences in children's materialism: The role of peer relations. *Personality and Social Psychology Bulletin*, 34,1, 17-31 (doi: 10.1177/0146167207309196)
53. Laukka P, Linnman C, Åhs F, Pissiota A, Frans Ö, Faria V, ... & Furmark T. 2008 In a nervous voice: Acoustic analysis and perception of anxiety in social phobics' speech. *Journal of Nonverbal Behavior*, 32, 4, 195-214 (doi: 10.1007/s10919-008-0055-9)
54. Leaper C. 2000 Gender, affiliation, assertion, and the interactive context of parent–child play. *Developmental Psychology*, 36, 3, 381–393 (doi: 10.1037/0012-1649.36.3.381)
55. Alan S, Ertac S, Mumcu I. 2018 Gender stereotypes in the classroom and effects on achievement. *Review of Economics and Statistics*, 100, 5, 876-890.
56. Braun, S. S., & Davidson, A. J. (2017). Gender (non) conformity in middle childhood: A mixed methods approach to understanding gender-typed behavior, friendship, and peer preference. *Sex Roles*, ,77, 1, 16-29 (doi: 10.1007/s11199-016-0693-z)
57. Salmivalli C, Ojanen T, Haanpää J, Peets K. 2005 "I'm OK but you're not" and other peer-relational schemas: explaining individual differences in children's social goals. *Developmental psychology*, 41, 2, 363 (doi: 10.1037/0012-1649.41.2.363)
58. Hodges-Simeon CR, Gaulin SJ, & Puts DA, (2010). Different vocal parameters predict perceptions of dominance and attractiveness. *Human Nature*, 21, 4, 406-427 (doi: 10.1007/s12110-010-9101-5).
59. O'Connor JJ, Barclay P 2017 The influence of voice pitch on perceptions of trustworthiness across social contexts. *Evolution and human behavior*, 38, 4, 506-512 (doi: 10.1016/J.EVOLHUMBEHAV.2017.03.001)
60. Oleszkiewicz A, Pisanski K, Lachowicz-Tabaczek K, & Sorokowski A. 2017 Voice-based assessments of trustworthiness, competence, and warmth in blind and sighted adults. *Psychonomic bulletin & review*, 24, 3, 856-862 (doi: 10.3758/s13423-016-1146-y)