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Opposites attract! Pitch divergence at turn breaks as cause and effect of perceived attractiveness

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Abstract

In a previous study on dating conversation it was found that speakers who perceived their interlocutor as more attractive showed a tendency to diverge from their interlocutor in terms of F0 mean immediately after taking the turn. One explanation brought forward was that speakers who were attracted to their interlocutor thereby tried to sound more attractive in return. It is widely acknowledged that there are features of a speaker's voice that are perceived as more attractive. In this study we want to ask whether speakers who show divergence as an effect of being attracted are actually perceived as more attractive in return. We investigated 98 spontaneous mixed-sex dating conversations and found that the speakers who diverged their F0 to a larger extent were in return perceived as significantly more attractive. Since speakers were explicitly instructed to rate the visual attractiveness only, we conclude that the vocal behavior of speakers can affect how they are perceived by an interlocutor, even concerning their visual attractiveness.

Index Terms: prosodic entrainment, perceived attractiveness, vocal attractiveness, pitch divergence

1. Introduction

The effect of an interlocutor's perceived visual attractiveness on a speaker's voice has received little attention so far. In a previous study, [1] found that both male and female speakers lowered their mean pitch level when talking to a more attractive opposite-sex interlocutor. In contrast, [2] found that female speakers raised their mean pitch when talking to a more attractive male. However, both studies were conducted with scripted monologues potentially affecting the perception of attractiveness and its effects (cf. [3]). Accordingly, we sought to investigate the effects of perceived attractiveness in spontaneous dating conversations in a previous study [4-7]. Our own results partly confirm the findings by [1] and [2] as we found that male speakers lowered their F0 mean when talking to a more attractive female interlocutor while female speakers raised their F0 mean. An advantage of this study was that perceived attractiveness was assessed in a face-to-face situation. As pointed out by [3], this difference in naturalness is expected to affect the generalizability of the results, probably through a difference in speaker intent. Furthermore, we found that speakers did not raise or lower their mean over the whole course of the conversation but specifically immediately after taking over the turn [7]. Additionally, our study did not investigate prosodic features on their own but in relation to prosodic entrainment (cf. [8, 9]). Overall, the findings show that shifting the pitch level resulted in pitch divergence at turn breaks which means that the differences between the F0 mean of the speaker that yielded the turn and speaker that took the turn were increased. This may be a secondary effect of the pitch shift but also the main effect of perceived attractiveness.

Concerning the findings of [1], [2] and [4-7] it was argued that speakers who perceive their interlocutor as attractive, become attracted and consequently try to sound more attractive themselves. Accordingly, we would expect the pitch features of perceived attractiveness to resemble the pitch characteristics of attractive voices. Although there are several acoustic contributors to vocal attractiveness, pitch remains the most frequently investigated. Furthermore, it is theoretically grounded in the predictions of the frequency code [10, 11] which postulates a general connection between low pitch and masculinity as well as high pitch and femininity. Studies show that low pitched male voices were perceived as more attractive by female listeners [12-16]. For female voices, we find contradicting results as both lower pitch [17, 18] as well as higher pitch [15, 16, 19, 20] were judged as more attractive. Explanations for this discrepancy can be sought in methodological differences, such as judging attractiveness from synthesized versus natural stimuli, as well as different concepts of vocal attractiveness for female speakers such as high pitched voices signaling femininity versus low pitched voices signaling seductiveness [21].

In summary, previous studies showed that lower pitched male voices and higher pitched female voices are in general perceived as more attractive. Moreover, male speakers lower their pitch level and female speakers raise their pitch level when talking to an interlocutor who is perceived as more attractive resulting in pitch divergence at turn breaks. Assuming that a speaker's reaction to perceived attractiveness, either unconsciously or consciously, is intended to make him/her sound more attractive, the question arises whether this actually has an effect on the interlocutor thus resulting in an interaction of pitch and perceived attractiveness.

It needs to be considered that the studies on attractive voices investigated the general acoustic features of an attractive voice. They did not explicitly investigate whether the same speaker was perceived as more or less attractive when talking at a higher or lower pitch level. The effect of perceived attractiveness described above limits the possible variation in pitch level to the respective speaker's F0 range. Accordingly, we are not asking whether assuming a low or high absolute pitch level affects perceived attractiveness but rather whether changing the relative pitch level within a speaker's natural F0 range affects perceived attractiveness. Furthermore, we want to investigate the reciprocity of the connection between pitch features and perceived attractiveness by taking both from the same speaker and the same conversation. We first seek to replicate the findings of [4-7], investigating whether perceived attractiveness shows the same effects in a now extended corpus. Secondly, we will look at whether these effects influence the perceived

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attractiveness of the respective interlocutor within the same conversation.

We arrive at the following research questions. 1) Does the perception of attractiveness in an opposite sex interlocutor systematically affect a speaker's pitch features in accordance with previous findings? 2) Do changes in a speaker's pitch features affect an interlocutor's perception of the speaker in terms of attractiveness in a spontaneous conversation? 3) Are these two expected effects connected in a systematic way?

2. Method

2.1. Subjects

10 female and 10 male paid volunteers from the University of Oldenburg participated in the study. All subjects were aged between 19 and 28 years, monolingual speakers of High German and grew up in Lower Saxony. For this study only heterosexual singles were considered. The subjects were unacquainted and interaction prior to the experiment was avoided.

2.2. Procedure

All subjects were informed about the dating setting prior to the experiment. Each participant was paired with each participant of the opposite sex for a total of 100 opposite-sex pairs. The subjects were seated in a quiet room and participated in short spontaneous conversations of 15 to 20 minutes each with no topic restrictions. All participants judged the visual attractiveness as well as the general likability of their interlocutor immediately before and after each conversation and the general impression they had of the conversation itself directly after the conversation on a 10-point Likert scale. These ratings were not revealed to the respective interlocutors. Recordings were made in stereo using a portable digital recorder (Tascam HD P2) at a sampling rate of 48 kHz and 24-bit resolution with head-mounted microphones (DPA 4065 FR).

2.3. Acoustic analysis

The acoustic analysis was carried out with Praat [22]. The speech parts of all speakers were segmented into interpausal units (IPU) (cf. Levitan 2014). Pauses were annotated manually but defined mechanically by an interruption of speech of at least 500 ms making no difference between actual pauses and hesitation pauses in favor of annotator consistency. The corpus consisted of a total of 14.687 IPUs extracted from 98 conversations since two conversations had to be excluded for technical reasons. We calculated the F0 mean for the interpausal units in immediate adjacency to a turn break inducing speaker change for both interlocutors. The measurements were converted to semitones with a reference of 50 Hz. The F0 mean values of all speakers were normalized around the group mean per speaker.

2.4. Statistical analysis

We conducted linear mixed effects models using *R* [23], the *lme4*-package [24], and the *lmerTest*-package [25]. Model fit was determined by maximum likelihood ratio tests. *P*-values were calculated using the Satterthwaite approximation. We calculated four different models separated first by whether perceived attractiveness was the dependent variable or the predictor and second by speaker sex. For the effects of perceived attractiveness on a speaker's pitch, we used the F0 mean of the speaker who took the turn (*taker F0*) as the dependent variable, the PERCEIVED ATTRACTIVENESS rating of the speaker passing the turn as a fixed factor, and *speaker* as a random factor. Furthermore, we included PERCEIVED LIKABILITY and CONVERSATIONAL QUALITY as fixed factors. The effects of those factors are not reported in this paper (see [4-7]) but their effects are included in the model to exclude their influence on perceived attractiveness from the analysis. For the effects of the interlocutor's pitch on perceived attractiveness, we used *perceived attractiveness* as the dependent variable. As fixed factors we used the F0 mean of the turn taking interlocutor (TAKER F0), the F0 mean of the turn passing interlocutor (GIVER F0), as well as their INTERACTION. *Speaker* was again included as a random factor.

3. Results

Table 1 and 2 show the statistical results for the effects of PERCEIVED ATTRACTIVENESS on a speaker's mean F0. For both sexes, the degree of PERCEIVED ATTRACTIVENESS shows significant effects on the relative height of the F0 mean. However, the effects point into different directions. While PERCEIVED ATTRACTIVENESS and *taker f0* are positively correlated for the female speakers, meaning that females raise their relative pitch level when talking to a more attractive interlocutor, it shows a negative correlation for the male speakers, i.e. an increase in the interlocutor's PERCEIVED ATTRACTIVENESS is connected to a relative lowering of the speaker's pitch level.

Table 1: *Effects of perceived attractiveness on the F0 mean of the turn taking speaker for female speakers.*

	b	*SE*	*df*	*t*	*p*
PERCEIVED ATTRACTIVENESS	0.29	0.08	7263	3.82	<.001

Table 2: *Effects of perceived attractiveness on the F0 mean of the turn taking speaker for male speakers.*

	b	*SE*	*df*	*t*	*p*
PERCEIVED ATTRACTIVENESS	-0.08	0.03	7372	-2.86	<.01

Table 3 and 4 show the statistical results for the effects of a speaker's F0 mean on how attractive they are perceived by their interlocutor. For the female speakers we find no significant effects for the main factors but for their interaction. The coefficients tell us that male speakers that lower their mean pitch after turn breaks are perceived as more attractive but only when this results in an increase in the absolute differences between the GIVER F0 and the TAKER F0. Accordingly, if a female speaker lowers her F0 and the male speaker responds by also lowering his voice to a similar extent, the PERCEIVED ATTRACTIVENESS is not increased. For the male speakers, we find comparable effects but in the opposite direction. The interaction suggests that female speakers were evaluated as more attractive if they diverged in their pitch level. However, in contrast to the female speakers, we find a significant main effect for TAKER F0 showing that female speakers who raised their pitch mean were perceived as more attractive in general.

Table 3: *Effects of the F0 mean of two interlocutors on the perceived attractiveness of the turn giving speaker for female speakers.*

	b	*SE*	*df*	*t*	*p*
GIVER F0	-5.89e-03	6.20e-03	7375	-1.13	n.s.
TAKER F0	1.14e-04	4.84e-03	7374	0.02	n.s.
GIVER F0 X TAKER F0	-6.08e-03	1.03e-03	7374	-5.91	<.001

Table 4: *Effects of the F0 mean of two interlocutors on the perceived attractiveness of the turn giving speaker for male speakers.*

	b	*SE*	*df*	*t*	*p*
GIVER F0	-1.21e-03	5.96e-03	7308	-0.20	n.s.
TAKER F0	2.36e-02	5.59e-03	7300	4.22	<.001
INTERACTION	4.61e-03	1.48e-03	7299	3.12	<.01

4. Discussion

In this study we investigated the connection between pitch features and perceived attractiveness of two speakers in spontaneous mixed-sex dating conversations. Specifically, we asked whether a speaker's mean pitch is affected by the perceived visual attractiveness of his/her interlocutor, whether a change in pitch level also affected how a speaker was perceived by his/her interlocutor in terms of visual attractiveness, and whether the two phenomena systematically interact.

Our results show that male speakers lowered their mean F0 when talking to a female interlocutor they perceived as more attractive, while female speakers showed the opposite effect by raising their mean F0 when talking to a more attractive male interlocutor. This is in accordance with our expectations from previous studies [1, 2, 4-7] and replicates the findings using unscripted conversations and a larger corpus, which introduces a greater degree of naturalness, which according to [3] can greatly affect how perceived attractiveness influences ones voice. As suggested by an anonymous reviewer, this may be attributed to a difference in intent. So far, there are only very few studies on the phenomenon in itself and especially to the contribution of speaker intent on the prosodic effects. However, we want to point out that we collected additional personal data from the participants prior to the experiment. From the 20 participants only three explicitly stated that they participated to 'flirt a little' while the rest just sought interesting conversations. Furthermore, all of those three participants were male. Accordingly, we find strong effects of perceived attractiveness on prosodic divergence although speakers stated that they did not intend to flirt. Thus, the question what part intention plays in this study becomes even more important but has to be postponed to later investigations.

Moreover, the results further corroborate the hypothesis that speakers react to perceived attractiveness by imitating the pitch features attributed to attractive voices suggested by [12-20].

So far, previous findings suggested that low pitch and high pitch respectively are perceived as attractive in absolute terms (cf. [12-20]). Since our subjects raised and lowered their F0 mean relative to their average mean, we were interested in whether a relatively low or high pitch level within a speaker's natural range causes a similar effect. Our results suggest that this is indeed the case. We find that female speakers judged male speakers who talked with a relatively lower mean F0 as significantly more attractive than male speakers talking with an average or relatively higher F0 mean. In return, male speakers judged female speakers with a relatively higher F0 mean as significantly more attractive. Since all F0 values were group mean normalized for speaker, female speakers for example did not in general judge male interlocutors with a lower voice as more attractive but rather male speakers who talked relatively low within their own natural voice's range in the respective conversation. In fact, we did a post-hoc analysis to check whether female speakers judge the male interlocutors who had a generally lower voice as more attractive and the other way around for the male speakers which in both cases yielded no significant effects.

Additionally, we found a significant interaction between the speaker's and the interlocutor's F0 mean which indicated that it was not sufficient to lower or raise the F0 mean but that speakers had to increase the differences in F0 mean at the point of speaker change. Since this interaction significantly overruled the main effects, we hypothesize that it is the pitch divergence which influences the perception of attractiveness which in turn is necessarily connected to the primary effects described above.

Speakers seem to be able to judge the location of an interlocutor's F0 mean within his/her natural F0 range and relative to his/her average F0 mean (cf. [26-29]). This suggests that female speakers for example can judge a higher F0 mean in absolute terms as more attractive than a lower F0 mean if the higher F0 mean is relatively low in the F0 range of a certain speaker while the lower F0 mean is relatively high in another speaker's natural F0 range. We arrive at the hypothesis that it may neither be the actual nor relative pitch level that speakers perceive as attractive but instead the fact that an interlocutor's voice indicates attraction towards the speaker. Accordingly, it may be the interlocutor's interest in the speaker which is perceived as attractive and not the voice itself. This hypothesis gets additional support from the fact that we did not ask the subjects to evaluate their interlocutor in terms of overall attractiveness but explicitly in terms of only visual attractiveness. Although it may be possible that subjects are simply incapable of separating the judgement of visual attractiveness from being affected by an attractive voice, we want to point out that subjects were quite capable of separating visual attractiveness from likability. It is therefore just as likely that the subjects noticed the attraction of their interlocutor which affected their judgement. However, we want to point out that perceiving someone as attractive does not necessarily lead to attraction. In any case we find that shifts in relative pitch level affect how visually attractive a speaker was perceived.

5. Conclusion

In conclusion, we found both male speakers and female speakers to change their pitch level when talking to an interlocutor judged as more attractive. Additionally, the changes they made lead to them being perceived as more attractive in return by their interlocutor. Furthermore, these adjustments occurred relative to a speaker's normalized F0 mean suggesting that speakers did not simply judge a high or low voice as more attractive but a speaker speaking relatively high or low within his/her natural F0 range. Lastly, the changes in relative pitch level were found to affect perceived attractiveness even when subjects were instructed to judge attractiveness based on a purely visual basis.

6. References

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