Farley Hughes LaFayette copy

Data · March 2015

CITATIONS
0

READS
52

3 authors, including:

Sally D Farley
University of Baltimore
18 PUBLICATIONS **157** CITATIONS
SEE PROFILE

Jack N. Lafayette
Albright College
2 PUBLICATIONS **9** CITATIONS
SEE PROFILE

People Will Know We Are in Love: Evidence of Differences Between Vocal Samples Directed Toward Lovers and Friends

Sally D. Farley, Susan M. Hughes & Jack N. LaFayette

Journal of Nonverbal Behavior

ISSN 0191-5886
Volume 37
Number 3

J Nonverbal Behav (2013) 37:123-138
DOI 10.1007/s10919-013-0151-3

Springer

J Nonverbal Behav (2013) 37:123–138
DOI 10.1007/s10919-013-0151-3

ORIGINAL PAPER

People Will Know We Are in Love: Evidence of Differences Between Vocal Samples Directed Toward Lovers and Friends

Sally D. Farley · Susan M. Hughes · Jack N. LaFayette

Published online: 6 April 2013

Abstract Research has documented the tendency for individuals to change their voices as a function of different emotional and motivational states, but little attention has been devoted to examining voice modulation in romantic relationships. The present research was conducted to determine (1) the way in which individuals alter their voices when speaking to romantic partners versus friends and (2) if independent raters perceive these differences. Independent raters ($N = 80$) listened to vocal clips obtained from telephone calls directed toward close same-sex friends and romantic partners. For several clips, raters were able to identify conversational partner (romantic versus friend) with greater than chance accuracy, and this accuracy was positively correlated with vocal pitch and perceived romantic interest. In addition, raters who listened to content-filtered clips judged callers less favorably when talking to their romantic partners than their friends. Results are interpreted in light of the "longing" but vulnerable condition of intense romantic love, and integrated into affection exchange theory and communication accommodation theory.

Keywords Voice · Affect expression · Romantic love · Vocal accommodation theory · Paralanguage

Introduction

As social animals, we are intuitively attuned to the emotional states of those who surround us. Many have argued for the importance of vocalic cues for the expression of our

S. D. Farley (✉)
Division of Applied Behavioral Sciences, University of Baltimore, Baltimore, MD 21201, USA
e-mail: sfarley@ubalt.edu

S. M. Hughes
Department of Psychology, Albright College, 13th and Bern Streets, Reading, PA 19612, USA
e-mail: shughes@alb.edu

J. N. LaFayette
Institutional Research, Albright College, 13th and Bern Streets, Reading, PA 19612, USA
e-mail: jlafayette@alb.edu

emotional states (Burgoon et al. 2010; Scherer 1986, 2003). In relational communication, our ability to correctly differentiate between angry, fearful, or elated tones of voice is essential to relational harmony and stability. For example, research has linked accurate vocal nonverbal communication to measures of marital satisfaction (Noller 1980). A number of findings are consistent with the notion that our voices evolved as effective communication devices beyond relaying semantic information through speech.

Scherer's (1986, 2003; Banse and Scherer 1996) theoretical work on vocal affect expression argued that different emotional states are expressed using unique vocal profiles. This emotional differentiation in voice is similar to the differentiation seen in facial expression (Scherer 2003; Ekman 1993). Despite the tendency for individuals to decode facial expressions of same-culture individuals with greater accuracy than those of a different culture, accuracy rates are significantly better than chance, which points toward universality (Scherer 2003). Other research has documented the similarity between vocalizations emitted by humans and primates as evidence of an evolutionary influence (Burgoon et al. 2010).

Using voice as our primary mode of communication affords us many advantages; it allows us to communicate over appreciable distances without having to be in direct contact with the listener, and the production and reception of vocalizations are not dependent upon light. Beyond what the content of speech communicates, the ability to use intonations, inflections, whispers, and otherwise change the overall sound of our vocalizations allows for even further transmission of information (Gallup and Cameron 1992). From an evolutionary standpoint, vocalizations are an important channel for survival (Floyd and Ray 2003). One interesting illustration of this logic is the specialized alarm calls emitted by capuchin monkeys in response to terrestrial versus arboreal predators (Fichtel et al. 2005).

Another evolutionary theory that argues for the critical value of recognizing affection displays in others is termed affection exchange theory (AET) (Floyd et al. 2008). AET posited that successful use of nonverbal cues to signal affection and connectedness to others offers individuals a survival advantage. Consequently, it is not surprising that individuals show great skill at encoding and decoding various signals of affection such as behavioral synchrony (Capella 1997; Karremans and Verwijmeren 2008), touch/haptics (Guerrero 1997; Koeppel et al. 1993) and vocalic cues. We may attend to vocal cues of romantic interest to avoid expending energy on individuals who are unavailable, such as those who are already in monogamous relationships, or those who are simply not interested in us. Consistent with this logic, research has indicated that listeners can detect sexual orientation with greater than chance accuracy through voice alone (Munson et al. 2006). Like other nonverbal behaviors, vocal cues are not only used to communicate connectedness and intimacy with our loved ones, but can also act as signals to others about our relationship status (Burgoon et al. 2010).

The modification of the sound of a person's voice appears to be of particular importance when it comes to romantic relationships. Several studies point to evidence that individuals manipulate the sound of their voices in order to attract potential mates. For instance, in an experimental "seduction" study, men who engaged in greater vocal modulation were more successful at obtaining a second date with their female partners (Anolli and Ciceri 2002). In addition, Hughes et al. (2010) found that both men and women lowered the pitch of their voices when speaking with an attractive member of the opposite sex (in order to sound more attractive) as opposed to an unattractive member of the opposite sex. Furthermore, independent raters assigned higher pleasantness ratings to voice samples directed toward attractive targets than unattractive targets (Hughes et al. 2010). Because those with more pleasant-sounding voices are believed to be more attractive (sight unseen) (Collins and

Missing 2003), and, in fact, possess more attractive traits such as body symmetry (Hughes et al. 2002) and ideal body shape (Hughes et al. 2004), it is not surprising that individuals manipulate their voices to become more pleasant-sounding when speaking with someone who they believe to be attractive (Snyder et al. 1977).

Beyond attracting a mate, once in a relationship, there is some evidence to suggest that romantic partners continue to modify the sound of their voices when speaking to their intimate partners. Bombar and Littig (1996) demonstrated that the frequency of "babytalk" (i.e., voice spoken using a higher register) between romantic couples was a strong predictor of intimacy and secure attachment. Montepare and Vega (1988) examined six women's voices during telephone conversations and showed that the women were perceived as sounding more "approachable, sincere, submissive, and scatterbrained" (p. 103) when talking to male romantic partners than when talking to male friends. However, Montepare and Vega did not examine the women's self-reported feelings for their conversational partners, nor did they include men in their study. One aim of the present research is to examine early state romantic love. Intense romantic love may yield a unique pattern of vocal modification, especially during the initial phases of a relationship when passion is a focal component (Fisher 2000; Hatfield and Rapson 1993; Sternberg 1986).

The prediction with regard to how vocal pitch (fundamental frequency) might communicate romantic desire is complex. First, vocal pitch may be dependent upon motivational and affective states, which are not uniform in people who are "in love." While it is certainly the case that romantic partners may wish to modulate their voices in order to appear sexy (possibly deepening the pitch of their voices) (Hughes et al. 2010; Tuomi and Fisher 1979), they may also be motivated to express intimacy, which is sometimes associated with a higher pitch (Burgoon et al. 2010) and sometimes associated with a lower-pitch (the "self-disclosure" voice, Anolli and Ciceri 2002). Another complication with regard to this prediction has to do with the intense arousal accompanied by romantic love. The vocal profiles of other high arousal emotional states, such as fear or joy/elation, are typically accompanied by pitch increases due to the effect of muscular contraction (Bänziger and Scherer 2005).

Some of these seemingly disparate findings may be unified according to predictions of communication accommodation theory (CAT) (Giles 2008). According to this theory, vocal convergence occurs when conversing individuals adopt one another's vocalic cues (such as pitch or rhythm) (Gregory 1990), and this tendency is especially likely when interaction partners like one another (Floyd and Ray 2003). As a result, findings may appear inconsistent because of the tendency for research in this area to utilize only men's or women's voices. Men may express affection and interest in female interaction partners by increasing the pitch of their voices, thus converging with women's higher pitch, whereas women may deepen the pitch of their voices, thus converging to men's lower pitch.

The purpose of this study was to explore the ways in which individuals may alter their voices (i.e., engage in voice modulation) when speaking to romantic love partners versus close same-sex friends during brief telephone conversations. The initial stages of romantic love are associated with intense physiological arousal, intrusive thoughts, and high levels of craving and longing for the other (Fisher 2000). In fact, Fisher and her colleagues have likened romantic love to an addiction, possessing all of the properties associated with addiction (including tolerance, withdrawal, and spontaneous recovery) (Aron et al. 2005; Fisher 2006). Because of the intensity of this emotional state, and because individuals who report being "in love" recount being very distressed when asked to consider the loss of their partner (Hatfield and Rapson 1993), we would expect the vocal channel to be a

particularly important medium to advertise one's relationship status. Furthermore, we predicted that the detection of these feelings through voice is also discernable to those outside of the partner dyad (i.e., others listening to their conversations), and even when the content of the conversation is obscured (i.e., through use of voice filtering, "paralanguage"). To obtain objective evidence of vocal modulation, we examined the physical properties of voice samples obtained from conversations between romantic partners in early stage romantic love using pitch analysis. Finally, we conducted a lens model analysis to facilitate greater understanding of the encoding and decoding processes of romantic love.

Previous research utilized opposite-sex friends as a control group (Montepare and Vega 1988), which may have been problematic due to the frequency of sexual tension in cross-sex friendships (Afifi and Faulkner 2000; Halatsis and Christakis 2009). As a result, conversations between callers and a close same-sex friend served as our comparison group. In light of the reviewed literature, we predicted the following hypotheses:

H1 Participants would be able to identify whether callers were speaking with a romantic partner or a close, same-sex friend with greater than chance accuracy.

H2 Vocal samples directed toward romantic partners would be perceived by independent raters as reflecting greater romantic interest than those directed toward friends.

H3 Based upon the tendency for individuals to sound more confident, warm and socially skilled when speaking with attractive others (Snyder et al. 1977), we predicted that raters would evaluate callers' personalities more positively when they were speaking with romantic partners as opposed to friends.

H4 Based upon the logic of CAT, we predicted that women would utilize a higher pitched voice when speaking to their friends than romantic partners, whereas men would speak in a higher-pitched voice when speaking to their romantic partners than their friends.

H5 There would be significant positive correlations between callers' self-reported love for their romantic partners and how positively romantic clips were rated (in terms of perceived romantic interest and positive qualities).

Method

Participants Providing Vocal Samples

Participants providing vocal samples ("callers") were recruited in several ways. First, callers were recruited through a daily electronic announcement ("Daily Digest") at the University of Baltimore advertising a study about "Conversational Style" in relationships. In order to increase the likelihood that the callers would be "passionately in love," callers were required to be involved in their romantic relationships for less than one year. Researchers also sent emails to individuals who were known to them to have been involved in romantic relationships for less than a year. In addition, we increased the sample size of the callers by relying upon snowball sampling, emailing individuals who were suggested by previous callers. The caller protocol was practiced with two pilots. Callers (12 men and 12 women) received $10–15 in compensation for their participation, which took approximately 30 min. The majority of the callers were Caucasian (79.2 %), followed by Hispanic (12.5 %), with equal representation of African-American and Asian (both 4.2 %).

Callers were on average 27.16 years old ($SD = 8.30$, range = 18–45). The average romantic relationship length of our sample was 6.75 months ($SD = 3.39$ months), while the average friend relationship length was 5.24 years ($SD = 4$ years).

Procedure for Callers

In order to decrease demand characteristics and social desirability concerns, callers were told that the study pertained to "Conversational Style." Two female experimenters obtained vocal samples from callers in private, quiet settings that were selected by the callers. These settings included homes, the laboratory at the University of Baltimore, offices, and classrooms. First, callers consented to the recording of their voices and were assured that the voices of their conversational partners would not be recorded. Next the callers placed 5-min phone calls to a close, same-sex friend and their romantic partner (the order was randomized per caller) after the experimenter left the room. Recordings were made with a DS-40 Olympus digital voice recorder. Last, the callers completed a questionnaire that included a brief demographic section and items that measured the level of love they felt for both of their conversational partners. The Love Questionnaire was comprised of the brief 15-item version of the Passionate Love Scale (PLS) (Hatfield and Rapson 1993) and eight items from the companionate love scale, four measuring intimacy and four measuring commitment (Hatfield and Rapson 1993, 1996). Two trust items were also added ("I feel I can confide in ____ about virtually anything" and "I trust ____ completely"). Callers were advised that some of the items on the questionnaire would seem more appropriate than others, but to answer questions as honestly as possible.

The calls were largely unstructured, but callers were asked to pose two questions to both conversational partners, "how are you?" and "what are you doing?," at some point during their 5-min conversations. Callers were asked to include these questions to ensure that there were some uniform phrases for which comparable pitch analyses could be performed. In addition, we asked callers to abstain from using formal names and obvious relationship identifiers such as terms of endearment or romantic idioms (e.g., "honey").

Procedure for Creating Voice Segments and Conducting Pitch Analysis

We adapted the method utilized by Montepare and Vega (1988), who created audio clips by segmenting out the first 20 s of each call. To increase the likelihood that callers would habituate to the audio recorder, we used Goldwave (Version 5.58) digital audio editing software to clip out a lengthy segment starting at the first full sentence that occurred after the 2-min mark for each call. We anticipated that callers would reach a natural conversational rhythm and would have accommodated to having their conversations recorded by this time.

Next, silences, formal names, and romantic idioms were removed from the clips so that raters would be exposed to exactly 20 s of continuous speech. Because of the silence-elimination and because raters were only exposed to one part of the conversation, the content of the conversation was difficult to comprehend. For example, a few seconds of one of the clips is as follows, "Well … What? … Let's see … You know what … Um, I didn't tell her until Monday." These clips are heretofore referred to as "longer content" clips. To further mask the verbal content of the conversations, an additional paralanguage version of each 20-second clip was created by applying a low-pass filter at 1,000 HZ using Goldwave software. This level was selected because the researchers believed that this was the minimum manipulation required to obscure content, while still retaining important

paralinguistic features like intonation and pitch. These clips are referred to as "paralanguage" clips.

We also utilized GoldWave software to clip out the phrases "how are you?" and "what are you doing?" segments for each call. Despite instructions, only 13 callers (6 men and 7 women) uttered the phrase "how are you?" to both their romantic partner and their friend, and the same number of callers ($N = 13$, 8 men and 5 women), but in some cases, different individuals, asked "how are you doing?" to both of their conversational partners (8 men and 5 women), reducing power for these analyses. These two phrases will be referred to as the "brief clips" throughout. The pitch analysis feature of the phonetic analysis software program Praat (Version 5.1.08) was utilized to extract mean fundamental frequency for these brief clips (Boersma and Weenink 2009).

Independent Raters

Students and volunteers ($N = 80$, 38 women and 42 men) from the University of Baltimore and Albright College listened to segments of audiotapes and completed vocal and personality ratings. Because of the possibility that there may be a different pattern of vocal cues associated with attraction in gay, lesbian, and heterosexual individuals, as there are some documented differences in vocalics between these groups (Munson et al. 2006), raters were only included in statistical analyses if they reported having a predominantly heterosexual orientation. Two exclusively gay men, two lesbians, and three individuals who failed to report sexual orientation were omitted from analyses. Raters were ethnically diverse (23.8 % African-American, 3.8 % Asian, 68.8 % Caucasian, 1.2 % Hispanic, and 2.4 % other) and had a mean age of 26.19 ($SD = 7.79$, range = 18–50). Raters completed the task either alone or in quiet groups of up to 10 individuals. Before ratings were collected, three female experimenters piloted the rater protocols with eight individuals.

Procedure for Raters

In order to reduce rater fatigue, raters were assigned to one of six rating conditions (*N*s ranging from 12 to 19), which lasted from 30 to 45 min. Group 1 listened to all of the "how are you?" segments, rating sexiness, pleasantness, and degree of romantic interest on 7 point bipolar scales, and made forced choice assessments (friend or romantic partner) for half of the longer content clips. Group 2 rated the sexiness, pleasantness, and degree of romantic interest of the "What are you doing?" segments and completed forced choice assessments for half of the paralanguage clips. Group 3 completed forced choice assessments for all of the "how are you?" segments and 10 ratings for half of the longer content clips. The 10 ratings included some judgments about the callers (The caller was physically attractive/confident/likable/popular/sounds like s/he is talking to an attractive person), and some judgments about callers' voices (sounds animated, pleasant, sexy, romantically interested, "babyish" or "childlike") on 5-point Likert scales. Group 4 completed forced choice assessments for all of the "what are you doing?" segments, in addition to the 10 ratings for half of the paralanguage clips. Group 5 listened to half of the longer content clips, and half of the paralanguage clips (we ensured they were not the same voices), completing the 10 ratings on all clips. Group 6 only completed forced choice ratings, rating half of the longer content clips and half of the paralanguage clips (again, the two tasks involved different voices).

Results

Self-Reported Love

Given the nature of the study, it was important to verify that callers reported significantly more love for their romantic partners than their friends. Before conducting these tests, we conducted Cronbach's alpha coefficients on the three love subscales (passion, intimacy, and commitment) to assess the internal consistency of these measures. The passion and commitment subscales possessed strong reliability for both conversational partners (PLS for friends, $\alpha = .77$; PLS for romantic partners, $\alpha = .88$; commitment for friends, $\alpha = .85$; commitment for romantic partner, $\alpha = .82$). The Cronbach's alpha for the intimacy subscale for romantic partners increased substantially ($\alpha = .77$) when the two trust items were added to the scale, in comparison to the original four-item scale ($\alpha = .66$). Including the two trust items in the intimacy subscale for friends resulted in excellent reliability ($\alpha = .91$). Therefore, analyses were computed with the sums of these subscales.

Paired-samples t tests were significant for intimacy, passion, and commitment. Callers reported significantly more passion toward romantic partners ($M = 62.17$, $SD = 6.87$) than friends ($M = 23.83$, $SD = 5.66$), $t(23) = -23.59$, $p < .001$. They also reported greater intimacy with romantic partners ($M = 27.58$, $SD = 2.62$) than friends ($M = 23.29$, $SD = 5.51$), $t(23) = -3.26$, $p = .003$, in addition to greater commitment toward romantic partners ($M = 16.75$, $SD = 2.47$) than friends ($M = 13.04$, $SD = 4.38$), $t(23) = -3.45$, $p = .002$. This was compelling evidence for the power of romantic love given that callers reported knowing their friends nine times as long as their romantic partners.

Overview of Statistical Procedure

Statistical analyses were conducted at the level of the rater, as in previous research (Montepare and Vega 1988; Rule et al. 2009). We conducted independent-sample t tests on all ratings completed by more than one group to ensure that rater group did not account for a significant portion of the variability. Out of 44 statistical tests, only 4 achieved statistical significance at the .05 level, thus indicating that individual differences in rater group were largely unrelated to perception of the voices. Consequently, average "romantic" and "friend" ratings were computed for each rater. We initially conducted 2×2 mixed-subjects analyses on the 10 voice and personality variables with relationship status as the within-subject factor and rater gender as a between subject factor. Because none of the main effects or interactions with rater gender were significant, we omitted rater gender from all subsequent analyses and compared raters' average judgment for friend samples to their average judgment for romantic samples.

H1: Forced-Choice Judgments

To determine whether participants were able to correctly identify whether callers were speaking with their friends or romantic partners, we compared rater accuracy (% correct in determining friend versus romantic partner) to a 50 % chance level using one-sample t tests (see Hughes et al. 2010; Montepare and Vega 1988; and Rule et al. 2009 for other research using this approach). Based upon the longer content clips, raters performed significantly greater than chance in discriminating between friend and romantic samples (64.6 %), $t(47) = 5.74$, $p < .001$. When the content was filtered, raters did not exceed

chance levels (52.3 %) on the forced choice decision when romantic and friend samples were combined, $t(47) = 1.13$, $p = .26$. However, although raters did not perform at better than chance for the paralanguage romantic samples (48.8 %), $t(23) = -.39$, $p = .70$, they did exceed chance levels for friend samples (55.7 %), $t(23) = 2.28$, $p = .03$.

For the brief clips, not all of the 24 callers adhered to instructions to say "how are you?" and "what are you doing?" to both conversational partners, thus decreasing the number of vocal samples rated for these analyses. Nevertheless, even based upon short "how are you?" segments, raters were able to identify whether a caller was speaking to his/her romantic partner or his/her friend with greater than chance accuracy (60.2 %), $t(25) = 4.86$, $p < .001$. Although the raters did not exceed chance levels (52.7 %) at determining friend versus romantic "what are you doing?" samples when the samples were combined, $t(37) = 1.42$, $p = .17$, raters did exceed chance (58.5 %) for friend samples, $t(18) = 4.38$, $p < .001$, but not romantic samples (46.8 %), $t(18) = -1.22$, $p = .24$.

H2: Romantic Interest

To test Hypothesis 2, raters assessed perceived romantic interest for all vocal clips. For the brief clips and the longer content clips, a romantic interest subscale that included perceived vocal pleasantness, sexiness and romantic interest attained Cronbach's alpha values ranging from .79 for the "what are you doing?" romantic samples to .91 for the "how are you?" friend samples, so romantic interest was calculated as the sums of these items. For the paralanguage clips, a subtle change to the measurement of romantic interest resulted in higher alpha values (.69 for friend and .71 for romantic) after substituting perceived attractiveness of the target for vocal pleasantness, so romantic interest included this item in addition to perceived sexiness and romantic interest.

Paired sample *t* tests were conducted on the composite romantic interest scales, comparing raters' mean romantic interest for friend to raters' mean romantic interest for romantic partners. For the longer content intact clips and the "how are you?" clips, raters perceived the samples directed toward romantic partners as conveying significantly more romantic interest than the friend samples (see Table 1 for results pertaining to Hypothesis 2 and 3). This trend achieved marginal significance for the paralanguage clips, but was not significant for the "what are you doing?" clips.

H3: Personality Inferences Based Upon Voice

We attempted to control family-wise error rate by combining similar personality assessments that raters completed for the longer content and paralanguage clips. Because the pattern of correlations between the longer content intact items was different than the correlations for the paralanguage items, we computed slightly different scales for these items. Nonetheless, the same subscale was utilized to compare personality inferences for friend samples and romantic samples. For longer clips, four characteristics (caller is popular/likable/attractive/talking to an attractive person) were combined to assess "positive qualities" ($\alpha = .82$ for friends, .78 for romantic), and the remaining dependent measures were assessed individually. For the paralanguage clips, six characteristics were summed to measure positive qualities (caller is popular/likable/attractive/confident/animated/has a pleasant voice) ($\alpha = .76$ for friends, .82 for romantic partners). Only the item assessing "babyish tone" was evaluated as its own dimension for paralanguage.

Interestingly, although raters did not evaluate callers' personalities differently based upon the longer content intact clips, when the content of those clips was filtered, raters

Table 1 Statistics and effect size estimates for perceived romantic interest and positive qualities ratings

	Friend	Romantic	*t*	*d*
Type of voice clip				
Romantic interest				
Longer clips	8.07 (1.51)	8.91 (1.27)	4.88***	1.01
Paralanguage	8.38 (1.21)	8.69 (1.21)	1.82[m]	.33
"How are you?"	3.58 (.92)	3.85 (.98)	2.45*	.71
"What are you doing?"	3.77 (.73)	3.81 (.85)	.16	.05
Positive qualities				
Longer clips	12.79 (1.30)	12.89 (1.16)	.54	.11
Paralanguage	19.86 (1.84)	19.11 (1.96)	−2.74**	.49

Values in parentheses are standard deviations

*** Significance at the .001 level

** Significance at the .01 level

* Significance at the .05 level

[m] $.05 < p < .10$

evaluated callers significantly more negatively when they were speaking to their romantic partners than their friends, which is contrary to hypothesis 3 (see Table 1 for statistics and effect sizes pertaining to these effects). In addition, based upon the longer unfiltered clips, raters judged the callers as sounding more animated when they were speaking to their friends ($M = 3.08$, $SD = .60$) than their romantic partners ($M = 2.91$, $SD = .60$), $t(24) = 2.77$, $p = .01$, $d = .55$. No other effects were significant.

H4: Pitch Analysis

Despite the small sample of brief clips from our study, some significant findings emerged. Although we failed to achieve significant pitch differences for the "what are you doing?" segments, in support of hypothesis 4, pitch analysis indicated that women said "how are you?" using a deeper pitch when talking to their romantic partners than to their friends, $t(7) = 4.83$, $p = .002$. Conversely, men said "how are you?" using a higher pitch when talking to their romantic partners than to their friends, $t(8) = -2.76$, $p = .03$ (see Fig. 1 for both of these effects).

H5: Lens model

We conducted an exploratory lens model analysis using ratings of the romantic samples to develop a greater understanding of the extent to which nonverbal cues mediate the encoding and decoding processes of romantic love (see Fig. 2). Because very few empirical investigations include all necessary components of the lens framework (self-reported personality dimension, measurement of nonverbal cues, and observer judgments of personality dimension) in the same study (Gifford 2006), and to our knowledge, this is the first such analysis of romantic love, the present analysis offers a unique contribution to the literature. In lens model terms, encoding or ecological validity pertains to the extent to which self-reported dispositions or emotions correlate significantly with nonverbal cues, whereas decoding or cue utilization refers to the extent to which observers' ratings

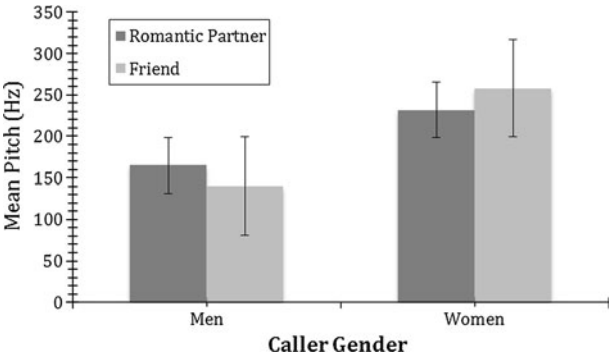

Fig. 1 Mean fundamental frequencies (pitch) of "how are you?" samples directed toward romantic partners and same-sex friends

correlate with nonverbal cues (Gifford 1994, 2006). In other words, encoding signifies which nonverbal behaviors are *actually* associated with different personality characteristics or emotional states (such as an increase in pitch during deception), and decoding reveals the behaviors which observers *believe* correspond to personality or emotional states (such as decreased eye contact during deception). Correlations between self-reported dispositions and observers' ratings of those dispositions are referred to as agreement (Gifford 2006).

For this model, all correlational analyses were conducted at the voice or encoder level, so we averaged observer ratings for each voice. We computed Cronbach's alpha on the measures utilized in the previous analyses, focusing exclusively on ratings of the romantic samples. Most of the ratings exceeded the acceptable level for conducting a lens analysis (.75 according to Gifford 2006), ranging from .82 for ratings of positive qualities for paralanguage to .96 for romantic interest ratings for paralanguage. We also included three other assessments that had somewhat poorer reliability because of the importance of these variables for interpreting the lens, but correlations with these variables should be interpreted with greater caution ($\alpha = .58$ for forced choice on the longer content clips or "long content accuracy," .64 for forced choice on "what?" samples, and .69 for romantic interest of longer clips). We omitted one set of ratings (forced choice ratings of the paralanguage clips), due to unacceptable reliability, less than .50.

The self-reported dimensions on the left-hand side of the lens correspond to caller's self-reported feelings of love. Because it was likely that different subscales of love would correlate differently with various nonverbal cues, we included commitment, intimacy, and passion, in addition to the total love score in the model. The primary observer ratings of interest were the accuracy assessments based upon forced-choice (long content accuracy, "what are you doing?" accuracy and "how are you?" accuracy). We believed that the nonverbal cues of pitch, perceived romantic interest, and perceived positive qualities were potential mediators between self-reported love and observers' accuracy ratings, thus these variables are inserted into the center of the model. To ensure rater independence, different individuals should provide assessments of the nonverbal cues and the observer ratings (Gifford 2006). For this experiment, some of the rater groups provided ratings for both nonverbal cues and accuracy judgments, which would typically cloud the ability to deduce cue utilization because raters could be relying upon the same processes for both judgments (Gifford 2006). However, neither of the two significant cue utilization correlations were

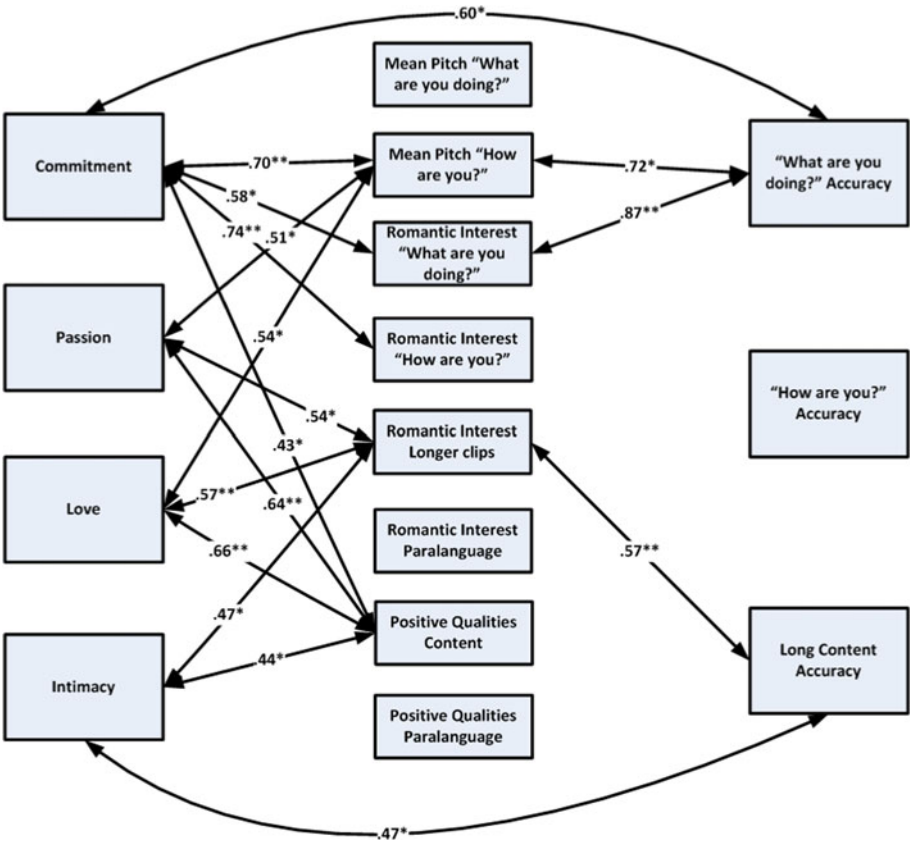

Fig. 2 Lens model with self-reported love dimensions, nonverbal cues, and observer accuracy ratings. Values are Pearson correlation coefficients. ** denotes significance at the .01 level. * denotes significance at the .05 level

between variables rated by the same group, so interpretation of the model is not affected by this issue.

The pattern of correlations from the lens model shows that generally, encoding was stronger than decoding. Consistent with hypothesis 5, all of the love scales were significantly associated with ratings of positive qualities, such that the more love callers' reported for their partners, the more positively their personalities were viewed by raters listening to longer clips. In addition, all of the love scales were correlated with at least one scale of perceived romantic interest. Achieving significant correlations between the love scales and the perceived romantic interest of the brief samples was somewhat more compelling given the extremely short duration of these samples, suggesting that romantic interest can be encoded accurately via "thin slices." On the decoding side of the lens, vocal pitch of "how are you?" and perceived romantic interest for the "what are you doing?" clips were associated with accuracy judgments for these clips, showing that observers relied upon these variables to make accurate judgments about those clips. Similarly, the greater the perceived romantic interest of the longer clips, the more accurate raters were in identifying them as "romantic." The lens model also suggested that love was encoded via increases in pitch for the "how are you?" clips. Agreement was demonstrated by correlations between

commitment and accuracy of the "what are you doing?" segments, and intimacy and long content accuracy.

An overview of the pattern of the results revealed that callers expressed love through their voices via increased pitch and perceived romantic interest, and observers accurately interpreted these vocal changes as evidence of romantic love. Our analyses suggest that the pitch for "what are you doing?" and paralanguage clips did not reliably express love (encoding), nor were they utilized by observers to signify love (decoding). We did not perform multiple correlations comparing the encoding and decoding sides of the lens because of the non-orthogonal nature of the nonverbal cues.

Discussion

The findings of this study provide some support for the notion that individuals have differing vocal profiles when speaking with friends and romantic partners, and that others are able to discern these differences, in large part by attending to vocal cues of pitch and romantic interest. In support of hypothesis 1, one of the most important trends in the results was the ability of raters to discern whether a caller was speaking to a romantic partner or a friend. Although at first this finding appears intuitive and non-compelling, it is important to underscore the minimal exposure the listeners had to the conversation in order to make these accurate determinations. Despite the fact that some of these voice samples included only 20 s of one side of a conversation and were relatively unintelligible due to deletions of silence and romantic idioms (rendering the conversations virtually meaningless), raters were still able to accurately interpret the underlying intentions of those vocalizations. Similarly, based merely upon 2 s of speech, ("how are you?"), raters were still able to identify with greater than chance accuracy to whom callers were speaking.

This tendency to make accurate assessments about others' relationship status based upon only minimal vocal information extends several previous investigations showing that a wealth of information can be obtained from brief exposure such as a number count (Hughes et al. 2002, 2004, 2010), a "hello", (Hughes et al. 2010), or a vowel pronunciation (Collins and Missing 2003). These results also complement the body of work on "thin slices" of nonverbal behavior by Ambady and Rule, who determined that individuals could accurately detect sexual orientation, an important relational marker, through mere milliseconds of exposure to faces (Ambady et al. 1999; Rule and Ambady 2008; Rule et al. 2008). Furthermore, our results communicate that tone of voice should be added to the myriad nonverbal signals discussed by Koeppel et al. (1993) that observers rely upon to infer romantic interest.

Consistent with hypothesis 2, vocal samples directed toward romantic partners were rated as sounding more pleasant, sexier, and reflecting greater romantic interest than those directed toward same-sex friends. Furthermore, in support of hypothesis 5, self-reported love for one's romantic partner was positively correlated with independent ratings of romantic interest and positive qualities based upon voice. Of these cues, romantic interest was the primary cue utilized by observers to accurately discriminate between friend and romantic samples. Taken together, these results point to the effectiveness of vocal change as a mechanism for communicating relationship status. Consistent with affection exchange theory (Floyd and Ray 2003), individuals in this experiment altered their vocal qualities in such a way as to communicate connectedness and intimacy with their romantic partners and friends. The greater the feelings of passion, commitment, and intimacy callers felt for their romantic partners, the more positively their voices were rated by others. Ensuring that

one is effectively communicating with one's partner by using a certain tone of voice may be critical due to the perceived relationship between vocal attractiveness and positive personality characteristics such as warmth and sincerity (Zuckerman and Driver 1989).

The results from the paralanguage clips are more difficult to interpret, given that their accuracy ratings were removed from the lens model due to poor reliability, and their ratings were not encoded or decoded. Nevertheless, when the content of the conversation was obscured, those listening only to paralanguage rated the personality characteristics of the callers differently; surprisingly, callers' personal characteristics were rated less favorably when they were speaking to their romantic partners than their friends (which contradicts hypothesis 3). Despite the fact that raters assigned marginally higher romantic interest ratings to romantic clips than friend clips based upon paralanguage, personality assessments were less positive for these romantic clips. Stripping the content from the paralanguage clips perhaps allowed raters to notice potential stress cues, such as differences in prosody and intensity (Streeter et al. 1977). These results potentially point to the vulnerability associated with early stage romantic love. Romantic love and relationship dependency are intricately intertwined (Hatfield and Rapson 1993) and callers who participated in this study reported a very high degree of passionate love ($M = 62.17$, $SD = 6.87$, maximum value on the scale $= 75$). The tendency for callers to appear less confident, likable, and popular is also consistent with the principle of lesser interest (Waller and Hill 1951), as the powerlessness due to love's intense longing may translate into perceived nervousness or a lack of social skill. Research finding that our voices "in love" sound more scatterbrained and submissive (Montepare and Vega 1988) and less fluent (Guerrero 1997) than our voices "in like" is consistent with this logic.

Despite the general tendency for romantic love to be positively correlated with the pitch of the "how are you?" segments directed toward romantic partners (with pitch increases typically indicating emotional intensity) (Bänziger and Scherer 2005), these segments had interesting gender patterns. Consistent with hypothesis 4 and communication accommodation theory (CAT) (Giles 2008), women in our study used a deeper-pitched voice when speaking to their romantic partners than to their friends, whereas men used a higher-pitched voice when speaking to their romantic partners than to their friends. This evidence of vocal convergence is parallel to behavioral mimicry research showing that we have a tendency to mirror the postures and nonverbal behaviors of our interaction partners (Chartrand and Bargh 1999).

More germane to this discussion, however, is that both non-conscious mimicry and vocal convergence are positively correlated with intimacy, cohesion, and the motivation to affiliate (Chartrand and Dalton 2009; Gregory et al. 1997, 1993). In terms of the vocal channel, raters listening to the voices of two interaction partners associate vocal convergence with intimacy. For example, Floyd and Ray (2003) found that raters perceived greater affection between individuals who matched the pitch of their conversational partner than those who did not (i.e., greater affection was perceived when women increased pitch while talking to other women and when men decreased their pitch while talking with other men). While Hall and Braunwald (1981) interpreted cross-sex pitch-matching as evidence of dominance-matching, it seems more likely that this effect represents desire for affiliation and intimacy (possibly adding pitch-matching to the myriad of other nonverbal behaviors signifying both dominance and affiliation). In this light, pitch matching, as a form of mimicry, is a way to communicate affection and relational connection—"I am one with you." Romantically-involved partners have been shown to mimic the nonverbal behaviors of an attractive opposite-sex interaction partner less than those who were not romantically-

involved, and in another study, the *degree* of romantic attachment to their romantic partner was negatively associated with mimicry (Karremans and Verwijmeren 2008).

There were a few instances in our results for which we failed to find a predicted effect. For example, raters listening to the romantic paralanguage clips were not able to exceed chance levels for the forced choice determination. As stated before, self-reported romantic love was not reliably associated with paralinguistic ratings, so given this, the failure of raters to correctly identify conversational partner is not surprising. With regard to the short clips, it may be the case that the "How are you?" clips were better able to capture the effect (as opposed to some of the "What are you doing?" clips) since they were usually spoken within the first moments of the phone conversation and may have reflected the initial excitement of speaking to romantic partners. Couples in romantic love often yearn and pine for one another when apart (even after a brief period of separation) (Fisher 2000), and as a consequence, they might have been highly motivated to reassert their relationship-status using nonverbal cues when first reunited (Karremans and Verwijmeren 2008).

One limitation with regard to the present study relates to the use of same-sex callers as a comparison group. Because we examined only heterosexual couples, the "romantic" condition involved only cross-sex calls and the "friend" condition included only same-sex calls, rendering it difficult to disentangle target gender from partner status. However, the alternative method, requiring callers to place calls only to "opposite-sex" friends, was considered a more problematic issue due to the frequency of sexual tension in cross-sex friendships (Afifi and Faulkner 2000; Halatsis and Christakis 2009). Given that our callers reported a very low level of passion for their friends ($M = 23.83$ on a scale ranging from 15 to 75), we were successful at eliminating the threat of sexual tension in friendships. Cross-sex friendships that involved attraction would have not represented a good comparison group because romantic attraction (independent of love) is also known to affect vocal cues (Hughes et al. 2010). Given the increased jealousy that often accompanies romantic love (Hatfield and Rapson 1993), cross-sex friendships are sometimes actively discouraged by romantic partners because they represent a potential threat to the romantic relationship.

Despite this limitation, this study is among the first to empirically demonstrate that men and women engage in voice accommodation in such a way as to significantly increase the sexiness, pleasantness, and romantic interest of their voices when talking to romantic partners. Furthermore, independent raters were able to discern whether someone was talking to a romantic partner or his/her friend with greater than chance accuracy, and sometimes after being exposed to a mere 2-s of vocal cues. In addition, we presented evidence that raters can discern not only the relational status of interaction partners, but that they also potentially sense the vulnerability of individuals in love, perceiving them to be less confident, popular, and likable when talking to romantic partners. Future research should examine the within-subject variability of lovers' voices as a function of their motivational goals (to increase affiliation, to express distress in the relationship, to deceive their partners) and affective states (such as loneliness). In addition, experimental research investigating the degree of voice modulation in response to attractive opposite-sex romantic partners is also a fruitful area of study worthy of pursuit.

Acknowledgments The authors would like to thank Judy Hall and Miles Patterson for their guidance on earlier versions of this manuscript, and Lisa Stickney for her assistance with Visio. Correspondence concerning this article should be addressed to Sally Farley.

References

Afifi, W. A., & Faulkner, S. L. (2000). On being 'just friends': The frequency and impact of sexual activity in cross-sex friendships. *Journal of Social and Personal Relationships, 17*(2), 205–222. doi:10.1177/0265407500172003.

Ambady, N., Hallahan, M., & Conner, B. (1999). Accuracy of judgments of sexual orientation from thin slices of behavior. *Journal of Personality and Social Psychology, 77*(3), 538–547. doi:10.1037/0022-3514.77.3.538.

Anolli, L., & Ciceri, R. (2002). Analysis of the vocal profiles of male seduction: From exhibition to self-disclosure. *Journal of General Psychology, 129*, 149–169. doi:10.1080/00221300209603135.

Aron, A., Fisher, H., Mashek, D. J., Strong, G., Li, H., & Brown, L. L. (2005). Reward, motivation, and emotion systems associated with early-stage intense romantic love. *Journal of Neurophysiology, 94*, 327–337. doi:10.1152/jn.00838.2004.

Banse, R., & Scherer, K. R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology, 70*(3), 614–636. doi:10.1037/0022-3514.70.3.614.

Bänziger, T., & Scherer, K. R. (2005). The role of intonation in emotional expressions. *Speech Communication, 46*, 252–267.

Boersma, P., & Weenink, D. J. M. (2009). Praat: Doing phonetics by computer (version 5.1.08). Retrieved April 15, 2009, from http://www.praat.org/.

Bombar, M. L., & Littig, L. W., Jr. (1996). Babytalk as a communication of intimate attachment: An initial study in adult romances and friendships. *Personal Relationships, 3*, 137–158.

Burgoon, J. K., Guerrero, L. K., & Floyd, K. (2010). *Nonverbal communication*. Boston, MA: Pearson/Allyn & Bacon.

Capella, J. N. (1997). Behavioral and judged coordination in adult informal social interactions: Vocal and kinesics indicators. *Journal of Personality and Social Psychology, 72*(1), 119–131. doi:10.1037/0022-3514.72.1.119.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception-behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893–910.

Chartrand, T., & Dalton, A. N. (2009). Mimicry: Its ubiquity, importance, and functionality. In E. Morsella, J. A. Bargh, P. M. Gollwitzer, E. Morsella, J. A. Bargh, & P. M. Gollwitzer (Eds.), *Oxford handbook of human action* (pp. 458–483). New York, NY: Oxford University Press.

Collins, S. A., & Missing, C. (2003). Vocal and visual attractiveness are related in women. *Animal Behaviour, 65*(5), 997–1004. doi:10.1006/anbe.2003.2123.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48*(4), 384–392. doi:10.1037/0003-066X.48.4.384.

Fichtel, C., Perry, S., & Gros-Louis, J. (2005). Alarm calls of white-faced capuchin monkeys: An acoustic analysis. *Animal Behaviour, 70*(1), 165–176. doi:10.1016/j.anbehav.2004.09.020.

Fisher, H. (2000). Lust, attraction, attachment: Biology and evolution of the three primary emotion systems for mating, reproduction, and parenting. *Journal of Sex Education & Therapy, 25*(1), 96–104.

Fisher, H. (2006). The drive to love: The neural mechanism for mate selection. In R. J. Sternberg, K. Weis, R. J. Sternberg, & K. Weis (Eds.), *The new psychology of love* (pp. 87–115). New Haven, CT: Yale University Press.

Floyd, K., Judd, J., & Hesse, C. (2008). Affection exchange theory. In L. A. Baxter, D. O. Braithewaite, L. A. Baxter, & D. O. Braithewaite (Eds.), *Engaging theories in interpersonal communication: Multiple perspectives* (pp. 285–293). Thousand Oaks, CA: Sage.

Floyd, K., & Ray, G. B. (2003). Human affection exchange: IV, Vocalic predictors of perceived affection in initial interactions. *Western Journal of Communication, 67*, 56–73.

Gallup, G. G., Jr, & Cameron, P. A. (1992). Modality specific metaphors: Is our mental machinery ''colored'' by a visual bias? *Metaphor and Symbolic Activity, 7*, 93–98.

Gifford, R. (1994). A lens mapping framework for understanding the encoding and decoding of interpersonal dispositions in nonverbal behavior. *Journal of Personality and Social Psychology, 66*, 398–412.

Gifford, R. (2006). Personality and nonverbal behavior: A complex conundrum. In V. Manusov & M. Patterson (Eds.), *The Sage handbook of nonverbal communication* (pp. 159–179). Thousand Oaks, CA: Sage.

Giles, H. (2008). Communication accommodation theory. In L. A. Baxter, D. O. Braithewaite, L. A. Baxter, & D. O. Braithewaite (Eds.), *Engaging theories in interpersonal communication: Multiple perspectives* (pp. 161–173). Thousand Oaks, CA: Sage.

Gregory, S. W. (1990). Analysis of fundamental frequency reveals covariation in interview partners' speech. *Journal of Nonverbal Behavior, 14*, 237–251.

Gregory, S. W., Dagan, K., & Webster, S. (1997). Evaluating the relation of vocal accommodation in conversation partners' fundamental frequencies to perceptions of communication quality. *Journal of Nonverbal Behavior, 21*(1), 23–43. doi:10.1023/A:1024995717773.

Gregory, S., Webster, S., & Huang, G. (1993). Voice pitch and amplitude convergence as a metric of quality in dyadic interviews. *Language & Communication, 13*(3), 195–217. doi:10.1016/0271-5309(93)90026-J.

Guerrero, L. K. (1997). Nonverbal involvement across interactions with same-sex friends, opposite-sex friends and romantic partners: Consistency or change. *Journal of Social and Personal Relationships, 14*, 31–58. doi:10.1177/0265407597141002.

Halatsis, P., & Christakis, N. (2009). The challenge of sexual attraction within heterosexuals' cross-sex friendship. *Journal of Social and Personal Relationships, 26*(6–7), 919–937. doi:10.1177/0265407509345650.

Hall, J. A., & Braunwald, K. G. (1981). Gender cues in conversations. *Journal of Personality and Social Psychology, 40*(1), 99–110. doi:10.1037/0022-3514.40.1.990022-3514.40.1.99.

Hatfield, E., & Rapson, R. L. (1993). *Love, sex, and intimacy: Their psychology, biology, and history*. New York: HarperCollins.

Hatfield, E., & Rapson, R. (1996). *Love and sex: Cross-cultural perspectives*. Needham Heights, MA: Allyn & Bacon.

Hughes, S. M., Dispenza, F., & Gallup, G. G., Jr. (2004). Ratings of voice attractiveness predict sexual behavior and body configuration. *Evolution and Human Behavior, 25*, 295–304. doi:10.1016/j.evolhumbehav.2004.06.001.

Hughes, S. M., Farley, S. D., & Rhodes, B. C. (2010). Vocal and physiological changes in response to the physical attractiveness of conversational partners. *Journal of Nonverbal Behavior, 34*, 155–167. doi:10.1007/s10919-010-0087-9.

Hughes, S. M., Harrison, M. A., & Gallup, G. G., Jr. (2002). The sound of symmetry: Voice as a marker of developmental instability. *Evolution and Human Behavior, 23*, 173–180.

Karremans, J. C., & Verwijmeren, T. (2008). Mimicking attractive opposite-sex others: The role of romantic relationship status. *Personality and Social Psychology Bulletin, 34*(7), 939–950. doi:10.1177/0146167208316693.

Koeppel, L. B., Montagne-Miller, Y., O'Hair, D., & Cody, M. J. (1993). Friendly? Flirting? Wrong? In P. J. Kalbfleisch (Ed.), *Interpersonal communication: Evolving interpersonal relationships* (pp. 13–32). Hillsdale, NJ: Erlbaum.

Montepare, J. M., & Vega, C. (1988). Women's vocal reactions to intimate and casual male friends. *Personality and Social Psychology Bulletin, 14*, 103–113.

Munson, B., McDonald, E. C., DeBoe, N. L., & White, A. R. (2006). The acoustic and perceptual bases of judgments of women and men's sexual orientation from read speech. *Journal of Phonetics, 34*(2), 202–240. doi:10.1016/j.wocn.2005.05.003.

Noller, P. (1980). Misunderstanding in marital communication: A study of couples' nonverbal communication. *Journal of Personality and Social Psychology, 39*(6), 1135–1148. doi:10.1037/h0077716.

Rule, N. O., & Ambady, N. (2008). Brief exposures: Male sexual orientation is accurately perceived at 50 ms. *Journal of Experimental Social Psychology, 44*(4), 1100–1105. doi:10.1016/j.jesp.2007.12.001.

Rule, N. O., Ambady, N., Adams, R., Jr, & Macrae, C. (2008). Accuracy and awareness in the perception and categorization of male sexual orientation. *Journal of Personality and Social Psychology, 95*(5), 1019–1028. doi:10.1037/a0013194.

Rule, N. O., Ambady, N., & Hallett, K. C. (2009). Female sexual orientation is perceived accurately, rapidly, and automatically from the face and its features. *Journal of Experimental Social Psychology, 45*, 1245–1251. doi:10.1016/j.jesp.2009.07.010.

Scherer, K. R. (1986). Vocal affect expression: A review and a model for future research. *Psychological Bulletin, 99*, 143–165. doi:10.1037/0033-2909.99.2.143.

Scherer, K. R. (2003). Vocal communication of emotion: A review of research paradigms. *Speech Communication, 40*(1), 227. doi:10.1016/S0167-6393(02)00084-5.

Snyder, M., Tanke, E. D., & Berscheid, E. (1977). Social perception and interpersonal behavior: On the self-fulfilling nature of social stereotypes. *Journal of Personality and Social Psychology, 35*, 656–666.

Sternberg, R. J. (1986). A triangular theory of love. *Psychological Review, 93*(2), 119–135. doi:10.1037/0033-295X.93.2.119.

Streeter, L. A., Krauss, R. M., Geller, V. J., Olson, C. T., & Apple, W. (1977). Pitch changes during attempted deception. *Journal of Personality and Social Psychology, 35*, 345–350. doi:10.1037/0022-3514.35.5.345.

Tuomi, S. K., & Fisher, J. E. (1979). Characteristics of a simulated sexy voice. *Folia Phoniatrica, 31*, 242–249.

Waller, W. W., & Hill, R. (1951). *The family: A dynamic interpretation*. New York: Dryden Press.

Zuckerman, M., & Driver, R. E. (1989). What sounds beautiful is good: The vocal attractiveness stereotype. *Journal of Nonverbal Behavior, 13*(2), 67–82. doi:10.1007/BF00990791.