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Vocal affect expression as an indicator of affective response

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This research is designed to validate the measurement of vocal affect expression as an accurate indicator of affective responses. Subjects who support legalized abortion read aloud either pro-attitudinal or counterattitudinal statements. Their recorded voices were digitized, standardized against their own baseline vocal parameters, and analyzed for differences in mean and range of fundamental frequency between the pro-attitudinal and counterattitudinal conditions. Subjects with strong initial attitudes exhibited the expected pattern of negative affect while reading counterattitudinal material. However, subjects with initial attitudes moderate in strength exhibited an unexpected pattern of negative affect when reading pro-attitudinal information. Written measures of the affective and evaluative components of attitudes toward abortion and a measure of mood were employed to validate the voice measure.

The most common measures of affect have typically been pencil-and-paper measures that ask the subjects to describe their feelings. However, people often have a difficult time verbally expressing how they feel (Izard, 1977). There is evidence that affective information is not fully encoded in a verbal representation in memory in the same manner as cognitive evaluations. In fact, affective information is probably encoded in a separate system that is not adequately accessed by verbal report (Breckler & Wiggins, 1989b). If this is the case, the pencil-and-paper measures of affect may be tapping cognitive representations of affect that represent only part of the affective response.

To accurately assess that part of the affective response not accessible to verbal representation, a nonverbal measure is required. Previous researchers have used physiological arousal measures (e.g., heart rate, galvanic skin response) in an attempt to measure emotion (see Izard, 1977, for discussion). But arousal measures have not proved useful in the detection of discrete emotions. In fact, a given response on such measures is often indicative of both positive and negative emotions (Izard, 1977; Schachter, 1964; but see Winton, Putnam, & Krauss, 1984). Other measures may be more sensitive to minor changes in affect or the subtle differences associated with discrete emotions. Petty and Cacioppo (see Cacioppo, Petty, & Green, 1989, for a review) have demonstrated that facial EMG measures can distinguish between low levels of positive and negative affects. This measure is reliable, but it is also obtrusive. Also, people can make deliberate attempts to conceal facial expressions (but see Ekman, Friesen, & O'Sullivan, 1988).

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VOCAL AFFECT EXPRESSION

An affective reaction that is less easily concealed is vocal affect expression (McGuire, 1985). Physiological changes in arousal and subtle movements in the facial and throat musculature associated with experienced affect cause changes in voice quality. Many of these changes, such as the salivary response, may not be under voluntary control. Furthermore, there is evidence that we are unaware of the changes in our facial and throat musculature that correspond to particular changes in our voice (Scherer, 1985b). Thus, even if we wish to conceal our affective state, we are unlikely to be able to do so.

Linguists and psychologists have long recognized that the voice carries many cues regarding the speaker's subjective state, independent of speech content (for reviews, see Kramer, 1963; Scherer, 1985a, 1985b, 1986). In fact, many early researchers assumed that affective state is revealed in the voice and concentrated their efforts, instead, on how well humans interpret those vocal cues (e.g., Costanzo, Markel, & Costanzo, 1969; Davitz & Davitz, 1974; Fairbanks & Provonost, 1939; Green & Cliff, 1975; Levin & Lord, 1975; Scherer, Koivumaki, & Rosenthal, 1972; Tartter, 1980). These researchers found that people can interpret the emotional state of the speaker with a fair amount of accuracy (see also Scherer, 1985a, 1986).

Some early theorists did recognize the need to assess the voice changes that naturally occur with experienced emotion. Skinner (1935) induced emotional states in a laboratory setting and measured voice changes (see also Bonner, 1943; Hecker, Stevens, von Bismarck, & Williams, 1968). Huttar (1968) and Williams and Stevens (1972) measured voice changes in naturally occurring situations. There was also a flurry of interest in vocal affect expression in a clinical setting (Eldred & Price, 1958; Hargreaves & Starkweather, 1964; Hargreaves, Starkweather, & Blacker,

1965; Roessler & Lester, 1976; see also Kramer, 1963, for a review).

This early research set the stage for current vocal affect expression research. However, research designs (and experimental results) were limited by the technology of that time. Much of the previous research determined voice characteristics, such as frequency and intensity, by averaging the ratings of several judges. This procedure not only lacks accuracy in making fine distinctions, but the various parameters of the sound-wave pattern can interact to confuse the human ear. With the development of high-quality sound-recording devices, equipment that can separate and visually display sound-wave patterns (viz., sound spectrograph), and computers that can handle enormous databases, more accurate and systematic research has become feasible.

Voice characteristics that distinguish among emotions fall into three major types (described in terms of ranges): narrow-wide, lax-tense, and full-thin (Scherer, 1986). Of these types, the narrow-wide range is of primary importance in this research. This continuum most clearly distinguishes between positive (wide) and negative (narrow) affective states. The narrow-wide endpoints are associated with a general constriction or relaxation of the major throat muscles affecting voice quality. The narrow-wide terms also provide a fairly comprehensive semantic description of the perceived voice characteristics.

In terms of sound-wave patterns, the narrow-wide range corresponds to the fundamental frequency (abbreviated F0) of the voice (Scherer, 1986). Fundamental frequency corresponds physically to the rate of vibration of the vocal folds and is perceived by the human ear as pitch (Fulcher & Breckler, 1989). Using this vocal characteristic, a number of parameters related to affect can be measured, including perturbation, mean, range, variability, and contour. The mean and range of F0 were the measures predominantly used in previous research on vocal affect expression because they are reasonable measures of general affective states and are easy to calculate. For each of these parameters, higher values are associated with positive affect (with the exception of extreme elation in which low values would be expected), whereas low values are associated with negative affect (see Scherer, 1986, for a review).[1] This is consistent with research by Tartter (1980) and Ohala (1984), which revealed systematic increases in F0 when subjects smiled while speaking.[2] F0 mean and range were used in the present study as nonverbal measures of affect.

In this study, emotional response was elicited through attitudes. This is not a new application of the technique. Researchers have shown that perceivers quite easily attach attitudinal meanings to vocal characteristics (Bugental, Kaswan, & Love, 1970; Mehrabian & Ferris, 1974; Uldall, 1960). Weitz (1972) used voice tone as a measure of subjects' attitudes toward blacks. She found that ratings of voice tone correlated highly with established nonverbal measures of attitude. The present study assessed subjects' affective reactions to exposure to pro-attitudinal and counterattitudinal information. It was predicted that subjects who read aloud information incongruent with their attitudes would have a more negative affective response than would those reading information that concurs with their attitudes. The attitude object used in the present study was the topic of legalized abortion—chosen for its current popularity in the political arena and the media. It was also expected that the subject pool would adequately represent both sides of the debate. Unfortunately, this was not the case. (Ramifications of this lack of representation will be discussed below.) It was hypothesized that subjects who read *counterattitudinal* information would exhibit the vocal pattern indicative of negative affect, whereas subjects who read *pro-attitudinal* information would exhibit a neutral or positive voice pattern. Established measures of attitudes and affect were included as a comparison.

METHOD

Overview

The experiment consisted of three parts. In the first, the subjects' initial attitudes toward legalized abortion were assessed. These data were used to screen the subjects for the second part, during which voice recordings were made while the subjects read aloud statements on neutral topics and statements regarding legalized abortion. In the third part of the study, the subjects completed self-report measures of mood and attitudes toward legalized abortion.

Design

The experimental design was a 2 (initial attitudes) × 2 (pro-life or pro-choice[3] statements) factorial. Responses to a screening questionnaire were used to categorize the subjects as either *pro-choice* or *pro-life*. The subjects were then randomly assigned to read pro-choice or pro-life statements, thus creating the 2×2 design. Unfortunately, very few subjects expressed pro-life attitudes, creating unequal cell sizes.

Subjects

The subjects were 141 undergraduate students at the Johns Hopkins University who received course credit in their introductory psychology classes for experiment participation. Twelve subjects were dropped from the study when they indicated "don't know" as their initial attitude toward abortion. Due to the low number of subjects who had pro-life initial attitudes, those cells were excluded from the study; the data from 25 pro-life subjects were discarded. All analyses were performed on 104 pro-choice subjects (63 males and 41 females).

Materials

Screening questionnaire. The subjects rated their attitudes toward 15 social and political issues on 5-point Likert-type scales (*strongly support*, *support*, *don't know/neutral*, *oppose*, and *strongly oppose*). Embedded among the issues was legalized abortion. Responses to this item

were used to select the subjects for the major portion of the study. The subjects' initial attitudes were considered pro-choice if they indicated *strongly support* or *support* and as pro-life if they indicated *strongly oppose* or *oppose*. The subjects who indicated *don't know/neutral* were excluded from the remaining portions of the study.

Selection of stimulus items. Three sets of stimulus statements were developed: neutral, pro-choice, and pro-life. Each subject read the neutral set and either the pro-choice or the pro-life set. Statements on legalized abortion were obtained from pro-life and pro-choice literature, pamphlets, and fliers, as well as from journal articles and the popular press. An initial pool of several hundred statements was developed. Pro-choice and pro-life items were selected from the pool in pairs that represented opposing views on the same abortion-related topic[4] and matched in structural characteristics (sentence length, average word length, and readability). An independent set of 21 subjects then rated each statement on two 7-point scales. The first scale measured the extent to which each statement represented the pro-choice (0) or pro-life (6) position. The set of pro-choice statements chosen as stimuli had a mean rating of 1.2 (SD = 1.2), and the chosen set of pro-life statements had a mean rating of 5.1 (SD = 1.1) [$t(417) = -34.70, p < .05$]. The second scale asked the subjects to rate each statement's emotionality, anchored with *not at all emotional* (0) and *highly emotional* (6). The mean ratings were 4.0 (SD = 1.4) and 4.3 (SD = 1.6) for the pro-choice and pro-life statement sets, respectively [$t(418) = -1.56$, n.s.].

The neutral statement set was used to establish baseline vocal affect measures. It included 10 items best described as factual statements about various topics (e.g., "Green plants change carbon dioxide into free oxygen," and "Public schools are financed by state and local authorities"). The pro-choice statement set included 11 items, such as "Abortion should be legal in the United States," and "When the unborn becomes a person is a matter of religion, not fact." The pro-life statement set included 11 items, such as "Abortion should not be legal in the United States," and "Abortion kills a life that has already begun."

Self-Report Measures

General attitudes. The subjects rated their attitudes toward legalized abortion on an 8-item general attitudes questionnaire. The questions were in the form of a Likert-type scale, with opposing extremes marking the endpoints. The questions were designed to elicit general attitudes toward the political topic of legalized abortion, as well as more self-relevant attitudes of knowledge and interest in the topic (e.g., "I support/oppose legalized abortion," "I know very much/very little about legalized abortion," "Legalized abortion is unsafe/safe," "The topic of legalized abortion interests me very little/very much"). This questionnaire was not included as an integral part of the study. It was included mainly as a check for the initial attitudes measure and to provide post hoc insight into the findings. There were no a priori hypotheses for the results of this scale.

Mood Adjective Checklist. The subjects' moods were assessed with the Mood Adjective Checklist (MACL; Nowlis, 1965). This scale consists of 18 mood-related adjectives divided into two subscales. There are nine adjectives representing positive affect (MACL+): *carefree*, *elated*, *affectionate*, *playful*, *overjoyed*, *kindly*, *witty*, *pleased*, and *warmhearted*. There are nine adjectives representing negative affect (MACL−): *angry*, *tense*, *regretful*, *defiant*, *fearful*, *sad*, *rebellious*, *jittery*, and *sorry*. The subjects rated the extent to which each adjective described their present moods on a 4-point scale (✓✓, ✓, ?, and *no*). The scale was verbally anchored with *definitely describes how I feel* and *definitely does not describe how I feel*.

Semantic differentials. Semantic differential scales (Osgood, 1965) were used to assess both affect and evaluation. The subjects rated their feelings and thoughts about legalized abortion on four continuums anchored by the adjectives: *bad/good*, *wise/foolish*, *kind/cruel*, and *selfish/unselfish*. On the semantic differential affect scale (SD-Affect), the subjects used the four scales to complete the stem "Legalized abortion makes me feel..."; on the semantic differential evaluation scale (SD-Evaluation), the subjects completed the stem "Legalized abortion is...."

Apparatus

A Tascam 22-2 reel-to-reel tape recorder and a Beyerdynamic DT209 microphone/headset employing a cardioid polar pattern were used to record the subjects' voices. The voice recordings were digitized at 10,000 samples/second using a Micro Technology Unlimited DigiSound-16 Audio A/D/A Converter with an antialiasing filter (3.3-kHz cutoff).

Procedure

When each subject arrived in the laboratory, he/she was seated in a small booth where he/she completed the initial attitudes questionnaire. While the subject completed administrative paper work to receive course credit, the subject's initial attitude toward legalized abortion was assessed and experimental condition assigned.[5]

The subject was then escorted to another part of the building where he/she was introduced to another experimenter, who seated him/her in a small (4×5×7 ft) sound-attenuated chamber. Each subject was seated at a small table. In front of him/her was the microphone/headset and a booklet containing instructions and stimulus statements. The subject put on the headset, and the experimenter adjusted the microphone to ensure equal distance from all subjects' mouths. The booklet explained that the study was about the delivery of editorials. The subject was to act as a control, reading the statements in a normal speaking voice as if talking to a friend seated across the table. He/she was instructed to turn to the first set of statements (the neutral statements) and to silently

read through the statements once. When finished, he/she was to read the statements aloud, pausing for several seconds between statements. The subject then followed the same procedure for two more statement sets: the experimental statement set and a second baseline measure with the neutral statements.

After completing the voice task, the subject was given a second experimental booklet containing the MACL, SD-Affect, SD-Evaluation, and general attitudes scale. The MACL always appeared first in order to assess mood as quickly as possible after the experimental manipulation. The other three scales were counterbalanced across subjects, creating six possible orders. After completing the booklet, the subject was debriefed and allowed to leave. No subject indicated knowledge of the experimental design.

RESULTS AND DISCUSSION

Comparisons were made between the subjects in the pro-attitudinal condition (the subjects who heard stimulus statements congruent with their initial attitudes) and the subjects in the counterattitudinal condition (those who heard statements opposing their initial attitudes). This variable will be termed *attitude congruency*. Because only pro-choice subjects were used, the pro-attitudinal condition entailed reading pro-choice statements, whereas the subjects in the counterattitudinal condition read pro-life statements. Implications of this confound will be addressed below. Within congruency levels, there were approximately equal numbers of subjects with strongly held attitudes and subjects with moderately held attitudes. Because the strength of an attitude or belief should be closely related to the affective component of the attitude, an *attitude extremity* factor was included in all analyses. Finally, because males and females were expected to differ in their degrees of involvement in the topic of legalized abortion, subject gender was included as a factor in the analyses.

Mood Manipulation—MACL

Responses to the MACL were scored by assigning a numerical value to each response category as follows: ✓✓ = 2, ✓ = 1, ? or *no* = 0. The two subscales—positive (MACL+) and negative (MACL−)—each contained nine adjectives. Scores on each scale were defined as the mean rating of the adjectives within that subscale. Thus, a given subject's score could range from 0 to 2. Internal consistency reliabilities (coefficient alpha) for the MACL+ and MACL− scales were .77 and .69, respectively. There was a significant negative correlation between these two measures ($r = -.17, p < .05$; see Table 5 for correlations among all measures). Correction for attenuation yielded a correlation coefficient of −.22 (Allen & Yen, 1979).

Analysis of the MACL revealed that affect was being manipulated as intended. Reading counterattitudinal statements increased ratings of experienced negative affect. This effect was predominantly due to the affective reactions of subjects with strongly held beliefs (see Table 1). An analysis of variance (ANOVA) revealed an attitude congruency by attitude extremity interaction [$F(1,95) = 5.58, p < .05$], with the strong pro-choice subjects who read pro-life statements showing the highest level of negative affect. There was no effect of gender on negative mood. These findings support the assumption that people experience negative affect when exposed to counterattitudinal information.

Table 1
Means and Standard Deviations of Negative Mood (MACL−) Scores

	Pro-attitudinal		Counterattitudinal	
	M	*SD*	*M*	*SD*
Strong Pro-choice	.21	.19	.41	.33
Moderate Pro-choice	.32	.31	.26	.20

Note—Since analyses revealed no effect of gender on negative mood, males and females were combined in the calculation of these means.

Table 2
Means and Standard Deviations of Positive Mood (MACL+) Scores

	Pro-attitudinal		Counterattitudinal	
	M	*SD*	*M*	*SD*
	Males			
Strong Pro-choice	.50	.36	.21	.17
Moderate Pro-choice	.42	.29	.30	.32
	Females			
Strong Pro-choice	.19	.26	.29	.36
Moderate Pro-choice	.16	.16	.28	.30

An ANOVA of positive mood revealed a somewhat different pattern. There was a main effect of gender on positive mood [$F(1,95) = 4.34, p < .05$], with the male subjects reporting generally higher positive mood than did the female subjects. There was also a significant attitude congruency by gender interaction [$F(1,95) = 6.62, p < .05$]. The males exhibited the expected pattern, with those reading attitude congruent (pro-choice) statements expressing more positive mood than those reading attitude incongruent (pro-life) statements. The level of positive mood in the females was constant across conditions (see Table 2). One possible reason for this finding is simply that women are more psychologically invested in the topic. It may be that their knowledge of the advantages and disadvantages is greater than that of their male counterparts. Thus, negative thoughts and feelings may be aroused, regardless of the subject's overall attitude. Post hoc analyses of the general attitudes questionnaire lend moderate support to this argument. The females rated the topic of legalized abortion as more important than the males did [$F(1,96) = 9.32, p < .05$]. They also expressed a greater interest in the topic [$F(1,96) = 12.97, p < .05$].

Semantic Differential Scales

Each of the four item pairs on the SD-Affect and SD-Evaluation scales were anchored on a 7-point scale. For each scale, a given subject's score was the mean of responses to the four items. A subject's mean score could

range from 1 to 7 (high scores reflecting positive attitudes toward abortion). The internal consistency reliabilities for the SD-Affect and SD-Evaluation scales were .85 and .85, respectively.

The SD-Affect and SD-Evaluation were highly correlated ($r = .73, p < .01$),[6] indicating a high degree of overlap in feelings and thoughts about legalized abortion (see Table 5 for correlations among all measures).[7] This effect may be an artifact of the measures used; the scales are very similar and they are both accessing verbal knowledge of the attitude object. Neither positive (MACL+) nor negative (MACL−) mood were correlated with feelings or thoughts about abortion. This absence of correlation is not surprising since there is no premise on which to expect attitudes to be explicitly related to mood.

As expected, the subjects with strong pro-choice attitudes indicated more positive feelings about abortion than did the subjects with moderate pro-choice attitudes. An ANOVA of the SD-Affect scale revealed a significant main effect of attitude extremity [$F(1,96) = 9.7, p < .05$] (see Table 3). There was no effect of attitude congruency or gender on the SD-Affect scale.

The males exhibited a pattern of evaluations similar to their pattern of affect. The females, however, exhibited a pattern of evaluations best described as reactionary. An ANOVA of the SD-Evaluation scale revealed a main effect of attitude extremity [$F(1,94) = 10.7, p < .05$], as well as a three-way interaction between attitude congruency, attitude extremity, and gender [$F(1,94) = 4.0$, $p < .05$] (see Table 4). The strong pro-choice males indicated more positive thoughts about legalized abortion than did the moderate pro-choice males, regardless of the experimental statements that they read. There was no difference in positive thoughts about legalized abortion between the strong and the moderate pro-choice females who read pro-attitudinal statements. However, the strong pro-choice females who read counterattitudinal statements expressed more positive thoughts about legalized abortion than did the moderate pro-choice females who read counterattitudinal statements. Thus, the statements that the strong pro-choice females read influenced their evaluation of legalized abortion.

Vocal Analyses

The Interactive Laboratory System (ILS) software (Signal Technology, Inc.) was used to analyze speech samples.

Table 3
Means and Standard Deviations of Semantic Differential Affect (SD-Affect) Scores

	Pro-attitudinal		Counterattitudinal	
	M	*SD*	*M*	*SD*
Strong Pro-choice	4.71	1.15	4.74	.91
Moderate Pro-choice	4.25	.85	4.01	1.07

Note—Since analyses revealed no effect of gender on the SD-Affect scale, males and females were combined in the calculation of these means.

Table 4
Means and Standard Deviations of Semantic Differential Evaluation (SD-Evaluation) Scores

	Pro-attitudinal		Counterattitudinal	
	M	*SD*	*M*	*SD*
	Males			
Strong Pro-choice	5.18	.84	4.83	.81
Moderate Pro-choice	4.62	.53	4.50	.71
	Females			
Strong Pro-choice	4.91	1.02	5.63	.60
Moderate Pro-choice	4.82	1.43	4.44	.61

Each statement was digitized separately. A mean fundamental frequency (F0 mean), standard deviation of fundamental frequency, and a range of fundamental frequency (F0 range) were calculated for each 25-msec frame of vocalization. The F0 mean, standard deviation, and F0 range scores for each 25-msec analysis frame were then averaged to arrive at a single F0 mean, standard deviation, and F0 range score for each statement.

A baseline F0 mean for each subject was calculated by averaging the F0 mean scores of the middle five neutral statements.[8] Similarly, a baseline standard deviation for each subject was calculated by averaging the standard deviations of the middle five neutral statements. Using these baseline measures, an ipsatized score was calculated for each subject for each experimental statement (abortion statement); the subject's baseline F0 mean was subtracted from the F0 mean of each experimental statement and this amount was divided by the baseline standard deviation. These scores were then averaged together across experimental statements to arrive at a single F0 mean score for each subject. The first and last statements in the experimental set were dropped from the analyses for reasons mentioned above. Thus, each subject served as his/her own control, and scores reflected a change in vocal patterns from reading neutral statements to reading affectively laden statements—a negative score reflecting a drop in F0 mean, a positive score reflecting a rise in F0 mean, and a score of zero reflecting no change. The above procedure was repeated to arrive at an F0 range score; baseline F0 range was subtracted from the F0 range of each experimental statement, and the difference was divided by the standard deviation of baseline F0 range scores.

Internal consistency reliabilities of F0 mean and F0 range were .84 and .60, respectively. The two voice measures were positively correlated ($r = .21, p < .05$)[9] (see Table 5).

The overall pattern of results of the voice analyses revealed the predicted drop in F0 mean and F0 range while the subjects were experiencing negative affect. The subjects with strong pro-choice attitudes exhibited the predicted negative affect voice pattern when reading pro-life statements. Correspondingly, the semantic differential scales revealed a high affective component to these sub-

Table 5
Correlations Among All Measures of Affect

	F0 Mean	F0 Range	MACL+	MACL−	SD-Evaluation	SD-Affect
F0 Mean	-	.21*	.07	−.11	.13	.03
F0 Range		-	−.03	−.05	−.03	−.06
MACL+			-	−.16*	.02	.11
MACL−				-	−.12	−.14
SD-Evaluation					-	.76*
SD-Affect						-

*Significant at $p < .05$.

jects' attitudes toward abortion, and mood measures provided additional evidence of the negative affect these subjects were experiencing.

The subjects with moderate pro-choice attitudes, however, exhibited a surprising vocal pattern. Although they were unaffected by reading counterattitudinal information, they exhibited the pattern of negative affect while reading pro-attitudinal material. An ANOVA of F0 mean uncovered a congruency × attitude extremity interaction [$F(1,96) = 8.46, p < .05$] (see Figure 1). Post hoc comparisons revealed the drop in F0 mean to be significant for both the strong pro-choice subjects reading pro-life statements [$t(25) = -2.74, p < .05$] and the moderate pro-choice subjects reading pro-choice statements [$t(26) = -2.41, p < .05$]. There was no effect of gender. One possible explanation for the unexpected finding is that the moderate pro-choice subjects are experiencing ambivalence in their attitudes toward abortion. The pro-choice statements used as stimuli contained no ambiguity. Thus, if the subject was unsure of his/her stance on the issue (or perhaps felt some guilt in relation to that stance), reading statements at the extreme may have caused him/her to experience negative affect. Unfortunately, ambivalence was not assessed.

Another possible explanation for the moderate subjects' negative responses to pro-attitudinal information is that the subjects may have recorded his/her first response having never really considered the issue. The general attitudes questionnaire revealed that the moderate subjects know less about abortion [$F(1,96) = 11.14, p < .05$], think it a less important topic [$F(1,96) = 20.36, p < .05$], and are less likely to encourage a friend to have an abortion [$F(1,96) = 6.50, p < .05$] than the subjects who strongly supported abortion. (However, they showed no less experience with or interest in the topic.)

The same analysis was conducted on the F0 range scores. Again, there was a congruency × attitude extremity interaction [$F(1,96) = 3.97, p < .05$] (see Fig-

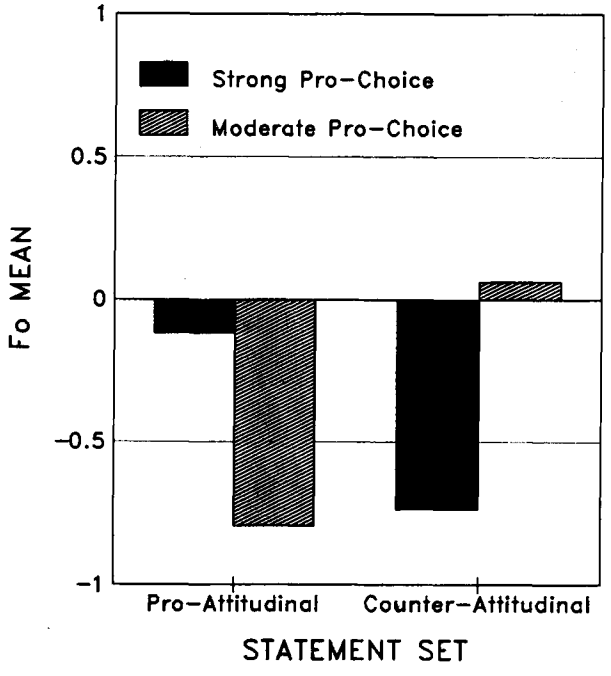

Figure 1. Change in mean fundamental frequency (F0 mean) from reading neutral statements to reading pro-attitudinal or counter-attitudinal statements.

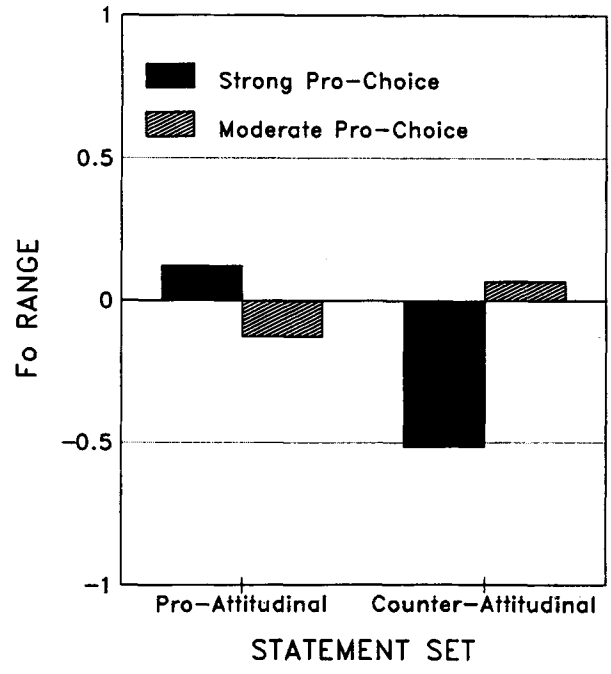

Figure 2. Change in range of fundamental frequency (F0 range) from reading neutral statements to reading pro-attitudinal or counter-attitudinal statements.

ure 2). Post hoc comparisons revealed the drop in F0 range for the strong pro-choice subjects reading pro-life statements to be significant [$t(25) = -3.0$, $p < .05$], whereas changes in the other groups were not significant. Thus, there appeared to be a narrowing of F0 ranges with the experience of sufficient negative affect. As with the F0 mean measure, there was no effect of gender.

Finally, a multivariate analysis of variance (MANOVA) employing both voice measures—F0 mean and F0 range—as dependent variables revealed the same pattern of results as the analysis of each variable independently; there was a congruency × attitude extremity interaction [$F(2,95) = 5.33$, $p < .05$].

Comparing Written Measures and Voice Measures

This research shows that both voice measures and established written measures indicate affective state. However, the two types of measures appear to be independent. Pearson product-moment correlations were calculated among the written and the voice measures. As mentioned above, the two voice measures (F0 mean and F0 range) were correlated and the pairs of measures derived from each type of written scale (MACL and semantic differential scales) were correlated. However, the voice measures were not correlated with the written measures (see Table 5).

Furthermore, a MANOVA, with the voice measures (F0 mean and F0 range) as dependent variables and the four written measures (MACL+, MACL−, SD-Evaluation, and SD-Affect) as covariates, revealed an attitude congruency × attitude extremity interaction [$F(2,87) = 5.61$, $p < .05$]. In turn, the same analysis using the written measures as the dependent variables and the voice measures as covariates revealed an interaction of congruency and attitude extremity [$F(4,87) = 2.38$, $p < .05$], as well as a congruency by gender interaction [$F(4,87) = 2.62$, $p < .05$] and a main effect of attitude extremity [$F(4,87) = 3.18$, $p < .05$]. Voice measures retain their prediction value when we control for the effects of the written measures; written measures retain their prediction value when we control for the effects of the voice measure.

The ramifications of the design limitations need to be addressed here. Lack of representation on the pro-life side of the issue unexpectedly forced the exclusion of two cells from the design: pro-life subjects reading pro-attitudinal and counterattitudinal statements. The basic assumption was that subjects experience negative affect when reading counterattitudinal information and positive or neutral affect when reading pro-attitudinal information. Following this assumption, the same findings would be expected for the pro-life subjects that were found for the pro-choice subjects. But, the abortion issue has the potential to carry much more emotional weight at one end of the scale than the other (see Pratkanis, 1989, for a discussion of alternatives to the bipolar attitude structure). Unfortunately, without data on the pro-life people, the possibility that the findings were specific to the pro-choice end of the scale cannot be ruled out.

CONCLUSIONS

Measures of vocal affect expression hold great potential as an additional measure of affective responses, allowing us to more accurately assess affective states than by using written measures alone. This study has provided evidence that vocal affect expression can be used to measure affective responses. Yet, the development of the measure is still in its infancy. Further research should be aimed at validating this measure under a variety of circumstances. Although the measure requires expensive equipment that may be cumbersome to master, its potential in emotion, mood, and attitude research is great and its possible applications are considerable.

The use of vocal affect expression analysis has three advantages. First, the measures are unobtrusive. Though bulky and intimidating equipment is required to record the subject's voice, a laboratory or interview room can be arranged to include only the microphone in the room with the subject. Second, the measures are reliable. Analysis of the voice patterns can be done digitally by computer, eliminating the need for subjective judgments on the part of the researchers. Finally, vocal affect expression can be used as an indicator of affective response when subjects are unable to express their feelings verbally or would prefer to conceal them.

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NOTES

1. This distinction refers to a continuum of positive to negative affect. The prediction of discrete emotions requires the assessment of patterns of several vocal parameters.

2. Ohala further elaborated the use of voice changes from an ethological perspective. He postulated that a lowering of our voice pitch warns our enemies to retreat, whereas rises in pitch indicate that it is safe to approach.

3. A number of terms have been used to describe people who support or oppose legalized abortion. The terms used in this paper are those endorsed by the proponents of each side.

4. There are many subtopics within the broad topic of abortion, including when life begins, husbands' rights, psychological effects of abortion, alternatives to abortion, and so forth. A range of these subtopics was included in the stimulus statement sets.

5. At this point, any subject responding "don't know" to the legalized abortion item was given credit for participation, debriefed, and allowed to leave.

6. This correlation is very close in magnitude to that found by Breckler and Wiggins (1989a) using the same topic, legalized abortion.

7. Correction for attenuation yielded a correlation coefficient of .89.

8. Only the middle statements from the initial set of neutral statements were used as a baseline to avoid any irregularities that might accompany the initiation of speech or the conclusion of it.

9. The correlation between these two measures is .29 after correction for attenuation.