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# Social and personality variables in compensation for altered auditory feedback*

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This paper documents that variation in one's personal sense of empowerment is related to one's phonetic response to altered auditory feedback. We see this as related to the actuation of sound change, identifying a personal characteristic of individuals who are likely to introduce a change variant. Many speakers react to gradual alteration of auditory feedback by compensating for the manipulation – for example, by raising the frequency of a vowel's F2 as it is reduced in auditory feedback. However, prior research has found that there is substantial individual variability in the degree of compensation. To test our hypothesis that this variability may be linked to social or personality factors, we investigated the relationship between participants' responses to altered auditory feedback and their answers on questionnaires measuring a number of personality variables. A significant negative correlation was discovered: the more empowered subjects felt, the less they compensated.

## 1. Introduction

Theories of sound change implicate a number of social factors, such as prestige, social hierarchy, social identity, and interconnectedness, in the spread of a sound change through a community and in contact across communities (Labov 1994). And research on the phonetics of sound change has identified several factors (such as gestural overlap and blending, as well as speech production and perception errors) that bias linguistic systems toward particular types of changes (Garrett & Johnson to appear).

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What is missing is the link between the phonetic forces that are constantly producing a pool of phonetic variation, and the social forces that guide the incorporation of new sound patterns into a community's speech norms. For Weinreich et al. (1968), the problem of identifying the phonetic and social factors of sound change is a "constraints" problem, and the issue that we are identifying here as a sort of missing link between phonetics and sound change, Weinreich et al. called the *actuation problem*. In brief, the actuation problem is the problem of determining why a sound change takes place in one language but not in another. Our study of compensation for altered auditory feedback suggests that actuation is tied to social psychological properties of individual speakers (see also Yu 2010). Speakers with personalities that dispose them to adopt variant forms in their own speech are more likely to actuate sound change.

Our research aims to contribute both to a better understanding of sound change and sociophonetic variation, and of speech motor control. We start with a brief discussion of the motor control literature and then turn to a discussion of sound change.

### 1.1 Motor control

In addition to high level phonological categories, successful speech also requires low level motor speech targets. It is by reference to these targets that we are able to carry on speaking while chewing on a pencil or wearing a dental appliance. If the speech motor control system detects that feedback from either the auditory or somatosensory systems are not on-target, it directs a corrective, compensatory change in articulation. Speakers have been shown to respond to experimentally-altered somatosensory feedback (e.g. Tremblay et al. 2003), as well as auditory feedback (e.g. Houde & Jordan 1998, 2002; Purcell & Munhall 2006; Villacorta et al. 2007; Katseff et al. 2011).

The present study focuses on the variability in responses to altered auditory feedback. Although most speakers compensate for altered auditory feedback by changing their articulation, many of the studies cited above report that a substantial minority of speakers behave unpredictably by wandering around their baseline, not compensating at all, or even following the manipulation. Some of this variation is linked to speakers' phonological spaces (Katseff 2010) or lexicons (Frank 2010); some may be due to perceptual changes that occur as a result of the feedback manipulation (Shiller et al. 2009). However, the source of variability remains largely unexplained. Several hypotheses on why a person might not compensate for altered auditory feedback are listed in Table 1.

**Table 1.** Proposed explanations for why some speakers do not compensate for altered auditory feedback

| |
|---|
| **Conscious resistance**: It is possible that some speakers notice the feedback alteration and consciously ignore it (Houde & Jordan 2002). |
| **Unreliable feedback**: The fidelity of the re-synthesized signal may not have been good enough for some subjects, so they ignored it (Houde & Jordan 2002). |
| **Compensation proclivity**: Participants have "natural tendencies" to rely on auditory feedback to various degrees (Houde & Jordan 2002). |
| **Perceptual adaptation**: Poor compensators exhibit selective adaptation to speech perception (Houde & Jordan 2002) |
| **Relative weight of feedback type**: Individual differences in compensation may be due to selective weighting of the two types of feedback. The poor compensator's increased reliance on somatosensory feedback may reduce the influence of auditory feedback (Purcell & Munhall 2006). |
| **Auditory Acuity**: Individual auditory acuity is significantly positively correlated with amount of compensation, with less acute speakers compensating less for altered auditory feedback (Villacorta et al. 2007). |
| **Linguistic factors**: Individual differences in the speaker's phonetic vowel space, or in the degree of vowel space crowding induced by the altered feedback (Katseff et al. 2010). |

It is likely that several of these factors may be simultaneously involved in determining the speaker's response to altered auditory feedback. Two of the factors in Table 1, compensation proclivity and linguistic factors, are of particular relevance for the study that we report here. First, we seek to test Houde & Jordan's (2002) suggestion that individuals may simply have different proclivities for compensation by measuring personality factors that may be related to these natural tendencies. Second, Katseff et al.'s (2010) investigation of the influence of linguistic factors on compensation for California English vowels provided a starting point for our study. The idea here is that the amount of compensation may be a function of the size of a particular vowel's range of formant variation.

### 1.2 Sound change

The absence of a conclusive phonetic explanation for the individual variation in compensation response presents an opportunity to research this phenomenon taking a sociophonetic approach. There seem to be two competing alternatives for speakers to choose from: to attend to external feedback (how the speech sounds to others) versus internal feedback (how their speech feels to themselves). We hypothesize that the unexplained variability in compensatory behavior may be due to independent variables related to social or personality factors that independently affect the speaker's attention to external feedback. Our argument in this paper is that individual differences in response to altered auditory feedback are related to speaker's proclivity to notice and respond to phonetic variation in general. This has potentially important implications for a listener-based model of sound change such as the one proposed by Ohala (1993). It is widely known that phonetic factors such as gestural overlap, aerodynamic interactions, and simple misperceptions create a pool of phonetic variation that can be noticed by listeners and incorporated into their subsequent speech plans (Ohala 1981, 1983, 1989, 1993; Blevins 2004, 2006; Blevins & Garrett 2004; Janda & Joseph 2003). The problem in sound change theory has been to specify when phonetic variation will lead to sound change and when it will not – the actuation problem. Our study seeks to identify social or personality based traits that might affect sensitivity to phonetic variation, and thus, inhibit or facilitate actuation of sound change.

### 1.3 The present study

Katseff et al. (2011) suggest that compensation for altered auditory feedback is largely unrestrained by somatosensory feedback as long as the compensation response does not result in a production that is outside of the bounds of normal variation for the vowel. This was confirmed by Katseff et al.'s study with /u/, /ɛ/, and /ʌ/ vowels (2010). They concluded that the compensation response for /u/ was larger than for the other vowels in the study because the range of acoustic variability for /u/ was larger than it was for the other vowels. The pronunciation of /u/ is also somewhat dialectally marked in California English (see Hagiwara 1995). These findings make /u/ a good test vowel for investigating social and personality variables in the altered auditory feedback paradigm. In the absence of restraint from somatosensory feedback, with a socially marked speech sound, social and personality factors may have heightened impact on compensation.

In the present experiment, we shifted the second formant (F2) of /u/ down by 300Hz in real-time as the person was speaking. This, in effect makes the speaker's /u/ vowel sound significantly more back than it would without the feedback alteration. We hypothesized that California speakers would interpret this backed /u/ in terms of dialect variation, so when we altered their /u/ F2 by shifting it to a lower frequency, this might induce a sense of drifting away from the usual "Californian" norm for this vowel. We hypothesize that those subjects who place a higher value and emotional significance on *California group membership* will compensate more for the F2 shift. The more they consider themselves to be Californian and implicitly want to be perceived as such, the more they will compensate by opposing the F2 manipulation.

The following paragraphs discuss a number of other social and personality factors that may play a role in determining the magnitude of a speaker's compensation for altered auditory feedback, and thus by hypothesis, also play a role in the actuation of sound change. In our experiment, we measured each of these and tested each for a relationship with compensation for altered auditory feedback. We will discuss each factor in turn, including a discussion of the hypothesis our experiment is designed to test. In the Methods section we describe the instruments that we used to measure these factors.

*Autism* is a developmental disorder marked by repetitive behaviors such as compulsions or repetitive movements; marked difficulties with speech and communication; and several social impairments (Myers and Johnson 2007). Because individuals vary in the degree to which they exhibit each of these behaviors, it is possible to place any particular person on a "spectrum from autism to normality" (Baron-Cohen et al. 2001); individuals who would not be classified as autistic can have autistic traits.

Yu (2010) has recently suggested that autistic traits may play a role in sound change driven by misperception (Ohala 1993). Because people with autistic traits have superior perceptual abilities for low level (simple) visual and auditory identification, but do not perform as well on complex perceptual tasks (Mottron et al. 2006), Yu hypothesized that individuals with less autistic traits have an inherent perceptual disadvantage and thus, would be more inclined to systematically initiate sound change. When his participants were given a standardized Autistic-Spectrum Quotient (AQ) (Baron-Cohen et al. 2001) and a test of perceptual correction, Yu found that the participants with more autistic traits were indeed more likely to perceptually compensate for phonetic coarticulation. We hypothesize that the more detail-oriented perceptual processing associated with higher AQ scores (Samson et al. 2006) might result in greater sensitivity to auditory feedback alteration for high AQ participants in our study. Paying more attention to auditory feedback may result in greater compensation to feedback alteration.

We also measured the subjects' tendency for *self-monitoring* (Snyder 1974). Those driven by a greater need for social approval look to the expression and self-presentation of others to determine how they should act themselves, and are therefore unusually sensitive both to their own behavior and to the behavior of others. Those with less need for social approval care less about the situational appropriateness of their conduct; hence, they focus less on other people's conduct and accordingly, are less likely to monitor and control the appropriateness of their demeanor in different social situations. We hypothesize that people who score low on self-monitoring might be less attentive to their auditory feedback, and thus, compensate less in the altered auditory feedback paradigm, while those with high self-monitoring scores will be more sensitive to their auditory feedback, and compensate more.

The next factor we investigated is *impulsivity*, a personality trait with three components (Patton et al. 1995): (1) *Motor* impulsivity, "acting without thinking", also referred to as Response Inhibition Deficit (Chamberlain & Sahakian 2007), (2) *Attentional* impulsivity, "making quick cognitive decisions and inability to focus attention or concentrate", (3) *Nonplanning* impulsivity, defined as "lack of planning". We hypothesize that high impulsivity might enhance compensation, in much the same way that lack of somatosensory feedback (when articulators are anesthetized, Larson et al. 2008) results in greater compensation for altered auditory feedback.

Finally, we studied the effect of one's sense of personal *empowerment* on compensation. Though traditionally, power has been defined through an individual's acts of coercion or control, more recent definitions of power instead focus on an individual's *capacity* to wield control (Keltner et al. 2003). Galinsky et al. (2006) found that high-power subjects exhibit reduced empathy and ability to take other people's perspectives. They rely more on their intrapsychic cognitive processes rather than on situational and interpersonal ones, and thus, are generally less sensitive to external influence (Galinsky et al. 2008). We hypothesized that individuals characterized by a high sense of empowerment might be relatively insensitive to external phonetic feedback (i.e. how they or others sound), and thus, compensate less for altered auditory feedback. The questionnaire that we used measures a subject's power along the modern scale of capacity. If people with less power, by definition, have less control over their and others' outcomes, and their fates are more dependent on situational circumstances (Magee et al. 2005), then they would "typically seek the most diagnostic information" and pay more attention to situational cues and context (Fiske & Dépret 1996). People with more power show less behavioral self-awareness (Ward & Keltner 1998) and may similarly pay less attention to their auditory feedback.

We also measured five personality traits (Saucier 1994): *Extroversion, Agreeableness, Conscientiousness, Emotional Stability, Intellect or Openness*. We did not have specific hypotheses relating these traits to phonetic compensation, but thought that these measures might aid in the interpretation of our results.

## 2. Methods

### 2.1 Subjects

Forty-nine male college students between the ages of 18 and 25 participated in this study. The study was limited to men because our formant re-synthesis algorithm is more stable with male voices. All subjects were native speakers of English, raised in California. Five were bilingual and 11 were fluent in a second language. None of them reported having any hearing, speech, or language disorders. They were compensated $10 and the experiment took about 50 minutes.

### 2.2 Materials and procedure

This experiment had two parts. First, subjects completed an altered auditory feedback experiment, then they filled out a set of social and personality questionnaires.

The speech task consisted of two subparts: "Vowel Inventory" and "Formant Shift". The experiment utilizes a variant of the technology used in Katseff et al. (2011) where further details are available. Participants were seated in a soundproof booth and wore an AKG HSC-271 Professional headset. Their speech was routed from the headset microphone through a Delta 44 sound card. All tokens from both the "Vowel Inventory" and "Formant Shift" subparts were analyzed and re-synthesized in real time. Re-synthesized speech was played through the headset's headphones in place of normal auditory feedback.

During the Vowel Inventory subtask, participants were recorded reading the following words, which were displayed in random order on a computer monitor: *hid, head, had, odd, awed, hode, hood, who'd, bood, poog, rude, dude*. Each word appeared in the vowel inventory portion of the experiment between 12 and 13 times for each subject. The words were presented in English orthography.

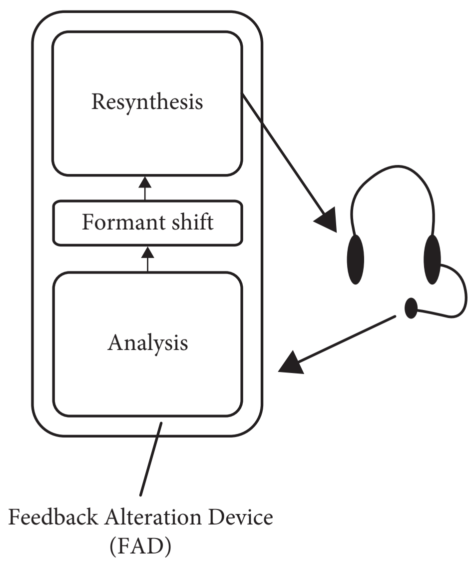


**Figure 1.** Schematic of Experimental Setup. Speech from the microphone is routed through a computer, where it is analyzed, re-synthesized, and played through the earphones

The pronunciation of the nonwords *bood* and *poog* was elicited from the participants before beginning the recording session to make sure they were pronouncing them using the vowel /u/. When subjects deviated from the targeted pronunciation they were instructed to read the two nonwords like the words "who'd" and "dude". Words with the vowel /u/ were selected on the basis of pilot work showing that they represented a broad range of phonetic variation in F2. Each word had equal probability of selection. A total of 165 words were displayed in sets of 15 trials; subjects could take breaks in between sets for as long as they wished. During this subtask, vowels were re-synthesized but not altered.

The Formant Shift subtask consisted of 210 trials with two nonword stimuli: "bood" and "poog", also displayed in random order in sets of 15 trials. Initial bilabial plosives were chosen on the basis of pilot work showing that this environment results in an F2 that falls in the middle of subjects' /u/ ranges. As a result, participants were able to compensate for altered feedback by fronting their /u/ without leaving their /u/ vowel regions.

The second formant in the stimulus words was altered in real time using a feedback alteration device (Katseff et al. 2011). The system works in three stages, as shown in Figure 1. In the first stage, custom software finds the pitch, formants, and spectral envelope of a short section of incoming speech. In the second stage, the formants are shifted – in the present experiment the F2 frequency was altered. In the third stage, the small section of sound is re-synthesized and played through the headphones. The entire process occurs within 12 ms. For more information on the analysis-resynthesis method, see Katseff (2010). Exit interviews at the end of the study confirmed that none of the subjects noticed either a delay in their feedback or a change in vowel quality.

The second formant was shifted in four consecutive phases as shown in Table 2. During the first, "Baseline" phase (30 trials), speech was re-synthesized but formant were not altered. During the second, "F2 Shift Ramp" phase, F2 was gradually reduced by 5Hz per trial until the shift reached -300Hz. During the third, "Maximum Shift" phase (100 trials), feedback continued to be shifted by -300Hz. During the fourth, "End" stage, feedback was again re-synthesized but not altered.

**Table 2.** The sequence of events in the Formant Shift portion of the experiment

| Phase | # of Trials | F2 Shift |
|---|---|---|
| 1. Baseline | 30 | 0Hz |
| 2. F2 Shift Ramp | 60 | From 0Hz to -300Hz |
| 3. Maximum Shift | 100 | -300Hz |
| 4. End | 20 | 0Hz |

The duration of the entire altered auditory feedback portion of the experiment was approximately 20 minutes.

After the altered feedback task, subjects were asked to complete a set of questionnaires. They were given the questionnaires one by one in the following order:

1. Attitude/Self-identification with California (attached in Appendix 1). A 20-item self-report questionnaire designed to quantify subjects' self-identification and attitude towards their native state of California. The test format represents a 7-level Likert scale questionnaire (from strongly disagree to strongly agree) where subjects must indicate their level of agreement to statements like "I consider myself to be a Californian". Scoring 0% indicates total lack of self-identification and negative attitude towards California. In contrast, scoring 100% means that subjects absolutely consider themselves to be Californian and like various aspects of being Californian.
2. Autism-Spectrum Quotient (AQ) (Baron-Cohen et al. 2001). A 50-item self-report questionnaire designed to place people on an autism continuum. The test format is a 4-level Likert scale where subjects express their agreement or disagreement with statements like "I usually concentrate more on the whole picture, rather than the small details".
3. Self-Monitoring. A 25-item self-administered questionnaire designed to measure to what degree people look to the expression and self-presentation of others to determine how they should act themselves (Snyder 1974). Subjects indicate whether statements like "When I am uncertain how to act in a social situation, I look to the behavior of others for cues" are *true* or *false* for them.
4. Impulsivity (Patton et al. 1995). A 30-item self-report questionnaire divided into 3 subcomponents (*attentional*, *nonplanning*, and *motor*) that capture and quantify the "multi-factorial nature" of impulsivity (Patton et al. 1995). These three subcomponents are candidate predictors in the stepwise regression model described later in the Data Analysis section. A combined measure of impulsivity was also included as a candidate predictor. This test utilizes a 4-level Likert scale that allows subjects to express how frequently they think or act according to statements like "I am self controlled".
5. Empowerment Scale (Rogers et al. 1997). The established procedure to investigate the psychology of power is to prime participants with power. However, the exploratory nature of the current study aimed at avoiding any priming in order to be able to test for multiple variables. To obtain a measure of power, a 28-item self-report questionnaire originally designed to measure empowerment among users of mental health services was chosen (see Appendix 2). The 4-level Likert scale consists of five subcomponents used as predictors: *power/powerlessness, optimism and control over the future, self-esteem, community*

*activism and autonomy,* and *righteous anger*. Subjects agree or disagree with statements like "I can pretty much determine what will happen in my life".

6. Big Five Mini-Markers (Saucier 1994). The Big Five Personality test is among the most popular tests in psychology. It broadly categorizes human personality into five traits used as predictors: *Extroversion, Agreeableness, Conscientiousness, Emotional Stability, Intellect or Openness*. The "Big Five" is a self-report test utilizing a 9-point Likert scale where subjects are given 40 adjectives to describe themselves.
7. Language Background. A questionnaire collecting information about subjects' foreign language knowledge, dialect of English, residential history, age, race, education, and parents' professions.

On average, subjects took less than 30 minutes to fill in the questionnaires. The whole study lasted approximately 50 minutes.

### 2.3 Data analysis

Due to technical difficulties, audio recordings from 3 of the 49 subjects were unusable. Audio recordings and questionnaires from the remaining 46 subjects were investigated using the following analysis. Formants from the temporal midpoints of vowels from all test words (*hid, head, had, odd, awed, hode, hood, who'd, bood, poog, rude, dude*) were measured in an automated script using conventional LPC analysis, and visually verified in spectrograms using PRAAT (Boersma & Weenink 2010). One /u/ baseline F2 measurement was taken from the mean F2 of the first 30 trials in the "Formant Shift" portion of the experiment, and a second baseline was taken from the mean F2 of /u/ in "bood" and "poog" during the "Vowel Inventory" portion of the experiment. The F2 compensation response was measured as the difference between the mean F2 value of the /u/ productions during the "Maximum Shift" phase and the /u/ baseline that had been measured in the 30 "Baseline" trials. Changes in F0 and F1 between the "Baseline" and "Maximum Shift" phases were measured using the same procedure. Outlier tokens more than 2 standard deviations from the mean, which constituted less than 10% of tokens, were discarded.

The questionnaires were scored using guidelines provided by their authors. The California identity questionnaire that we devised for this study was scored by converting the 7-level scale to a 7-point scale where "strongly disagree" = 1, and "strongly agree" = 7. Then, all values were summed (after reversing the reverse questions) and divided by the maximum total score possible. With the exception of the Autism-Spectrum Quotient (AQ), all scores have values from 0 to 1 (0% to 100%). The AQ is scored on a scale from 0 to 50.

**Table 3.** Descriptive statistics for the predictors drawn from personality questionnaires

| | Californian | Autism | Self.Monit |
|---|---|---|---|
| Min.: | 0.5210 | 7.00 | 0.2800 |
| 1st Qu.: | 0.7465 | 13.25 | 0.4400 |
| Median: | 0.8035 | 19.00 | 0.5200 |
| Mean: | 0.7912 | 18.24 | 0.5652 |
| 3rd Qu.: | 0.8640 | 23.75 | 0.6700 |
| Max.: | 0.9520 | 27.00 | 0.9200 |

| | Impulsiveness | Nonplan | Motor | Attentional |
|---|---|---|---|---|
| Min.: | 0.3920 | 0.2950 | 0.3640 | 0.3750 |
| 1st Qu.: | 0.4920 | 0.4605 | 0.4550 | 0.4768 |
| Median: | 0.5330 | 0.5230 | 0.5230 | 0.5625 |
| Mean: | 0.5366 | 0.5380 | 0.5208 | 0.5538 |
| 3rd Qu.: | 0.5920 | 0.6082 | 0.5680 | 0.5940 |
| Max.: | 0.6670 | 0.7730 | 0.7270 | 0.8130 |

| | Empow | R.Anger | Optim. | ComAct | Power | S.Est |
|---|---|---|---|---|---|---|
| Min.: | 0.6340 | 0.3130 | 0.5630 | 0.6670 | 0.5310 | 0.528 |
| 1st Qu.: | 0.7680 | 0.5000 | 0.7035 | 0.8330 | 0.6560 | 0.785 |
| Median: | 0.7860 | 0.5940 | 0.8130 | 0.8750 | 0.6880 | 0.861 |
| Mean: | 0.7839 | 0.6145 | 0.8064 | 0.8831 | 0.7008 | 0.843 |
| 3rd Qu.: | 0.8130 | 0.6880 | 0.9223 | 0.9580 | 0.7810 | 0.917 |
| Max.: | 0.9290 | 1.0000 | 1.0000 | 1.0000 | 0.8440 | 1.000 |

| | Extrov | Agree | Conscie | Emo.Stab | Intel.Open |
|---|---|---|---|---|---|
| Min.: | 0.3060 | 0.4860 | 0.3470 | 0.3060 | 0.4030 |
| 1st Qu.: | 0.4860 | 0.6940 | 0.5487 | 0.4930 | 0.6975 |
| Median: | 0.5560 | 0.7640 | 0.6530 | 0.6040 | 0.8060 |
| Mean: | 0.5843 | 0.7551 | 0.6542 | 0.6088 | 0.7873 |
| 3rd Qu.: | 0.6940 | 0.8470 | 0.7570 | 0.6940 | 0.8905 |
| Max.: | 0.9860 | 0.9210 | 0.9440 | 0.9720 | 1.0000 |

Table 3 shows the range and central tendency for each of the predictor variables drawn from the personality questionnaires. Because the California Attitudes questionnaire was devised for this experiment and has not been normed for a large population, we are not sure what range to expect on this instrument. If anything, it seems as if the range of California attitudes is somewhat narrow. There are no concerns about the ranges or mean values for any of the other variables.

**Table 4.** Correlations among the main personality variables (i.e. not including the subcomponents of impulsivity and empowerment). Reliable ($p < 0.05$) correlations are in bold face

| | AQ | Self-Monitoring | Impulsivity | Empowerment | Extroversion | Agreeableness | Conscientiousness | Emotional-Stability | Openness |
|---|---|---|---|---|---|---|---|---|---|
| Californian | –0.08 | 0.1 | 0.07 | 0.22 | 0.16 | 0.05 | 0.21 | 0 | –0.05 |
| AQ | | –0.33 | –0.13 | **–0.42** | **–0.48** | –0.05 | –0.05 | –0.09 | –0.22 |
| Monitoring | | | 0.3 | 0.24 | **0.38** | –0.16 | –0.16 | –0.21 | **0.51** |
| Impulsiveness | | | | 0.03 | 0.02 | –0.19 | **–0.53** | –0.13 | 0.03 |
| Empowerment | | | | | **0.56** | 0.19 | 0.25 | 0.08 | **0.38** |
| Extroversion | | | | | | 0.22 | **0.38** | 0.07 | 0.15 |
| Agreeableness | | | | | | | 0.33 | 0.33 | –0.05 |
| Conscientiousness | | | | | | | | 0.1 | 0.11 |
| Emotional Stability | | | | | | | | | **–0.39** |

Table 4 shows a correlation matrix of the personality questionnaire responses for the main variables (i.e. for the sake of space, not including all of the subcomponents of the Impulsivity and Empowerment questionnaires). Autism Spectrum Quotient (AQ) was negatively correlated with Empowerment and Extroversion, which were positively correlated with each other, and Empowerment was also positively correlated with Openness while Extroversion was positively correlated with Conscientiousness. The highest correlations in the table were the negative correlation between Conscientiousness and Impulsiveness, and the positive correlation between Openness and Self-monitoring.

The correlations in Table 5 indicate that among the subcomponents of the empowerment scale, Optimism, Autonomy and Self-Esteem were associated with each other on the one hand, and Power and Righteous Anger formed another related pair of subcomponents.

**Table 5.** Correlations among the sub-components of the empowerment questionnaire. Reliable ($p < 0.05$) correlations are in bold face

| | Righteous Anger | Optimism | Autonomy | Power | Self Esteem |
|---|---|---|---|---|---|
| Empowerment | 0.28 | **0.54** | **0.57** | **0.43** | **0.79** |
| Righteous Anger | | –0.26 | –0.04 | **0.43** | 0 |
| Optimism | | | **0.39** | –0.15 | **0.36** |
| Autonomy | | | | 0.12 | 0.27 |
| Power | | | | | 0.05 |

A total of 26 variables were entered as predictors of the F2 compensation response and a forward stepwise regression using the Akaike Information Criterion (AIC) selected the best combination of factors to predict the degree of F2 compensation a subject would produce. In addition to the 17 social and personality variables derived from the questionnaires discussed above, we included (1) four baseline /u/ F2 measures (two from "bood" and "poog" as discussed above, one from the average F2 of "rude", and one from the average F2 of "dude"), (2) two measures of possible concurrent compensation to altered auditory feedback (the degree of F0 and F1 difference between the 30 baseline tokens and the 100 maximum shift tokens)[1], and (3) two qualitative measures of subjects' language background: whether they were bilingual (5 subjects) or not (41 subjects), and the region of California where they grew up (Southern – 13s, Northern – 27s, or Central – 6s).

## 3. Results

As has been observed in previous studies, speakers in this study had a large F2 range for the vowel /u/, spanning 441Hz on average (see Figure 2). The mean F2 of /u/ "who'd" was 1239Hz, while the mean F2 of /u/ in the coronal environment "dude" was 1680Hz. From Figure 2, it is evident that, consistent with previous research (Hagiwara 1995; Clopper & Pisoni 2004; Clopper et al. 2005; Labov et al. 2006), California English exhibits a fronted /u/ vowel region. Second formant values for /u/ in this subject pool parallel those found by Hagiwara's 1995 study of California vowels: Hagiwara's observed mean /u/ values in a preceding coronal and bilabial environment were 1679Hz and 1341Hz, respectively, and this study's averages were 1680Hz and 1315Hz.

Figure 2 also shows average F1 and F2 of the pooled "bood" and "poog" recordings for each subject in grey crosses and illustrates that there was a substantial range of /u/ F2 values[2]. Although there seems to be a slight tendency for Northern Californian subjects to have lower F2 values in /u/ than do Southern or Central Californians (see Table 6), there was also substantial individual variation in the baseline /u/ F2.

1. The rationale for including additional acoustic compensation measures is that speakers may have compensated for altered F2 in the feedback synthesis using gestures that affected other acoustic variables. In future work it would be good to include F3 compensation as a predictor.

2. The pooled measurements for "bood" and "poog" from the "baseline" phase immediately preceding the formant shifting had separate F2 averages of 1342Hz and 1289Hz, respectively. Combined, their average was 1315Hz.

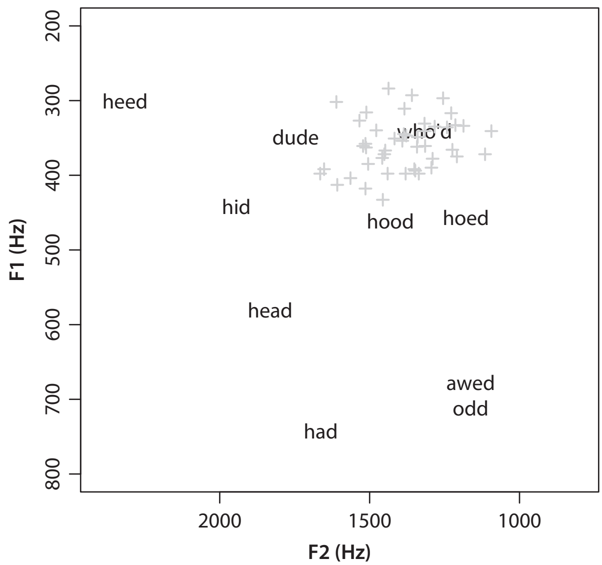


**Figure 2.** The average vowel space of the subjects in this study (plotted with the words used to elicit the vowel). The gray crosses mark the mean baseline "bood"/"poog" of each of the 46 subjects

**Table 6.** Average F2 for speakers from different parts of California. Measurements for [bud] and [pug] were pooled and labeled "bood". The first column labeled "bood" was from the "vowel inventory" (VI) recording, and the second column labeled "bood" was from the "baseline" (B) phase of the "formant shift" recordings. Number of speakers in each group is given in parentheses

| | bood (VI) | bood (B) | rude | dude |
|---|---|---|---|---|
| South (n = 13) | 1302 | 1330 | 1545 | 1722 |
| Central (n = 6) | 1300 | 1326 | 1520 | 1676 |
| North (n = 27) | 1295 | 1305 | 1514 | 1661 |

The majority of the subjects compensated for the altered auditory feedback by increasing the F2 of their /u/ vowel productions, as expected – recall that the feedback alteration was to decrease the vowel's F2. Figure 3 shows example formant measurements on a trial-by-trial basis for a typical subject. As the feedback alteration is introduced from trial 30 through trial 90, the subject responded by increasing his F2 gradually so that by trial 75 the heard F2 (the result of the feedback alteration) remained steady between 1200 and 1300Hz, and the F2 actually produced by the subject neared 1500Hz, a compensation of nearly 200Hz. As the feedback

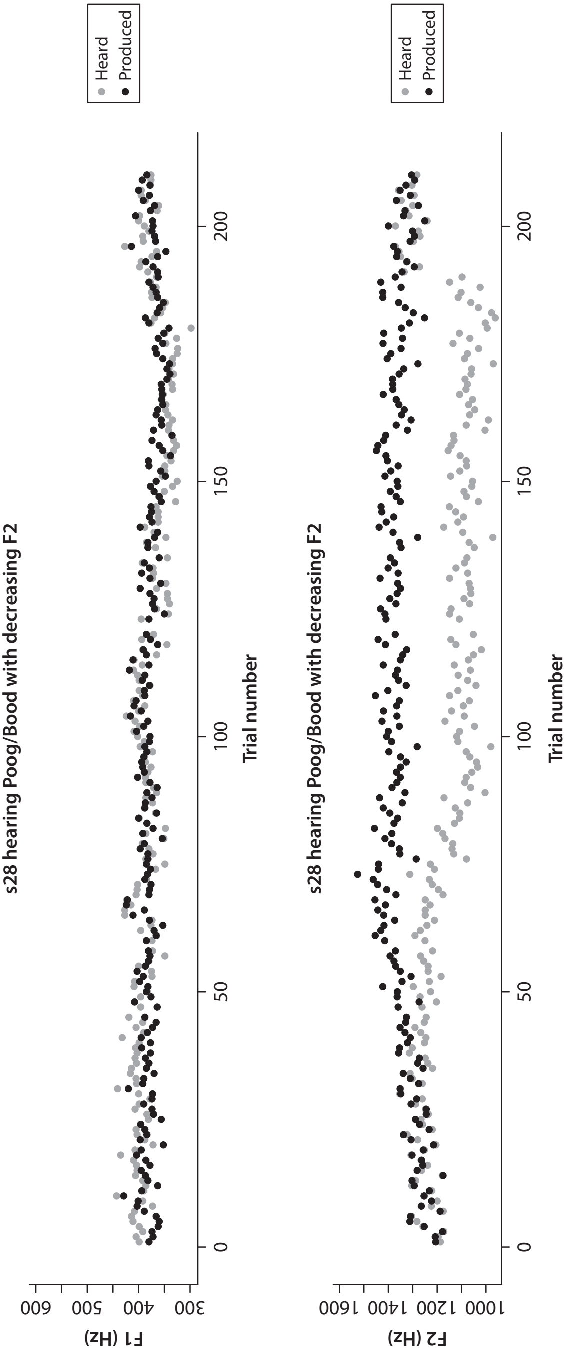


**Figure 3.** Trial-by-trial results for a typical subject. F1 and F2 measurements are shown in separate plots. The F2 plot displays gradual F2 shift of auditory feedback and resultant compensation in production

alteration continued, the subject's response no longer kept the F2 within his normal range for /u/ – even though he was producing a vowel that had a quite high F2, the F2 delivered at the headphones was quite low.

The range of compensation responses seen in our 46 subjects is shown in Figure 4. Most subjects compensated for the 300Hz drop in F2 with an F2 increase of 50 to 150Hz. Four subjects compensated nearly 200Hz, and two followed the altered feedback rather than opposing it.

The results of the stepwise regression are shown in Table 7. Recall that 26 variables were entered as candidate predictors for this regression analysis, including acoustic vowel space descriptors, a social identity variable, and variables measuring several personality traits. The stepwise regression procedure produced a model with four predictor variables – two subcomponents from Rogers et al.'s (1997) empowerment scale (the optimism and control over the future subcomponent, and the power/powerlessness subcomponent), one measure of the speaker's starting acoustic vowel space (the "bood"/ "poog" baseline measured during the "baseline" phase of the experiment), and the "Nonplanning" subcomponent from Patton et al.'s (1995) inventory of impulsivity. No other factors were reliably correlated with subjects' compensation response.

The model has an overall adjusted $R^2$ of 0.37, and a residual standard error of 45.15 on 41 degrees of freedom. The unadjusted multiple $R^2$ is 0.43.

The relationship between baseline /u/ F2 frequency and the amount of F2 compensation is shown in Figure 5. Subjects who started the experiment with relatively backed, low F2, productions of /u/ tended to show a larger compensation response.

The relationship between the empowerment subcomponent, "Optimism and Control over the Future" and the amount of F2 compensation is shown in Figure 6.

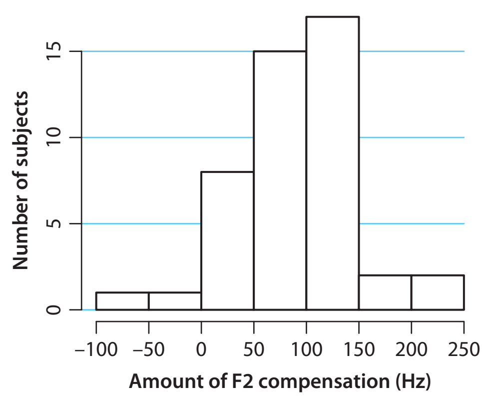


**Figure 4.** Degree of compensation. The y-axis shows the number of subjects who compensated to various degrees (compensation in Hz is shown on the x-axis)

**Table 7.** Results of the step-wise regression analysis. The best-fitting multiple regression model to predict F2 compensation

| | Estimate | SE | t | P |
|---|---|---|---|---|
| (Intercept) | 534.81438 | 106.98 | 4.999 | <0.01*** |
| Optimism | −251.59739 | 56.33 | −4.466 | <0.01*** |
| Baseline /u/ F2 | −0.12044 | 0.05 | −2.459 | 0.0182* |
| Power | −192.65752 | 87.69 | −2.197 | 0.0337* |
| Nonplanning | 91.20033 | 67.11 | 1.359 | 0.1816 |

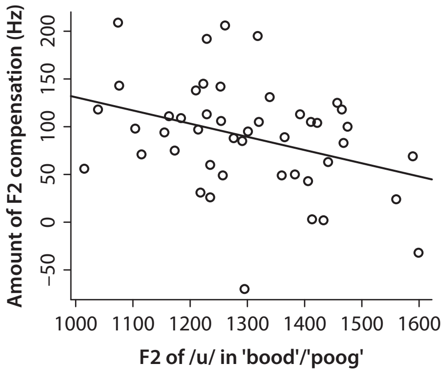


**Figure 5.** The correlation between baseline F2 of /u/ and F2 compensation

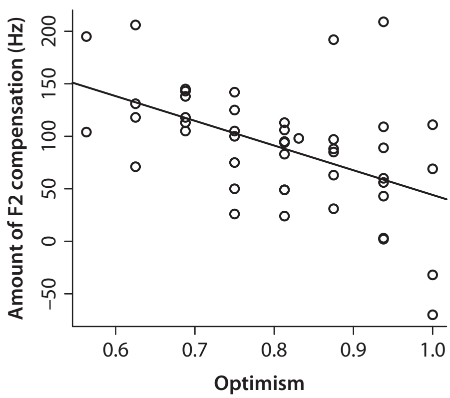


**Figure 6.** The negative correlation between F2 compensation and the "Optimism" subcomponent of the Empowerment scale

This correlation is also negative. Subjects who scored higher for "Optimism" tended to have smaller compensation responses when auditory feedback was altered.

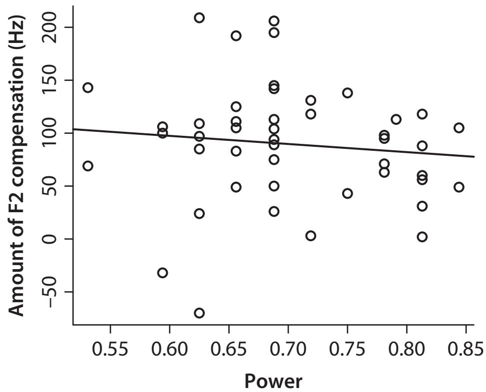


**Figure 7.** The negative correlation between F2 compensation and the "Power" subcomponent of the Empowerment scale

The "Power" subcomponent (Figure 7) was also negatively related to compensation, although more weakly. The final factor found by the stepwise regression procedure, "Nonplanning", was only weakly correlated with the amount of F2 compensation. Comparison of a model with "Nonplanning" as a predictor versus a model without this additional factor, found that the increase in variance accounted for with the factor added was non-significant ($F[1,41] = 1.85$, $p = 0.18$; 40.2% variance accounted for without the "Nonplanning" variable, and 42.8% with it).

## 4. Discussion

The pattern of compensation demonstrated by the majority of the subjects in this study is similar to that documented in previous studies; most subjects significantly changed their production so as to oppose the altered auditory feedback. Additionally, this study, like others before, observed variability in the amount of compensation. Some subjects compensated almost completely, most compensated for about 30% of the F2 feedback shift (100Hz of compensation for a 300Hz shift), and some failed to compensate at all. The incomplete compensation seen for most speakers in this paradigm has been taken to indicate a tension between a need to produce a vowel that matches one's internal somatosensory target (i.e. don't compensate with a vowel that feels too far forward) while simultaneously producing a vowel that matches one's more external auditory target (i.e. don't make a vowel that doesn't sound right). Individuals resolve this tension in different ways.

Some of this inter-participant variation can be explained by subjects' baseline /u/ formants. Participants who started the experiment with relatively backed, low F2, productions of /u/ tended to show a larger compensation response. Altered auditory feedback affected those who started with a low F2 differently than those who started with a higher F2. Decreasing an already low F2 would result in shifting the /u/ off the edge of the vowel space, to a vowel with formants that may be only marginally possible with a human vocal tract. Subjects with naturally higher /u/ F2 heard themselves producing /u/ with a humanly possible F2, but one that was merely atypical for their dialect of English. So, it would seem that the motivation for compensation was stronger for subjects who normally say /u/ with a low F2.

In addition to the baseline effect, as we hypothesized, some of the variation in compensation was linked to personality traits. Two subcomponents of empowerment (Optimism & Control over the Future and Power/Powerlessness) were negatively correlated with amount of compensation. The statistical analysis revealed that the less powerful subjects felt, and the less they were optimistic about their future and felt that they have control over it, the more they compensated for altered auditory feedback. This finding is consistent with the literature on power that we cited above (Fiske & Dépret 1996; Ward & Keltner 1998; Magee et al. 2005; Galinsky et al. 2006; 2008). It is possible that, just like low-power participants in other studies, these subjects were more reliant on situational cues, were more perceptually acute, paid more attention to their auditory feedback, monitored their speech production more, and their linguistic behavior was in general more susceptible to influence, causing them to compensate more for the manipulation.

California identity was not a predictor for compensation. Assuming that the questionnaire we devised for this study was able to reflect subjects' attitudes and self-identification with California, it seems possible that: (1) for this subject pool, fronted /u/ was not an important marker of regional Californian identity, (2) the participants did not associate a more backed /u/ with a non-Californian dialect region, (3) if they did recognize that their /u/ production sounded non-Californian, they did not consider it threatening because they did not have negative attitudes towards regions, people, culture, and everything else they associate with a more backed /u/. Ideally, other experimental designs (e.g. priming one group of participants with pro-California sentiments before the feedback alteration and then observing differences in compensation with the control group) would provide a better measure for the significance of Californian dialect as a marker of regional identity.

In conclusion, this paper reported that social and personality variables modulate compensation for altered auditory feedback. We provided evidence that personal empowerment affects the amount of compensation a person will produce in an altered auditory feedback experiment. The fact that a construct derived entirely from social interactions can influence speech so significantly lends support for the inclusion of a social-psychological approach in phonetic research.

Although we only measured the direct influence of personality measures on compensation, it is possible that personality influences compensation indirectly, by affecting other intermediate variables known to influence compensation (for example, perceptual boundaries (Shiller et al. 2009), or perceptual acuity (Villacorta et al. 2007)). We did not conduct perceptual boundary or discrimination tests, but it seems evident that this remains an interesting area for future investigations.

Obviously, people do not face natural speech environments in which the F2 is selectively altered in the way that we altered it in this experiment. So, in a strict interpretation our results have no bearing on any theory of normal speech communication. Nonetheless, we speculate that our results on compensation for altered auditory feedback are relevant to sound change because they reflect a role of personality variables in speech processing more generally. Our claim is that the same personality characteristic that makes a person sensitive to altered auditory feedback makes him sensitive to phonetic variation more generally – whether in his own speech, or in the speech of others.

As we mentioned in the introduction, it is widely accepted that phonetic factors such as articulatory overlap, biomechanical effects, and aerodynamic constraints result in phonetic variation that may become part of speech plans. The problem in a theory of sound change is to determine when this ubiquitous phonetic variation will lead to sound change – the actuation problem. Our findings relating empowerment to adaptation to altered auditory feedback may be relevant in identifying a social variable that appears to be related to sensitivity to phonetic variation. Although the link between empowerment and sound change is somewhat speculative at this time, we see this line of research as an important direction to explore as we seek to make a link between the phonetic motivation for sound change and the actuation of change in communities of speakers.

The findings of this study warrant a more in-depth investigation on the effect of empowerment on speech processing as it may be related to sound change. If empowerment proves to affect other, more natural acts of speech production, then it would likely be an important part of a personality-based solution to the actuation problem. If traditionally powerless segments of the society (e.g. people of lower social class, women, etc.) are systematically inclined to alter their speech when exposed to novel phonetic variants, then they may be the locus of sound change actuation.

## References

Baron-Cohen Simon, Sally Wheelwright, Richard Skinner, Joanne Martin & Emma Clubley. 2001. "The Autism-Spectrum Quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males, females, scientists and mathematicians". *Journal of Autism & Developmental Disorders* 31.5–17.

Blevins, Juliette. 2004. *Evolutionary Phonology: The emergence of sound patterns*. Cambridge: Cambridge University Press.
Blevins, Juliette. 2006. "A Theoretical Synopsis of Evolutionary Phonology". *Theoretical Linguistics* 32:117–165.
Blevins, Juliette, & Andrew Garrett. 2004. "The Evolution of Metathesis. *Phonetically Based Phonology* ed. by Bruce Hayes, Robert Kirchner & Donca Steriade, 117–156. Cambridge: Cambridge University Press.
Boersma, Paul & David Weenink. 2010. "Praat: Doing Phonetics by Computer" (version 5.0.08) [computer program]. *http://www.praat.org/*.
Chamberlain, Samuel R. & Barbara J. Sahakian. 2007. "The Neuropsychiatry of Impulsivity". *Current Opinion in Psychiatry* 20:3.255–261.
Clopper, Cynthia G. & David B. Pisoni. 2004. "Some Acoustic Cues for the Perceptual Categorization of America English Regional Dialects". *Journal of Phonetics* 32.111–140.
Clopper, Cynthia G., David B. Pisoni & Kenneth de Jong. 2005. "Acoustic Characteristics of the Vowel Systems of Six Regional Varieties of American English". *Journal of the Acoustical Society of America* 118.1661–1676.
Fiske, Susan T. & Eric Dépret. 1996. "Control Interdependence and Power: Understanding social cognition in its social context". *European Review of Social Psychology*ed. by W. Stroebe & M. Hewstone, vol. VII, 31–61. New York: Wiley.
Frank, Austin F. 2010. *Integrating Linguistic, Motor, and Perceptual Information in Language Production*. Ph.D. dissertation, University of Rochester.
Galinsky, Adam D., Joe C.Magee, M. Ena Inesi & Deborah H. Gruenfeld. 2006. "Power and Perspectives Not Taken". *Psychological Science* 17.1068–1074.
Galinsky, Adam D., Joe C. Magee, Deborah H. Gruenfeld, Jennifer A. Whitson & Katie A. Liljenquist. 2008. "Social Power Reduces the Strength of the Situation: Implications for creativity, conformity, and dissonance". *Journal of Personality and Social Psychology* 95.1450–1466.
Garrett, Andrew & Keith Johnson. In press. "Phonetic Bias in Sound Change". *Origins of Sound Patterns: Approaches to phonologization* ed. by A. C. L. Yu. Oxford: Oxford University Press.
Hagiwara, Robert. 1995. "Acoustic Realizations of American /r/ as Produced by Women and Men". *UCLA Working Papers in Phonetics* 90.1–187.
Houde, John & Michael I. Jordan. 1998. "Sensorimotor Adaptation in Speech Production". *Science* 279(5354).1213–1216.
Houde, John F. & Michael I. Jordan. 2002. "Sensorimotor Adaptation of Speech I: Compensation and adaptation". *Journal of Speech, Language, and Hearing Research* 45:2.295–310.
Janda, Richard & Brian D. Joseph. 2003. "Reconsidering the Canons of Sound-Change: Towards a "Big Bang" theory". *Historical Linguistics 2001. Selected Papers from the 15th International Conference on Historical Linguistics, Melbourne, 13–17 August 2001* ed. by Barry Blake & Kate Burridge, 205–219. Amsterdam: John Benjamins.
Katseff, Shira. 2010. *Linguistic Constraints on Compensation for Altered Auditory Feedback*. Ph.D. dissertation, University of California at Berkeley.
Katseff, Shira, John F. Houde & Keith Johnson. 2011. "Partial Compensation for Altered Auditory Feedback: A tradeoff with somatosensory feedback?" *Language* & *Speech* DOI: 101177/0023830911417802
Katseff, Shira, John Houde, & Keith Johnson. 2010. "Integration of Somatosensory and Auditory Information in Vowel Production". Poster presented at Laboratory Phonology 12, University of New Mexico, Albuquerque, July 2010.

Keltner, Dacher, Deborah H. Gruenfeld, & Cameron Anderson. 2003. "Power, Approach, and Inhibition". *Psychological Review* 110.265–284.

Labov, William. 1994. *Principles of Linguistic Change: Internal factors*. Cambridge, Mass.: Blackwell.

Labov, William, Sharon Ash & Charles Boberg. 2006. *The Atlas of North American English: Phonetics, phonology, and sound change*. Berlin: Walter de Gruyter.

Larson, Charles R., Kenneth W. Altman, Hanjun Liu & Timothy C. Hain. 2008. "Interactions between Auditory and Somatosensory Feedback for Voice f0 Control". *Experimental Brain Research* 187.613–621.

Magee, Joe C., Deborah H. Gruenfeld, Dacher H. Keltner & Adam D. Galinsky. 2005. "Leadership and the Psychology of Power". *The Psychology of Leadership: New perspectives and research* ed. by D. M. Messick & R. Kramer, 275–294. Mahwah, N.J.: Erlbaum.

Mottron Laurent, Michelle Dawson, Isabelle Soulières, Benedicte Hubert & Jake Burack. 2006. "Enhanced Perceptual Functioning in Autism: An update, and eight principles of autistic perception". *Journal of Autism & Developmental Disorders* 36.27–43.

Myers, Scott M. & Chris P. Johnson. 2007. "American Academy of Pediatrics, Council on Children with Disabilities. Management of Children with Autism Spectrum Disorders". *Pediatrics* 120:5.1162–1182.

Ohala, John J. 1981. "The Listener as a Source of Sound Change". *Papers from the Parasession on Language and Behavior* ed. by Carrie S. Masek, Roberta A. Hendrick & Mary Fances Miller, 178–203. Chicago: Chicago Linguistic Society.

Ohala, John J. 1983. "The Origin of Sound Patterns in Vocal Tract Constraints". *The Production of Speech* ed. by Peter F. MacNeilage, 189–216. New York: Springer-Verlag.

Ohala, John J. 1989. "Sound Change is Drawn from a Pool of Synchronic Variation". *Language Change: Contributions to the study of its causes* ed. by L.E. Breivik & E.H. Jahr, 173–198. Berlin: Mouton de Gruyter.

Ohala, John J. 1993. "The Phonetics of Sound Change". *Historical Linguistics: Problems and Perspectives* ed. by C. Jones, 237–278. London: Longman Academic.

Patton, Jim H., Matthew S. Stanford & Ernest S. Barratt. 1995. "Factor Structure of the Barratt Impulsiveness Scale". *Journal of Clinical Psychology* 51.768–774.

Purcell, David W. & Kevin G. Munhall. 2006. "Adaptive Control of Vowel Formant Frequency: Evidence from real-time formant manipulation". *Journal of the Acoustical Society of America* 120.966–977.

Rogers, E. Sally, Judi Chamberlin, Marsha Langer Ellison & Tim Crean. 1997. "A Consumer-Constructed Scale to Measure Empowerment among Users of Mental Health Services". *Psychiatric Services* 48.1042–1047.

Samson Fabienne, Laurent Mottron, Boutheina Jemel, Pascal Belin & Valter Ciocca. 2006. "Can Spectro-Temporal Complexity Explain the Autistic Pattern of Performance on Auditory Tasks?" *Journal of Autism and Developmental Disorders* 36:1.

Saucier, Gerard. 1994. "Mini-Markers: A brief version of Goldberg's unipolar big-five markers". *Journal of Personality Assessment* 63:3.506–516.

Shiller, Douglas M., Marc Sato, Vincent L. Gracco & Shari R. Baum. 2009." Perceptual Recalibration of Speech Sounds Following Speech Motor Learning". *Journal of the Acoustical Society of America* 126.1103–1113.

Snyder, Mark. 1974. "Self-Monitoring of Expressive Behavior". *Journal of Personality and Social Psychology* 30:4.526–537.

Tremblay, Stephanie, Douglas M. Shiller & David J. Ostry. 2003. "Somatosensory Basis of Speech Production". *Nature* 423.866–869.

Villacorta, Virgilio, Joseph S. Perkell & Frank H. Guenther. 2007. "Sensorimotor Adaptation to Feedback Perturbations of Vowel Acoustics and Its Relation to Perception". *Journal of the Acoustical Society of America* 122.2306–3219.

Ward, Daniel & Dacher Keltner. 1998. "Power and the Consumption of Resources". Unpublished manuscript.

Weinreich, Uriel, William Labov & Marvin Herzog. 1968. "Empirical Foundations for a Theory of Language Change". *Directions for Historical Linguistics: A symposium* ed. by W.P. Lehmann and Y. Malkiel, 95–188. Austin: University of Texas Press.

Yu, Alan C.L. 2010. "Perceptual Compensation Is Correlated with Individuals' "Autistic" Traits: Implications for models of sound change". *PLoS ONE* 5(8):e11950. doi:10.1371/journal.pone.0011950.

**Appendix 1.** Attitude/Self-identification with California questionnaire

**DIRECTIONS: People differ in the ways they act and think in different situations. How much do you agree or disagree with the statements below? Read each statement and put an X in the appropriate column on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.**

| | Strongly Disagree | Disagree | Somewhat Disagree | Neither Agree nor Disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|
| 1. I consider myself to be a Californian. | | | | | | | |
| 2. My family considers me to be a Californian. | | | | | | | |
| 3. There is nothing special about being a Californian. | | | | | | | |
| 4. My friends consider me to be a Californian. | | | | | | | |
| 5. Sometimes I am ashamed of being a Californian. | | | | | | | |
| 6. I love and am devoted to the state of California. | | | | | | | |
| 7. I hope to move out of California within the next 5 years. | | | | | | | |
| 8. Most California residents enjoy living in California. | | | | | | | |
| 9. There is nothing exceptional about being from California. | | | | | | | |
| 10. I don't think of myself as a Californian. | | | | | | | |
| 11. My family doesn't regard me as a Californian. | | | | | | | |
| 12. I find it easy to live in California. | | | | | | | |
| 13. My friends don't regard me as a Californian. | | | | | | | |
| 14. I am proud of being a Californian most of the time. | | | | | | | |
| 15. I dislike the state of California. | | | | | | | |
| 16. Being a Californian is cool. | | | | | | | |
| 17. Most California residents don't like living in California. | | | | | | | |
| 18. I would rather live in California than anywhere else. | | | | | | | |
| 19. California is a unique place to be from. | | | | | | | |
| 20. Living in California is hard. | | | | | | | |
| | Strongly Disagree | Disagree | Somewhat Disagree | Neither Agree nor Disagree | Somewhat Agree | Agree | Strongly Agree |

**Appendix 2.** Empowerment Scale questionnaire

**Directions: People differ in the ways they act and think in different situations. How much do you agree or disagree with the statements below? Read each statement and put an X in the appropriate column on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.**

| | Strongly Disagree | Slightly Disagree | Slightly Agree | Strongly Agree |
|---|---|---|---|---|
| 1. I can pretty much determine what will happen in my life. | | | | |
| 2. People are limited only by what they think is possible. | | | | |
| 3. People have more power if they join together as a group. | | | | |
| 4. Getting angry about something never helps. | | | | |
| 5. I have a positive attitude toward myself. | | | | |
| 6. I am usually confident about the decisions I make. | | | | |
| 7. People have no right to get angry just because they don't like something. | | | | |
| 8. Most of the misfortunes in my life were due to bad luck. | | | | |
| 9. I see myself as a capable person. | | | | |
| 10. Making waves never gets you anywhere. | | | | |
| 11. People working together can have an effect on their community. | | | | |
| 12. I am often able to overcome barriers. | | | | |
| 13. I am generally optimistic about the future. | | | | |
| 14. When I make plans, I am almost certain to make them work. | | | | |
| 15. Getting angry about something is often the first step toward changing it. | | | | |
| 16. Usually I feel alone. | | | | |
| 17. Experts are in the best position to decide what people should do or learn. | | | | |
| 18. I am able to do things as well as most other people. | | | | |
| 19. I generally accomplish what I set out to do. | | | | |
| 20. People should try to live their lives the way they want to. | | | | |
| 21. You can't fight city hall (authority). | | | | |
| 22. I feel powerless most of the time. | | | | |
| 23. When I 'm unsure about something, I usually go along with the rest of the group. | | | | |
| 24. I feel I am a person of worth, at least on an equal basis with others. | | | | |
| 25. People have a right to make their own decisions, even if they are bad ones. | | | | |
| 26. I feel I have a number of good qualities. | | | | |
| 27. Very often a problem can be solved by taking action. | | | | |
| 28. Working with others in my community can help to change things for the better. | | | | |
| | Strongly Disagree | Slightly Disagree | Slightly Agree | Strongly Agree |