Supplementary Online Materials for

Signs of Social Class: The Experience of Economic Inequality in Everyday Life

Michael W. Kraus, Yale University

Jun Won Park, Yale University

Jacinth J. X. Tan, University of California, San Francisco

In this supplementary file we include as much detail as possible for the methods and analysis of our brief speech study of social class signaling, to supplement the main text article. The section begins with detailed methods that outline our sample characteristics and procedures, and ends with our data analyses.

Method

Speaker Sample

Speaker content was provided by the International Dialects of English Archive, an online repository of dialects from across the English-speaking world. We collected speech from the 48 of the 50 states in the USA from this repository (data from Delaware and Idaho were unavailable), which featured 246 individuals reading one of two literary passages—"Comma gets a cure" or "the Rainbow passage." We identified seven words appearing in both passages and created individual isolated recordings of the words (i.e., 'and,' 'from,' 'thought,' 'beautiful,' 'imagine,' 'yellow,' and 'the'). The dialects archive also provides information on demographic characteristics of speakers along with their occupational status, educational attainment, and current region of residence. Geographic regions were coded based on USA Census categories. Demographic characteristics of the speaker sample are provided in Table S1.

Table S1. Demographic frequency characteristics of the speaker sample. Numbers fluctuate around the total sample size ($N = 246$) due to missing data.

	White	Black	Latina/o	Other
Race/Ethnicity	183	15	17	25

	Men	Women
Gender	117	129

	South	West	East	Midwest
Region	90	40	57	59

Educational attainment and occupation status of speakers were coded independently by the first two authors blind to the estimated social class of speakers made by observers. Educational attainment was coded on a 4-point scale as the following: 1) high school or less, 2) some college or associates degree, 3) college graduation, or 4) advanced degree, as in prior research (Kraus & Keltner, 2009). Coders showed a high degree of consistency in educational attainment codes ($K = .82$; $r_{ICC(2)} = .97$, $p < .001$). The mean education code for the speaker sample was 2.69 ($SD = 1.01$).

The occupation status of speakers was coded using the four digit standard international socio-economic index of occupational status by the first two authors (Ganzeboom, De Graaf, & Treiman, 1992). As with educational attainment, coded occupation showed high levels of consistency between coders ($K = .84$; $r_{ICC(2)} = .78$, $p < .001$). The mean occupation code for the speaker sample was 2918.29 ($SD = 1920.16$) where higher scores indicate lower social class occupations. After this initial reliability analysis, occupation scores were multiplied by -1 so that higher scores indicate higher social class, and occupation and educational attainment scores were then standardized and averaged to create our metric of speaker social class ($M = -0.02$, $SD = 0.87$). A one-way Analysis of Variance (ANOVA) revealed no regional differences in speaker social class based on this measure $F(3,209) = 0.86$, $p = .46$.

Vocal pitch analysis was conducted using PRAAT (Boersma, 2002). Average pitch was computed by examining a file containing speakers uttering the seven words used in the social class perception task. In PRAAT, the mean of the vocal pitch across theses seven words was computed for each speaker ($M = 153.87$Hz, $SD = 38.07$Hz). Vocal pitch was positively associated with perceived social class *r*(238) = -.27, *p* < .001, with lower pitch associated with higher perceived social class—a finding that aligns with prior research on status based on dominance and vocal pitch (Gregory & Webster, 1996).

In our analysis, we examine the relationship between perceived and actual social class while controlling for local population characteristics that include population density (*M* = 21,780.83, *SD* = 18,058.32), proportion of population who graduated from high school (*M* = 86.81, *SD* = 8.99), and median income (*M* = 53,569.96, *SD* = 24,978.58), defined at the zip code level (Census Factfinder). We conducted these analyses because census regions of the USA differ in terms of unique dialects and also in terms of population density, median income, and proportion of high school graduates *Fs*(3,240) = 2.97 to 8.28, *ps* = .03 to < .001. The South showed the lowest levels on all three of these local indicators.

Observer Sample

We collected a National online panel sample of 568 observers for the status perception portion of the study using Qualtrics National panel surveys (Qualtrics Panels). The large sample was collected to gain data from participants from all regions of the USA. Demographic characteristics for the sample are provided in Table S2. Observers were included in the final sample if they successfully completed an attention check item. The study was approved by the institutional review board of Yale University.

Table S2. Demographic characteristics of the observer sample. Numbers fluctuate around the total sample size (*N* = 568) due to missing data, or because observers identified as more than one category.

	White	Black	Latina/o	Other
Race/Ethnicity	461	47	36	43

	Men	Women	Other	
Gender	167	399	2	
	South	West	East	Midwest
Current Region	242	98	88	136
Birth Region	189	88	116	165
	Some college or less	College graduation	Advanced degree	
Education	304	212	52	
	<$30,000	$30,001-$50,000	$50,001-$90,000	> $90,000
Income	286	118	113	48

After consenting to take part in the study, participants were instructed that they would be listening to people speaking seven different words from all over the USA. Observers listened to these words and then were asked to rate the social class of participants. Observers were instructed that if they were unsure of the social class of the speaker, to guess, "to the best of your ability." After listening to the seven spoken words, participants rated the social class of each speaker using the MacArthur Scale of Subjective Socioeconomic Status (Adler, Epel, Castellazzo, & Ickovics, 2000). This single-item scale presents a 10-rung ladder to participants and describes it as representing "where people stand in society in terms of education, income, and occupation status." Observers used this scale to rate each speaker's social class, with higher numbers indicating higher social class (M = 5.85, SD = 0.68). Attesting to its validity, this self-report measure of social class reliably predicts well-being and mortality rates (Kopp, Skrabski, Réthelyi, Kawachi, & Adler, 2004).

To prevent fatigue, observers rated social class on a sample of 50 speakers, randomly chosen from the overall speaker sample, but balanced in terms of region of origin—perceivers were assigned to one of five, 50 speaker samples. Reliability analyses were conducted using absolute agreement intra-class correlation coefficients for each of the five random subsets of speakers. The reliability coefficients for each sample are presented in Table S3. Observers showed a high level of agreement with respect to the social class of speakers based solely on listening to the seven words. We chose a sample of more than 500 to have at least 100 perceivers per speaker sample, which exceeds the sample needed for establishing perceiver reliability estimates in prior research (Ambady & Rosenthal, 1993; Kenny, 1991).

Following these social class ratings, participants filled out demographic characteristics including their age, gender, race, educational attainment on a 3-point scale: 1) some college or less, 2) college graduation, or 3) advanced degree, and annual income on an 8-point scale: 1) < $15,000, 2) $15,001-$30,000, 3) $30,001-$50,000, 4) $50,001-$75,000, 5) $75,001-$90,000, 6) $90,001-$125,000, 7) $125,001- $150,000, and 8) > $150,000.

Table S3. Reliability of perceiver social class perceptions calculated using the absolute agreement intra-class correlation coefficients.

Speaker Subset	Intra-class correlation
1 (*n* = 119)	.92*
2 (*n* = 115)	.91*
3 (*n* = 121)	.93*
4 (*n* = 118)	.92*
5 (*n* = 118)	.90*

Results

Procedure for Assessing Observer Accuracy

We conducted the observer accuracy analysis for the three samples by dividing up the observer estimates and average participant social class into four equal quartiles and two halves. We then counted up the number of times observer ratings and target self-reports came from the same quartile or half as accurate guesses and those from disparate quartiles or halves as incorrect guesses. We then compared these observed rates to rates expected by chance guessing for quartiles (25%) and halves (50%). In total, there were 426 estimates made by observers across the three modalities. Observers guessed the correct quartile on 152 of those estimates and on 260 of the half estimates.

Social Class Signaling in Brief Speech

To test our hypothesis about class signaling, we first examined correlations between perceived social class and speaker actual social class. Importantly, results were consistent with our first hypothesis: Observers provided judgments of speaker social class that were related to actual speaker social class, coded based on speaker educational attainment and occupation status, at levels above chance accuracy, $r(211) = .22$, $p = .002$. Observer estimates were also correlated with coded educational attainment ($r = .15$, $p = .04$), occupation status ($r = .27$, $p = .001$), as well as race and gender (see Table S4).

Table S4. Inter-correlations between speaker characteristics and observer estimates of social class. Race is coded as White ("1") or not ("-1"). Asterisks indicate that $p < .05$.

	Perceived social class	Speaker social class	Speaker gender	Speaker race
Perceived social class	____			
Speaker social	.22*	____		

class				
Speaker gender	.28*	.13	____	
Speaker race	.18*	.06	.02	____

To examine this association more fully, we next conducted a multiple regression analysis to determine associations between perceived social class and the actual social class of speakers while simultaneously controlling for variables that may account for this association, including speaker gender, ethnic background, vocal pitch, as well as local demographic characteristics like population density, median income, and proportion of high school graduates calculated at the zip code level.

When we included speaker social class, gender, ethnicity, and vocal pitch as well as local population, median income, and high school graduation rates as predictors in a multiple regression analysis predicting perceived social class, the relationship between perceived and actual social class remained significant (β = .14, $t(192) = 2.12$, $p = .036$). In this analysis dummy-coded race of the speaker was related to social class perceptions, with Black speakers (β = -.25, $t(192) = -3.77$, $p < .001$) judged as lower in social class than Whites. All other variables in the model did not reach conventional levels of statistical significance (see Table S5).

Table S5. Results from the hierarchical linear regression analysis predicting perceptions of social class with actual social class, dummy-coded race, gender, vocal pitch, population density, high school graduation rates, and median local income.

Predictor	Beta	T-value
Actual social class	.14	2.12*

Black	-.25	-3.77*
Latino/a	-.11	-1.59
Other race/ethnicity	-.02	-0.23
Gender	.11	1.03
Vocal pitch	-.15	-1.38
Local population size	.02	0.26
Local high school graduation rates	.02	0.26
Local median income	.08	0.94

*p < .05

Regional Variation

We explored regional variation in the social class signaling effect by examining variation in mean accuracy of social class perceptions as a function of the four Census-defined regions of the USA. We calculated mean accuracy at the perceiver level as the average correlation of a perceiver estimate with standardized speaker social class ($M = .05$, $SD = .15$). Regions did not differ in speaker race, gender, or social class. An Analysis of Variance (ANOVA) examining the mean accuracy of perceiver social class as a function of region revealed regional differences in social class perceptual accuracy, $F(3,1632) = 46.78$, $p < .001$. Similar levels of accuracy were observed for perceivers of the social class of speakers from the Eastern *CI 95%* [.02 to .07] (Effect size $R = .14$) and Southern USA *CI 95%* [.04 to .08] ($R = .19$). Interestingly, though the effect was in the same direction as in the Eastern and Southern USA, perceptions of social class were more strongly linked to actual speaker social class in the West *CI 95%* [.17 to .24] ($R = .46$). All of these regions show significant positive mean accuracy coefficients. In contrast, for speakers from the Midwest, we find that perceptions of speaker social class were negatively associated with actual speaker social class *CI 95%* [-.07 to -.01] (R = -.11). Because sample sizes are small with respect to the number of unique speakers per region (i.e., less than 100 per region) we are wary of interpreting the Midwestern findings without additional replications of this work with other stimuli and speaker samples.

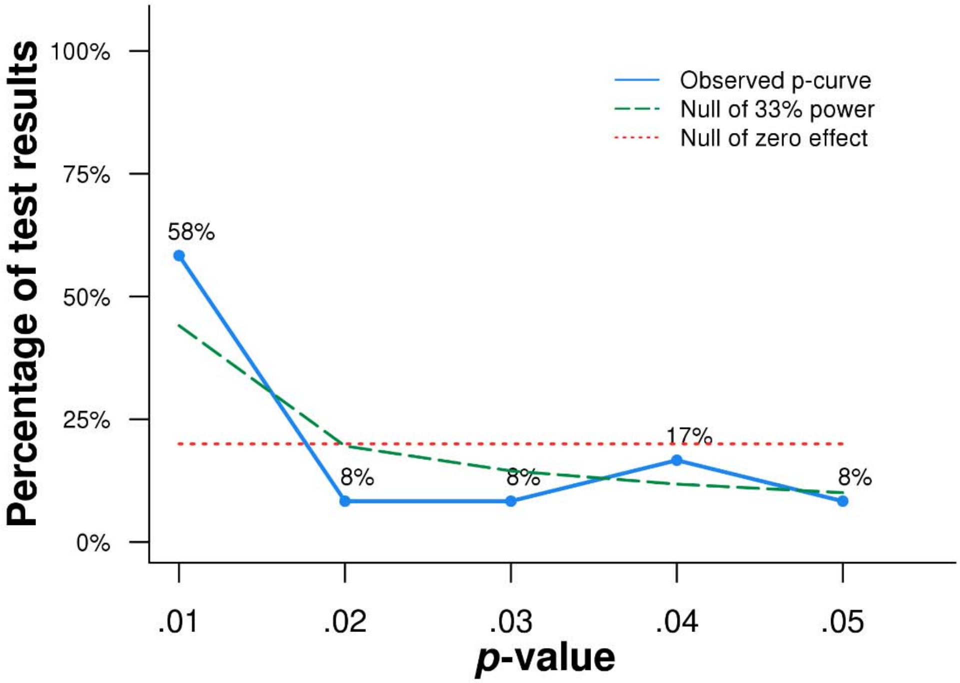
We also examined perceiver region differences using an ANOVA comparing mean accuracy scores by current region and region participants were born in. No significant region differences emerged when examining accuracy based on current $F(3, 551) = 2.19$, $p = .09$, or growing up region $F(3, 545) = 0.85$, $p = .47$. As well, no effect of matching between current or past perceiver region and speaker region emerged Fs = 0.15 to 1.34.

In Study 1, we also conducted a similar analysis of social class accuracy in brief speech wherein occupation was coded using a different 9-point occupation scale (Hollingshead, 1975). Occupation scores using this coding scheme were also reliable ($r_{ICC(2)} = .85$, $p < .001$), correlated highly with coded occupation used in the original analyses ($r = .64$, $p < .001$), and when combined into our index of social class, replicated the association with observer estimated social class ($r = .23$, $p = .007$).

Bias Testing

Before submitting this article for publication we conducted a p-curve analysis to determine the strength of our observed evidence. As the curve shows, the statistical tests we report are consistent with a distribution one would expect when the study contains evidential value. We only included statistics reported in the main text that were relevant to our focal class signaling hypotheses. See Figure S1 for the p-curve and Table S6 for the disclosure table.

Figure S1. P-curve of the analyses reported in the manuscript testing our social class signaling hypothesis.



	Binomial Test *Share of p<.025*	Continuous Test *Aggregate pp-values (Stouffer Method)*	
		Full p-curve (p's<.05)	***Half p-curve (p's<.025)***
1) Studies contain evidential value *(Right-skew)*	*p=.073*	*Z=-4.71, p<.0001*	*Z=-4.75, p<.0001*
2) Evidential value, if any, is inadequate *(Flatter than when power=33%)*	*p=.7144*	*Z=2.15, p=.9842*	*Z=5.12, p>.9999*

	Statistical Power
Power of tests included in p-curve *(Correcting for publication bias)*	Estimate: 72% Confidence interval: (43%,89%)

The observed p-curve includes 12 statistically significant (p<.05) results, of which 9 are p<.025.
There were no non-significant results entered.

Table S6. Disclosure table showing all p-values used in p-curve analysis reported above.

Test entered by user	*p*-value	*pp*-values				Z Scores			
		Full *p*-curve		Half *p*-curve		Full *p*-curve		Half *p*-curve	
		Righ Skew	Power of 33%	Righ Skew	Power of 33%	Righ Skew	Power of 33%	Righ Skew	Power of 33%
r(211)=.22	.00123	.02462	.87046	.04924	.93937	-1.97	1.13	-1.65	1.55
t(192)=2.12	.03529	.70581	.15430	NA	NA	0.54	-1.02	NA	NA
r(98)=.28	.00478	.09561	.71413	.19122	.86577	-1.31	0.57	-0.87	1.11
r(111)=.27	.00383	.07652	.74818	.15305	.88184	-1.43	0.67	-1.02	1.18
chi2(1)=5.33	.02096	.41923	.34682	.83846	.69513	-0.20	-0.39	0.99	0.51

Test entered by user	*p*-value	***pp*-values**				**Z Scores**			
		Full *p*-curve		**Half *p*-curve**		**Full *p*-curve**		**Half *p*-curve**	
		Righ Skew	**Power of 33%**	**Righ Skew**	**Power of 33%**	**Righ Skew**	**Power of 33%**	**Righ Skew**	**Power of 33%**
chi2(1)=5.45	.01957	.39137	.36943	.78273	.70568	-0.28	-0.33	0.78	0.54
chi2(1)=4.00	.04550	.91001	.04337	NA	NA	1.34	-1.71	NA	NA
chi2(1)=4.68	.03052	.61031	.21129	NA	NA	0.28	-0.80	NA	NA
chi2(1)=15.38	.00009	.00176	.97494	.00352	.98831	-2.92	1.96	-2.70	2.27
chi2(1)=12.21	.00048	.00951	.92600	.01901	.96546	-2.35	1.45	-2.07	1.82
chi2(1)=25.92	<.00001	.00001	.99945	.00001	.99974	-4.34	3.26	-4.19	3.47
chi2(1)=20.74	.00001	.00011	.99628	.00021	.99826	-3.71	2.68	-3.53	2.92
SUM of Z-Scores in column, dividing by sqrt(N of tests) Z Scores reported under p-curve figure above----->						**-4.71**	**2.15**	**-4.75**	**5.12**

References

Adler, N.E., Epel, E.S., Castellazzo, G., & Ickovics, J.R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. *Health Psychology, 19*, 586-592.

Ambady, N., & Rosenthal, R. (1993). Half a minute: Predicting teacher evaluations from thin slices of nonverbal behavior and physical attractiveness. *Journal of Personality and Social Psychology, 64*, 431-460.

Boersma, P. (2002). PRAAT, a system for doing phonetics by computer. *Glot International 5*, 341-345.

Census Factfinder. Retrieved from http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

Ganzeboom, H., De Graaf, P.M., & Treiman, D.J. (1992). A standard international socio-economic index of occupational status. *Social Science Research, 21*, 1-56.

Gregory Jr, S. W., & Webster, S, (1996). A nonverbal signal in voices of interview partners effectively predicts communication accommodation and social status perceptions. *Journal of Personality and Social Psychology,* **70**, 1231-1240.

Hollingshead, J. B. (1975). Four-factor index of social status. *Yale Journal of Sociology,* **8**, 21-52.

Kenny, D. A. (1991). A general model of consensus and accuracy in interpersonal perception. *Psychological review*, *98*(2), 155-163.

Kopp, M., Skrabski, Á., Réthelyi, J., Kawachi, I., & Adler, N.E. (2004). Self-rated health, subjective social status, and middle-aged mortality in a changing society. *Behavioral Medicine 30,* 65-72.

Kraus, M.W., & Keltner, D. (2009). Signs of Socioeconomic Status: A Thin-Slicing Approach. *Psychological Science. 20,* 99-106.

Qualtrics Panels, ESOMAR 28: 28 questions to help research buyers of online samples. Retrieved from http://success.qualtrics.com/rs/qualtrics/images/ESOMAR%2028%202014.pdf