IS PERCEPTION PERSONAL?

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ABSTRACT

Listeners categorized an /s–ʃ/ continuum in front of the vowels [u, a, i] spoken by two male and two female speakers. One of each gender was more typical than the other. Listeners' adjustments for these vowel and speaker characteristics were associated to their self-ratings with respect to both the specific personality traits measured by the Autism-Spectrum Quotient and the more general Big Five personality traits.

Keywords: Individual differences; autism-spectrum quotient; Big-Five personality markers; speech perception

1. INTRODUCTION

Listeners' responses in routine speech perception experiments often differ considerably from one another. These differences are typically and informally written off as byproducts of listeners' motivation, attention to the stimuli and/or task, boredom, sleepiness, caffeine intake, etc., or to the time of day, day of the week, or week in the semester. Participants might be excluded from eventual analyses because they failed to reach some threshold of performance, but the reasons for their failure are very seldom investigated. In mixed effects models, these differences can be captured by the random effect of participants on the intercept and the slopes of the fixed effects and their interactions, but these random effects are themselves usually not interpreted.

It is, however, unknown whether these differences are occasional or characteristic of the listener. If the latter, then it is important to discover what they reflect about the listener and how to measure such characteristic differences, so that their contribution to how individual listeners' performance differs in speech perception tasks can be accounted for. Such differences may even explain aspects of listeners' behavior outside the laboratory, cf. [3]. Listeners' performance was assessed in Experiment 1 with respect to their self-ratings for the specific personality traits captured by the Autism-Spectrum Quotient (AQ) [1] and in Experiment 2 with respect to the more general International Personality Item Pool Big-Five Factor Markers (B5) [2]. Experiment 1 replicates and expands an earlier study by Yu [3].

2. METHOD

The same stimuli and procedures were used in both experiments. Only the participants and the personality assessment differed.

2.1. Stimuli

Yu's [3] stimuli consisted of members of an /s–ʃ/ fricative continuum preceding the vowels [a] and [u], produced by one female and one male speaker. We added [i] and another speaker of each gender. One male and female speaker had voices that by ear and measurement were typical of their genders, while the other two had less gender-typical voices.

A 20-step /s–ʃ/ continuum was made from /s/ and /ʃ/ tokens recorded in front of [a]. A 175-ms interval was extracted from each fricative, and their amplitudes were equalized before being adjusted to correspond to the fricatives' original intensities relative to the following [a]. Their waveforms were then mixed in complementary proportions to make the continuum and spliced in front of the three vowels spoken by the four speakers. The vowels were originally recorded after an initial [st] cluster, so they began with the formant transitions expected after a voiceless unaspirated alveolar stop [t]; cf. Yu [3], who took his vowels from a similar context, i.e. after a voiced [d].

2.2. Procedure

In each of three training-testing blocks, listeners were first trained with correct answer feedback in 24 trials consisting of the continuum endpoints followed by one of the 12 vowel-speaker combinations, and then tested with one trial each with steps 4 and 18 and four trials each of steps 7, 9, 11, 13, and 15 in each of the 12 vowel-speaker combinations, for a total 264 trials/block, and a total of 792 trials/participant. Trials were randomized in training and testing.

Participants in Experiment 1 then used a 5-point scale to rate how well the 50 items from the AQ applied to them[1], while those in Experiment used

Table 1: Means, ranges, and standard deviations for total AQ and AD, AS, I, C, and SS subtests, by gender.

Measure	Gender	Mean	Range	SD
AQ	f	103.52	84-123	11.25
	m	111.12	86-134	12.60
AD	f	21.30	17-26	2.22
	m	24.96	19-35	3.90
AS	f	21.57	15-28	3.42
	m	24.12	17-35	4.88
I	f	17.87	12-22	2.88
	m	19.46	13-32	4.43
C	f	22.35	18-26	2.39
	m	21.75	16-29	3.73
SS	f	20.42	16-27	3.17
	m	20.83	15-31	4.16

Table 2: Means, ranges, and standard deviations of the B5 Agr, Con, Emo, Ext, and II subtest scores, by gender.

Subtest	Gender	Mean	Range	SD
Agr	f	42.14	32-50	5.05
	m	39.67	28-49	5.65
Con	f	36.49	24-49	5.73
	m	35.92	19-48	6.58
Emo	f	29.32	17-47	6.94
	m	30.58	17-49	8.21
Ext	f	32.05	17-46	8.24
	m	30.58	16-43	7.20
II	f	36.32	23-49	5.72
	m	39.04	31-49	5.09

that scale to rate how well the the 50 items from B5 applied to them [2]. Self-ratings on the AQ provided both a total AQ score and five subtest scores, for attention to detail (AD), attention switching (AS), communication (C), imagination (I), and social skills (SS), each from 10 items. Higher scores indicated stronger expression of autistic traits. Self-ratings on the B5 yielded only five subtest scores, for agreeableness (Agr), conscientiousness (Con), emotional stability (Emo), extraversion (Ext), and intellect and imagination (II), also each from 10 items. Higher scores indicated stronger expression of the positive end of each scale. Participants in both experiments were adult native speakers of a North American dialect of English, who reported no hearing or speaking disorders. All gave informed consent. 23 female and 24 male listeners participated in Experiment 1, and 37 female and 24 male listeners participated in Experiment 2. The 3:2 female:male ratio in Experiment 2 is typical of experiments run at our institution.

3. RESULTS

3.1. AQ and B5 statistics

AQ and B5 statistics are listed in Tables 1 and 2, respectively.

3.2. Stimulus characteristics and listener gender

Figures 1 and 2 show mean proportions of “s” responses, collapsed across step to bring out the effects of vowel and listener gender. Listeners in both experiments responded “s” most often to the typical male speaker (lower right) and least often to the typical female speaker (upper right), with intermediate proportions of “s” responses to the two atypical speakers (left). The figures also show that for the atypical speakers of both genders, listeners responded “s” the most before [u] and the least before [i], with [a] falling in between, while for the male typical speaker, it was [a] rather than [u] that elicited the most “s” responses. This speaker’s [u] elicited more “s” responses than his [i] from male listeners in both experiments, while his [u] and [i] elicited more similar proportions of “s” reponses from female listeners. The effect of vowel only differed between experiments for the typical female speaker: in Experiment 1, her vowels affected “s” response proportions most like those of the two atypical speakers, i.e. [u] $>$ [a] $>$ [i], while in Experiment 2, her vowels’ effect resembled that of the typical male speaker, i.e. [a] $>$ [u] $\approx$ [i]. Male listeners responded “s” less often than female listeners, but their responses didn’t differ dramatically as a function of speaker gender or typicality or vowel quality.

For each experiment, a two-step hierarchy of mixed-effects logistic regression models was fit to the relative proportions of “s” responses. Fixed effects included step along the [s–ʃ] continuum, speaker gender (male = 1, female = -1), speaker typicality (typical = 1, atypical = -1), vowel (u = 1, a = 0, i = -1), and listener gender (male 1, female -1). To account for the obvious differences in Figures 1 and 2 in the effect of speaker gender between typical and atypical speakers, speaker gender was also nested within speaker typicality. All fixed effects were centered, by subtracting their means, and scaled, by dividing by their standard deviations. Random effects of listener on the intercept and the slopes of each of the individual fixed effects were included, but not of any interactions. The models in the first step of

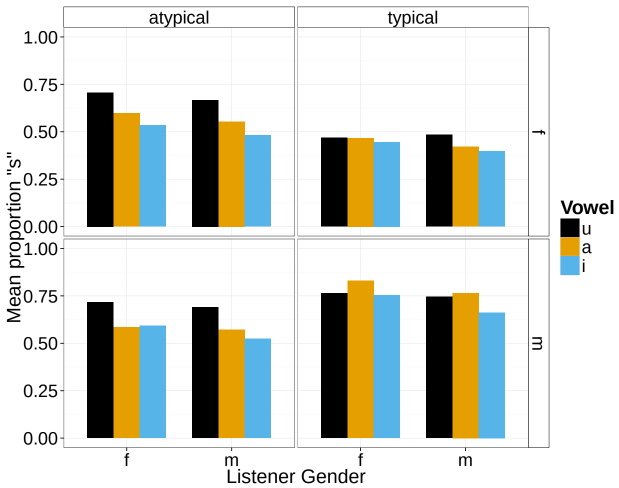


Figure 1: Exp. 1: Mean "s" proportions by speaker typicality (columns) and gender (rows), vowel (grays), and listener gender (triplets).

each hierarchy included these fixed effects as well as the two- and three-way interactions between speaker gender, speaker typicality, and vowel and the two-way interactions between listener gender and each of these speaker characteristics. In the second step of the hierarchy, either the total AQ scores and each one of its subtest scores were added in turn (Experiment 1) or each of the B5 subtest scores (Experiment 2), along with their two- and three-way interactions with speaker gender nested within speaker typicality, vowel, and listener gender. Estimates of fixed effects and their interactions for the first model in the hierarchies are listed in Table 3 and 4, respectively, for Experiments 1 and 2.

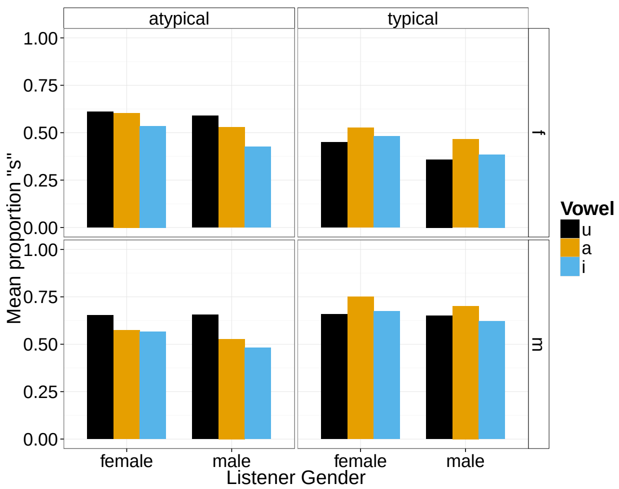


Figure 2: Exp. 2: Mean "s" proportions by speaker typicality (columns) and gender (rows), vowel (grays), and listener gender (triplets).

Table 3: Exp. 1: Estimates for step, speaker gender (SG), speaker typicality (ST), vowel (V), and listener gender (LG), all 2-way interactions between SG, ST, and V, and all two-way interactions between SG, ST, and V and LG.

	Estimate	*se*	*z*	*p*
Int	0.701758	0.108129	6.49	8.58e-11
Step	-1.515444	0.102403	-14.80	< 2e-16
ST	0.010898	0.029475	0.37	0.7116
SG	0.540855	0.047278	11.44	< 2e-16
V	0.291259	0.068188	4.27	1.94e-05
LG	-0.090467	0.109324	-0.83	0.4079
ST:SG	0.467370	0.014051	33.26	< 2e-16
ST:V	-0.137190	0.013921	-9.85	< 2e-16
SG:V	-0.015018	0.013941	-1.08	0.2814
ST:SG:V	0.026817	0.013889	1.93	0.0535
SG:LG	-0.006515	0.051450	-0.13	0.8992
ST:LG	-0.001689	0.031624	-0.05	0.9574
V:LG	0.106924	0.072740	1.47	0.1416

Table 4: Experiment 2: Estimates for step, speaker gender (SG), speaker typicality (ST), vowel (V), and listener gender (LG), all 2-way interactions between SG, ST, and V, and all two-way interactions between SG, ST, and V and LG.

	Estimate	*se*	*z*	*p*
Int	0.375079	0.090614	4.139	3.48e-05
Step	-1.302303	0.096433	-13.505	< 2e-16
ST	0.010336	0.014286	0.724	0.46937
SG	0.397479	0.039054	10.178	< 2e-16
V	0.123464	0.058791	2.100	0.03572
LG	-0.153798	0.089571	-1.717	0.08597
ST:SG	0.302763	0.011313	26.761	< 2e-16
ST:V	-0.153244	0.011325	-13.531	< 2e-16
SG:V	0.030739	0.011353	2.707	0.00678
ST:SG:V	0.005810	0.011290	0.515	0.60682
SG:LG	0.056631	0.036871	1.536	0.12456
ST:LG	-0.007266	0.013886	-0.523	0.60077
V:LG	0.056863	0.058180	0.977	0.32839

The effects of stimulus characteristics are quite similar in the two experiments. Listeners responded "s" more often than "sh" overall, less often as the fricative became more /ʃ/-like, more often when the speaker was male, and more often when the vowel was [u] than [a] and less often when it was [i] than [a]. Male listeners responded "s" marginally less often than female listeners in Experiment 2. Listeners responded "s" more often to the typical male than the typical female speaker, but this gender difference was reversed for the atypical speakers. The effect of

Figure 3: z-scores for each AQ score (A) and its interactions with speaker typicality (T), vowel (V), speaker gender nested within speaker typicality (T:G), and listener gender (L). Horizontal lines at $|z| = 2$.

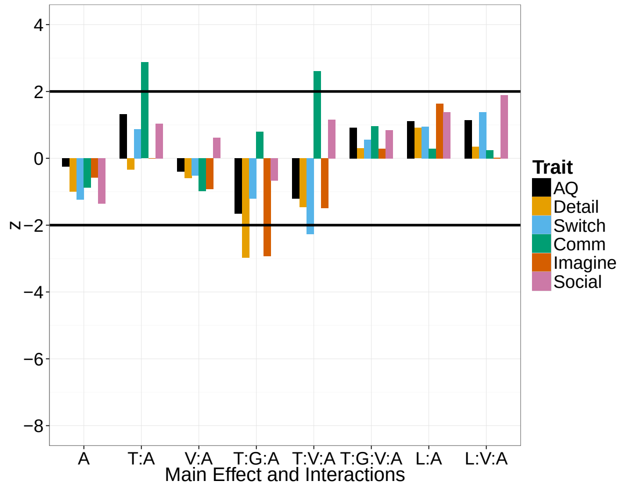
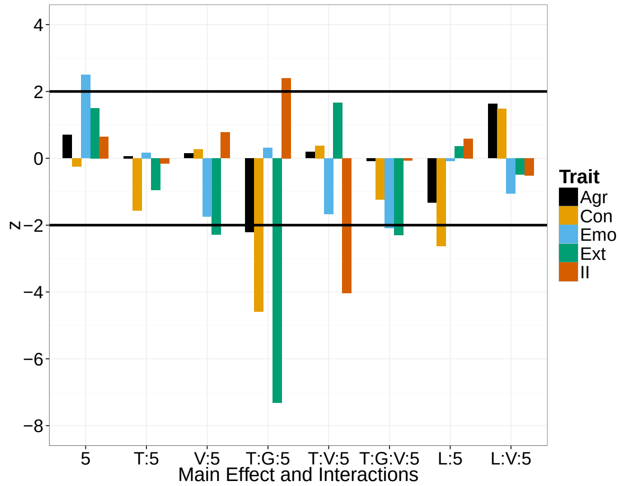


Figure 4: z-scores for each B5 score (5) and its interactions with speaker typicality (T), vowel (V), speaker gender nested within speaker typicality (T:G), and listener gender (LG). Horizontal lines at $|z| = 2$.



vowel depended on speaker typicality in both experiments: typical [i] > [a] > [u], atypical [u] > [a] > [i], and on speaker gender in Experiment 2: male [u] > [a] > [i], female [i] > [a] > [u]. No effect of speaker characteristics depended on listener gender.

3.3. Personality traits

Figures 3 and 4 show the z-scores for AQ or individual AQ subtests and for B5 subtests and their interactions; significant z-scores exceed the horizontal lines at $|z| = 2$.

For Experiment 1, neither total AQ nor any subtest score significantly affected "s" response proportions on its own. Listeners with higher communication scores responded "s" more often to typical speakers and before [u] > [a] > [i] for typical speakers. Listeners with higher attention to detail and imagination scores responded "s" less often to the typical male than the typical female. Finally, listeners with higher attention switching scores responded "s" less often before [u] < [a] < [i] produced by the typical speakers. For Experiment 2, only listeners with higher emotional stability scores responded "s" more often. Listeners with higher extraversion scores responded "s" less often before [u] < [a] < [i]. Listeners with higher intellect and imagination scores responded "s" more often to the typical male than the typical female speaker, while listeners with higher conscientiousness and extraversion scores responded "s" less often. Listeners with higher intellect and imagination scores also responded "s" less often before [u] < [a] < [i] produced by the typical speakers, and listeners with higher emotional stability and extraversion scores responded "s" less often before [u] < [a] < [i] produced by the typical male than the typical female speaker. Finally, more conscientious male listeners responded "s" less often, more conscientious female listeners more often.

4. GENERAL DISCUSSION

Is perception personal? Yes. Do listeners' AQ and/or B5 personality traits explain differences between them in how they adjusted for speaker and vowel in categorizing the /s–ʃ/ continuum? Not obviously. For example, higher attention to detail and imagination scores as well as higher conscientiousness and extraversion scores corresponded to fewer "s" responses to the typical male than the typical female speaker. Attention to detail and conscientiousness may certainly have something in common. And because higher imagination scores in Experiments 1 and 2 measure a *lack* and an excess of imagination, respectively, the association of such scores with fewer "s" responses to the typical male than the typical female in Experiment 1 doesn't conflict with its association with more "s" responses in Experiment 2. But what unites a lack of imagination with an excess of extraversion? These uncertainties don't, however, imply that individual differences in routine speech perception tasks can't be explained; they only tell us that the search for explanation has just begun.

5. REFERENCES

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