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Revisiting Spoken and Musical Phonemic Production and Comprehension

Introduction

There is a rich tradition in the study of spoken and sung phoneme production and comprehension that discusses an increased level of difficulty in accurate phoneme identification in musical form, especially at higher pitches (Sundberg 1970, 1987, Benolken and Swanson 1988). The tacit assumption is that production and comprehension of phonemes in speech is much more regularized than when embedded in musical form and does not present significant difficulty for speakers. However, the work of Philip Lieberman (2006) in particular brings into question certain assumptions about the unambiguous production and interpretation of phonemes in speech. Specifically, Lieberman contextualizes the findings of Barney and Peterson (1952) and Hillenbrand et al. (1995) to demonstrate that spoken phoneme production in contemporary standard English involves a much greater amount of vowel overlap than is generally acknowledged in the field.

In order to more clearly understand what the potential differences are in spoken and sung phoneme production and comprehension, we have engaged in a year-long study of vocalic phonemes in spoken and sung Italian with subjects to achieve a deeper level of understanding of the complexities of the phenomenon.[1] The role that pitch differences may play in accuracy of perception of spoken and sung phonemes is also analyzed.

The design of our experiment, where there is a direct comparison of spoken and sung phonemes in the same format, should yield data sets with greater empirical significance. Furthermore, we have been very sensitive to the *ecological validity* of the experimental design, and believe that phoneme perception in context provides more reliable data than individual phonemes taken out of context. Our data show that, contrary to prior opinion, the accuracy of comprehension of sung phonemes in Italian is not fundamentally different than the comprehension of spoken phonemes, and in fact there are errors made by listeners in both of these areas.

Formant frequencies and phoneme production and comprehension:

While formant frequencies demonstrate that speech and singing are qualitatively different phenomena, listeners are still able to understand both (Sundberg 1970: 28). It is generally acknowledged that vowel formant frequency patterns are sufficiently different and that it is possible to determine if the vowel was sung or spoken (Hollien et al. 2000: 288). These differences may be due to articulatory differences or by differences in the glottal wave form (Sundberg 1970: 28). For example, sung vowels are generally produced at a lower frequency than spoken vowels and the third and fourth formant frequencies are closer in singing than in speaking (Sundberg 1970: 29). Millhouse and

Clermont (2004:283-288), by using PLP (perceptual linear predication), identify a very stable second formant (F2') across all sung vowels. In singing, pitch changes are usually an "order of magnitude" slower than pitch changes of consonants in speech (Zatorre 2002: 39).

According to Hollien et al. (2000), previous research on speech shows that loud productions of /i/ and /a/ were correlated with higher correct identification as opposed to the back vowel /u/, perhaps because it is a rounded vowel (Hollien et al. 2000: 292). Confusion was most significant with the central vowels, especially in those contexts when they were uttered at a high pitch (Hollien et al. 2000: 297). When the vowels were isolated and without context, fewer vowels were correctly identified, especially when the F0 reaches the usual F1 of the vowel (Hollien et al. 2000: 297). Context and the "coarticulatory environment" are very important in vocalic identification in music (Hollien et al. 2000: 297).[2]

Lieberman (2006: 110-129) reexamines the evidence provided by two important studies measuring formant frequencies in vocalic phoneme production (Peterson and Barney 1952 and Hillenbrand et al. 1995) and demonstrates quite convincingly that (1) the products of speech are much less distinguished acoustically than many have thought and (2) these overlaps may or may not be the cause of listener mistakes. Articulatory phonetics does not demonstrate sufficient explanatory power to solve the problem. Lieberman proposes the supralaryngeal vocal tract (SVT) and a neurological parallel across species as part of the solution.

Another series of important outcomes of Lieberman's research include (1) the derivational nature of formant frequencies, (2) the importance of the supralaryngeal

airways in this process of extraction, (3) the role of F0 frequency in speech perception, and (4) the extraordinary rate of phonemic production in human speech (2006: 88-104).

As a response to Lieberman's synthesis of a more complex and realistic view of the diversity of phonemic production (even within a single dialect as given in Hillenbrand et al. 1995), our laboratory devised an experiment using spoken and sung vocalic phonemes in Italian. Our study (henceforth called SSPP) provides a unique glimpse into perception of spoken and sung vowels in context.

SSPP Study

The study presented in this work is unique for several reasons. To increase ecological validity, this study looks at the singing and speaking of Italian in context. Previous studies have looked at Germanic languages, including Swedish, German and English. Similar to the Hollien study, this study required participants to use an answer sheet to identify vowels (Hollien 2000: 291).

Previous research on spoken and sung vowels have been stimulating and were inspirational for the current study. While the current study is notably different, Benolken and Swanson (1990: 1781-1785) is a good example of data collection using sung vowels. There are 101 respondents included in the present study. For detailed information about the linguistic backgrounds of the participants, see Table A below.[3]

TABLE A: SSPP Respondents
Number of respondents: 101
Age range: 18-22, with one 50-year-old participant
Common language of all respondents: English
Number of languages known by respondents: All respondents had been exposed to at least 2 languages
Languages represented by respondents: 27 languages[4]

Number of respondents who had singing lessons: 14
Number of respondents who claim to know Italian: 2
Number of respondents with a L1 other than English: 22

Previous Research

Most of the previous studies on the relationship between language and music have conducted experiments that consider one or the other, but not both together. Schon et al. et al. (2005) discusses the problems that arise in trying to examine the complex relationship between language and music and point to the central problems that arise, including the difficulty of comparing "results issued from different tasks, different subjects, different types of analyses, and different statistical thresholds to define what is considered significant" (Schon et al. 2005: 71). Schon et al. stressed the importance of using singing as an essential path in order to see the direct relationship between language and music.

While some studies have demonstrated how musical and linguistic factors interact in song, others have showed the independence of language and music processing. Schon et al. believes that the differences in stimuli and experimental designs can lead to these key differences. The relationship of language can depend heavily on "the allocation of attentional resources to different dimensions of song" (Schon et al. 2005: 73).

Recent studies have also demonstrated the right hemispheric dominance in singing through transcranial magnetic stimulations (TMS). This is contrary to the general belief that the left hemisphere is dominant for speech. However, it is still unclear whether or not the sung and spoken dimensions of song are more independent or interactive. The clearest way to study their relationship would be to directly compare

spoken and sung linguistic utterances within the same design and using the same participants. This, in fact, is what the experiment discussed here has done.

In three studies conducted by Schon et al. (2005), the results demonstrated that brain lateralization depends on what component of song holds the most attention. When paying attention to the language, linguistic processing is mostly bilateral. When paying attention to the melody, the processing is heavily right lateralized. However, when the music itself is less relevant, there was still right hemisphere lateralization; when language is relevant, there was strong bilateral lateralization. These results demonstrate how it is impossible to separate the linguistic and melodic components in music perception.

One of the strengths of the present study is the commitment to ecological validity and an experimental design that allows for direct comparison and contrast between spoken and sung phonemes presented in context.

Lieberman (2006: 92-99) discusses at length the importance of context when encoding vowels. Theoretical linguistics has treated phonemes in a variety of ways, including the view that phonemes represent discrete units that could be arranged at will to create words and phrases. However, he demonstrates that consonants cannot be separated from the vowel and that the physical transmission of the vowel depends on the context. The most vivid example involves the formant frequencies for the sounds [di] and [du]. In this case, the F2 formants are markedly different for the phoneme [d] (2006: 99).

The explanation for this important difference can be found in the superlaryngeal vocal tract (SVT) (2006: 110-111). The human brain's ability to *normalize* SVT length is crucial to speech perception. Lieberman reminds us that the formant frequencies of the

phrase in which a particular phoneme is embedded will have a powerful impact on the listener's perception of the phoneme, leading to broadly different interpretations (ibid.).

Peterson and Barney (1952) demonstrated that vowels overlap in normal speech production. This means that there is redundancy and overlap, and vowel production is not as clear as previously assumed. One of the notions that is encountered frequently in the literature on phoneme perception in song concerns the increased ambiguity of vowel phonemes when sung (as opposed to being spoken). However, data resulting from analyses like Peterson and Barney, and later Hillenbrand et al., indicate a much more complex phonemic production picture. In these two studies, one finds that there is a great deal of overlap in vowel phoneme production for English based on mappings of the F1 and F2 formants (Peterson and Barney 1952: 182, Hillenbrand et al. 1995:3103, Lieberman 2006: 110-121).

The differences between the two studies are also fascinating. In 1995, Hillenbrand and his colleagues replicated the Peterson and Barney experiment and controlled specifically for any dialect variations. Hillenbrand thought that dialect variation could be responsible for the speech perception errors that were found in the Peterson and Barney study. In the replicated study, there was a much heavier emphasis on controlling for dialect, and the experiment included a larger sampling of children. A majority of the speakers participating in the study were raised in Michigan's lower peninsula. Furthermore, Hillenbrand may have suspected that the confusion between [a] and [ɔ] had to do with the way the study was conducted, so they made sure that in the replicated study that all of the speakers were able to distinguish the difference between the vowel [a] and [ɔ] independently of the task.

After running the experiment with 136 participants (90 adults and 46 children), they found similar results from Peterson and Barney's experiment, which demonstrated that there is confusion and lack of clarity in spoken vowels. In fact, Hillenbrand et al. found more overlap than in Peterson and Barney (2005: 3103). Because of these results, Hillenbrand suspected that the durational distinctions between the vowels became important in telling them apart. As Lieberman points out (2006: 121), long vowels became diphthongs, and the perceptual effects of the length of vowel sounds can be a seen in F1 and F2 formants. The results of Hillenbrand's experiment demonstrated the confusion among the same vowels found in Peterson and Barney's experiment. Furthermore, the vowel [i] was the most resistant to confusion, followed by [u] and [o].

III. Hypotheses

Since previous studies have not adequately addressed the effects of context and environment on vowel perception, we designed an experiment using real words in real sentences. It is our hope that this experimental design maximizes the ecological validity of our study and thus the application of our results. Moreover, unlike past research, our experimental design allows direct comparison of spoken and sung phonemes, which we predict will yield accurate data with high empirical significance by minimizing confounding factors related to comparisons of spoken and sung phonemes across different experimental designs. Given the variation and redundancy in spoken and sung vowel production, we predict that there may a great deal of variation in spoken and sung vowel perception. Our choice of a language, which most of the participants do not speak, makes this prediction relevant, as it reduces the listening objective to identifying realistic

vowel sounds in unfamiliar contexts, so the vowel sound itself is the object of the participant's attention and not the context in which the vowel is found. Though pitch appears to play a role in vowel perception, we predict similar errors will be made in both spoken and sung vowel perception primarily as a result of vowel qualities, including vowel height, front/back and roundedness. Thus, we predict that our experimental design will allow for both accurate assessment and valid comparison of spoken and sung vowel perception, and we predict that, as a result of the design, more variation than has been reported previously will be found in spoken vowel perception and errors in spoken vowel perception will resemble errors in sung vowel perception.

IV. Methods

A. Materials: Basic information and language background questionnaire (see Appendix A); International Phonetic Alphabet (IPA) chart for Italian vowels; two sets, set A and set B, of five sound clips in Italian; two fill-in-the-blank worksheets- one for set A and one for set B; headphones and computers.

B. Participants: 101 adults from the Duke University community volunteered to participate in the study. There were 48 women and 53 men, ranging from 18-22 in age with a single participant age 50. Participants were recruited from classrooms, public areas, and by word-of-mouth. All participants were guaranteed anonymity.

C. Sound Clips: Sound clips in German, Latin, Russian, English, and Italian were considered initially. Given the context in which the study was conducted, it was almost certain that English would be a common language for the subjects. In order to attempt to focus the listener's attention to the phonemes themselves, we selected a language that (1)

has a relatively small vowel system, and (2) would generally not be known by the participants in the study. This helped minimize the tendency of participants to use context clues and known words to fill in vowel sounds during the listening exercise. Ultimately, Italian was chosen because it has the simplest vowel system and because it is the language of opera, which provided a mixture of high and low pitches.

Two professional opera sopranos and two male native speakers of Italian assisted us in making two sound-clip sets (see following table), designated as sets A and set B. Each set consisted of two sung clips, numbered 1 and 2, and three spoken clips, numbered 3-5. Clips 4 and 5 in each set were the spoken versions of clips 1 and 2, respectively, in each set. Soprano clips were chosen for the sung portion because they contain higher frequency vowel sounds, which are assumed in the literature to be more difficult to understand (cf. Benolken and Swanson 1990, Sundberg 1970) and because these higher frequency sounds contrast with the lower frequency sounds found in the spoken clips. Also, the portions of the songs used in the study were chosen because they contain a variety of pitches, which allowed us to contrast vowel perception at relatively high and relatively low frequencies.

1. Recording Equipment

The sound clips were recorded using an Audio-Technica P160 microphone on a Dell Inspiron I4150 Pentium 4, 1.80 GHz on Sound Forge 8 audio editing software.

2. Praat

Praat is a program used for speech synthesis, manipulation, and analysis. We utilized Praat (v. 5.1.03) in our experiment to analyze the pitch and formant structures of recordings of spoken and sung speech; however, we focused primarily on recordings of

singing, which exhibit a much larger range in pitch than those of spoken speech. Since we were interested in creating clips with a diversity of pitches, we used Praat to locate sections in the recordings that exhibited unique (particularly high or low) pitch structures before selecting and cutting the clips with GarageBand. This analysis also allowed us to verify that both high and low notes were present within each individual clip so that we could test for any differences in comprehension within the excerpts. We were also able to isolate the formant structures (F0, F1, F2, F3, F4, and sometimes F5) in regions of particular interest.

We set the pitch floor at 75 Hz and the ceiling at 500 Hz when measuring pitch, as recommended by the Praat User's Guide when recordings include both male and female voices. In Clip 1A (Soprano 1, "Andrei"), the pitch ranged from about 240.92 Hz to 431.25 Hz over 7.11 secs; in clip 1B (Soprano 2, "Andrei"), from 85.04 Hz to 530.41 Hz over 7.37 secs; in clip 2A (Soprano 2, "Mi piace"), from 219.45 Hz to 527.15 Hz over 6.98 secs; in clip 2B (Soprano 1, "Mi piace"), from 235.70 Hz to 510.76 Hz over 7.90 secs; in clip 3A (Male speaker, "Mi struggo"), from 75.89 Hz to 124.18 Hz over 1.81 secs; in clip 3B (Female speaker, "Mi struggo"), from 165.63 Hz to 251.98 Hz over 2.34 secs; in clip 4A (Female speaker, "Andrei"), from 159.61 Hz to 212.78 Hz over 2.15 secs; in clip 4B (Male speaker, "Andrei"), from 76.09 Hz to 104.44 Hz over 1.68 secs; in clip 5A (Female speaker, "Mi piace"), from 103.62 Hz to 231.56 Hz over 1.91 secs; and in clip 5B (Male speaker, "Mi piace"), from 74.91 Hz to 480.41 Hz over 2.18 secs. As illustrated by these pitch ranges, there are differences between different singers. In both sung clips (clips 1 and 2), Soprano 2 reaches higher frequencies than Soprano 1. The male speaker consistently speaks at lower frequencies than the female speaker. Because

each participant listened to clips of both sopranos and both speakers, these differences allow us to test perception at a greater range of frequencies.

In terms of phoneme production, it is important to note that Soprano 1 and Soprano 2 rendered the final vowel of "piace" differently, where Soprano 1 sang /e/ and Soprano 2 sang /ɛ/.

We also analyzed formant structures, which provide a visual image of consonants and vowels. From those images, we could see that consonants and vowels have predictable patterns and relationships to each other. In past experiments, many researchers assumed that speech becomes unclear at higher fundamental frequencies. By analyzing the formant graphs in Praat, we did see the same general differences between spoken and sung speech that Sundberg observed (although F4 and F5 were at times difficult to distinguish). Specifically, as noted by Sundberg for sung vowels, "F2 is lowered in the non-back vowels, F3 is raised in the back vowels and lowered in the other vowels, F4 and F5 are lowered in all vowels, and the frequency distance between F3 and F4 is reduced in all vowels" (Sundberg 1970: 32). The "singing formant" that Sundberg describes— a single formant formed by the collapse of the highest two or three formants — was also visible in our analyses (Sundberg 1970: 44). However, we saw that F0, F1 and F2 are clearly defined in the spoken and sung clips, with the higher formants more scattered in both, despite the differences in pitch. Furthermore, because "speech is inherently encoded at the acoustic level" and "the formant transitions [...] meld the consonants and vowels of the speech signal" (Lieberman 2006: 95), we know that the formant structure of each vowel phoneme of interest is different, even for the same vowels in distinct phonemic environments. We could see these differences reflected in

our Praat analyses. These differences, however, do not make the phonemes incomprehensible; in fact, such variability is inevitable and observed in individual speakers and across different speakers (Peterson and Barney 1952: 175, 182). Although certain vowels tend to be recognized accurately more consistently, such as /i/, /a/ and /u/, even the scatter plots of F2 against F1 of those phonemes is larger than might be expected (Peterson and Barney 1952: 183). Therefore, data analyzed in Praat confirms that if sung speech is ambiguous, spoken speech is equally ambiguous.

Set	Clip Number	Speaker/Singer	Sound Clip	Clip Type
A	1	Soprano 1	Andrei	Sung
A	2	Soprano 2	Mi piace	Sung
A	3	Male 1	Mi struggo	Spoken
A	4	Female 1	Andrei	Spoken
A	5	Female 1	Mi piace	Spoken
B	1	Soprano 2	Andrei	Sung
B	2	Soprano 1	Mi piace	Sung
B	3	Female 1	Mi struggo	Spoken
B	4	Male 1	Andrei	Spoken
B	5	Male 1	Mi piace	Spoken

D. Data Collection: The purpose of the study was explained to participants before administration of the study began, anonymity was guaranteed, and participants were assigned to either set A or set B and asked to complete a basic information and language background questionnaire (see appendix). After participants were given a brief explanation of IPA, they were given the opportunity to become familiar with a vowel IPA chart. Once the participants were ready, they were given headphones and told they could listen to each sound clip up to three times. At the cue of each participant, researchers cycled through the sound clips until they were completed. It is important to note that knowledge of IPA was not a prerequisite for participation in this study, as participants were allowed to reference the IPA chart throughout the listening exercise.

For the primary method, the sound clips were administered in order, 1-5. A separate method for a small sampling of 5 was carried out in which the sound clips were presented in the following order: 4,5,1,2,3. This was done to determine if presenting the spoken versions of the clips first would prime the participants to choose the same vowel sounds for the sung clips that they had chosen for the spoken clips. One other administration method was used for in which the researchers transcribed the vowel sounds that participant reported. This was done to test whether participant difficulties with IPA and our IPA chart confounded the results. In fact, there were no significant different in the results obtained using these three methods.

V. Results

The results of the study clearly show that there are significant errors in phonemic perception in both spoken and sung phoneme identification. Appendix B (Tables 1-16) shows a complete graph of all responses divided by gender and combined. Below is a description of specific results.

1. Vowel quality overrides high pitch in terms of errors in phoneme perception. The perception of phonemes sung at the highest pitches exhibit fewer errors than those at lower pitches (see clips 1.2 and 2.7 for all groups).
2. The largest error margins were found in the spoken, not sung, clips. The highest percentage of error is 48% in the combined A male/female responses and 45% in the combined B male/female responses ([e] for [ɛ]).

3. Females and males both show errors, but the females opt for "no response" more frequently than males.
4. The largest number of "no response" answers corresponded to passages where the [ɛ] was spoken and sung (2.5 and 5.5).
5. Participants were correct more often than they were incorrect overall, but there are some very interesting patterns of errors.

TABLE B compares errors in the identification of spoken and sung phonemes where the majority of the respondents selected an incorrect phoneme.

TABLE B:

SUNG phoneme identification errors:

GROUP A:	GROUP B:
[o] for [u]	[o] for [u]
[a] for [o]	[i] for [ɛ]
[i] and [I] for [ɛ]	[i] for [e]*

* In the case of Group B, this difference is due to a difference in the singers' pronunciation, which was [e] in 2.4 B and [ɛ] in 2.4 A.

SPOKEN phoneme identification errors:

GROUP A:	GROUP B:
[e] for [ɛ]	[i] for [ɛ]
[e] for [ɛ]	[e] for [ɛ]
[i] for [ɛ]	

TABLE C notes instances where the percentages between the correct choice and an incorrect choice were identical or close in terms of percentages within both Groups A and B.

TABLE C:

GROUP A	**percentages (%)**	**GROUP B**	**percentages (%)**
1.2 ɛ/e	18/28	same	21.5/21.5
1.3 a/o/u	18/38/8	o/u	27.45/9.8
1.4 a/o	22/22	a/ ɔ /o	19.61/19.61/27.45
1.6 ɛ /i/I	24/40/26	same	13.76/35.29/17.65
3.4 e/i/o	16/20/12	ɛ /e/i/I	19.61/13.73/45.1/13.73
3.7 ɛ /e	66/26	same	66.67/15.69
5.4 ɛ /e	34/48	same	33.33/45.1
5.5 ɛ /e	54/22	ɛ /e/I	21.57/19.61/13.73

VI. Discussion

Evaluation of Surveys:

1. Diverse set of languages represented by the 101 participants. Twenty-seven languages are known by the participants. Of these twenty-seven languages listed by the participants, 22 languages were spoken at the superior levels of fluency (as both first and second languages for the participants) by over half of the participants. The level of proficiency in two or more languages did not have a direct impact on the subject's ability to identify the correct phonemes.
2. Fourteen participants reported having some form of singing or vocal lessons in one or more languages. Here again, these 14 subjects did not perform better than the overall population of subjects.
3. Sample size was larger than previous studies examining spoken and sung phonemic perception, and also included a set of subjects representing a diverse population in terms of gender, languages spoken and training in singing.
4. Seventy-nine participants indicated knowledge of a Romance language. Of this group, four listed knowledge of Latin. Eleven of the 69 participants have advanced-level proficiency in French or Spanish. We initially anticipated that knowledge of a Romance language might improve performance in the perception and identification of spoken and sung phonemes; however, this was not the case.

Data analysis:

Tables 1-16 identify the responses of all 101 respondents, divided by the protocol that they listened to (A or B) and gender.[5] Given the proximity in age of 100 of the 101

participants, we did not include a breakdown by age. These tables include individual information for males and females in each group, as well as aggregate data and percentages where the correct responses are identified for each segment. The overall picture demonstrates that there are errors in the perception of both spoken and sung phonemes. However, there is no correlation between errors in the perception of sung phonemes and high pitch (cf. 1.2 and 2.7 for the highest pitches [F and A^b]. In fact, a higher percentage of errors are found in the sung passages in the lower pitches (cf. 1.3, 1.4, 2.4, 2.5).

If we look closely at the actual errors made, we see an interesting pattern (cf. Table B). Here, we find errors in the spoken passages restricted to central and high front vowels only (both tense and lax - ɛ, e, I, i]), while in the sung passages we see errors not only with central and high front vowels, but also with the rounded back vowels [o] and [u]. This specific outcome is not predicted by previous research, but also does not contradict Sundberg's conclusions about formant frequency differences between spoken and sung vowels, namely (1970: 32):

> "1. F2 is lowered in the non-back vowels; 2. F3 is raised in the back vowels and lowered in the other vowels; 3. F4 and F5 are lowered in all vowels; 4. The frequency distance between F3 and F4 is reduced in all vowels."

Furthermore, Sundberg specifically addresses the difference in tongue positioning for /o/ and /u/ in singing versus speech (1970: 41). He suggests that these changes in tongue positioning move these vowel phonemes closer to /a/. In our data, there is hardly any

confusion between /o/ or /u with /a/ in the sung passages (cf. Group B: 1.3 – 5.9% for /a/ instead of /u/, 1.4 – 19. 6% for /a/ instead of /o/, 2. 7 – 5.9% for /a/ instead of /o/, and 2.9 – 1.96% for /a/ instead of /o/). There are, however, also instances with similarly low percentages of confusion between /a/ and /o/, but not /u/, in the spoken passages.

Benolken and Swanson (1990: 1781-2) found shifts in perception of /ɛ/ to /æ/ between 415 Hz and 587Hz. This did not occur in our study, but it would not be expected since we were working with the Italian vowel system, not English.

VII. Preliminary Conclusions

The results of our experiment, where there is direct comparison of spoken and sung phonemes in the same design using full words and utterances, have provided a basis for deriving the following conclusions: (1) Pitch does not play as significant a role in phoneme perception in singing as specific vowel qualities, including vowel height, front/back and roundedness; (2) the variations in normal speech production are more significant than has generally been acknowledged in those studies that look at differences in spoken and sung phoneme perception; (3) errors in both spoken and sung phoneme recognition and identification occur in a regular fashion; (4) knowledge of multiple languages does not guarantee a more accurate ability to perceive and identify sung or spoken phonemes; (5) the largest percentage of selection of an incorrect phoneme in the sung passages (41.18%) is lower than the largest percentage of selection of an incorrect phoneme in a spoken passage (48%).

Given the design of the experiment, where listeners engage with the sung phonemes before the spoken ones, they were, in fact, given every opportunity to perform better in spoken phoneme identification. This was done to ensure that there would be no claim of bias that the experimental design allowed for better identification of sung phonemes than spoken ones. If listeners had encountered the spoken passages first, we would potentially expect them to perform better on the subsequent repetitions of the same text in song. However, that also did not occur. Thus, it appears that the listeners were not primed by listening to the same text in song before hearing it spoken, nor in those instances with a reversed presentation.

One of the most surprising results for the group was the fact that knowledge of Italian did not enhance the listening performance of the two participants who listed Italian as one of their languages.

VIII. Future Directions

The results of this experiment are based solely on spoken and sung Italian phonemes. In order to strengthen the conclusions of this preliminary study, further research should therefore seek to include excerpts from other languages, such as German, Russian, and English that utilize a greater variety of vowel phonemes. The importance of ecological validity in experimental design and data presentation, as well as a robust and random sample of participants, are essential components for obtaining reliable data and deriving reasonable conclusions. A deeper analysis using PRAAT of formant structures and their relationships in speech and singing will bring experiments like the present one provide more cross-over data with the rich body of research on production and perception

of sung phonemes. Researchers could also explore the influence of other sociolinguistic variables, such as the age, educational background, and gender of participants, on phonemic perception. For those interested in the neurobiological bases of phonemic production and comprehension, imaging-based techniques could be incorporated into the experimental design.

Notes

1.This analysis is the first of several where the focus is to measure potential differences in the perception of spoken and sung phonemes across several languages and determine if there are significant differences in the perception of these different realizations of phonemes.

2.Formants are vocal tract resonances. The lowest frequency of a periodic waveform is called the fundamental formant (F0). Formant structures are viewed with spectrographs, which produce spectrograms (concentrations of high energy). Multiple formants are required for phoneme identification. Articulators (defined as jaw, tongue body, tongue tip, lips, and larynx by Sundberg (1987: 96) have a direct impact on formant frequencies. For a good discussion of these basic terms and relationships, see Nair 1999, Sundberg 1987, and Johnson 2003.

Hollein, Mendes-Schwartz and Nielsen (2000: 298) point out in their conclusions that incorrect identification of vowel phonemes often involves mid vowels, especially in high pitches sung by sopranos. In fact, we would argue that this happens because many operatic sopranos substitute low and mid vowels for high vowels in musical phrases at higher pitches. The "common perceptual illusion…that he or she accurately produces the intended word and its constituent vowels" referred to by Hollein et al. (2000: 287) is an illusion driven by visual images and lip movements and not one that is explainable in acoustic terms.

3. The SSPP study was vetted by the Duke University Institutional Review Board and granted an exemption.

4. Respondents had some knowledge of the following languages other than English: Spanish, French, German, Slovak, Hungarian, Polish, Russian, Chinese, Tamil, Latin, Hindi, Portugese, Korean, Teluga, Bulgarian, Bengali, Sanskrit, Arabic, Farsi, Dari, Japanese, Turkish, Indonesian, Zulu, Swahili, Afrikaans, Vietnamese

5.The sample size of the participant pool plays a major role in the results obtained. In the case of our study, we did a preliminary analysis with 24 subjects and the results obtained show a very different distribution in percentages than the final results with 101 subjects. In particular, there seemed to be more errors in distinguishing between mid and high back vowels (/o/ vs. /u/) in both sung and spoken texts. Also, the misidentification of /ə/ was more significant in the smaller sample size than in the full sample. The confusions between /e/ and /ɛ/ were demonstrated in the smaller sampling and that initial pattern turned out to be similar in the final data set.

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Appendix A

I. Basic Information

Age: _____

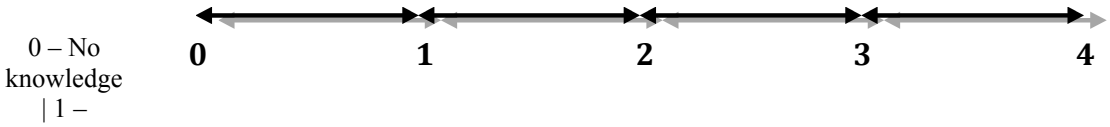
Gender: _____ Year (if applicable):_____

II. Language Survey:

- Please list the languages you know in the order in which you learned them. (Please make a note if you have learned a language in close proximity with another).
- Rate your speaking, reading, and writing proficiency using the scale below.
- Please list any formal evaluations (i.e. AP Exam, Oral Proficiency Test, etc.) you may have had in each language.
- Indicate the context(s) in which you learned in each language (i.e. location, classroom, etc.)
- How often you speak/hear/listen to the languages you have listed.
- List the modes of communication you use with this language.

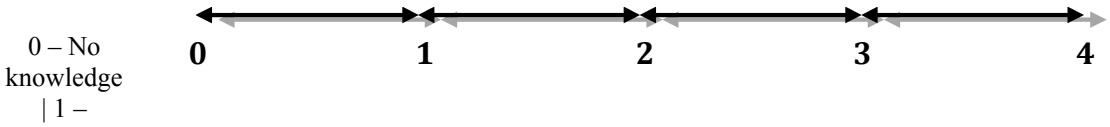
1. _____

Rate your SPEAKING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)



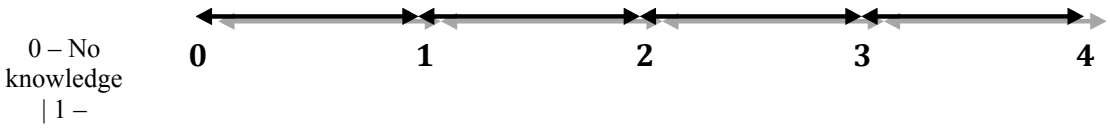
| 1 – Novice | 2 – Intermediate | 3 – Advanced | 4 - Expert

Rate your READING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)



| 1 – Novice | 2 – Intermediate | 3 – Advanced | 4 – Expert

Rate your WRITING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)



| 1 – Novice | 2 – Intermediate | 3 – Advanced | 4 - Expert

Evaluations: _____

Context: School (# years _____) | Home | Other: _____

How often do you speak/read/hear this language:

Speak: _____ Listen: _____ Read: _____

What modes of communication are involved with this language? (Circle all that apply)

[Face-to-face Interaction] [Television] [Music/Film]

[Telephone or other auditory-only forms of communication]

2. _____

Rate your SPEAKING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)

Rate your READING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)

Rate your WRITING proficiency (Circle the value that best corresponds to your proficiency, you may assign yourself fraction values)

Evaluations: _____

Context: School (# years _____) | Home | Other: _____

How often do you speak/read/hear this language:

Speak: _____ Listen: _____ Read: _____

What modes of communication are involved with this language? (Circle all that apply)

[Face-to-face Interaction] [Television] [Music/Film]

[Telephone or other auditory-only forms of communication]

III. Where have you lived, and for how long (Include any international study abroad experiences)?

1. Location of Birth:_____# years_____
2._____# years_____
3. _____ # years_____
4. _____ # years_____

IV. What language(s) do your parents/guardians or other close relatives know?

1. _____
2. _____
3. _____
4. _____

In what language(s) do your parents/guardians or other close relatives speak to you?

1. _____
2. _____
3. _____
4. _____

V. Vocal/Linguistic Training

1. Have you ever had professional vocal (singing) training?

If so, how long and in which language(s):

_____

2. Have you had formal linguistic training?
   - Do you know what a phoneme or morpheme is?
   - Do you know IPA?

3. Is there any other information that you feel is relevant to this category?

4. Do you or did you have a hearing/speech impairment?
If yes, have you received any formal training or been involved in any speech/hearing therapy?

VI. Vocal Music Preferences
1. What kind of music do you like to listen to? Provide some examples.
2. Do you listen to popular music in a language other than English?

If so, what other language(s) do you listen to:

3. Do you listen to opera? What operas do you enjoy?

4. Do you enjoy classical vocal music? Share any specific examples with us.

VII. Is there any other information you would like to share with us that is relevant to our study?

Thank you for your participation.
Your identity will not be disclosed as a result of publication of findings.
Responses will be compiled and analyzed for research purposes only.

TABLE 1
Group A

MALE													
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	11	5	1		3	2	1				2	1	26
1.2	4		3	8		1	2	3	3			2	26
1.3	3	1	2	2	3	1	1	10	1		2		26
1.4	8	1		2			7	2	1	1	4		26
1.5			2	3	15	5		1					26
1.6			7	1	10	8							26
1.7					19	4		3					26
1.8	2						2	19	2		1		26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1				1	24	1							26
2.2	1				20	2					1	2	26
2.3	12	1		2			3	5			1	2	26
2.4	1		9	11		2		1			1	1	26
2.5	4	1	3	4	1		1	1	1		2	8	26
2.6			13	6	2		2	1	2				26
2.7	4	1	1		1			16			1	2	26
2.8	1	1	10	6	4	1	1		1		1		26
2.9	4		2					18				2	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1				1	22	3							26
3.2								5	17	4			26
3.3		1	5	1	1	2		9	6	1			26
3.4	5		3	5	6			1	1		3	2	26
3.5			2	4	17	3							26
3.6							1	19	4	2			26
3.7		2	16	6	1	1							26
3.8								25				1	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	19	3				1	1				2		26
4.2			8	18									26
4.3			1	2	1			2	18	2			26
4.4							3	16	5	2			26
4.5			6	13	1	2		2	1		1		26
4.6	2	3	19	1							1		26
4.7			1		18	1			5	1			26
4.8	1		1	1			1	18	2			2	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1				1	24	1							26
5.2					25	1							26
5.3	22			1							3		26
5.4		1	7	15	3								26
5.5	2	2	15	4	2						1		26
5.6			21	4				1					26
5.7				1				25					26
5.8			22	3							1		26
5.9				1				25					26

CORRECT

Incorrect Plurality

TABLE 2
Group A

FEMALE

A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	14	2	1			3	1					3	24
1.2	4	1	6	6			3	3				1	24
1.3	6			2		2		9	3	1	1		24
1.4	3		1		2		3	9	2	1	2	1	24
1.5			1	2	19	1						1	24
1.6			5	4	10	5							24
1.7					15	2	1	4	1	1			24
1.8			1				2	16	2	1	1	1	24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
2.1			1	2	20							1	24
2.2				1	19	1		1	1		1		24
2.3	15						3	2				4	24
2.4	1	1	11	7	1	1						2	24
2.5	4		4	5	4						1	6	24
2.6			9	6	1	4		1			3		24
2.7	4			1		1		17			1		24
2.8	1	1	7	6	4	2		2	1				24
2.9	3	1			1		1	17	1				24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
3.1			1	1	17	5							24
3.2								4	16	3	1		24
3.3	1		2	1	2			13	1	2	2		24
3.4			2	3	4	1		5		1	1	7	24
3.5			2	1	20	1							24
3.6								19	1	4			24
3.7			17	7									24
3.8								23	1				24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
4.1	21	2					1						24
4.2	1	2	8	12					1				24
4.3	1		2		3			6	10	2			24
4.4			1					11	10	2			24
4.5	2	1	5	8				7	1				24
4.6		1	12	9	1	1							24
4.7			1	1	16	2			3	1			24
4.8								18	5	1			24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
5.1			1		21	2							24
5.2			1		22	1							24
5.3	22	1						1					24
5.4	1		10	9		2		1	1				24
5.5	2		12	7							2	1	24
5.6			17	7									24
5.7	2							21	1				24
5.8			17	7									24
5.9	2							21	1				24

TABLE 3
Group A

MALE & FEMALE A COMBINED

A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	25	7	2	0	3	5	2	0	0	0	2	4	50
1.2	8	1	9	14	0	1	5	6	3	0	0	3	50
1.3	9	1	2	4	3	3	1	19	4	1	3	0	50
1.4	11	1	1	2	2	0	10	11	3	2	6	1	50
1.5	0	0	3	5	34	6	0	1	0	0	0	1	50
1.6	0	0	12	5	20	13	0	0	0	0	0	0	50
1.7	0	0	0	0	34	6	1	7	1	1	0	0	50
1.8	2	0	1	0	0	0	4	35	4	1	2	1	50
A	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**Total**
2.1	0	0	1	3	44	1	0	0	0	0	0	1	50
2.2	1	0	0	1	39	3	0	1	1	0	2	2	50
2.3	27	1	0	2	0	0	6	7	0	0	1	6	50
2.4	2	1	20	18	1	3	0	1	0	0	1	3	50
2.5	8	1	7	9	5	0	1	1	1	0	3	14	50
2.6	0	0	22	12	3	4	2	2	2	0	3	0	50
2.7	8	1	1	1	1	1	0	33	0	0	2	2	50
2.8	2	2	17	12	8	3	1	2	2	0	1	0	50
2.9	7	1	2	0	1	0	1	35	1	0	0	2	50
A	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**Total**
3.1	0	0	1	2	39	8	0	0	0	0	0	0	50
3.2	0	0	0	0	0	0	0	9	33	7	1	0	50
3.3	1	1	7	2	3	2	0	22	7	3	2	0	50
3.4	5	0	5	8	10	1	0	6	1	1	4	9	50
3.5	0	0	4	5	37	4	0	0	0	0	0	0	50
3.6	0	0	0	0	0	0	1	38	5	6	0	0	50
3.7	0	2	33	13	1	1	0	0	0	0	0	0	50
3.8	0	0	0	0	0	0	0	48	1	0	0	1	50
A	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**Total**
4.1	40	5	0	0	0	1	2	0	0	0	2	0	50
4.2	1	2	16	30	0	0	0	0	1	0	0	0	50
4.3	1	0	3	2	4	0	0	8	28	4	0	0	50
4.4	0	0	1	0	0	0	3	27	15	4	0	0	50
4.5	2	1	11	21	1	2	0	9	2	0	1	0	50
4.6	2	4	31	10	1	1	0	0	0	0	1	0	50
4.7	0	0	2	1	34	3	0	0	8	2	0	0	50
4.8	1	0	1	1	0	0	1	36	7	1	0	2	50
A	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**Total**
5.1	0	0	1	1	45	3	0	0	0	0	0	0	50
5.2	0	0	1	0	47	2	0	0	0	0	0	0	50
5.3	44	1	0	1	0	0	0	1	0	0	3	0	50
5.4	1	1	17	24	3	2	0	1	1	0	0	0	50
5.5	4	2	27	11	2	0	0	0	0	0	3	1	50
5.6	0	0	38	11	0	0	0	1	0	0	0	0	50
5.7	2	0	0	1	0	0	0	46	1	0	0	0	50
5.8	0	0	39	10	0	0	0	0	0	0	1	0	50
5.9	2	0	0	1	0	0	0	46	1	0	0	0	50

TABLE 4
Group A

MALE & FEMALE A COMBINED (Percentages)													50 Participants
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	50.00%	14.00%	4.00%	0.00%	6.00%	10.00%	4.00%	0.00%	0.00%	0.00%	4.00%	8.00%	100.00%
1.2	16.00%	2.00%	18.00%	28.00%	0.00%	2.00%	10.00%	12.00%	6.00%	0.00%	0.00%	6.00%	100.00%
1.3	18.00%	2.00%	4.00%	8.00%	6.00%	6.00%	2.00%	38.00%	8.00%	2.00%	6.00%	0.00%	100.00%
1.4	22.00%	2.00%	2.00%	4.00%	4.00%	0.00%	20.00%	22.00%	6.00%	4.00%	12.00%	2.00%	100.00%
1.5	0.00%	0.00%	6.00%	10.00%	68.00%	12.00%	0.00%	2.00%	0.00%	0.00%	0.00%	2.00%	100.00%
1.6	0.00%	0.00%	24.00%	10.00%	40.00%	26.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
1.7	0.00%	0.00%	0.00%	0.00%	68.00%	12.00%	2.00%	14.00%	2.00%	2.00%	0.00%	0.00%	100.00%
1.8	4.00%	0.00%	2.00%	0.00%	0.00%	0.00%	8.00%	70.00%	8.00%	2.00%	4.00%	2.00%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1	0.00%	0.00%	2.00%	6.00%	88.00%	2.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.00%	100.00%
2.2	2.00%	0.00%	0.00%	2.00%	78.00%	6.00%	0.00%	2.00%	2.00%	0.00%	4.00%	4.00%	100.00%
2.3	54.00%	2.00%	0.00%	4.00%	0.00%	0.00%	12.00%	14.00%	0.00%	0.00%	2.00%	12.00%	100.00%
2.4	4.00%	2.00%	40.00%	36.00%	2.00%	6.00%	0.00%	2.00%	0.00%	0.00%	2.00%	6.00%	100.00%
2.5	16.00%	2.00%	14.00%	18.00%	10.00%	0.00%	2.00%	2.00%	2.00%	0.00%	6.00%	28.00%	100.00%
2.6	0.00%	0.00%	44.00%	24.00%	6.00%	8.00%	4.00%	4.00%	4.00%	0.00%	6.00%	0.00%	100.00%
2.7	16.00%	2.00%	2.00%	2.00%	2.00%	2.00%	0.00%	66.00%	0.00%	0.00%	4.00%	4.00%	100.00%
2.8	4.00%	4.00%	34.00%	24.00%	16.00%	6.00%	2.00%	4.00%	4.00%	0.00%	2.00%	0.00%	100.00%
2.9	14.00%	2.00%	4.00%	0.00%	2.00%	0.00%	2.00%	70.00%	2.00%	0.00%	0.00%	4.00%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1	0.00%	0.00%	2.00%	4.00%	78.00%	16.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.00%	66.00%	14.00%	2.00%	0.00%	100.00%
3.3	2.00%	2.00%	14.00%	4.00%	6.00%	4.00%	0.00%	44.00%	14.00%	6.00%	4.00%	0.00%	100.00%
3.4	10.00%	0.00%	10.00%	16.00%	20.00%	2.00%	0.00%	12.00%	2.00%	2.00%	8.00%	18.00%	100.00%
3.5	0.00%	0.00%	8.00%	10.00%	74.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.00%	76.00%	10.00%	12.00%	0.00%	0.00%	100.00%
3.7	0.00%	4.00%	66.00%	26.00%	2.00%	2.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	96.00%	2.00%	0.00%	0.00%	2.00%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	80.00%	10.00%	0.00%	0.00%	0.00%	2.00%	4.00%	0.00%	0.00%	0.00%	4.00%	0.00%	100.00%
4.2	2.00%	4.00%	32.00%	60.00%	0.00%	0.00%	0.00%	0.00%	2.00%	0.00%	0.00%	0.00%	100.00%
4.3	2.00%	0.00%	6.00%	4.00%	8.00%	0.00%	0.00%	16.00%	56.00%	8.00%	0.00%	0.00%	100.00%
4.4	0.00%	0.00%	2.00%	0.00%	0.00%	0.00%	6.00%	54.00%	30.00%	8.00%	0.00%	0.00%	100.00%
4.5	4.00%	2.00%	22.00%	42.00%	2.00%	4.00%	0.00%	18.00%	4.00%	0.00%	2.00%	0.00%	100.00%
4.6	4.00%	8.00%	62.00%	20.00%	2.00%	2.00%	0.00%	0.00%	0.00%	0.00%	2.00%	0.00%	100.00%
4.7	0.00%	0.00%	4.00%	2.00%	68.00%	6.00%	0.00%	0.00%	16.00%	4.00%	0.00%	0.00%	100.00%
4.8	2.00%	0.00%	2.00%	2.00%	0.00%	0.00%	2.00%	72.00%	14.00%	2.00%	0.00%	4.00%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1	0.00%	0.00%	2.00%	2.00%	90.00%	6.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.2	0.00%	0.00%	2.00%	0.00%	94.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.3	88.00%	2.00%	0.00%	2.00%	0.00%	0.00%	0.00%	2.00%	0.00%	0.00%	6.00%	0.00%	100.00%
5.4	2.00%	2.00%	34.00%	48.00%	6.00%	4.00%	0.00%	2.00%	2.00%	0.00%	0.00%	0.00%	100.00%
5.5	8.00%	4.00%	54.00%	22.00%	4.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.00%	2.00%	100.00%
5.6	0.00%	0.00%	76.00%	22.00%	0.00%	0.00%	0.00%	2.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.7	4.00%	0.00%	0.00%	2.00%	0.00%	0.00%	0.00%	92.00%	2.00%	0.00%	0.00%	0.00%	100.00%
5.8	0.00%	0.00%	78.00%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.00%	0.00%	100.00%
5.9	4.00%	0.00%	0.00%	2.00%	0.00%	0.00%	0.00%	92.00%	2.00%	0.00%	0.00%	0.00%	100.00%

TABLE 5
Group B

MALE													
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**Total**
1.1	16	3					5		1		2		27
1.2	5	2	3	6	1	2	2		1	1	3	1	27
1.3	2		3		1	1	1	10	3	1	4	1	27
1.4	6			1	1		7	9	2			1	27
1.5			3	9	7	2		1	3		1	1	27
1.6	2		3	3	13	3		1			1	1	27
1.7	2		1	1	12	1	2	5	1		1	1	27
1.8	5			1	1		2	10		2	3	3	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
2.1					27								27
2.2	2	1	1		15	3	1		3		1		27
2.3	15			1			1	3	1		3	3	27
2.4		1	5	8	12			1					27
2.5	2		8	2	2	1	1		1		1	9	27
2.6		1	8	6	2	6	1	3					27
2.7	2	1		1	1		2	17	2			1	27
2.8			8	6	2	6	1	3			1		27
2.9		1						17	7	1		1	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
3.1			1		26								27
3.2								2	20	5			27
3.3							1	24	1	1			27
3.4	1	1	6	3	11	5							27
3.5				1	26								27
3.6								20	2	2	2	1	27
3.7			17	5	2	3							27
3.8								26	1				27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
4.1	21	1		1			2	1			1		27
4.2		2	5	19								1	27
4.3				1	1			5	18	1	1		27
4.4	2			1			3	14	3	4			27
4.5	1		5	9	4	1	1	3			3		27
4.6	1		15	9	1							1	27
4.7	1		1		18	1	1		3	1		1	27
4.8								22	2			3	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
5.1				1	25	1							27
5.2	1		1		25								27
5.3	22	1					2				2		27
5.4			7	17				1			2		27
5.5	2		6	7	3			1		1	1	6	27
5.6		1	20	6									27
5.7	1							24	2				27
5.8		1	20	6									27
5.9								25	2				27
										11/16/2010	**Total Participants**		27

CORRECT

Incorrect Plurality

B = 51

TABLE 6
Group B

FEMALE													
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
1.1	17	1					4				2		24
1.2	5	1	8	5	1		1		1			2	24
1.3	1		2	2	1	2	3	4	2	1	1	5	24
1.4	4	1			1		3	5	3		1	6	24
1.5			7	3	2	1	1	3		1	2	4	24
1.6	2	1	4	3	5	6	1		1			1	24
1.7	1				7	1	5	5		2	2	1	24
1.8	3				1		6	9	1	1		3	24
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
2.1			1	1	20	2							24
2.2	4				11	3	1	2	2	1			24
2.3	13		2		2		2		1	1	1	2	24
2.4			9	5	9			1					24
2.5		1	3	2	4	1	2	3			2	6	24
2.6	2		9	4	3	2		1			1	2	24
2.7	1		1				1	17	1			3	24
2.8	2		11	5	2	2					1	1	24
2.9	1						1	19	2			1	24
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
3.1			1	1	21	1							24
3.2				1				5	18				24
3.3			3		1		1	18		1			24
3.4		1	4	4	12	2		1					24
3.5			2		18	3			1				24
3.6			2			1		18	3				24
3.7			17	3		2		1			1		24
3.8				1				22		1			24
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
4.1	15	3					1		2	1	2		24
4.2			8	12		2			2				24
4.3				1	2		1	6	14				24
4.4	1		1		2		2	12	4	2			24
4.5		1	11	4				6		1	1		24
4.6	2	1	15	3	1	1		1					24
4.7					13			7	4				24
4.8							2	17	3			2	24
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
5.1			1	1	22								24
5.2	3	1			18	1	1						24
5.3	17	3	3						1				24
5.4			10	6	3			3	2				24
5.5	2	1	5	3	4			3				6	24
5.6			19	4	1								24
5.7				1				22	1				24
5.8			19	4	1								24
5.9				1				22	1				24

TABLE 7
Group B

MALE & FEMALE B COMBINED

B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	33	4	0	0	0	0	9	0	1	0	4	0	51
1.2	10	3	11	11	2	2	3	0	2	1	3	3	51
1.3	3	0	5	2	2	3	4	14	5	2	5	6	51
1.4	10	1	0	1	2	0	10	14	5	0	1	7	51
1.5	0	0	10	12	9	3	1	4	3	1	3	5	51
1.6	4	1	7	6	18	9	1	1	1	0	1	2	51
1.7	3	0	1	1	19	2	7	10	1	2	3	2	51
1.8	8	0	0	1	2	0	8	19	1	3	3	6	51
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1	0	0	1	1	47	2	0	0	0	0	0	0	51
2.2	6	1	1	0	26	6	2	2	5	1	1	0	51
2.3	28	0	2	1	2	0	3	3	2	1	4	5	51
2.4	0	1	14	13	21	0	0	2	0	0	0	0	51
2.5	2	1	11	4	6	2	3	3	1	0	3	15	51
2.6	2	1	17	10	5	8	1	4	0	0	1	2	51
2.7	3	1	1	1	1	0	3	34	3	0	0	4	51
2.8	2	0	19	11	4	8	1	3	0	0	2	1	51
2.9	1	1	0	0	0	0	1	36	9	1	0	2	51
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1	0	0	2	1	47	1	0	0	0	0	0	0	51
3.2	0	0	0	1	0	0	0	7	38	5	0	0	51
3.3	0	0	3	0	1	0	2	42	1	2	0	0	51
3.4	1	2	10	7	23	7	0	1	0	0	0	0	51
3.5	0	0	2	1	44	3	0	0	1	0	0	0	51
3.6	0	0	2	0	0	1	0	38	5	2	2	1	51
3.7	0	0	34	8	2	5	0	1	0	0	1	0	51
3.8	0	0	0	1	0	0	0	48	1	1	0	0	51
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	36	4	0	1	0	0	3	1	2	1	3	0	51
4.2	0	2	13	31	0	2	0	0	2	0	0	1	51
4.3	0	0	0	2	3	0	1	11	32	1	1	0	51
4.4	3	0	1	1	2	0	5	26	7	6	0	0	51
4.5	1	1	16	13	4	1	1	9	0	1	4	0	51
4.6	3	1	30	12	2	1	0	1	0	0	0	1	51
4.7	1	0	1	0	31	1	1	7	7	1	0	1	51
4.8	0	0	0	0	0	0	2	39	5	0	0	5	51
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1	0	0	1	2	47	1	0	0	0	0	0	0	51
5.2	4	1	1	0	43	1	1	0	0	0	0	0	51
5.3	39	4	3	0	0	0	2	0	1	0	2	0	51
5.4	0	0	17	23	3	0	0	4	2	0	2	0	51
5.5	4	1	11	10	7	0	0	4	0	1	1	12	51
5.6	0	1	39	10	1	0	0	0	0	0	0	0	51
5.7	1	0	0	1	0	0	0	46	3	0	0	0	51
5.8	0	1	39	10	1	0	0	0	0	0	0	0	51
5.9	0	0	0	1	0	0	0	47	3	0	0	0	51

TABLE 8
Group B

MALE & FEMALE B COMBINED (Percentages)													51 Participants
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	64.71%	7.84%	0.00%	0.00%	0.00%	0.00%	17.65%	0.00%	1.96%	0.00%	7.84%	0.00%	100.00%
1.2	19.61%	5.88%	21.57%	21.57%	3.92%	3.92%	5.88%	0.00%	3.92%	1.96%	5.88%	5.88%	100.00%
1.3	5.88%	0.00%	9.80%	3.92%	3.92%	5.88%	7.84%	27.45%	9.80%	3.92%	9.80%	11.76%	100.00%
1.4	19.61%	1.96%	0.00%	1.96%	3.92%	0.00%	19.61%	27.45%	9.80%	0.00%	1.96%	13.73%	100.00%
1.5	0.00%	0.00%	19.61%	23.53%	17.65%	5.88%	1.96%	7.84%	5.88%	1.96%	5.88%	9.80%	100.00%
1.6	7.84%	1.96%	13.73%	11.76%	35.29%	17.65%	1.96%	1.96%	1.96%	0.00%	1.96%	3.92%	100.00%
1.7	5.88%	0.00%	1.96%	1.96%	37.25%	3.92%	13.73%	19.61%	1.96%	3.92%	5.88%	3.92%	100.00%
1.8	15.69%	0.00%	0.00%	1.96%	3.92%	0.00%	15.69%	37.25%	1.96%	5.88%	5.88%	11.76%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1	0.00%	0.00%	1.96%	1.96%	92.16%	3.92%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
2.2	11.76%	1.96%	1.96%	0.00%	50.98%	11.76%	3.92%	3.92%	9.80%	1.96%	1.96%	0.00%	100.00%
2.3	54.90%	0.00%	3.92%	1.96%	3.92%	0.00%	5.88%	5.88%	3.92%	1.96%	7.84%	9.80%	100.00%
2.4	0.00%	1.96%	27.45%	25.49%	41.18%	0.00%	0.00%	3.92%	0.00%	0.00%	0.00%	0.00%	100.00%
2.5	3.92%	1.96%	21.57%	7.84%	11.76%	3.92%	5.88%	5.88%	1.96%	0.00%	5.88%	29.41%	100.00%
2.6	3.92%	1.96%	33.33%	19.61%	9.80%	15.69%	1.96%	7.84%	0.00%	0.00%	1.96%	3.92%	100.00%
2.7	5.88%	1.96%	1.96%	1.96%	1.96%	0.00%	5.88%	66.67%	5.88%	0.00%	0.00%	7.84%	100.00%
2.8	3.92%	0.00%	37.25%	21.57%	7.84%	15.69%	1.96%	5.88%	0.00%	0.00%	3.92%	1.96%	100.00%
2.9	1.96%	1.96%	0.00%	0.00%	0.00%	0.00%	1.96%	70.59%	17.65%	1.96%	0.00%	3.92%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1	0.00%	0.00%	3.92%	1.96%	92.16%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.2	0.00%	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	13.73%	74.51%	9.80%	0.00%	0.00%	100.00%
3.3	0.00%	0.00%	5.88%	0.00%	1.96%	0.00%	3.92%	82.35%	1.96%	3.92%	0.00%	0.00%	100.00%
3.4	1.96%	3.92%	19.61%	13.73%	45.10%	13.73%	0.00%	1.96%	0.00%	0.00%	0.00%	0.00%	100.00%
3.5	0.00%	0.00%	3.92%	1.96%	86.27%	5.88%	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	100.00%
3.6	0.00%	0.00%	3.92%	0.00%	0.00%	1.96%	0.00%	74.51%	9.80%	3.92%	3.92%	1.96%	100.00%
3.7	0.00%	0.00%	66.67%	15.69%	3.92%	9.80%	0.00%	1.96%	0.00%	0.00%	1.96%	0.00%	100.00%
3.8	0.00%	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	94.12%	1.96%	1.96%	0.00%	0.00%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	70.59%	7.84%	0.00%	1.96%	0.00%	0.00%	5.88%	1.96%	3.92%	1.96%	5.88%	0.00%	100.00%
4.2	0.00%	3.92%	25.49%	60.78%	0.00%	3.92%	0.00%	0.00%	3.92%	0.00%	0.00%	1.96%	100.00%
4.3	0.00%	0.00%	0.00%	3.92%	5.88%	0.00%	1.96%	21.57%	62.75%	1.96%	1.96%	0.00%	100.00%
4.4	5.88%	0.00%	1.96%	1.96%	3.92%	0.00%	9.80%	50.98%	13.73%	11.76%	0.00%	0.00%	100.00%
4.5	1.96%	1.96%	31.37%	25.49%	7.84%	1.96%	1.96%	17.65%	0.00%	1.96%	7.84%	0.00%	100.00%
4.6	5.88%	1.96%	58.82%	23.53%	3.92%	1.96%	0.00%	1.96%	0.00%	0.00%	0.00%	1.96%	100.00%
4.7	1.96%	0.00%	1.96%	0.00%	60.78%	1.96%	1.96%	13.73%	13.73%	1.96%	0.00%	1.96%	100.00%
4.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.92%	76.47%	9.80%	0.00%	0.00%	9.80%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1	0.00%	0.00%	1.96%	3.92%	92.16%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.2	7.84%	1.96%	1.96%	0.00%	84.31%	1.96%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.3	76.47%	7.84%	5.88%	0.00%	0.00%	0.00%	3.92%	0.00%	1.96%	0.00%	3.92%	0.00%	100.00%
5.4	0.00%	0.00%	33.33%	45.10%	5.88%	0.00%	0.00%	7.84%	3.92%	0.00%	3.92%	0.00%	100.00%
5.5	7.84%	1.96%	21.57%	19.61%	13.73%	0.00%	0.00%	7.84%	0.00%	1.96%	1.96%	23.53%	100.00%
5.6	0.00%	1.96%	76.47%	19.61%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.7	1.96%	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	90.20%	5.88%	0.00%	0.00%	0.00%	100.00%
5.8	0.00%	1.96%	76.47%	19.61%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.9	0.00%	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	92.16%	5.88%	0.00%	0.00%	0.00%	100.00%

TABLE 9
Group A

MALE													
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	11	5	1		3	2	1				2	1	26
1.2	4		3	8		1	2	3	3			2	26
1.3	3	1	2	2	3	1	1	10	1		2		26
1.4	8	1		2			7	2	1	1	4		26
1.5			2	3	15	5		1					26
1.6			7	1	10	8							26
1.7					19	4		3					26
1.8	2						2	19	2		1		26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1				1	24	1							26
2.2	1				20	2					1	2	26
2.3	12	1		2			3	5			1	2	26
2.4	1		9	11		2		1			1	1	26
2.5	4	1	3	4	1		1	1	1		2	8	26
2.6			13	6	2		2	1	2				26
2.7	4	1	1		1			16			1	2	26
2.8	1	1	10	6	4	1	1		1		1		26
2.9	4		2					18				2	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1				1	22	3							26
3.2								5	17	4			26
3.3		1	5	1	1	2		9	6	1			26
3.4	5		3	5	6			1	1		3	2	26
3.5			2	4	17	3							26
3.6							1	19	4	2			26
3.7		2	16	6	1	1							26
3.8								25				1	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	19	3				1	1				2		26
4.2			8	18									26
4.3			1	2	1			2	18	2			26
4.4							3	16	5	2			26
4.5			6	13	1	2		2	1		1		26
4.6	2	3	19	1							1		26
4.7			1		18	1			5	1			26
4.8	1		1	1			1	18	2			2	26
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1				1	24	1							26
5.2					25	1							26
5.3	22			1							3		26
5.4		1	7	15	3								26
5.5	2	2	15	4	2						1		26
5.6			21	4				1					26
5.7				1				25					26
5.8			22	3							1		26
5.9				1				25					26

CORRECT

Incorrect Plurality

TABLE 10
Group A

MALE	Percentages												
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
1.1	42.31%	19.23%	3.85%	0.00%	11.54%	7.69%	3.85%	0.00%	0.00%	0.00%	7.69%	3.85%	100.00%
1.2	15.38%	0.00%	11.54%	30.77%	0.00%	3.85%	7.69%	11.54%	11.54%	0.00%	0.00%	7.69%	100.00%
1.3	11.54%	3.85%	7.69%	7.69%	11.54%	3.85%	3.85%	38.46%	3.85%	0.00%	7.69%	0.00%	100.00%
1.4	30.77%	3.85%	0.00%	7.69%	0.00%	0.00%	26.92%	7.69%	3.85%	3.85%	15.38%	0.00%	100.00%
1.5	0.00%	0.00%	7.69%	11.54%	57.69%	19.23%	0.00%	3.85%	0.00%	0.00%	0.00%	0.00%	100.00%
1.6	0.00%	0.00%	26.92%	3.85%	38.46%	30.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
1.7	0.00%	0.00%	0.00%	0.00%	73.08%	15.38%	0.00%	11.54%	0.00%	0.00%	0.00%	0.00%	100.00%
1.8	7.69%	0.00%	0.00%	0.00%	0.00%	0.00%	7.69%	73.08%	7.69%	0.00%	3.85%	0.00%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
2.1	0.00%	0.00%	0.00%	3.85%	92.31%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
2.2	3.85%	0.00%	0.00%	0.00%	76.92%	7.69%	0.00%	0.00%	0.00%	0.00%	3.85%	7.69%	100.00%
2.3	46.15%	3.85%	0.00%	7.69%	0.00%	0.00%	11.54%	19.23%	0.00%	0.00%	3.85%	7.69%	100.00%
2.4	3.85%	0.00%	34.62%	42.31%	0.00%	7.69%	0.00%	3.85%	0.00%	0.00%	3.85%	3.85%	100.00%
2.5	15.38%	3.85%	11.54%	15.38%	3.85%	0.00%	3.85%	3.85%	3.85%	0.00%	7.69%	30.77%	100.00%
2.6	0.00%	0.00%	50.00%	23.08%	7.69%	0.00%	7.69%	3.85%	7.69%	0.00%	0.00%	0.00%	100.00%
2.7	15.38%	3.85%	3.85%	0.00%	3.85%	0.00%	0.00%	61.54%	0.00%	0.00%	3.85%	7.69%	100.00%
2.8	3.85%	3.85%	38.46%	23.08%	15.38%	3.85%	3.85%	0.00%	3.85%	0.00%	3.85%	0.00%	100.00%
2.9	15.38%	0.00%	7.69%	0.00%	0.00%	0.00%	0.00%	69.23%	0.00%	0.00%	0.00%	7.69%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
3.1	0.00%	0.00%	0.00%	3.85%	84.62%	11.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.23%	65.38%	15.38%	0.00%	0.00%	100.00%
3.3	0.00%	3.85%	19.23%	3.85%	3.85%	7.69%	0.00%	34.62%	23.08%	3.85%	0.00%	0.00%	100.00%
3.4	19.23%	0.00%	11.54%	19.23%	23.08%	0.00%	0.00%	3.85%	3.85%	0.00%	11.54%	7.69%	100.00%
3.5	0.00%	0.00%	7.69%	15.38%	65.38%	11.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%	73.08%	15.38%	7.69%	0.00%	0.00%	100.00%
3.7	0.00%	7.69%	61.54%	23.08%	3.85%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	96.15%	0.00%	0.00%	0.00%	3.85%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
4.1	73.08%	11.54%	0.00%	0.00%	0.00%	3.85%	3.85%	0.00%	0.00%	0.00%	7.69%	0.00%	100.00%
4.2	0.00%	0.00%	30.77%	69.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
4.3	0.00%	0.00%	3.85%	7.69%	3.85%	0.00%	0.00%	7.69%	69.23%	7.69%	0.00%	0.00%	100.00%
4.4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.54%	61.54%	19.23%	7.69%	0.00%	0.00%	100.00%
4.5	0.00%	0.00%	23.08%	50.00%	3.85%	7.69%	0.00%	7.69%	3.85%	0.00%	3.85%	0.00%	100.00%
4.6	7.69%	11.54%	73.08%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%	0.00%	100.00%
4.7	0.00%	0.00%	3.85%	0.00%	69.23%	3.85%	0.00%	0.00%	19.23%	3.85%	0.00%	0.00%	100.00%
4.8	3.85%	0.00%	3.85%	3.85%	0.00%	0.00%	3.85%	69.23%	7.69%	0.00%	0.00%	7.69%	100.00%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
5.1	0.00%	0.00%	0.00%	3.85%	92.31%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.2	0.00%	0.00%	0.00%	0.00%	96.15%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.3	84.62%	0.00%	0.00%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.54%	0.00%	100.00%
5.4	0.00%	3.85%	26.92%	57.69%	11.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.5	7.69%	7.69%	57.69%	15.38%	7.69%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%	0.00%	100.00%
5.6	0.00%	0.00%	80.77%	15.38%	0.00%	0.00%	0.00%	3.85%	0.00%	0.00%	0.00%	0.00%	100.00%
5.7	0.00%	0.00%	0.00%	3.85%	0.00%	0.00%	0.00%	96.15%	0.00%	0.00%	0.00%	0.00%	100.00%
5.8	0.00%	0.00%	84.62%	11.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%	0.00%	100.00%
5.9	0.00%	0.00%	0.00%	3.85%	0.00%	0.00%	0.00%	96.15%	0.00%	0.00%	0.00%	0.00%	100.00%

TABLE 11
Group B

MALE													
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**Total**
1.1	**16**	**3**					**5**		**1**		2		27
1.2	**5**	**2**	**3**	**6**	**1**	**2**	**2**		**1**	**1**	3	**1**	27
1.3	**2**		**3**		**1**	**1**	**1**	**10**	**3**	**1**	4	**1**	27
1.4	**6**			**1**	**1**		**7**	**9**	**2**			**1**	27
1.5			**3**	**9**	**7**	**2**		**1**	**3**		**1**	**1**	27
1.6	**2**		**3**	**3**	**13**	**3**		**1**			**1**	**1**	27
1.7	**2**		**1**	**1**	**12**	**1**	**2**	**5**	**1**		**1**	**1**	27
1.8	**5**			**1**	**1**		**2**	**10**		**2**	**3**	**3**	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
2.1					**27**								27
2.2	**2**	**1**	**1**		**15**	**3**	**1**		**3**		**1**		27
2.3	**15**			**1**			**1**	**3**	**1**		**3**	3	27
2.4		**1**	**5**	**8**	**12**			**1**					27
2.5	**2**		**8**	**2**	**2**	**1**	**1**		**1**		**1**	9	27
2.6		**1**	**8**	**6**	**2**	**6**	**1**	**3**					27
2.7	**2**	**1**		**1**	**1**		**2**	**17**	**2**			**1**	27
2.8			**8**	**6**	**2**	**6**	**1**	**3**			**1**		27
2.9		**1**						**17**	**7**	**1**		**1**	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
3.1			**1**		**26**								27
3.2								**2**	**20**	**5**			27
3.3							**1**	**24**	**1**	**1**			27
3.4	**1**	**1**	**6**	**3**	**11**	**5**							27
3.5				**1**	**26**								27
3.6								**20**	**2**	**2**	**2**	**1**	27
3.7			**17**	**5**	**2**	**3**							27
3.8								**26**	**1**				27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
4.1	**21**	**1**		**1**			**2**	**1**			**1**		27
4.2		**2**	**5**	**19**								**1**	27
4.3				**1**	**1**			**5**	**18**	**1**	**1**		27
4.4	**2**			**1**			**3**	**14**	**3**	**4**			27
4.5	**1**		**5**	**9**	**4**	**1**	**1**	**3**			**3**		27
4.6	**1**		**15**	**9**	**1**							**1**	27
4.7	**1**		**1**		**18**	**1**	**1**		**3**	**1**		**1**	27
4.8								**22**	**2**			3	27
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
5.1				**1**	**25**	**1**							27
5.2	**1**		**1**		**25**								27
5.3	**22**	**1**					**2**				**2**		27
5.4			**7**	**17**				**1**			**2**		27
5.5	**2**		**6**	**7**	**3**			**1**		**1**	**1**	6	27
5.6		**1**	**20**	**6**									27
5.7	**1**							**24**	**2**				27
5.8		**1**	**20**	**6**									27
5.9								**25**	**2**				27
										11/16/2010	**Total Participants**		27
CORRECT													
Incorrect Plurality													

TABLE 12
Group B

MALE	Percentages												
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**Total**
1.1	**59.26%**	11.11%	0.00%	0.00%	0.00%	0.00%	18.52%	0.00%	3.70%	0.00%	7.41%	0.00%	100.00%
1.2	**18.52%**	7.41%	11.11%	**22.22%**	3.70%	7.41%	7.41%	0.00%	3.70%	3.70%	11.11%	3.70%	100.00%
1.3	7.41%	0.00%	11.11%	0.00%	3.70%	3.70%	3.70%	**37.04%**	**11.11%**	3.70%	14.81%	3.70%	100.00%
1.4	22.22%	0.00%	0.00%	3.70%	3.70%	0.00%	25.93%	**33.33%**	7.41%	0.00%	0.00%	3.70%	100.00%
1.5	0.00%	0.00%	11.11%	**33.33%**	25.93%	7.41%	0.00%	3.70%	11.11%	0.00%	3.70%	3.70%	100.00%
1.6	7.41%	0.00%	11.11%	**11.11%**	**48.15%**	11.11%	0.00%	3.70%	0.00%	0.00%	3.70%	3.70%	100.00%
1.7	7.41%	0.00%	3.70%	3.70%	**44.44%**	3.70%	7.41%	18.52%	3.70%	0.00%	3.70%	3.70%	100.00%
1.8	18.52%	0.00%	0.00%	3.70%	3.70%	0.00%	7.41%	**37.04%**	0.00%	7.41%	11.11%	11.11%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**T**
2.1	0.00%	0.00%	0.00%	0.00%	**100.00%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
2.2	7.41%	3.70%	3.70%	0.00%	**55.56%**	11.11%	3.70%	0.00%	11.11%	0.00%	3.70%	0.00%	100.00%
2.3	**55.56%**	0.00%	0.00%	3.70%	0.00%	0.00%	3.70%	11.11%	3.70%	0.00%	11.11%	11.11%	100.00%
2.4	0.00%	3.70%	18.52%	**29.63%**	**44.44%**	0.00%	0.00%	3.70%	0.00%	0.00%	0.00%	0.00%	100.00%
2.5	7.41%	0.00%	29.63%	7.41%	7.41%	3.70%	3.70%	0.00%	3.70%	0.00%	3.70%	**33.33%**	100.00%
2.6	0.00%	3.70%	**29.63%**	22.22%	7.41%	22.22%	3.70%	11.11%	0.00%	0.00%	0.00%	0.00%	100.00%
2.7	7.41%	3.70%	0.00%	3.70%	3.70%	0.00%	7.41%	**62.96%**	7.41%	0.00%	0.00%	3.70%	100.00%
2.8	0.00%	0.00%	**29.63%**	22.22%	7.41%	22.22%	3.70%	11.11%	0.00%	0.00%	3.70%	0.00%	100.00%
2.9	0.00%	3.70%	0.00%	0.00%	0.00%	0.00%	0.00%	**62.96%**	25.93%	3.70%	0.00%	3.70%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**T**
3.1	0.00%	0.00%	3.70%	0.00%	**96.30%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.41%	**74.07%**	18.52%	0.00%	0.00%	100.00%
3.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.70%	**88.89%**	3.70%	3.70%	0.00%	0.00%	100.00%
3.4	3.70%	3.70%	**22.22%**	11.11%	**40.74%**	18.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.5	0.00%	0.00%	0.00%	3.70%	**96.30%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**74.07%**	7.41%	7.41%	7.41%	3.70%	100.00%
3.7	0.00%	0.00%	**62.96%**	18.52%	7.41%	11.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**96.30%**	3.70%	0.00%	0.00%	0.00%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**T**
4.1	**77.78%**	3.70%	0.00%	3.70%	0.00%	0.00%	7.41%	3.70%	0.00%	0.00%	3.70%	0.00%	100.00%
4.2	0.00%	7.41%	18.52%	**70.37%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.70%	100.00%
4.3	0.00%	0.00%	0.00%	3.70%	3.70%	0.00%	0.00%	18.52%	**66.67%**	3.70%	3.70%	0.00%	100.00%
4.4	7.41%	0.00%	0.00%	3.70%	0.00%	0.00%	11.11%	**51.85%**	11.11%	14.81%	0.00%	0.00%	100.00%
4.5	3.70%	0.00%	**18.52%**	**33.33%**	14.81%	3.70%	3.70%	11.11%	0.00%	0.00%	11.11%	0.00%	100.00%
4.6	3.70%	0.00%	**55.56%**	33.33%	3.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.70%	100.00%
4.7	3.70%	0.00%	3.70%	0.00%	**66.67%**	3.70%	3.70%	0.00%	11.11%	3.70%	0.00%	3.70%	100.00%
4.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**81.48%**	7.41%	0.00%	0.00%	11.11%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	**T**
5.1	0.00%	0.00%	0.00%	3.70%	**92.59%**	3.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.2	3.70%	0.00%	3.70%	0.00%	**92.59%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.3	**81.48%**	3.70%	0.00%	0.00%	0.00%	0.00%	7.41%	0.00%	0.00%	0.00%	7.41%	0.00%	100.00%
5.4	0.00%	0.00%	**25.93%**	**62.96%**	0.00%	0.00%	0.00%	3.70%	0.00%	0.00%	7.41%	0.00%	100.00%
5.5	7.41%	0.00%	**22.22%**	**25.93%**	11.11%	0.00%	0.00%	3.70%	0.00%	3.70%	3.70%	22.22%	100.00%
5.6	0.00%	3.70%	**74.07%**	22.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.7	3.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**88.89%**	7.41%	0.00%	0.00%	0.00%	100.00%
5.8	0.00%	3.70%	**74.07%**	22.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**92.59%**	7.41%	0.00%	0.00%	0.00%	100.00%

TABLE 13
Group A

FEMALE													
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	14	2	1			3	1					3	24
1.2	4	1	6	6			3	3				1	24
1.3	6			2		2		9	3	1	1		24
1.4	3		1		2		3	9	2	1	2	1	24
1.5			1	2	19	1						1	24
1.6			5	4	10	5							24
1.7					15	2	1	4	1	1			24
1.8			1				2	16	2	1	1	1	24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
2.1			1	2	20							1	24
2.2				1	19	1		1	1		1		24
2.3	15						3	2				4	24
2.4	1	1	11	7	1	1						2	24
2.5	4		4	5	4						1	6	24
2.6			9	6	1	4		1			3		24
2.7	4			1		1		17			1		24
2.8	1	1	7	6	4	2		2	1				24
2.9	3	1			1		1	17	1				24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
3.1			1	1	17	5							24
3.2								4	16	3	1		24
3.3	1		2	1	2			13	1	2	2		24
3.4			2	3	4	1		5		1	1	7	24
3.5			2	1	20	1							24
3.6								19	1	4			24
3.7			17	7									24
3.8								23	1				24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
4.1	21	2					1						24
4.2	1	2	8	12					1				24
4.3	1		2		3			6	10	2			24
4.4			1					11	10	2			24
4.5	2	1	5	8				7	1				24
4.6		1	12	9	1	1							24
4.7			1	1	16	2			3	1			24
4.8								18	5	1			24
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	
5.1			1		21	2							24
5.2			1		22	1							24
5.3	22	1						1					24
5.4	1		10	9		2		1	1				24
5.5	2		12	7							2	1	24
5.6			17	7									24
5.7	2							21	1				24
5.8			17	7									24
5.9	2							21	1				24

CORRECT

Incorrect Plurality

TABLE 14
Group A

FEMALE Percentages													
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
1.1	**58.33%**	8.33%	4.17%	0.00%	0.00%	12.50%	4.17%	0.00%	0.00%	0.00%	0.00%	12.50%	100.0%
1.2	16.67%	4.17%	25.00%	**25.00%**	0.00%	0.00%	12.50%	12.50%	0.00%	0.00%	0.00%	4.17%	100.0%
1.3	25.00%	0.00%	0.00%	8.33%	0.00%	8.33%	0.00%	**37.50%**	**12.50%**	4.17%	4.17%	0.00%	100.0%
1.4	12.50%	0.00%	4.17%	0.00%	8.33%	0.00%	12.50%	**37.50%**	8.33%	4.17%	8.33%	4.17%	100.0%
1.5	0.00%	0.00%	4.17%	8.33%	**79.17%**	**4.17%**	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	100.0%
1.6	0.00%	0.00%	**20.83%**	16.67%	**41.67%**	20.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
1.7	0.00%	0.00%	0.00%	0.00%	**62.50%**	**8.33%**	4.17%	16.67%	4.17%	4.17%	0.00%	0.00%	100.0%
1.8	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	8.33%	**66.67%**	8.33%	4.17%	4.17%	4.17%	100.0%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
2.1	0.00%	0.00%	4.17%	8.33%	**83.33%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	100.0%
2.2	0.00%	0.00%	0.00%	4.17%	**79.17%**	4.17%	0.00%	4.17%	4.17%	0.00%	4.17%	0.00%	100.0%
2.3	**62.50%**	0.00%	0.00%	0.00%	0.00%	0.00%	12.50%	8.33%	0.00%	0.00%	0.00%	16.67%	100.0%
2.4	4.17%	4.17%	**45.83%**	29.17%	4.17%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	8.33%	100.0%
2.5	16.67%	0.00%	**16.67%**	20.83%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	**25.00%**	100.0%
2.6	0.00%	0.00%	**37.50%**	25.00%	4.17%	16.67%	0.00%	4.17%	0.00%	0.00%	12.50%	0.00%	100.0%
2.7	16.67%	0.00%	0.00%	4.17%	0.00%	4.17%	0.00%	**70.83%**	0.00%	0.00%	4.17%	0.00%	100.0%
2.8	4.17%	4.17%	**29.17%**	**25.00%**	16.67%	8.33%	0.00%	8.33%	4.17%	0.00%	0.00%	0.00%	100.0%
2.9	12.50%	4.17%	0.00%	0.00%	4.17%	0.00%	4.17%	**70.83%**	4.17%	0.00%	0.00%	0.00%	100.0%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
3.1	0.00%	0.00%	4.17%	4.17%	**70.83%**	20.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
3.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.67%	**66.67%**	12.50%	4.17%	0.00%	100.0%
3.3	4.17%	0.00%	8.33%	4.17%	8.33%	0.00%	0.00%	**54.17%**	4.17%	8.33%	8.33%	0.00%	100.0%
3.4	0.00%	0.00%	**8.33%**	12.50%	16.67%	4.17%	0.00%	20.83%	0.00%	4.17%	4.17%	**29.17%**	100.0%
3.5	0.00%	0.00%	8.33%	4.17%	**83.33%**	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
3.6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**79.17%**	4.17%	16.67%	0.00%	0.00%	100.0%
3.7	0.00%	0.00%	**70.83%**	29.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
3.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**95.83%**	4.17%	0.00%	0.00%	0.00%	100.0%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
4.1	**87.50%**	8.33%	0.00%	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
4.2	4.17%	8.33%	33.33%	**50.00%**	0.00%	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	100.0%
4.3	4.17%	0.00%	8.33%	0.00%	12.50%	0.00%	0.00%	**25.00%**	**41.67%**	8.33%	0.00%	0.00%	100.0%
4.4	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	**45.83%**	**41.67%**	8.33%	0.00%	0.00%	100.0%
4.5	8.33%	4.17%	**20.83%**	33.33%	0.00%	0.00%	0.00%	**29.17%**	4.17%	0.00%	0.00%	0.00%	100.0%
4.6	0.00%	4.17%	**50.00%**	37.50%	4.17%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
4.7	0.00%	0.00%	4.17%	4.17%	**66.67%**	8.33%	0.00%	0.00%	12.50%	4.17%	0.00%	0.00%	100.0%
4.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**75.00%**	20.83%	4.17%	0.00%	0.00%	100.0%
A	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	Total
5.1	0.00%	0.00%	4.17%	0.00%	**87.50%**	8.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
5.2	0.00%	0.00%	4.17%	0.00%	**91.67%**	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
5.3	**91.67%**	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	100.0%
5.4	4.17%	0.00%	**41.67%**	**37.50%**	0.00%	8.33%	0.00%	4.17%	4.17%	0.00%	0.00%	0.00%	100.0%
5.5	8.33%	0.00%	**50.00%**	**29.17%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.33%	4.17%	100.0%
5.6	0.00%	0.00%	**70.83%**	29.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
5.7	8.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**87.50%**	4.17%	0.00%	0.00%	0.00%	100.0%
5.8	0.00%	0.00%	**70.83%**	29.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.0%
5.9	8.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**87.50%**	4.17%	0.00%	0.00%	0.00%	100.0%

TABLE 15
Group B

FEMALE

B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
1.1	17	1					4				2		24
1.2	5	1	8	5	1		1		1			2	24
1.3	1		2	2	1	2	3	4	2	1	1	5	24
1.4	4	1			1		3	5	3		1	6	24
1.5			7	3	2	1	1	3		1	2	4	24
1.6	2	1	4	3	5	6	1		1			1	24
1.7	1				7	1	5	5		2	2	1	24
1.8	3				1		6	9	1	1		3	24
B	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**T**
2.1			1	1	20	2							24
2.2	4				11	3	1	2	2	1			24
2.3	13		2		2		2		1	1	1	2	24
2.4			9	5	9			1					24
2.5		1	3	2	4	1	2	3			2	6	24
2.6	2		9	4	3	2		1			1	2	24
2.7	1		1				1	17	1			3	24
2.8	2		11	5	2	2					1	1	24
2.9	1						1	19	2			1	24
B	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**T**
3.1			1	1	21	1							24
3.2				1				5	18				24
3.3			3		1		1	18		1			24
3.4		1	4	4	12	2		1					24
3.5			2		18	3			1				24
3.6			2			1		18	3				24
3.7			17	3		2		1			1		24
3.8				1				22		1			24
B	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**T**
4.1	15	3					1		2	1	2		24
4.2			8	12		2			2				24
4.3				1	2		1	6	14				24
4.4	1		1		2		2	12	4	2			24
4.5		1	11	4				6		1	1		24
4.6	2	1	15	3	1	1		1					24
4.7					13			7	4				24
4.8							2	17	3			2	24
B	**a**	**æ**	**ɛ**	**e**	**i**	**ɪ**	**ɔ**	**o**	**u**	**ʊ**	**ə**	**NR**	**T**
5.1			1	1	22								24
5.2	3	1			18	1	1						24
5.3	17	3	3						1				24
5.4			10	6	3			3	2				24
5.5	2	1	5	3	4			3				6	24
5.6			19	4	1								24
5.7				1				22	1				24
5.8			19	4	1								24
5.9				1				22	1				24

CORRECT

Incorrect Plurality

TABLE 16
Group B

FEMALE Percentages													
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
1.1	**70.83%**	4.17%	0.00%	0.00%	0.00%	0.00%	16.67%	0.00%	0.00%	0.00%	8.33%	0.00%	100.00%
1.2	20.83%	4.17%	**33.33%**	**20.83%**	4.17%	0.00%	4.17%	0.00%	4.17%	0.00%	0.00%	8.33%	100.00%
1.3	4.17%	0.00%	8.33%	8.33%	4.17%	8.33%	12.50%	16.67%	**8.33%**	4.17%	4.17%	**20.83%**	100.00%
1.4	16.67%	4.17%	0.00%	0.00%	4.17%	0.00%	12.50%	**20.83%**	12.50%	0.00%	4.17%	**25.00%**	100.00%
1.5	0.00%	0.00%	**29.17%**	**12.50%**	8.33%	4.17%	4.17%	12.50%	0.00%	4.17%	8.33%	16.67%	100.00%
1.6	8.33%	4.17%	16.67%	**12.50%**	20.83%	**25.00%**	4.17%	0.00%	4.17%	0.00%	0.00%	4.17%	100.00%
1.7	4.17%	0.00%	0.00%	0.00%	**29.17%**	4.17%	20.83%	20.83%	0.00%	8.33%	8.33%	4.17%	100.00%
1.8	12.50%	0.00%	0.00%	0.00%	4.17%	0.00%	25.00%	**37.50%**	4.17%	4.17%	0.00%	12.50%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
2.1	0.00%	0.00%	4.17%	4.17%	**83.33%**	8.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
2.2	16.67%	0.00%	0.00%	0.00%	**45.83%**	12.50%	4.17%	8.33%	8.33%	4.17%	0.00%	0.00%	100.00%
2.3	**54.17%**	0.00%	8.33%	0.00%	8.33%	0.00%	8.33%	0.00%	4.17%	4.17%	4.17%	8.33%	100.00%
2.4	0.00%	0.00%	**37.50%**	**20.83%**	37.50%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	100.00%
2.5	0.00%	4.17%	12.50%	8.33%	16.67%	4.17%	8.33%	12.50%	0.00%	0.00%	8.33%	**25.00%**	100.00%
2.6	8.33%	0.00%	**37.50%**	16.67%	12.50%	8.33%	0.00%	4.17%	0.00%	0.00%	4.17%	8.33%	100.00%
2.7	4.17%	0.00%	4.17%	0.00%	0.00%	0.00%	4.17%	**70.83%**	4.17%	0.00%	0.00%	12.50%	100.00%
2.8	8.33%	0.00%	**45.83%**	20.83%	8.33%	8.33%	0.00%	0.00%	0.00%	0.00%	4.17%	4.17%	100.00%
2.9	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	**79.17%**	8.33%	0.00%	0.00%	4.17%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
3.1	0.00%	0.00%	4.17%	4.17%	**87.50%**	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3.2	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	20.83%	**75.00%**	0.00%	0.00%	0.00%	100.00%
3.3	0.00%	0.00%	12.50%	0.00%	4.17%	0.00%	4.17%	**75.00%**	0.00%	4.17%	0.00%	0.00%	100.00%
3.4	0.00%	4.17%	**16.67%**	16.67%	**50.00%**	8.33%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	100.00%
3.5	0.00%	0.00%	8.33%	0.00%	**75.00%**	12.50%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	100.00%
3.6	0.00%	0.00%	8.33%	0.00%	0.00%	4.17%	0.00%	**75.00%**	12.50%	0.00%	0.00%	0.00%	100.00%
3.7	0.00%	0.00%	**70.83%**	12.50%	0.00%	8.33%	0.00%	4.17%	0.00%	0.00%	4.17%	0.00%	100.00%
3.8	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	**91.67%**	0.00%	4.17%	0.00%	0.00%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
4.1	**62.50%**	12.50%	0.00%	0.00%	0.00%	0.00%	4.17%	0.00%	8.33%	4.17%	8.33%	0.00%	100.00%
4.2	0.00%	0.00%	**33.33%**	**50.00%**	0.00%	8.33%	0.00%	0.00%	8.33%	0.00%	0.00%	0.00%	100.00%
4.3	0.00%	0.00%	0.00%	4.17%	8.33%	0.00%	4.17%	25.00%	**58.33%**	0.00%	0.00%	0.00%	100.00%
4.4	4.17%	0.00%	4.17%	0.00%	8.33%	0.00%	8.33%	**50.00%**	16.67%	8.33%	0.00%	0.00%	100.00%
4.5	0.00%	4.17%	**45.83%**	16.67%	0.00%	0.00%	0.00%	25.00%	0.00%	4.17%	4.17%	0.00%	100.00%
4.6	8.33%	4.17%	**62.50%**	12.50%	4.17%	4.17%	0.00%	4.17%	0.00%	0.00%	0.00%	0.00%	100.00%
4.7	0.00%	0.00%	0.00%	0.00%	**54.17%**	0.00%	0.00%	29.17%	16.67%	0.00%	0.00%	0.00%	100.00%
4.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.33%	**70.83%**	12.50%	0.00%	0.00%	8.33%	100.00%
B	a	æ	ɛ	e	i	ɪ	ɔ	o	u	ʊ	ə	NR	T
5.1	0.00%	0.00%	4.17%	4.17%	**91.67%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.2	12.50%	4.17%	0.00%	0.00%	**75.00%**	4.17%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.3	**70.83%**	12.50%	12.50%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	100.00%
5.4	0.00%	0.00%	**41.67%**	25.00%	12.50%	0.00%	0.00%	12.50%	8.33%	0.00%	0.00%	0.00%	100.00%
5.5	8.33%	4.17%	**20.83%**	12.50%	16.67%	0.00%	0.00%	12.50%	0.00%	0.00%	0.00%	**25.00%**	100.00%
5.6	0.00%	0.00%	**79.17%**	16.67%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.7	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	**91.67%**	4.17%	0.00%	0.00%	0.00%	100.00%
5.8	0.00%	0.00%	**79.17%**	16.67%	4.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.9	0.00%	0.00%	0.00%	4.17%	0.00%	0.00%	0.00%	**91.67%**	4.17%	0.00%	0.00%	0.00%	100.00%

IPA	Examples
b	**b**oat
d	**d**uck
dž	**g**in
f	**f**at
g	**g**ood
j	**y**es
k	**c**at
l	**l**ove
m	**m**an
n	**n**o
ŋ	fi**ng**er
p	**p**iano
r	**r**ock
s	**s**oup
š	**sh**ip
t	**t**iger
ts	pi**zz**a
č	**ch**ip
v	**v**alor
z	**z**ipper

IPA	Examples
a	f**a**ther
æ	**a**pple
ɛ	**e**cho
e	**a**ble
i	**e**vil
ɪ	**i**n
ɔ	**aw**ful
o	**o**h
u	t**oo**l
ʊ	h**oo**d
ə	**a**bout

(A)

1.) ___ndr___ s___ p___nt___ v___kk___ ___

2.) M___ p___ ___č___ ___ b___ll___ b___ll___

3.) M___ str___gg___ ___ m___ t___rm___nt___

4.) ___ndr___ s___ p___nt___ v___kk___ ___

5.) M___ p___ ___č___ ___ b___ll___ b___ll___

(B)

1. ___ndr___ s___ p___nt___ v___kk___ ___

2. M___ p___ ___č___ ___ b___ll___ b___ll___

3. M___ str___gg___ ___ m___ t___rm___nt___

4. ___ndr___ s___ p___nt___ v___kk___ ___

5. M___ p___ ___č___ ___ b___ll___ b___ll___