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# Examining the Intelligibility Differences between Two Types of Clear Speech

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# ABSTRACT

This study investigates the intelligibility differences between global and focal clear speech adjustments in comparison to baseline or conversation speech. The objective is to determine what adjustments need to be made for individuals with speech disorders to produce intelligible and effective speech. Clear speech is a style of speaking where words are longer, articulatory precision is greater, and speaking rate is slower than conversational speech (Picheny et al. 1986). Clear speech represents a style of speech that supports better understanding than other speech. These adjustments are beneficial for many individuals, specifically those with conditions like dysarthria secondary to amyotrophic lateral sclerosis (ALS) (Lee et al., 2019). The current study recruited listeners through Prolific to listen to recordings of 9 different words produced by 12 talkers embedded in speech-shaped noise. Through conducting this study, we can understand what perceptual qualities contribute to higher intelligibility rates of clear speech while also considering factors such as vocal fatigue. This research study can help further speech recognition technologies, speech therapy practices, and contribute to overall effective and efficient communication.

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# Chapter 1

## Introduction

Being in a noisy environment such as a restaurant, bar, concert, or anywhere overpopulated with noise can make conversing difficult. In these noisy environments, people struggle to hear one another and communicate effectively. These situations can be particularly challenging for someone with a hearing or language disorder. To avoid this problem, one must consider a solution: the intelligibility benefits of clearly spoken speech.

Examining clear speech is important for many reasons because it not only helps people in their daily lives to communicate more efficiently and effectively but it also has been shown to help individuals across various speech and hearing disorders. Clear speech is a way for individuals to enhance their natural speech to become better understood. Clear speech is a style of speaking where words are longer, articulatory precision is greater, and speaking rate is slower than conversational speech (Picheny, Durlach, & Braida, 1986). These adjustments improve speech intelligibility for listeners when compared to habitual conversational speech. There will be two types of clear speech that will be tested for their intelligibility levels which include global and focal speech. These clear speech adjustments will be compared to baseline speech which is normal conversation speech (Picheny, Durlach, & Braida, 1985).

The goal of this study is to investigate the intelligibility modifications that are made when a person is speaking conversationally and then adapts a clear speaking style (Smiljanić & Bradlow, 2009). Conversational speech is natural and usually occurs spontaneously while clear speech is elicited when someone is given specific speaking instructions or cues. These

instructions can consist of global or focal adjustments. From this study, it is predicted that global and focal adjustments yield higher accuracies of intelligibility compared to baseline speech. It is also predicted that global speech adjustments will show more accuracy than focal speech adjustments.

## Sub-Chapter 1 (Global and Focal Speech Adjustments)

Global and focal adjustments are alterations talkers make when they are trying to speak to someone more clearly (Maniwa et al., 2009). Maniwa et al., (2009) investigate the acoustic properties of clearly produced constants in clear spoken English compared to conversational English. It is important to consider the acoustic characteristics that contribute to clear speech and its increased intelligibility. Global or sentence-level patterns are characterized by reduced speaking rate, more frequent and longer pauses, increased mean and range of fundamental frequencies (f0), shifts in energy to higher frequency regions in long-term spectra, and deeper temporal amplitude modulations (Maniwa et al., 2009). Focal patterns are more targeted adjustments to specific sounds and speech patterns, for example, to elicit this type of speech someone could say, “Say this word so it is not confused with that word”. Global and focal speech can be prompted through different directions. These directions help speakers understand the importance of clarity in how they should produce that word or sentence. Some examples of global directions include, “Speak to someone as if you are in a noisy bar” or “Speak to someone who has a hearing impairment”. These simple directions can completely change the output of someone's speech leading them to produce more enhanced and intelligible speech (Maniwa et al., 2009).

To gather results, Maniwa et al., (2009) recruited 20 talkers (10 male and 10 female) who were directed to record themselves speaking in conversational and clear speaking styles. The tokens consisted of vowel-fricative-vowel syllables where the 8 English fricatives (/f/, /θ/, /s/, /ʃ/, /v/, /ð/, /z/ were used in conjunction with the vowels, /ʒ/ and /ɑ/. For example, the tokens were listed as, “afa”, “atha”, “asa”, etc. Participants were given the tokens before they recorded themselves to become familiar with the syllables. The study was divided into two blocks: one where the participants were directed to speak conversationally and the other where they had to speak clearly as if they were talking to someone who was hearing-impaired or an elderly person.

Because the researchers looked at the acoustic properties of the two types of speaking patterns in detail, they confirmed that clear speech adjustments were more understandable and not just different than conversational speech. They found this by analyzing the different fricative sounds to see how they changed over each participant and speaking style. The recordings were played for listeners with normal hearing, non-native speakers, and simulated hearing loss, and the results showed that clear speech was more intelligible than conversational for these listeners.

Although Maniwa et al., (2009) conducted an acoustic study, it still shows that they were able to find that clear speech provides higher intelligibility levels than conversational speech when using global and focal speech adjustments. This is just one study out of many that supports the benefit of clear speech.

## Sub-Chapter 2 (Dysarthria Secondary to ALS)

The study of clear speech is quite relevant to the Communication Sciences and Disorders field for various reasons. Clear speech can prompt individuals with certain speech disorders to

speak better than they would if they were talking conversationally. This prompting increases intelligibility among people who suffer from speaking limitations (Lee et al., 2019). Limitations such as dysarthria secondary to amyotrophic lateral sclerosis (ALS) and cerebral palsy are just two of the many conditions that can be highly influenced by clear speech (Lee et al., 2019). Individuals with dysarthria secondary to ALS have slower speaking rates, trouble with precise articulation of sounds, and changes in vocal quality (Lee et al., 2019).

Lee et al., (2019) examined acoustic differences between 23 individuals with dysarthria secondary to ALS and 22 typically aging individuals. The 2 severity groups of the individuals with dysarthria secondary to ALS included mild and severe. To conduct this study, each speaker said a sentence or a carrier phrase that had the stimulus included. The stimulus consisted of 10 monophthongs from the English language (/i, ɪ, ɛ, æ, u, ʊ, o, ʌ, ɔ, ɑ/) and were embedded into the carrier phrase, "I say a __ again" through /hvd/ words. After the speech samples were collected, 135 listeners listened to 30 edited audio files and then picked what they heard from a multiple-choice question. Three listeners were assigned to one speaker and could only listen to the audio file once in a randomized order. It was concluded that some vowels such as /ɪ/ showed to be less intelligible in speakers with severe dysarthria.

Vowel-specific intelligibility is an important topic of research because of its contribution to furthering interventions for speaker intelligibility with individuals who struggle with dysarthria secondary to ALS. Specifically with individuals who have dysarthria secondary to ALS, clear speech is a useful tactic that could improve the overall intelligibility of their speech (Lee et al., 2019). There is evidence that these speakers have more difficulty with shaping their mouths and using the muscles in their mouths to produce the sounds they want. This is because speakers with dysarthria secondary to ALS have lost some control over the muscles in their

mouths due to nerve damage. Although some speakers with language or speech disorders can struggle due to certain limitations, clear speech is a tool that can be used to improve their quality of speech and overall intelligibility.

## Sub-Chapter 3 (Parkinson's Disease)

Dysarthria is a neuromotor speech disorder that affects the way a person is able to produce speech (Stipancic et al., 2022). Dysarthria can result in individuals having less intelligible speech which can negatively affect their quality of life. This is the case for many individuals with Parkinson's Disease (PD) which Stipancic et al., (2022) discusses. The purpose of the study was to elicit three variants of clear speech to see if there was an increase in intelligibility among individuals with PD. 14 speakers with PD and 14 neurologically healthy speakers participated in the study. Each participant said 18 sentences in habitual or conversational speech, clear speech (given instructions to speak clearly), hearing impaired (given instructions to speak with someone as if they had a hearing impairment), and overenunciation (they had to overenunciate each word). They were also asked to report levels of fatigue and effort. Once the recordings from each participant were collected, 50 native listeners orthographically transcribed the sentences.

The results of the Stipancic et al., (2022) paper showed that each of the three clear speech variants significantly improved intelligibility for the speakers with PD. For the habitual or conversational variant, intelligibility did not improve which was expected. It was noted that speaking effort was much higher for the clear speech variants than for the habitual. This is just another example of how clear speech can drastically improve an individual's quality of speech

and life. Although these speaking styles may come with more effort and fatigue, they still give individuals with PD the potential to communicate effectively and be understood by their loved ones.

## Sub-Chapter 4 (Hearing Impairments)

Clear speech has the potential to help individuals who struggle with hearing impairments. It allows family members and friends to communicate more effectively with their loved ones who have these deficits (Picheny, Durlach, & Braida, 1985). Picheny, Durlach, & Braida, (1985) examined whether or not clear speech could be a more effective and intelligible form of communication than conversational speech for individuals with sensorineural hearing loss. 5 listeners with sensorineural hearing loss were recruited as well as 3 male talkers. The talkers recorded groups of 40 conversational sentences and 40 clear sentences and were requested to speak as clearly as possible and as if they were trying to speak to someone with a hearing impairment in a noisy setting. The recordings were then altered into two separate conditions: speech sounds were adjusted (frequency-gain characteristics) and the volume (level) at which the recordings were played. There were then two types of sound adjustments that were made: ORTH, where the speech was played at an even sound across all frequencies, and OMCL, where the listeners could adjust the volume at four different frequencies. For each sound adjustment, the speech was played at three different volumes including the most comfortable volume (MCL), the loudest tolerable volume (MAX), and the volume slightly quieter than the most comfortable (MCL-10).

Because of the many different variations, the listeners heard the recordings in 36 different conditions. Each listener was requested to listen to 50 sentences in each condition and the sentences were repeated twice. Once a set of 50 conversational sentences was presented, the listener waited one month to listen to the clear sentences. The main takeaway from this study showed that speaking clearly can significantly improve speech intelligibility for listeners with hearing impairments. Clear speech compared to conversational speech differed by an average of 17 percentage points regardless of all of the factors. These factors included the listener's hearing profile, the frequency adjustments, and the volume. Fatigue was also a factor being that the listeners mentioned it took more effort to understand the clear speech because of its slower rate. Overall, the results showed that clear speech can once again improve intelligibility and help pave the way for effective speech comprehension for individuals with hearing impairments.

Picheny, Durlach, & Braida, (1986) was the second paper to be written about the benefit of clear speech for individuals with hearing impairments, but from the angle of analyzing the acoustic characteristics. The goal of this study was to understand the different methods of eliciting clear speech, compare acoustic properties of conversational speech versus clear speech, see what acoustic properties lead to higher intelligibility rates, and lastly, apply all of the findings to further the research of hearing aids and communication problems. To gather this data, the same three talkers from the previous study (Picheny, Durlach, & Braida, 1985) were instructed to repeat fifty nonsense sentences in either conversational or clear speech. The sentences were examined through three different groups: global, phonological, and phonetic. To analyze global changes, the researchers looked at speaking rate, pause, and fundamental frequency distributions (f0: lowest frequency of a sound wave), and long-term RMS (Root Mean Square) spectra (measuring loudness of a sound over a long period). For phonological changes,

they looked at the number of times a specific phonological phenomenon occurred. Looking at phonetic changes, phoneme durations, short-term RMS spectra (measuring the loudness of a sound over a short period), amplitudes of vowels and consonants, and formant frequencies were observed. The acoustic analysis for this study can be summarized as follows: for clear speech productions, average speaking rates are faster, there were longer and more frequent pauses, the volume of speech was somewhat higher than conversational but did not contribute to overall intellgibility, and there were no dramatic differences in fundamental frequencies (Picheny, Durlach, & Braida, 1986).

## Sub-Chapter 5 (Fatigue & Speaking Effort)

The benefits of clear speech can be measured acoustically, but for this study, the focus will be on the intelligibility benefits of clear speech (Smiljanić & Bradlow, 2009). Although it may be true that clear speech can lead to better intelligibility in individuals with disordered speech, it is also true that vocal fatigue is a very prominent component of this type of speech. This is specifically apparent in individuals with degenerative diseases such as Parkinson's disease (Stipancic et al., 2022). Clear speech can be quite effortful which is why those individuals should be encouraged to focus on certain aspects that will be beneficial for their speech intelligibility. Speaker effort is not something that only affects individuals with disorders, but it is also a part of our daily lives. Speakers tend to use minimal effort as long as they are being understood and more often when using conversational or habitual speech (Stipancic et al., 2022). Effort is increased when directed or prompted to use clear speech because it requires more thought and action to carry out. In the case that someone struggles with producing intelligible

speech, if the type of clear speech that is being prompted requires too much effort from the speaker, the value of the clear speech being used becomes less. Instead of improving speech, it may cause frustration or lead to fatigue and end up counteracting the overall benefit (Stipancic et al., 2022). It is important to focus on the parts of clear speech that are most useful for a particular individual who struggles with their speech and being understood. This is why research is conducted to test the effectiveness of clear speech and the main components of global and focal speech that make it increasingly intelligible to listeners. By conducting this study, we can examine the intelligibility differences between two types of clear speech: global and focal.

## Sub-Chapter 6 (Previous Study)

A previous study conducted by Chelsea Kirsch elicited two types of clear speech and examined their acoustic properties. The types consisted of global and focal speech adjustments. Variability between the two types was found suggesting that there may be differences in intelligibility. This perceptual study will address the overarching question to see if there are intelligibility differences between global versus focal speech. For instance, if a listener were to hear two different types of clear speech, which one would be more intelligible?

# Chapter 2

## Methods

A. Participants

To complete this study, a total of 30 participants (14 males, 16 females) aged between 24 and 67 years were recruited through Prolific where this research study has been published. All participants reported that they had no language-related disorders. The participants who were used in the previous study consisted of 12 healthy American English talkers, but only 9 of them were chosen for the study. The speech samples or stimuli were collected asynchronously, and the participants were prompted in various ways to produce sentences in global, focal, or baseline speech. The sentences were focused around 9 different /hvd/ words meaning each word started with the letter “h” had a vowel in between, and then ended with the letter /d/.

B. Materials

The materials used to complete this study included the pre-recorded stimulus from the previous study. The participants were asked to use headphones during the task and were directed to take the study on a desktop computer.

C. Procedure

Once the participants were selected on Prolific and began the study, they were directed to find a quiet room and use headphones to ensure that they could hear the stimuli properly. They were given a headphone test before the study started to make sure that their volume worked. After the participants read through the directions, they were given 5 trial runs of stimuli to become accustomed to how the stimuli sounded. Once the trials were completed, the participants were directed to start the experiment. There were 6 groups consisting of 3 speakers which were randomly assigned to each participant. During the preliminary phase of this study, 3 of the 6

groups were giving the participants some issues so they were excluded from the study. The participants were either given groups 3,4, or 5. The participants then listened to the group that they were assigned and selected the word they heard for each stimulus. After the participants play the sound, the next slide gives them the 9 possible /hvd/ words to choose from. Each group has over 200 stimulus recordings. After the trial is completed, the participants are directed to respond to a demographic questionnaire that asks for their age, gender, racial background, if English is their first language, what other languages they speak, where they have lived most of their lives, if they have normal vision, and if they have any diagnosed speech or hearing disorders. It should also be noted that Prolific has specific options to ensure the participants are English speakers and that English is their first language. Overall, the study took most participants about 30-35 minutes to complete.

D. Stimuli

Global, focal, and baseline speech stimuli were gathered from a previous research study that I had previously worked on with master's student, Chelsea Kirsch. The stimuli consist of over a thousand recordings of 9 different words which have been divided into 6 groups. Each group of stimuli has 3 different native English speakers who did their best to provide clear and articulate pronunciations of the given tokens. The groups also contain baseline or conversational speech stimuli to compare the global and focal stimuli to the baseline stimuli. Each group has over 200 stimuli recordings. The token sentences include /hvd/ words “hid”, “had”, “hood”, “head”, “hud”, “hod”, “hoed”, “heed”, and “whod”. “H” vowel “d” words are a way to isolate the desired vowel to get a precise pronunciation of the vowel sounds. /h/ is the consonant sound at the beginning of the word, like “hat”, /v/ is the vowel sound between the word, like “ah” or “eh”, and /d/ is the constant sound at the end of the word, like “had”. Each of these words was

extracted from the whole sentence to ensure the listeners would not be confused with what they should be listening for. The words were then covered with noise that is similar to human patterns of speech which is called speech-shaped noise. The purpose of doing this is to mask the sounds to create a controlled environment to see what the listener can hear clearly versus not. This can also help the listener focus on the stimuli rather than the background noise.

To get speech-shaped noise, one must take white noise and the envelope of someone's speech and match the noise to that. This creates a sound that is focused on the part of the acoustic spectrum that contains their speech signal causing the stimuli to be masked. It is essentially a form of background noise that is harder to hear than white noise and is specific to each speaker's speech. To calculate this, all the productions from the speakers are taken. A speech-shaped noise is then calculated using samples from each speaker. Single words are taken from the samples and the specific noises from that speaker. To break it down further, someone’s speech is taken, and calculations of their long-term average spectrum (average of frequencies in a sound) are done to find the frequency envelope of this speech and then used to impose it on a noise sample.

# Chapter 3

## Results

The purpose of this study was to determine if global and focal speech adjustments can lead to the perception of higher intelligibility of speech in comparison to baseline or conversational speech. It was hypothesized that global and focal speech adjustments would be more intelligible than baseline speech. Although this was the case, it is important to consider which speech adjustments can lead to increasingly intelligible speech. The results showed that overall global and focal speech adjustments did yield a higher accuracy of perceiving the /hvd/ words than baseline speech. This was true for each task (groups 3,4, and 5) as well as each condition (global, focal, and baseline). Figures 1 and 2 show clear examples of the accuracy average data being represented across two different x-axes.

Figure 1 shows the accuracy averages of each condition across the three different groups. To break this bar chart down, it is shown that the global and focal conditions were higher in accuracy than the baseline condition. It is noted that the global and focal conditions are very close in accuracy for the group 3 task and group 4 task. In the group 3 task, the accuracy averages for the global and focal conditions are both 65%. In the group 4 task, the focal condition stands at 66% and the global accuracy is 67%, showing that they are very similar in accuracy averages.

A shift is seen in the group 5 task where the focal condition is much higher in accuracy compared to the global condition. The global condition has an accuracy of 53% while the focal condition has an accuracy of 57%. This could be for various reasons, including that the talkers did not adjust their global speech as clearly as they did for their focal speech adjustments. There

is also the possibility that the listeners or participants who randomly received Group 5 did not have the best hearing or struggled to hear the stimuli that were presented.

Figure 2 goes more into detail about the accuracy averages of each /hvd/ word giving us a better understanding of the words that were the most intelligible to the listeners through each of the 3 conditions. From the bar chart, we can see that “had” and “heed” were perceived the most accurately compared to the other /hvd/ words. “Hid” is another /hvd/ word that stands out over the 3 conditions. It shows 80% accuracy in the focal condition, 75% accuracy in the global condition, and 79% in the baseline condition. This is very surprising to see that the baseline condition shows a higher accuracy than the global condition. We can also see that the global and focal conditions have a greater accuracy overall in comparison to baseline speech. The global and focal conditions are not very far off from one another when looking at each of the different /hvd/ words. More significant differences are shown in the accuracy averages of global and focal in comparison to the baseline conditions. Some examples include that “head” for baseline shows 50% accuracy while focal shows 69% and global stands at 62% accuracy. Another example is “whod” showing 66% for focal, 59% for global, and only 51% for baseline.

At first, it was surprising to see a trend of the focal condition being the most intelligible while perceived by the listeners, which is why it is important to consider the contents of Table 1. This table shows the number of trials of stimuli each participant received throughout the study. It is broken down by each condition: global, focal, and baseline. We are also given the grand total of the trials that each participant had. Right away we can see that the focal condition had the most trials for each participant consisting of anywhere from 116 to 117 trials. The baseline condition consists of 66 to 68 trials and the global condition is anywhere between 53 and 63 trials. These numbers tell us that the participants had many more opportunities to hear the focal

conditions rather than the global or baseline conditions. Baseline also has more trials than global, giving the global condition the least number of trials to be heard by the participants.

**Figure 1**

*Note.* This figure demonstrates the accuracy averages across three different groups in three different conditions.

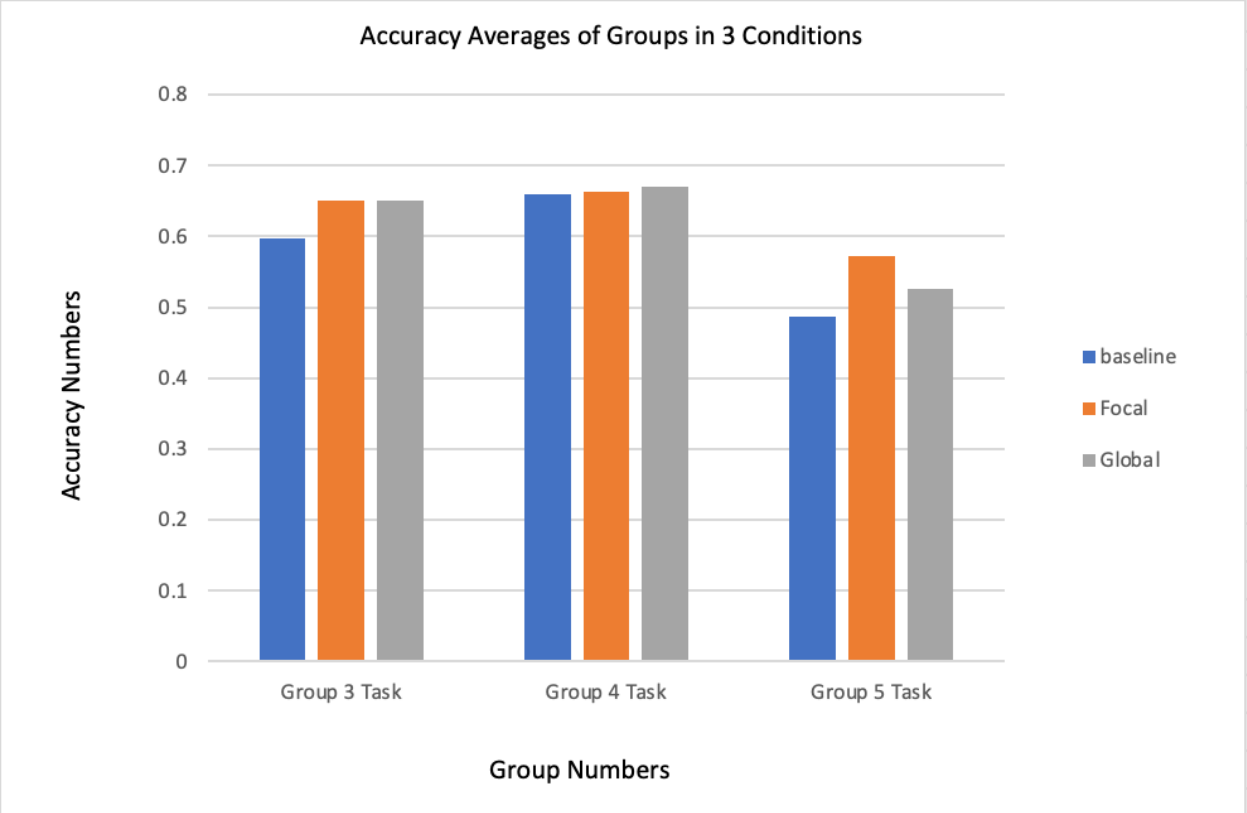

**Figure 2**

*Note.* This figure demonstrates accuracy averages across three different conditions in six /hvd/ words.

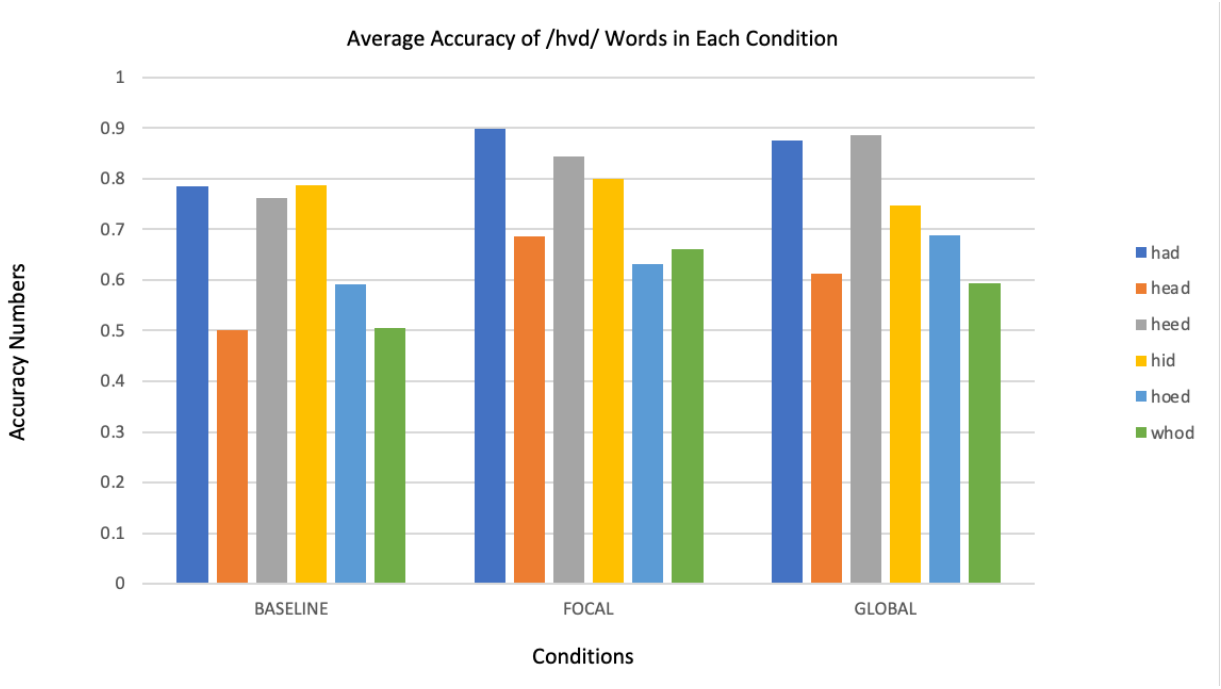

**Table 1**

*Note.* This table demonstrates the number of participants present in the study as well as the number of trials each participant was given in each of the three conditions.

| Participant Numbers | baseline | Focal | Global | Grand Total |
|---|---|---|---|---|
| 1021450 | 66 | 116 | 63 | 245 |
| 1026426 | 67 | 117 | 63 | 247 |
| 1026585 | 67 | 117 | 63 | 247 |
| 1028135 | 68 | 117 | 53 | 238 |
| 1028137 | 66 | 116 | 63 | 245 |
| 1028140 | 67 | 117 | 63 | 247 |
| 1028141 | 68 | 117 | 53 | 238 |
| 1028142 | 66 | 116 | 63 | 245 |
| 1028143 | 68 | 117 | 53 | 238 |
| 1028155 | 67 | 117 | 63 | 247 |
| 1028157 | 66 | 116 | 63 | 245 |
| 1028257 | 66 | 116 | 63 | 245 |
| 1028259 | 68 | 117 | 53 | 238 |
| 1028260 | 67 | 117 | 63 | 247 |
| 1028262 | 66 | 116 | 63 | 245 |
| 1028263 | 66 | 116 | 63 | 245 |
| 1028265 | 67 | 117 | 63 | 247 |
| 1028267 | 68 | 117 | 53 | 238 |
| 1028275 | 66 | 116 | 63 | 245 |
| 1028289 | 67 | 117 | 63 | 247 |
| 1028296 | 68 | 117 | 53 | 238 |
| 1028297 | 68 | 117 | 53 | 238 |
| 1028319 | 66 | 116 | 63 | 245 |
| 1028324 | 68 | 117 | 53 | 238 |
| 1028374 | 66 | 116 | 63 | 245 |
| **Grand Total** | **1673** | **2915** | **1495** | **6083** |

# Chapter 4

## Discussion

The focus of this study was to investigate the differences in the intelligibility of focal and global speech adjustments in comparison to baseline speech. We are trying to understand if the difference in a speech adjustment can contribute to a higher intelligibility of understanding speech. For the focal condition, we are looking at targeted adjustments that are made to a specific speech sound. For example, if someone were to elicit this type of speech they would say, "Produce the word 'had' so it is not confused with 'hid'." This instructs the speaker to only focus on that one vowel difference rather than targeting the whole sentence or word. For the global condition, the whole sentence or phrase is being targeted and it is a broader adjustment to the speech that is being produced. If someone were to elicit global speech they could say, "Speak to someone as if they have a hearing impairment". This helps the speaker understand that they need to focus on the whole phrase rather than one singular speech sound or pattern. The baseline condition is just natural conversation speech.

From the results, we found that clear speech adjustments do show an overall intelligibility improvement in speech compared to the baseline condition. The global and focal conditions both contributed to higher accuracy of intelligibility when compared to baseline speech. When the results were broken down further, it seemed to show that the focal condition provided a higher accuracy than the global condition. This was surprising to see because, in the preliminary data that had been previously gathered, the global condition seemed to be higher in terms of accuracy. Before running the study, it was expected that the global condition would be more intelligible because it addresses the overall adjustment. Now that the study has been completed and the data has been gathered, multiple reasons make sense for why the focal condition would be the most

accurate. One of the reasons is because of the number of trials of the focal condition that each listener received. There was a much greater number of focal tokens rather than the global or baseline conditions. This means the listeners heard more focal tokens overall, rather than the number of trials evenly spread across the three conditions. This shows us that even though the focal condition resulted in the highest accuracy, it could solely be because the participants were given more focal tokens than any of the other conditions.

Although it was unexpected that the focal conditions provided the highest accuracy, there are reasons to believe that if future directions were to take place and the participants were given a larger number of global tokens, the results could be different. A big takeaway here is that even though the focal and global conditions differ, overall, they are both more intelligible than the baseline condition. In terms of future directions, because this is a perceptual study, we also need to consider the idea of delving into the acoustic and phonetic characteristics that contribute to clear speech and its overall intelligibility. This research along with previous and future studies should be applied to intervention approaches for individuals who struggle with producing or perceiving intelligible speech as well as diverse populations across different languages and disorders. It is also important to consider that if focal adjustments provide more intelligibility than global adjustments, then this could contribute to helping an individual with dysarthria secondary to ALS. As fatigue was mentioned previously, individuals with these conditions may find it easier to focus on a more specific adjustment rather than a global approach to avoid that fatigue.

Collecting data and running a study can come with challenges and limitations. Originally the study was supposed to have 6 groups consisting of 3 talkers per group and over 200 tokens in each group. Sometimes things do not go exactly as planned which is what happened in this case.

Once the study was published on prolific and participants were being run, 3 groups malfunctioned and had to be removed. This left 3 groups that worked properly which in turn decreased the amount of data to work with in the end. Instead of being able to compare the 3 conditions over the 6 groups, we could only compare the 3 conditions to 3 groups. Although this was a limitation, it did not keep from completing the study and continuing to run participants.

Overall, the study and the findings have helped further the research that clear speech adjustments can and do contribute to a higher intelligibility of understanding and communicating speech. These results show us the importance of clear speech and how effective minor adjustments can be for individuals with or without speech and hearing disorders.

## REFERENCES

Lee, J., Dickey, E., & Simmons, Z. (2019). Vowel-specific intelligibility and acoustic patterns in individuals with dysarthria secondary to amyotrophic lateral sclerosis. Journal of Speech, Language, and Hearing Research, 62(1), 34–59. https://doi.org/10.1044/2018_jslhr-s-17-0357

Maniwa, K., Jongman, A., & Wade, T. (2009). Acoustic characteristics of clearly spoken English fricatives. The Journal of the Acoustical Society of America, 125(6), 3962–3973. https://doi.org/10.1121/1.2990715

Picheny, M. A., Durlach, N. I., & Braida, L. D. (1985). Speaking clearly for the hard of hearing I: Intelligibility differences between clear and conversational speech. Journal of Speech and Hearing Research, 28(1), 96-103.

Picheny, M. A., N. I. Durlach, and L. D. Braida. (1986). Speaking clearly for the hard of Hearing II: Acoustic Characteristics of Clear and Conversational Speech. Journal of Speech, Language, and Hearing Research 29(4):434–46. doi: 10.1044/jshr.2904.434.

Smiljanić, R., & Bradlow, A. R. (2009). Speaking and hearing clearly: Talker and listener factors in speaking style changes. Language and Linguistics Compass, 3(1), 236–264. https://doi.org/10.1111/j.1749-818x.2008.00112.x

Stipancic, K. L., van Brenk, F., Kain, A., Wilding, G., & Tjaden, K. (2022). Clear speech variants: An investigation of intelligibility and speaker effort in speakers with

parkinson's disease. American Journal of Speech-Language Pathology, 31(6), 2789–2805. https://doi.org/10.1044/2022_ajslp-22-00189