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Educational Information Improves Listener Attitudes Toward People With Dysarthria Secondary to Parkinson's Disease

Annalise R. Fletcher,[a] Madison W. Potts,[b] and Stephanie A. Borrie[a]

[a] Department of Communicative Disorders and Deaf Education, Utah State University, Logan [b] Department of Audiology and Speech-Language Pathology, University of North Texas, Denton

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ABSTRACT

Purpose: People with dysarthria have been rated as less confident and less likable and are often assumed by listeners to have reduced cognitive abilities relative to neurotypical speakers. This study explores whether educational information about dysarthria can shift these attitudes in a group of speakers with hypokinetic dysarthria secondary to Parkinson's disease.
Method: One hundred seventeen listeners were recruited via Amazon Mechanical Turk to transcribe sentences and rate the confidence, intelligence, and likability of eight speakers with mild hypokinetic dysarthria. Listeners were assigned to one of four conditions. In one condition, listeners were provided with no educational information prior to exposure to speakers with dysarthria (n = 29). In another condition, listeners were given educational statements from the American Speech-Language-Hearing Association website (n = 29). In a third condition, listeners were given additional information stating that dysarthria does not indicate reduced intelligence or understanding (n = 30). Finally, in a fourth condition, listeners only heard samples from neurotypical, age-matched adults (n = 29).
Results: Results revealed statistically significant effects of educational statements on ratings of speakers' confidence, intelligence, and likability. However, educational statements did not affect listeners' transcription accuracy.
Conclusions: This study presents preliminary evidence that educational material can positively influence listener impressions of speakers with hypokinetic dysarthria, especially when it is explicitly stated that the disorder does not affect intelligence or understanding. This initial examination provides preliminary support for educational awareness campaigns and self-disclosure of communicative difficulties in people with mild dysarthria.

People with the neurological speech disorder of dysarthria face many barriers when attempting to communicate in everyday situations (Baylor et al., 2011). In addition to difficulties making themselves understood, many speakers report that they are highly conscious of people's reactions to their disordered speech and often perceive that they are being evaluated negatively (Walshe & Miller, 2011). These communication difficulties tend to be exacerbated when speaking with new and unfamiliar listeners (Baylor et al., 2011; Hartelius et al., 2008). Indeed, some speakers with dysarthria have identified that listeners' attitudes contribute to a "negative atmosphere for communication" that is present even when they are not speaking (Walshe & Miller, 2011, p. 200). This study assesses the degree to which attitudes from unfamiliar listeners can be changed by providing educational statements about dysarthria. We also examine whether this educational information can influence the listener's ability to understand the speaker with dysarthria.

The World Health Organization's (WHO's) International Classification of Functioning, Disability and Health (ICF; WHO, 2001) acknowledges the interplay between

Correspondence to Annalise R. Fletcher: Annalise.Fletcher@usu.edu.
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body structures and functions, the execution of tasks and actions (i.e., activities), and a person's involvement in life situations (i.e., participation). Importantly, the ICF framework also recognizes the role of personal and environmental factors that influence a person's overall level of disability. Although these contextual factors are complex and unique to each individual, common environmental barriers are often reported by speakers with dysarthria. Specifically, the attitude of communication partners has been identified as one of the most significant environmental contributors to disability for this population (Whitehill et al., 2010). Garcia et al. (2002) reported that speakers with dysarthria, as compared to people with other communication disorders, are particularly affected by the attitudes of others. Specifically, speakers with dysarthria cited reduced respect and negative assumptions regarding their intelligence as key barriers to their integration within the workplace. Communication partners have also been observed to modify their speech when conversing with speakers with dysarthria relative to neurotypical speakers, using more precise articulation and slower speaking rates (Lubold et al., 2021). It has been suggested that these speaking changes occur due to an assumption that the person with dysarthria is experiencing cognitive decline or reduced competence. Other studies of listener behavior have also confirmed that unfamiliar listeners tend to rate speakers with dysarthria less favorably (Isetti et al., 2014; Lass et al., 1988, 1993; Schölderle et al., 2019). For example, people with dysarthria have been rated as less confident and less likable and are often assumed by listeners to have reduced cognitive abilities relative to neurotypical speakers (Connaghan et al., 2021; Schölderle et al., 2019).

In addition to reducing communicative participation, listener attitudes may also have effects on speech intelligibility. Research on social dialect has suggested that there are associations between judgments of the status and friendliness of a dialect and its relative intelligibility (Eisenstein & Verdi, 1985). In addition, certain socio-indexical information can negatively affect listeners' transcription skills even when a speech signal is otherwise unchanged (Babel & Russell, 2015). These studies suggest some relationship between listeners' attitudes toward a speaker and their ability to accurately transcribe speech. Models of listening effort suggest that these types of intelligibility reductions may be due to changes in listener motivation. For example, the Framework for Understanding Effortful Listening highlights that reduced motivation, arousal, or displeasure will change a listener's level of attention (Pichora-Fuller et al., 2016). Reduced attention will, in turn, influence a listener's resource allocation policy, resulting in fewer cognitive resources spent decoding an ambiguous speech signal. Thus, it is reasonable to expect that negative attitudes toward people with communication disorders could contribute to decreases in both listener effort and resultant speech intelligibility measurements.

Raising awareness and providing educational information are key methods used to improve attitudes toward people with disabilities and are broadly based on theories of persuasion (Fisher & Purcal, 2017). According to the elaboration likelihood model, the central route of persuasion involves a person considering the merits of new information in support of a given issue (Petty & Cacioppo, 1986). When conditions foster a person's ability to engage with this information (e.g., high personal relevance, lack of conflict with existing beliefs, low distractibility), the person is more likely to engage. Although this premise may seem simple, research into the effectiveness of educational information regarding communication disorders has been mixed. For example, Gilmore (1974) observed that when listeners were provided with information regarding laryngectomees and the effects of surgery, they were more willing to accept a speaker who used esophageal speech. However, speakers of esophageal speech were still rated as less socially acceptable and competent in handling jobs (Gilmore, 1974). Gorenflo and Gorenflo (1991) also found mixed results in their examination of written statements about an adult who was non-speaking. Although information about the speaker's condition positively influenced evaluations of their intelligence, confidence, and sociability, it was not enough to modify listeners' willingness to interact with the individual.

In the voice disorder literature, there has been some suggestion that knowledge of the cause of a voice difference may influence listeners' attitudes toward a speaker. For example, Eadie et al. (2017) found some improvement in attitudes toward speakers with spasmodic dysphonia when educational information about the disorder was provided. Specifically, ratings of the speakers' personalities (i.e., how interesting, kind, and friendly they were perceived) were significantly improved when listeners were given written information about the medical etiology of their voice difference. The authors speculated that understanding the neurological cause of the disorder was sufficient to address misconceptions that a speaker's voice quality was linked to their lifestyle or personality. However, ratings of the speakers' intellect and social desirability (i.e., approachableness, healthiness, or attractiveness) were unchanged, and additional information about the speech disorder did not appear to further influence listeners' attitudes. Lallh and Rochet (2000) also noted that listeners were likely to be more familiar with hoarse rather than hypernasal voices, and familiarity with the voice difference appeared to result in more positive impressions of hoarse speakers. However, the study found limited effects of educational information on listener attitudes when it was explained how the voice differences resulted from nodules, surgery, or other medical interventions.

In summary, the previous literature on educational statements reveals mixed evidence of their efficacy in changing listeners' attitudes toward people with communication disorders. Questions related to speakers' social desirability or listeners' willingness to interact with them tend to reveal negative attitudes that are relatively fixed (Eadie et al., 2017; Gorenflo & Gorenflo, 1991; Lallh & Rochet, 2000). However, judgments of speakers' personalities (i.e., ratings of their kindness or confidence) appear to be more readily malleable (Eadie et al., 2017; Gorenflo & Gorenflo, 1991). It has been suggested that the type and severity of a given communication disorder may be particularly important in determining listener attitudes, as listeners are less likely to associate certain voice characteristics with reduced intelligence (Nagle et al., 2015; Schölderle et al., 2019). Educational information may also be more effective when it highlights that a person's disorder is not related to lifestyle decisions, such as smoking (Eadie et al., 2017). Since features of dysarthria are often associated with reduced intelligence (Connaghan et al., 2021; Fox & Pring, 2005) and a dysarthria diagnosis cannot be easily attributed to lifestyle decisions, it seems likely that educational information could have a more positive effect for this speaker population.

This Study

The aim of this study was to measure the degree to which different types of educational information affect listener attitudes and their ability to understand dysarthric speech. More specifically, we examine statements that provide a diagnostic label and explanation of dysarthria, as well as statements directly highlighting that the diagnosis does not indicate reduced intelligence or ability to understand information. For this initial study, we evaluated speakers with hypokinetic dysarthria due to Parkinson's disease (PD). Most speakers with PD experience a gradual deterioration of speech features, almost always affecting voice quality first (e.g., reduced volume, breathiness), followed by general reductions in articulatory precision and intelligibility (Ho et al., 1998). The number of people living with the disease is expected to significantly increase over the next 2 decades (Dorsey et al., 2007; Rossi et al., 2018). On the basis of the elaboration likelihood model, we postulated that educational information would lead to broad attitude changes, assuming that the listener is sufficiently motivated to give a higher level of thought to the information provided. Our second hypothesis was based on models of listening effort (Herrmann & Johnsrude, 2020; Pichora-Fuller et al., 2016). Based on these models, if attitude changes occur in response to educational information, modest increases in listeners' speech intelligibility scores may also arise if listeners better understand the value of the task and/or take more pleasure in it. Prior studies of speech and voice disorders have suggested that judgments of speakers' personality and intelligence are most likely to be malleable to the effects of education (Eadie et al., 2017; Gorenflo & Gorenflo, 1991). For this reason, this study will focus on three attitudes that have been reported to be negatively influenced by dysarthria: perceived intelligence, likability, and confidence (Connaghan et al., 2021; Isetti et al., 2014; Schölderle et al., 2019).

Method

Listeners

Institutional review board approval for this study was obtained through Utah State University. Listeners were recruited via Amazon Mechanical Turk (MTurk), a platform for crowdsourcing online workers to complete small jobs. One of the benefits of using MTurk for participant recruitment is its potential to represent the U.S. population more accurately when compared to traditional, in-person convenience samples (Berinsky et al., 2012). In this study, participation was geographically restricted on MTurk, so only workers with U.S. IP addresses were able to view and participate in the experiment. Participants also needed to be over 18 years old to create an MTurk account. Consistent with previous studies (e.g., Borrie et al., 2018; Lansford et al., 2016), we also required MTurk workers to have a prior task approval rating of 98% or better and approval from a minimum of 500 tasks. These criteria were chosen to increase the quality of responses, as the task was only available to workers who historically adhered to task instructions.

Workers all received $3 in exchange for their participation, and any participant who met the above criteria was able to complete the study. However, we later removed data from participants who reported that they were not native speakers of American English or who reported a history of speech, language, or hearing disorders (n = 11). We also removed data from listeners who were otherwise deemed "noncompliant," based on an atypically low transcription accuracy (n = 14). The criteria used to remove these participants are described further in the Removal of Noncompliant Listeners section. After removing these participants, there was a total of 117 listeners. Prior to beginning the study, listeners were also asked if they had "significant experience communicating with people with speech disorders." Only two of the 117 listeners, each assigned to a different condition, responded that they had significant experience. Since the type and amount of experience they had were difficult to quantify in an online survey and the inclusion of these speakers did not meaningfully alter the results, we opted to keep their data in our final analysis. The average age of listeners was 39 years (*SD* = 12, range: 20–69), with 53 participants identifying as female and 64 participants identifying as male.

Speech Stimuli

As part of a larger investigation, speech stimuli were elicited from eight native speakers of American English with a diagnosis of PD (M_{age} = 70.5 years, *SD* = 8.59). A perceptual analysis was completed by two experienced speech-language pathologists (SLPs) via a consensus rating procedure on the basis of speakers' recordings. All speakers were diagnosed as having mild hypokinetic dysarthria. Hypokinetic dysarthria was operationally defined as a perceptual impression of a weak, breathy, and/or rough voice quality, with monopitch and monoloudness. Most speakers (*n* = 6) also exhibited mild articulatory imprecision, and three of the eight speakers were perceived as having a faster rate of speech. As this is a preliminary study, we first aimed to establish whether findings could be applied to a single clinically relevant population of speakers with hypokinetic dysarthria. The speech symptoms and severity level exhibited by the speakers in this study were considered representative of the general growing population of speakers with PD (Ho et al., 1998) and were also similar to the speech symptoms and severity level of those who would be seeking speech therapy (Ramig et al., 2018). In addition to the perceptual analysis, the speakers with PD were also screened using the Montreal Cognitive Assessment (Nasreddine et al., 2005) and received scores of 20 or above (*M* = 24.3, *SD* = 1.98). Prior studies have suggested that a cutoff of 20 may be appropriate to avoid over-pathologizing individuals who are not experiencing true cognitive impairment (see Waldron-Perrine & Axelrod, 2012, for discussion), and differences in scores above this level have very low correlations with speech production when age is controlled for (Wisler et al., 2020).

Eight age- and sex-matched native speakers of American English were recruited as neurotypical control speakers (M_{age} = 67.3, *SD* = 8.56). The control speakers reported no history of speech, language, or hearing impairments. A perceptual analysis of these speakers was completed by two experienced SLPs (same as above) to confirm that their speech and voice characteristics (e.g., quality, pitch, and loudness) were typical given each speaker's age, gender, and geographic location. Speakers with dysarthria and control speakers were prompted to read the Caterpillar Passage (Patel et al., 2013), one sentence at a time, in their everyday speaking voice. Digital recordings of the sentence productions were made via a cardioid lavalier microphone positioned approximately 20 cm from the speaker's mouth. Speech was recorded directly to a laptop using custom software, via a Shure X2U XLR-to-USB signal adapter, with a sampling rate of 48 kHz and 16 bits of quantization. After recording, each phrase had its average intensity scaled to 70 dB SPL for consistency in the listening experiments. Both groups of speakers were monetarily compensated based on the duration of their participation.

Procedure

The experiment was completed remotely by the listeners on their personal device. Details of the study were posted on MTurk, outlining the time commitment (20 min) and basic tasks the participants would be asked to complete. Interested participants were then instructed to access the experiment, hosted on a secure, university-based web server, via an embedded link in the task description. The application could not be run on cellphones, and participants were instructed to use a computer with headphones. The task was released in small batches (with recruitment restricted to nine participants per batch), which allowed for a regular rotation of the four listening conditions. An additional qualifier was added to prevent participants from completing the task more than once. After clicking the link embedded in the task description, participants reviewed a consent form and indicated their consent by clicking the "Agree" button on the screen. Following consent, participants completed a demographic survey to collect information on their age; gender; native language; and history of speech, language, or hearing impairment.

Listening Conditions

The participants were assigned to one of four conditions, based on the embedded link they clicked. As mentioned earlier, during the time that the task was available on MTurk, the embedded link was alternated periodically to ensure comparable numbers were recruited in each condition. In three of the conditions, listeners heard the same set of eight speakers with dysarthria. In one condition, listeners were provided with no educational information prior to exposure to the speakers with dysarthria (Dysarthria—No Statement; *n* = 29). In another condition, listeners were given general educational statements about dysarthria prior to exposure (Dysarthria—ASHA Statement; *n* = 29). The educational statements were copied from the public section of the American Speech-Language-Hearing Association (ASHA) website (ASHA, n.d.; https://www.asha.org/public/speech/disorders/dysarthria/) and are included in the Appendix. In a third condition, this educational information was adapted to add a comment directly highlighting that a diagnosis of dysarthria does not indicate that a speaker has reduced intelligence or understanding (adapted statement; Dysarthria—Adapted Statement; $n = 30$). Finally, in a fourth condition, listeners only heard samples from eight neurotypical, age-matched adults (Neurotypical—No Statement; $n = 29$). Although individual audio quality could not be controlled across listeners' computers, phrases in the four conditions all had their average intensity scaled to 70 dB SPL to provide some consistency across the presentation of stimuli. Prior to the presentation of the first sound file, listeners were also reminded: "Before proceeding, please make sure the sound on your computer is ON and you are wearing headphones."

Intelligibility and Attitude Ratings

All listeners were exposed to a total of 16 trials, with each trial consisting of one unique sentence read aloud from the Caterpillar Passage, which were presented in a random order. Each listener heard exactly two sentences from each of the eight speakers (either the eight speakers with dysarthria or the eight neurotypical speakers). However, the sentence–speaker combination was randomized for every listener, so each participant heard a unique combination of speaker–sentence stimuli.

Listeners could control the pacing of the experiment by clicking "play" to hear the speech sample. After hearing each sentence, listeners were immediately asked to type what they heard the speaker say. They were not able to replay the file. After submitting their response, listeners heard the sentence play a second time. Then, utilizing a 5-point Likert scale, listeners reported the extent to which they agreed with the following statements: "This person is likable," "This person is intelligent," and "This person is confident." Each point was labeled with the following response anchors: *disagree*, *somewhat disagree*, *neutral*, *somewhat agree*, and *agree*. Likert scales have a long history of use in the measurement of attitudes toward people, objects, and other phenomenon (Likert, 1932). Although other rating methods, such as visual analog scales, have the potential to provide additional precision (with a greater number of response points), it is still unclear to what degree humans can reliably make these distinctions when rating highly complex feelings or personal attributes (Simms et al., 2019). For this reason, in addition to its ease of interpretability, we chose a simple Likert scale for this preliminary study.

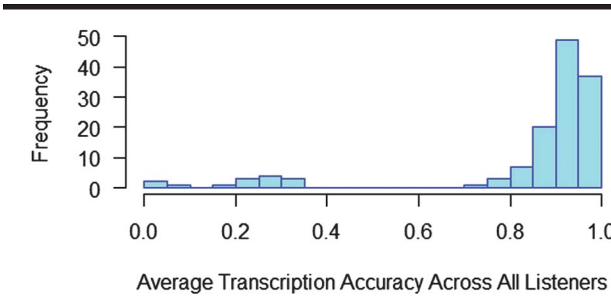
Transcription Scoring

A percent-correct intelligibility score was obtained for the presentation of each sentence stimulus based on the number of words correctly transcribed by a listener divided by the total number of words in the sentence. Transcription accuracy was automatically calculated using the open-source tool Autoscore (http://autoscore.usu.edu/), which reliably compares the word spoken by the talker to the word that was transcribed by the listener (see Borrie et al., 2019, for details on the tool and its reliability). Listener responses were considered correct when they were identical to the word spoken by the talker. Additional Autoscore scoring rules, including the acceptable spell, tense, and plural rules, were also applied to be consistent with prior studies of dysarthric speech perception (e.g., Lansford et al., 2019; see also Borrie et al., 2019, for rule descriptions). Following the use of Autoscore, a research assistant manually screened the files for any common spelling errors or homonyms that were not in the default acceptable spell list (e.g., "tic" vs. "tick"). If an incorrect word was a homonym or was clearly attributable to a spelling error, the response was manually re-coded as correct.

Removal of Noncompliant Listeners

After completing the transcription scoring, we examined the average percentage of words each listener correctly transcribed. This information is visualized in Figure 1, indicating the frequency of scores across listeners in all four conditions. As shown in Figure 1, most listeners were able to accurately transcribe an average of > 70% of words, regardless of whether they were listening to the control speakers or the speakers with dysarthria. Given that the speakers with hypokinetic dysarthria had relatively mild dysarthria, average scores above 70% were expected in this study, and not a single listener transcribed between 35% and 70% of words correct. However, several listeners correctly transcribed fewer than 35% of words. On closer examination, the majority of these listeners skipped trials without entering information and/or only wrote one or two words in response to each sentence. It is hypothesized that

Figure 1. Histogram detailing the average transcription accuracy of 131 listeners recruited via Amazon Mechanical Turk. The graph contains data from all listening conditions, including participants who heard neurotypical speech patterns. Fourteen participants had accuracy values below 35% and were consequently removed from further analysis.



some of these listeners may have experienced inadequate audio quality on their device, typing difficulties, or impatience with the task. Regardless of the reason, since intelligibility scores below 35% did not reflect the clinical severity of the speech samples, we opted to remove all listeners with a score of < 35% from our data. This resulted in the removal of 14 listeners (five from the Dysarthria—ASHA Statement condition, one from the Dysarthria—Adapted Statement condition, four from the Dysarthria—No Statement condition, and four from the Neurotypical—No Statement condition). The final number of participants was 117, with 29 people assigned to the Dysarthria—ASHA Statement, Dysarthria—No Statement, and Neurotypical—No Statement conditions and 30 people assigned to the Dysarthria—Adapted Statement condition.

Reliability of Listener Responses

After the removal of listeners deemed noncompliant, interrater reliability was analyzed. To assess interrater reliability, intraclass correlation coefficients (ICCs) were calculated (as described in Shrout & Fleiss, 1979) for different listener responses to the same speech stimuli (i.e., all instances where listeners heard the same speaker and phrase). For ratings of speakers' likability, the ICC(2,k) coefficient was .88, 95% CI [.85, .90]. For ratings of intelligence, the ICC(2,k) coefficient was .96, 95% CI [.95, .97]. For ratings of confidence, the ICC(2,k) coefficient was .97, 95% CI [.96, .97]. Finally, for repeated measures of speech intelligibility, the ICC(2,k) coefficient was .98, 95% CI [.98, .98]. These coefficients indicated that there was good-to-excellent interrater reliability across listener responses.

Statistical Analysis

To provide a descriptive overview of results, the combined average and standard deviation of listener responses in different listening conditions were compared. We also calculated Pearson correlation coefficients to demonstrate the relationship between impressions of likability, intelligence, confidence, and speech intelligibility scores given to each speaker. To calculate these correlations, we averaged listener responses given to each of the 16 speakers when all sentences and listening conditions were combined.

The primary aim of this study was to measure the degree to which different types of educational information affected listener attitudes and their ability to understand dysarthric speech. To address this research question, we used a series of mixed-effects regression models. For each attitude rating (confidence, intelligence, and likability), a linear mixed-effects regression model was applied to assess whether the presence of educational information significantly changed listener ratings as compared to the Dysarthria—No Statement condition. A fixed effect for condition was included, as well as random intercepts for repeated measures of individual speakers, listeners, and sentence stimuli. To determine intelligibility, the number of words correctly transcribed in each trial was divided by the total number of words in the sentence. A linear mixed-effects regression model was applied to determine whether intelligibility level changed in response to educational statements relative to the Dysarthria—No Statement condition, with random intercepts for repeated measures of individual speakers, listeners, and sentence stimuli. For all models, the Dysarthria—No Statement condition was mapped to intercept, as the base condition to which others were compared.

Results

A summary of listener data is included in Tables 1 and 2. Table 1 indicates the average intelligibility, as well as average ratings of confidence, intelligence, and likability that were provided in each listening condition. The relationships between a speaker's perceived likability, intelligence, confidence, and overall intelligibility are outlined in Table 2. This table presents the Pearson correlation coefficients between the attitude ratings and intelligibility scores given to each speaker. Although there were

Table 1. Average listener responses to each experimental condition.

Speakers	Listening condition	Intelligibility (% of words correctly understood)	Confidence rating	Intelligence rating	Likability rating
Neurotypical	No Statement	94 (11)	3.98 (1.05)	3.80 (1.11)	3.95 (0.91)
Dysarthria	No Statement	91 (15)	3.56 (1.23)	3.48 (1.18)	3.74 (0.93)
Dysarthria	ASHA Statement	92 (14)	3.82 (1.17)	3.91 (0.98)	4.09 (0.82)
Dysarthria	Adapted ASHA Statement	92 (15)	3.89 (1.04)	3.95 (0.95)	4.16 (0.89)

Note. Mean values are presented, with standard deviations in parentheses. Rating scale scores ranged from 1 to 5, with a score of 5 indicating that listeners agree that the speaker is confident, intelligent, or likable and a score of 1 indicating disagreement. A score of 3 indicates that the listener has a neutral opinion. ASHA = American Speech-Language-Hearing Association.

Table 2. Pearson correlation coefficients between average listener responses given to the 16 speakers.

Measurement	Intelligibility (% of words correctly understood)	Rating of confidence	Rating of intelligence	Rating of likability
Intelligibility	1			
Rating of confidence	.641*	1		
Rating of intelligence	.474	.881*	1	
Rating of likability	.366	.601*	.700*	1

*$p < .05$.

only small intelligibility differences between the control group and the speakers with dysarthria (as indicated in Table 1), it is noteworthy that increased intelligibility in a speaker was still correlated with higher ratings of the speaker's confidence (as indicated in Table 2). Furthermore, ratings of all three attitudes (likability, intelligence, and confidence) were positively correlated. The next sections provide a summary of the mixed-effects models used to answer our primary research question: Were there statistically significant changes in attitude ratings and transcription scores across the four listening conditions?

Listener Ratings of Confidence

The mixed-effects model of confidence ratings indicated that differences between the Neurotypical—No Statement and Dysarthria—No Statement conditions were not statistically significant ($b = 0.41$, $SE = 0.27$, $p = .14$). In contrast, there was a statistically significant increase in the perceived confidence of people with dysarthria when listeners were given adapted educational statements (Dysarthria—Adapted Statement) as compared to the Dysarthria—No Statement condition ($b = 0.32$, $SE = 0.15$, $p = .04$). Listeners also gave higher ratings when provided with the original ASHA statement (Dysarthria—ASHA Statement) relative to the Dysarthria—No Statement condition, but this did not reach the threshold for statistical significance ($b = 0.26$, $SE = 0.15$, $p = .10$).

Listener Ratings of Intelligence

The mixed-effects model of intelligence ratings found no statistically significant differences between the Neurotypical—No Statement and Dysarthria—No Statement conditions ($b = 0.30$, $SE = 0.27$, $p = .28$). However, listeners in the Dysarthria—Adapted Statement condition had statistically significant increases in their ratings of intelligence toward speakers with dysarthria as compared to listeners in the Dysarthria—No Statement condition ($b = 0.47$, $SE = 0.18$, $p < .01$). There was also a statistically significant increase in intelligence ratings for listeners who received the original ASHA statements (Dysarthria—ASHA Statement) as compared to the Dysarthria—No Statement condition ($b = 0.43$, $SE = 0.18$, $p = .02$).

Listener Ratings of Likability

The mixed-effects model of likability ratings found no statistically significant differences between the Neurotypical—No Statement and Dysarthria—No Statement conditions ($b = 0.19$, $SE = 0.16$, $p = .24$). Again, however, listeners provided with adapted educational statements demonstrated statistically significant increases in their ratings of likability toward speakers with dysarthria as compared to listeners in the Dysarthria—No Statement condition ($b = 0.42$, $SE = 0.15$, $p < .01$). There was also a statistically significant increase in likability ratings for listeners who received ASHA statements as compared to the Dysarthria—No Statement condition ($b = 0.35$, $SE = 0.15$, $p = .02$).

Differences in Speech Intelligibility

The mixed-effects model of speech intelligibility revealed no statistically significant differences between the Neurotypical—No Statement and Dysarthria—No Statement conditions ($b = 2.72$, $SE = 1.91$, $p = .17$). There was also no significant improvement in transcription accuracy when information about dysarthria was supplied via the adapted educational statements ($b = 0.52$, $SE = 1.29$, $p = .69$) or via the ASHA statements ($b = 0.16$, $SE = 1.30$, $p = .90$) as compared to the Dysarthria—No Statement condition.

Discussion

The results of this study provide evidence that reading educational information about dysarthria can improve listeners' attitudes toward speakers with hypokinetic dysarthria. Specifically, information outlining that speakers do not have reduced intelligence and understanding led to the largest shifts in listener attitudes. Speakers were perceived as not only more intelligent but also more likable and confident. In contrast, providing educational statements did not have a statistically significant influence on the intelligibility of the speakers.

As determined by the mixed-effects model of speech intelligibility, listener attitudes toward speakers with hypokinetic dysarthria were not significantly reduced relative to age-matched controls in this study. This is likely due to the mild cases of dysarthria in our data set, with no statistically significant intelligibility declines exhibited in the speaker group with dysarthria relative to the age-matched controls. More positive listener attitudes have been reported when listeners are able to attribute a speaker's symptoms to common and familiar causes (Lallh & Rochet, 2000; Nagle et al., 2015), and it is likely that some mild cases of hypokinetic dysarthria may resemble symptoms of presbyphonia or laryngitis that listeners are already familiar with (e.g., breathiness, roughness). Prior studies have also found links between the severity of dysarthria and listener attitudes, suggesting that people with milder dysarthria are less negatively affected (Schölderle et al., 2019). In this study, on average, listeners tended to be close to a neutral rating of speakers with dysarthria (i.e., they did not agree or disagree that the speaker was likable, intelligent, or confident).

Despite the relatively neutral attitudes displayed toward speakers with mild hypokinetic dysarthria in this study, educational statements still significantly improved listener ratings. With educational statements, average listener ratings indicated general agreement that the speakers with dysarthria were likable, intelligent, and confident (i.e., ratings of 3.82–4.16). Improved ratings were found across all attitude scales, with the largest changes occurring in ratings of speaker intelligence. According to the elaboration likelihood model, this suggests that our crowdsourced listeners were able to engage with the written information, and there was no significant conflict between this information and their preexisting beliefs. This finding is distinct from prior research, which has typically reported mixed results in response to written educational information (Eadie et al., 2017; Gilmore, 1974; Gorenflo & Gorenflo, 1991; Lallh & Rochet, 2000). There are several possible reasons for these differing results. The most obvious may be the medical etiology of dysarthria and listeners' lack of preexisting beliefs about this diagnosis. As mentioned in the introduction, educational statements may be particularly beneficial when they clarify that the disorder is not caused by the speaker's lifestyle or other choices (Eadie et al., 2017). The ASHA statement used in this study specified that dysarthria was caused by brain damage and may have promoted more sympathy than the educational material provided in previous studies. In addition, this explanation is unlikely to have conflicted with preexisting beliefs or biases that relate to other sources of voice or speech change, such as aging or smoking.

A second reason for the effectiveness of educational statements could be related to the attitudes that were targeted in this study. It is possible that initial impressions of a person's personality and intelligence are more malleable than ratings of listeners' behavioral intent (e.g., willingness to interact with an individual; Gorenflo & Gorenflo, 1991). However, this does not mean that initial impressions of a speaker are unimportant. Indeed, other studies have found strong links between immediate trait ratings and a person's intentions to interact with that individual (Sasson et al., 2017). In addition, it is well established that people pay attention to information that supports their preconceived impressions, which can lead to downstream changes when interpreting new information about a person (Costabile & Madon, 2019). Thus, it is plausible that more positive initial impressions of people with dysarthria would facilitate improvements in communicative participation over time. Further research is needed to examine connections between a listener's initial impressions and behavioral intentions as well as their consequent participation in conversations with these speakers.

Another important finding of this study was the potential benefit of stating that a speech disorder is not due to reduced intelligence or understanding. Although differences between the two educational statements were small and not statistically significant in this study, the statement highlighting intact cognitive abilities consistently produced the highest average ratings of perceived intelligence, likability, and confidence. It is not entirely surprising that perceptions of intelligence would be related to other personality traits; impressions of intelligence have been linked with higher ratings of emotional stability, extraversion, and openness to new experiences in prior studies (Mõttus et al., 2008). Furthermore, the effect of perceived intelligence on personality ratings may be particularly salient when a rater regards the individual as less intelligent than themselves (Jonason & Hughes, 2021). For these reasons, it is possible that increasing the perceived intelligence of a speaker with dysarthria could more broadly improve impressions of the speaker's approachableness and personality.

This study found no relationship between educational statements and speech transcription accuracy. Based on models of listening effort, it was hypothesized that informing listeners of the speech disorder may increase their motivation, resulting in greater recruitment of cognitive resources to the speech intelligibility task. However, the results of this study suggest that the impact of educational statements on listener motivation and listening effort was insufficient to produce significant changes in intelligibility. This lack of effect may be partly due to a high baseline intelligibility in the speakers with hypokinetic dysarthria in this study. It is likely that changes in listener effort would be most salient when listening to speakers with more severe intelligibility decrements, as differences in individual listener performance tend to be greater around the 50% intelligibility level (Fletcher et al., 2019; Rönnberg et al., 2013). In future studies, it is also possible that listener motivation could be increased through the inclusion of more personal information or real interactions with speakers. However, in these cases, it may be challenging to separate the effects of motivation from the well-established benefits of perceptual learning on intelligibility of dysarthric speech (see Borrie & Lansford, 2021). Thus, studies that manipulate listener motivation in controlled settings are still needed to understand its potential effects.

Limitations

There are several limitations to this study. First, there were only eight speakers with dysarthria, and the speakers were relatively homogeneous in their dysarthria presentation. Thus, it is unclear to what degree these findings might generalize to other dysarthria subtypes and severities, and it is possible that the educational statements might have either larger or smaller effects when different speech symptoms are present. In addition, although MTurk enables online data collection from a diverse sample of listeners, it does limit the ability to control the listening conditions in this study. Without a researcher present, we cannot verify whether distractions occurred during the experiment or guarantee that adequate volume and audio quality was achieved across all computer devices. This may have contributed to increased variability in listener responses and a relatively high rate of removal of participants with low transcription accuracy. However, it should be noted that prior studies have found no significant differences in intelligibility scores from participants transcribing dysarthric speech in laboratory conditions versus from those recruited through MTurk (Lansford et al., 2016).

In addition, some caution must also be applied when interpreting the results of this study, due to the lack of ecological validity inherent in the speech transcription and rating tasks. Different effect sizes might be expected if educational material were provided in more naturalistic settings. Visual information and more personal interactions with speakers, for example, hearing the speaker self-disclose their disorder, may introduce additional variance in listener ratings, but these interactions could also further improve the effectiveness of educational information (e.g., Byrd et al., 2017). In addition, different types of speech stimuli are likely to increase listening effort, as single sentences without context have been found to not be particularly motivating (Herrmann & Johnsrude, 2020). Future studies may benefit from further examining these factors using larger samples of speakers and listeners.

In conclusion, in line with persuasion theory models, this study presents preliminary evidence that ASHA educational material can positively influence listener impressions of speakers with hypokinetic dysarthria, especially when it is explicitly stated that the disorder does not affect intelligence or understanding. The results suggest that educational information affects attitudes toward speakers, including perceptions of speaker intelligence and personality. This initial examination provides preliminary support for educational awareness campaigns and self-disclosure of communicative difficulties in people with mild dysarthria. Further work is needed to understand whether these results can be replicated in more natural communicative contexts.

Data Availability Statement

Anonymized listener data, analysis code, and model outputs associated with this work are available on request from the authors.

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Appendix

Listener Educational Statements

ASHA Educational Statement

We use many muscles to talk. These include muscles in our face, lips, tongue, and throat, as well as muscles for breathing. It is harder to talk when these muscles are weak. Dysarthria happens when you have weak muscles due to brain damage. It is a motor speech disorder and can be mild or severe. In this experiment, you will hear from several speakers who have dysarthria.

Adapted Educational Statement

We use many muscles to talk. These include muscles in our face, lips, tongue, and throat, as well as muscles for breathing. It is harder to talk when these muscles are weak. Dysarthria happens when you have weak muscles due to brain damage. It is a motor speech disorder and can be mild or severe. Dysarthria does not affect intelligence or understanding. In this experiment, you will hear from several speakers who have dysarthria.

Note. ASHA Educational Statement reprinted from ASHA (n.d.).