5-2015

Dysarthria: A Study of Effects on Communication

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INTRODUCTION

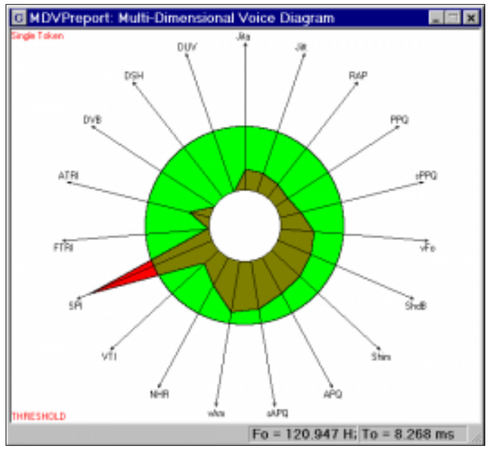
Dysarthria is an impairment classified by slow, weak, and imprecise muscle movements that affect speech and communication. It can be caused by neurologic disorders such as stroke, Down syndrome, cerebral palsy, or Parkinson's disease. The largest problem associated with dysarthria is it's negative impact on communication, and therefore its negative impact on a patient's quality of life. The ability to is speak intelligibly is essential to fulfill social and emotional needs. In many interactions, people with dysarthria cannot be fully understood, which makes it difficult and frustrating to engage in daily tasks and can lead to feelings of isolation and loneliness (Mahler & Ramig, 2012). The purpose of this project was to look at the effects of treatment on dysarthria of an adult with Down syndrome and the impact of dysarthria on speech and swallowing in people with Parkinson's disease. Qualitative and quantitative measures were used, such as listener studies, surveys, acoustic analyses, and careful observation of therapy sessions.

METHODS

A variety of techniques were used to collect information regarding the effects of treatment on dysarthria.

Multi-Dimensional Voice Program

A computer program called the Multi-Dimensional Voice Program (MDVP) measured quantitative acoustic variables of voice quality, calculating more than 22 parameters on a single vocalization. Recordings from a patient with Down Syndrome were recorded and analyzed using this software. MDVP is valuable in its ability to work accurately over a wide range of pathological voices. Its normative references are based on an extensive database of normal and disordered voices; and results are graphically and numerically compared to these normative threshold values. A key feature of MDVP is the visual "snapshot" it provides that summarizes the speech. An example can be seen below. (http://kayelemetrics.com/)



	Avg Fund Freq	Rel Avg Pert	Pitch Pert Quo
Pre2 Ah1	279.507	1.147	1.107
Pre2 Ah2	263.258	1.026	0.989
Pre2 Ah3	260.859	1.274	1.146
Pre2 Ah4	266.864	1.07	1.019
Pre2 Ah5	263.821	0.806	0.714
Pre2 Ah6	267.651	1.279	1.171
Pre3 Ah1	255.777	0.907	0.846
Pre4 Ah1	244.831	0.553	0.553
Pre4 Ah2	246.993	0.652	0.607
MEAN	261.06	0.97	0.91
STD	10.72	0.26	0.24

Normal Values: Average Fundamental Frequency= 243.973, Relative Average Perturbation=.378, Pitch Perturbation Quotient=.366.

Listener Studies

Conducting listener studies provides voice and speech ratings from unfamiliar listeners. Participants were asked to repeat a phrase, such as "The boot on top is packed to keep" multiple times while being audio recorded. These recordings were played back for the unfamiliar listeners to rate the intelligibility on a scale from -50 to +50. The listeners would hear 2 recordings, and be asked to give a rating based on their opinion of which sounded more clear. Negative numbers indicate that Sample B sounds worse than Sample A and positive numbers indicate that sample B sounds better. A rating of 0 indicates that the speech samples are equivalent. Below is an example of the scale that the listeners were asked to rate on.

Trial #1

-50 **0** **50**

Surveys

Surveys were administered asking patients with Parkinson's Disease to rate their communication and swallowing characteristics on a scale, to gain knowledge of their perceptions of the impact of PD. The EAT-10 Swallowing Screening tool consists of ten questions about different aspects of the swallowing process, and each answer is rated on a scale of 0 (no problem) to 4 (severe problem). These numbers were added to obtain a total EAT-10 score. A score of 3 or higher signifies that swallowing is a safety issue and should be discussed with a physician.

The Visual Analog Scale Perceptual Rating Form is a perceptual rating form that consists of ten questions about swallowing and ten questions about communication. The participant marked a spot on a scale, rating various components of communication. The results were calculated by dividing the length of the line to the mark by the total length of the line, then multiplying by 100 to determine a percentage. A complete summary of the results of these surveys can be seen below.

Name	Sex	Age	EAT-10 Total	Sp1	Sp2	Sp3	Sp4	Sp5	Sp6	Sp7	Sp8	Sp9	Sp10	Sw1	Sw2	Sw3	Sw4	Sw5	Sw6	Sw7	Sw8	Sw9	Sw10
BB	Male	72	4	43%	33%	73%	77%	53%	55%	55%	45%	55%	35%	17%	15%	15%	12%	8%	7%	5%	55%	32%	17%
EB (For BB)	Wife		12	10%	53%	98%	50%	50%	50%	32%	52%	28%	52%	7%	10%	35%	52%	25%	3%	3%	3%	95%	53%
DD	Male	63	17	73%	53%	57%	77%	53%	55%	77%	77%	63%	53%	20%	33%	42%	32%	77%	0%	50%	50%	50%	50%
MF	Male	71	4	35%	53%	100%	80%	92%	48%	28%	33%	53%	53%	0%	0%	0%	13%	23%	0%	8%	20%	5%	3%
PG (For TG)	Wife		3	34%	83%	77%	67%	67%	35%	27%	32%	82%	85%	18%	38%	17%	22%	37%	17%	12%	15%	33%	13%
TG	Male	72	0	47%	50%	60%	58%	61%	60%	61%	52%	72%	77%	25%	26%	20%	25%	18%	18%	8%	13%	17%	13%
JL	Male	84	22	20%	87%	20%	87%	17%	27%	23%	23%	23%	23%	23%	30%	80%	80%	80%	87%	93%	93%	90%	93%
NL (For JL)	Wife		5	27%	93%	93%	93%	29%	52%	30%	52%	52%	98%	0%	0%	27%	13%	13%	13%	0%	13%	35%	13%
JM	Female	65	6	57%	67%	67%	70%	67%	65%	63%	67%	70%	77%	0%	0%	13%	14%	27%	0%	0%	10%	10%	13%
DP	Male	64	9	75%	32%	62%	48%	28%	72%	30%	57%	32%	33%	0%	8%	43%	43%	43%	27%	0%	25%	17%	32%
FP	Female	63	0	62%	82%	82%	85%	87%	83%	82%	77%	80%	82%	10%	15%	13%	13%	10%	10%	10%	10%	10%	7%
BR	Male	75	9	35%	52%	33%	22%	30%	22%	20%	30%	37%	73%	7%	7%	30%	7%	30%	2%	2%	30%	53%	3%
MR (For BR)	Wife		10	32%	33%	50%	32%	27%	50%	33%	32%	23%	22%	37%	37%	53%	53%	53%	20%	53%	57%	53%	53%
CS	Male	69	2	0%	87%	73%	17%	17%	77%	20%	22%	63%	53%	13%	30%	17%	20%	17%	17%	17%	17%	48%	22%
SS (For CS)	Wife		7	32%	73%	97%	8%	17%	52%	28%	27%	50%	13%	3%	25%	25%	20%	20%	3%	40%	50%	55%	27%
MW (For TW)	Wife		5	33%	95%	95%	95%	75%	52%	78%	55%	95%	83%	22%	2%	8%	12%	10%	2%	2%	17%	57%	18%
TW	Male	86	3	33%	70%	90%	80%	36%	52%	43%	33%	67%	57%	8%	8%	10%	10%	10%	10%	8%	22%	22%	7%

KEY:

Sp1: The patient is always loud enough __ percent of the time
Sp2: The patient can always find the right words __ percent of the time.
Sp3: The patient never speaks in a shaky voice __ percent of the time.
Sp4: The patient is never monotone __ percent of the time.
Sp5: The patient never slurs __ percent of the time.
Sp6: The patient never speaks in a "strained" voice __ percent of the time.
Sp7: The patient never mumbles __ percent of the time.
Sp8: The patient always speaks so others can understand __ percent of the time.
Sp9: The patient always participates in a conversation __ percent of the time.
Sp10: The patient always starts a conversation __ percent of the time.

Sw1: Swallowing causes the patient to lose weight __ percent of the time.
Sw2: Swallowing intereferes with the patients ability to eat out __ percent of the time.
Sw3: Swallowing liquids requires extra effort __ percent of the time.
Sw4: Swallowing solid foods requires extra effort __ percent of the time.
Sw5: Swallowing pills requires extra effort __ percent of the time.
Sw6: Swallowing is painful __ percent of the time.
Sw7: The pleasure of eating is affected by swallowing __ percent of the time.
Sw8: Food sticks in the throat __ percent of the time.
Sw9: I cough when eating and drinking __percent of the time.
Sw10: Swallowing is stressful __ percent of the time.

DISCUSSION OF RESULTS

Multi-Dimensional Voice Program

As this project is still ongoing, we have only collected pre-treatment data from the observed participant DS03, a person with Down Syndrome who received speech therapy to improve her intelligibility. The chart included shows her Average Fundamental Frequency, Relative Average Perturbation, and Pitch Perturbation Quotient which was taken from MDVP snapshot. These numbers show us that the mean value for each of these measures are above the norm. The goal of the treatment was to lower these values closer to that of the norm, therefore making her speech clear and intelligible. To date, the participant whose voice was analyzed using MDVP had improved speech in therapy, but not outside of the treatment room.

Listener Studies

Intelligibility ratings data are still being collected for this project and have not yet been analyzed.

Surveys

I identified several trends in the data after analyzing the visual analog scales for communication and swallowing as well as the results of the EAT-10 questionnaire. People with Parkinson's disease (PD) seem to underestimate the severity of their symptoms. This was supported by differences in results when a spouse took the same survey and rated the person with PD. Spouses consistently rated the symptoms as being more impaired than the patient on almost all communication and swallowing parameters. These results highlight the sensory problem in people with PD that makes it difficult for them to accurately monitor their own behaviors. It could be a health risk for swallowing since people with PD did not appear to recognize signs and symptoms of swallowing impairment. Another conclusion I drew from the data was that people with PD identified more deficits with their speech than their swallowing. A partial explanation may be that Loud Crowd, a weekly therapy group that these participants belong to, is meant to address voice and speech changes resulting from PD, and not their swallowing deficits.

REFERENCES

Mahler, L.A. & Ramig, L.O. (2012). Intensive treatment of dysarthria secondary to stroke. *Clinical Linguistics and Phonetics,6* (8), *681-694.* Retrieved from http://informahealthcare.com/doi/abs/10.3109/02699206.2012.696173.