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Speech Naturalness of Recovered and Relapsed Persons with Stuttering Following Treatment

Pravesh Arya, M.Sc. (SLP), Ph.D. Candidate

Geetha Y.V., Ph.D. (Speech and Hearing)

Abstract

Relapse is an ever-present concern for those in recovery from stuttering, and also for the professionals who treat them. Recovery can be defined as the restoration to a former or better condition whereas Relapse is defined as the recurrence of symptoms after a period of improvement (Webster, 1979).

The main aim of the present study was to provide a preliminary data, comparing the speech naturalness of recovered and relapsed persons with stuttering (PWS) following treatment.

The participants (age range 18 to 38 years) were selected on the basis of inclusion and exclusion criteria and were asked to report after 3 months and 6 months post treatment follow-up

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evaluations. A total of twenty two participants reported after 3 months and nineteen participants reported after 6 month post treatment follow-ups.

Spontaneous speech samples were collected using audio/video recording of the participant during the evaluations. Multidimensional speech naturalness scale (Kanchan, 1997) and recorded speech samples were provided to three judges i.e., experienced speech and language pathologists (SLPs). The judges were asked to analyze and perceptually rate the naturalness of provided speech samples on the basis of different speech parameters given in the scale. Results of the present study showed a significant difference between recovered and relapsed group of persons with stuttering following treatment across different speech parameters.

The present study concludes that recovered persons with stuttering showed a perceptually more natural sounding speech across all the parameters as compared to relapsed persons with stuttering following treatment.

Keywords: Speech naturalness, Recovery, Relapse, Perceptual scale

Stuttering and Naturalness of Speech

Stuttering is a complex speech disorder with a variety of dimensions and it has been defined as having discontinuous, effortful and relatively slow rate of speech. Disruptions in continuity and rate are considered to affect the naturalness of speech in addition to articulation and intonation patterns (Starkweather, 1980). The acceptable speech quality in stuttering therapy determines the treatment outcomes. Therefore, it becomes very important to assess the naturalness of speech in persons with stuttering (PWS) who attain recovery after treatment and whether he/she is able to maintain the naturalness in long-term follow-up. In general, recovery can be defined as the restoration to a former or better condition, and it could be with or without formal treatment. Williams (2006, p. 9) stated that “Some people stop overt disfluencies as a result of therapy, although they constantly monitor their speech in order to remain fluent.” For some still unknown reasons, short term mastery of program goals by PWS does not always lead to long term application and lead to relapses. Relapse is defined as the recurrence of symptoms

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after a period of improvement (Webster, 1979). In other words, relapse is defined as a return of considered symptoms that therapy either had replaced or brought under control.

Relapse and Stuttering

Prins (1970) noted that majority of the clients self reported that a maximum regression occurred within six months after the termination of formal treatment, and other author have suggested that clients should be followed for at least two to five years following formal treatment (Bloodstein & Bernstein Ratner, 2008; Young, 1975). Although it has been well documented that a number of different approaches to the treatment of stuttering consistently have achieved success in establishing fluent speech for PWS (Guitar, 1998; Onslow, 1999), relapse following successful treatment continues to be a major cause of concern for clients and speech-language professionals. Probably the reason could be that relapse in stuttering is not well defined as it covers all forms of client regression from occasionally stuttered words to the resumptions of speaking to pre-therapy patterns.

Perceptual Characteristics of Speech of PWS

The perceptual characteristic of the speech of successfully treated persons with stuttering (PWS) is an area of study that has been given considerable attention. Franken (1980) reported that, speech of a PWS can be judged as normal, or unnatural compared to the speech of persons with no stuttering (PWNS). The speech naturalness of people who stutter has generated research interest for decades. Much of these researches (Ingham & Packman, 1978; Ingham, Gow, & Costello, 1985; Kalinowski, Noble, Armson, & Stuart, 1994) were conducted to examine perceptual naturalness after fluency shaping therapies and, quite consistently, listeners rated post-treatment speech as more unnatural sounding than the speech of fluent speakers. This raises a question as to whether dysfluencies are the only cause of lack of normalcy or naturalness in individuals with stuttering or the fluency shaping techniques adopted during therapy results in unnatural sounding speech while reducing the dysfluencies.

Concept of Naturalness

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Parrish (1951) may have been the first to argue about the concept of naturalness and many notions about desirable speech behavior and also highlighted the importance of distinguishing between a speaker's judgment of natural speech production and a listener's perceptual judgment of natural sounding speech.

A number of other previous perceptual studies (Jones & Azrin, 1969, Runyan, 1976; Ingham & Packman, 1978; Runyan & Adams, 1978; Runyan, Hames, & Prosek, 1982; Prosek & Runyan, 1983) have focused on the methods of differentiating between the speech of PWS and PWNS. Frayne, Coates and Marriner (1977) used a perceptual analysis technique to investigate the speech quality of PWS who had been treated by prolonged speech technique. Twenty seven listeners were provided with two different recordings containing samples of stutter-free speech from 10 treated PWS, 6 to 18 months following therapy and similar samples from 10 controls. Results showed that the listeners generally failed to distinguish between the samples from PWS and PWNS, although the range of smoothness ratings for PWS was greater than for PWNS.

In some studies (Finn & Ingham, 1989), the fluent speech of PWS has been defined as speech that is free from perceptually overt stuttering. In other studies (Franken, 1987; Franken, Boves, Peters & Webster, 1992), it has been shown that naturalness is a multifaceted variable that is related to a number of other perceptual characteristics of a speech sample. Thus, speech may fail to sound natural for a number of reasons.

Multidimensional Nature of Speech Naturalness

Because of the multidimensional nature of speech naturalness, the probability that a clinician can help a PWS to improve the overall speech quality becomes higher if he or she can diagnose the dimensions that are most deviant. Most of these previous studies have not proposed a metric for such measures.

Starkweather (1987) defined speech fluency in terms of continuity, rate, duration, co-articulation and effort. Continuity relates to the degree to which the syllables and words are logically sequenced with the presence or absence of pauses. The speech is interpreted as fluent, if

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the semantic units follow one another in a continual and logical flow of information. However, despite a continual flow of sound and the absence of pauses, the speech could not be thought of as fluent if unnecessary or illogical sounds or words are present.

Considering all important speech parameters, Kanchan (1997) developed a binary naturalness scale including speech parameters such as rate, continuity, effort, stress, intonation, rhythm, articulation, breathing pattern and overall rating and the developed scale was given to judges to rate the speech naturalness of 198 speech samples of PWS in pre-and post-therapy conditions. The judges (five sophisticated listeners) were instructed to rate the given speech samples of PWS on 2-point scale as '1' or '0' for natural or unnatural respectively. The study reported that the speech naturalness scores were better on post-therapy sample and the mean naturalness scores were correlated with naturalness rating of various parameters. Also, the factor analysis indicated that speech parameters such as rate, continuity, effort and stress to be important factors in the judgment of naturalness.

Some of the recent studies focused on comparing naturalness among PWS in pre- and post-therapy conditions. Conture (2001) conducted a study to compare speech naturalness of PWS with that of PWNS, and reported that if the treatment of choice for PWS is fluency shaping, speech may be more fluent than it was prior to therapy, but it can also sound more controlled and less lively than the speech of PWNS. Santosh and Savithri (2007) studied speech naturalness in spontaneous speech of 30 PWS across different conditions i.e., pre-therapy, post therapy and 6-months post therapy. The authors reported that the mean naturalness score of spontaneous speech of PWS was significantly higher in post therapy and also, in 6-months follow-up conditions when rated by 10 naive listeners on multidimensional speech naturalness scale given by Kanchan (1997).

Scientific research comparing speech characteristics of recovered and relapsed PWS has been scarce. Reason for this state of affairs include significant proportion of persons treated who

experience relapse (Craig & Calver,1991), and the lack of objective and controlled studies in this domain highlights the immense need for the present study.

Aim of the Study

The primary purpose of the present study was to provide preliminary data on comparing the speech naturalness of recovered and relapsed PWS following treatment on different speech parameters. It has been hypothesized that there is no difference between recovered and relapsed persons with stuttering with respect to speech naturalness.

Method

Participants: The participants were selected based on the inclusion and exclusion criteria. The inclusion criteria required adult persons (18-38 years age) diagnosed with stuttering by a qualified speech and language pathologist in the fluency evaluation prior to the treatment provided. The PWS who underwent fluency therapy using fluency shaping technique and showed a marked improvement (equal to or less than 5 percentile score) on stuttering severity instrument: SSI-3 (Riley, 1994) in immediate post treatment were considered as participants for the present study. Individuals with acquired stuttering or having a positive history of neurological, psychological, audiological or any other associated problem along with stuttering were not considered for the present study. Demographical details such as age of onset of the problem, cause of the problem, family history, type of speech therapy provided, duration of therapy provided, maintenance of improvement and treatment outcomes details were gathered from the participants. Those participants who fulfilled the inclusion criteria were asked to come for a follow-up after 3 months and 6 months of discharge from therapy. All the 22 participants reported after 3 months of follow-up. However, on second follow-up i.e., after 6 months of discharge from therapy, 3 participants out of total 22 did not reported for follow up. Hence, second follow-up evaluation was done on a total of 19 participants who reported after 6 months of discharge from therapy.

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Materials: Stuttering Severity Instrument (SSI-3) by Riley (1994) was administered on all the participants to obtain total stuttering severity scores and percentiles of stuttering. A perceptual rating scale ‘*Multi dimensional speech naturalness scale for stutterers*’ (Kanchan, 1997) was used to rate the speech characteristics of recovered and relapsed PWS in terms of speech naturalness across seven parameters i.e., rate of speech, continuity, effort, stress, intonation & rhythm, articulation, and breathing pattern. Speech samples of all the participants were audio-video recorded using a Sony Handy-cam Model no- HDR- TG1E.

Speech samples collection: All the participants were seated comfortably in a quiet room and were asked to converse and speak spontaneously on a given topic by the investigator such as ‘your hobbies’, ‘your daily routine’, or ‘the city you live in’. An 8 to 10 minute speech sample for each participant was video recorded on a handy-camera. Total 22 videos containing spontaneous speech samples were collected. Further, the obtained connected speech samples were edited to obtain one-minute randomly selected speech sample. Each speech sample was given a separate anonymous code by the investigator. These samples were then saved in the digital video disc (DVD) and were then given to the judges for rating.

Grouping of participants: Stuttering severity instrument (SSI-3) was administered on all the participants. Participants were divided into two groups i.e., recovered and relapsed person with stuttering (PWS) on the basis of a comparison between their stuttering severity scores obtained on pre-treatment and on respective follow-ups. For instance, a participant was considered as ‘relapsed’ if he/she was diagnosed as having moderate stuttering and obtained a score of 25 to 31 on pre-treatment evaluation as per the scoring of SSI-3, and the participant discharged successfully with a marked improvement (less than 5 percentile dysfluency) on immediate post treatment, if the participant reported and obtained same or more scores on SSI-3 (as on pre-treatment level) at post treatment follow-up evaluation. On contrary, if the participant was found to be successful in maintaining the improvement (as on immediate post treatment level) on follow-up evaluation, the participant was considered as ‘recovered’. The scoring was done based

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on total score obtained by the participant, thus if a participant is recovered and obtain a score of 10 or less, was considered as ‘? normal’ and grouped under recovered PWS.

Data analysis and scoring: The binary perceptual rating scale ‘*Multidimensional speech naturalness scale*’ (Kanchan, 1997) was provided to three experienced SLPs to analyze and perceptually rate the given recorded speech samples. The judges were instructed to listen to the speech samples carefully and to assign a rating of ‘0’ for a perceptually unnatural sounding speech and to rate ‘1’ for perceptually natural sounding speech on the basis of description provided for unnaturalness and naturalness across all seven parameters in the perceptual scale. They could listen to the speech sample as many times as required and each listener rated the sample over a week. Listeners’ ratings were tabulated separately under spontaneous speech samples of recovered and relapsed PWS following treatment. The naturalness ratings given by each judge for all the recorded speech samples were converted to percentage naturalness rating for each listener and mean naturalness score was calculated using the below formulae.

$$\text{Naturalness rating for each group of PWS} = \frac{\text{No. of PWS rated as natural/unnatural}}{\text{Total no. of PWS in recovered/relapsed group}}$$
$$\text{Average rating of each sample} = \frac{\text{Sum of parameters rated as natural/unnatural}}{\text{Total no. of Parameters}}$$

Intra and inter judge reliability: Ten percent of the total speech samples data was given to one of the same judges and asked to rate the speech samples again after one week in order to check for the intra judge reliability of the speech naturalness ratings. Another experienced speech language pathologist unaware of the purpose of the study rated the ten percent of speech samples for inter-judge reliability. A Cronbach’s alpha value for inter (0.92) and intra (0.94) judge were obtained on 3 months post treatment follow-up. And, on 6 months post treatment follow-up a Cronbach’s alpha value for inter (0.84) and intra (0.98) judge were obtained, which suggest that the ratings given by the judges for speech samples were highly reliable.

Results and Discussion

Data entry and statistical analysis was done using SPSS 18 software. Fisher exact test was performed to find the association between recovered and relapsed group of PWS across different speech parameters in the perceptual scale. A mean value obtained from listener' rating for naturalness of speech sample of each participant was used to compare the two groups using Independent sample test. Equality of proportion test was done to find significance of difference between recovered and relapsed PWS across each speech parameter. From Table 1, it is to be noted that the grouping was done based on total score obtained by the participant in SSI-3, thus if a participant obtained a total overall score of 10 or less with percentile of 1-4, was considered as 'normal' and grouped under recovered PWS whereas, a total overall score between 10-17 with percentile of 1-4 was considered as very mild according to SSI-3.

As shown in Table 1, among the total 22 participants, 59% (n = 13) maintained recovery and the other 41% (n=9) showed relapse after 3 months of discharge from treatment. All the participants were asked to report for a second follow-up i.e., six months post treatment. Out of total 22, three participants did not report, and only 19 participants reported for 6 months post treatment follow up.

A second post treatment follow-up evaluation of the 19 participants who reported after six months of discharge from treatment was done, where 47% (n =9) participants were found to have maintained recovery and other 53% (n =10) showed relapse following treatment. Similar results were reported by Silverman (1980, 1992), where relapse rates for stuttering was reported at over 50% for adolescence and adult PWS and a fewer than 50% for those who acquired normal sounding fluency during treatment and were able to maintain fluency permanently. In another study, Craig and Hancock (1995) reported a relapse rate in excess of 70% on a long term follow-up.

Table 1 Demographic and SSI details of the participants

Participants'			Pre-treatment		Immediate post		Post 3 months			Post 6 months		
N	A	G	Percen	Severity	Percen	Severity	Percen	Severity	Grp	Percen	severity	Grp
1	23	F	42-60	Mod	1-4	V.mild	10-12	V.mild	Rec	1-4	V.mild	Rec
2	18	M	24-40	Mild	1-4	V.mild	1-4	?normal	Rec	1-4	?normal	Rec
3	18	M	61-67	Mod	1-4	?normal	1-4	?normal	Rec	1-4	?normal	Rec
4	21	M	24-40	Mild	1-4	V.mild	1-4	?normal	Rec	24-40	Mild	Rel
5	26	M	24-40	Mild	1-4	?normal	1-4	?normal	Rec	1-4	?normal	Rec
6	23	M	12-23	Mild	1-4	V.mild	1-4	?normal	Rec	5-11	V.mild	Rel
7	18	M	24-40	Mild	1-4	?normal	1-4	?normal	Rec	12-23	Mild	Rel
8	21	M	78-88	Severe	1-4	V.mild	41-60	Mod	Rel	12-23	Mild	Rel
9	22	M	41-60	Mod	1-4	V.mild	24-40	Mild	Rel	12-23	Mild	Rel
10	26	M	12-23	Mild	1-4	V.mild	1-4	?normal	Rec	1-4	?normal	Rec
11	24	M	61-67	Mild	1-4	?normal	1-4	?normal	Rec	1-4	?normal	Rec
12	27	M	41-60	Mod	1-4	V.mild	61-67	Mod	Rel	61-67	Mod	Rel
13	25	M	61-67	Mod	1-4	V.mild	1-4	?normal	Rec	12-23	Mild	Rel
14	26	M	78-88	Severe	1-4	V.mild	61-67	Mod	Rel	96-99	v.severe	Rel
15	20	M	24-40	Mild	1-4	V.mild	12-23	Mild	Rel	1-4	?normal	Rec
16	38	M	41-60	Mod	1-4	V.mild	12-23	Mild	Rel	41-60	Mod	Rel
17	18	M	12-23	Mild	1-4	?normal	1-4	?normal	Rec	1-4	?normal	Rec
18	20	M	41-60	Mod	1-4	?normal	1-4	?normal	Rec	1-4	?normal	Rec
19	33	M	12-23	Mild	1-4	?normal	1-4	?normal	Rec	24-40	Mild	Rel
20	20	M	12-23	Mild	1-4	?normal	12-23	Mild	Rel	NR	NR	NR
21	18	M	41-60	Mod	1-4	V.mild	61-67	Mod	Rel	NR	NR	NR
22	23	M	61-67	Mod	1-4	V.mild	24-40	Mild	Rel	NR	NR	NR

In the above table, N indicates participants' number; A-Age; G-Gender; Percen-Percentile; Grp- group; Rec-recovered PWS; Rel-Relapse PWS; V.mild-very mild; mod-moderate; V.severe-very severe; NR- not reported.

Table 2 Result of Fisher exact test

Parameters	Post 3 months treatment follow-up			Post 6 months treatment follow-up		
	Total no. of PWS (N=22)			Total no. of PWS (N=19)		
	Recovered (n=13)	Relapsed (n=9)	Sig	Recovered (n=9)	Relapsed (n=10)	sig
1 Rate of speech	11 (85%)	3 (33%)	.026*	9 (100%)	5 (50%)	.033*
2 Continuity	13 (100%)	0 (0%)	.001**	8 (89%)	0 (0%)	.001**
3 Effort	11 (85%)	2 (22%)	.007	8 (89%)	4 (40%)	.057
4 Stress	13 (100%)	3 (33%)	.005*	9 (100%)	5 (50%)	.033*
5 Intonation and Rhythm	9 (69%)	3 (33%)	.192	7 (78%)	1 (10%)	.006
6 Articulation	12 (92%)	5 (55%)	.116	9 (100%)	7 (70%)	.007
7 Breathing pattern	13 (100%)	3 (33%)	.001**	9 (100%)	3 (33%)	.087

* Significant at <0.05; ** significant at <0.01; N=total no. of participants; n = no. of participants in groups

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Table 3 Results of equality of proportion test

Parameters	3 months post treatment				6 months post treatment			
	P ₁	P ₂	z value	p value	P ₁	P ₂	z value	p value
1. Rate of speech	0.84	0.33	2.4	0.01**	1.00	0.50	2.4	0.01**
2. Continuity	1.00	0.00	4.6	0.01**	0.88	0.00	3.9	0.00**
3. Effort	0.84	0.22	2.9	0.01**	0.88	0.40	2.2	0.02*
4. Stress	1.00	0.66	2.2	0.02*	0.88	0.70	1.7	0.07
5. Intonation and Rhythm	0.69	0.33	1.6	0.09	1.00	0.10	2.9	0.00**
6. Articulation	0.92	0.55	2.0	0.04*	0.77	0.70	1.7	0.07
7. Breathing pattern	1.00	0.33	3.4	0.01**	1.00	0.60	2.1	0.03*

P1= PWS rated as natural /total no. of recovered PWS; P2= PWS rated as natural/total no. of relapsed PWS

*indicates, the value is significant at <0.05; ** significant at <0.01

All the participants were perceptually rated by three judges on speech naturalness scale across seven speech parameters i.e. rate, continuity, effort, stress, intonation-rhythm, articulation and breathing pattern. The results are discussed for the seven speech parameters of speech during two follow ups i.e., 3 month and 6 months post treatment respectively.

A. Comparison between recovered and relapsed PWS across speech parameters on 3 and 6 months post treatment follow-up

1. Rate of speech: Table 2 depicts the result of Fisher exact test, performed to find a significance association between two groups of PWS across seven speech parameters. As shown in Table 2 and Figure 3, in the recovered group (n =13), 11 (85%) participants scored a rating of '1' i.e. natural sounding speech and the other 2 (15%) participants scored a rating of '0' i.e. unnatural sounding speech. On the contrary, in relapsed group (n=9), a higher number 6 (67%) of participants scored as unnatural sounding speech whereas the other 3 (33%) participants scored a rating of natural sounding speech on perceptual scale. There was a significant association (P <0.01) found between the groups for the rate of speech parameter on the statistical test done. Further, equality of proportion test was done to compare the two groups across parameters. Results in the Table 3, shows that a significant difference in equality of proportion (p <0.01) was found between the two groups on the rate of speech for both the follow-ups.

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A total (N= 19) participants reported for second follow-up evaluation that was done after 6 months of post treatment. Speech of recovered (n= 9) and relapsed (n= 10) participants were perceptually rated by three judges. As shown in Table 2, it was found that all the 9 (100%) recovered participants obtained rating for natural sounding speech and none (0%) was rated for unnatural sounding speech. Whereas, in relapsed group (n=10), a total 5 (50%) participants scored natural sounding speech and the other 5 (50%) were rated for unnatural sounding speech.

2. Continuity in speech: The results in the Table 2 depicts that all the 13 (100%) participants in the recovered group obtained ratings for natural sounding speech and none (0%) obtained unnatural sounding speech by listeners on perceptual rating scale. On contrary, in relapsed group, all 9 (100%) participants obtained rating for unnatural sounding speech and none (0%) was rated as natural for continuity in speech on 3 months post treatment follow up. Results shows a significant association ($p<0.01$) between the two groups of PWS in their speech continuity and also, a significant difference in equality of proportion ($p<0.01$) was found between the two PWS groups on continuity in speech.

On 6 months post treatment follow up, As shown in Table 2, a total of 8 (89%) participants were rated as natural sounding continuity in speech; and only 1 (11%) participant was rated as unnatural sounding speech in the recovered group. all the participants 10 (100%) were rated as unnatural and none 0 (0%) was rated as natural sounding speech continuity in relapsed PWS group. As shown in Table 2, there was a significant association ($p<0.05$) between recovered and relapsed group for parameter 2 i.e. continuity in speech on 3 month and 6 month post treatment follow up respectively. Table 3 depicts a significant difference (<0.01) in equality of proportion of continuity and speech of recovered and relapsed PWS.

3. Effort: During 3 months post treatment, as shown in Table 2, total 11 (84%) participants obtained a rating for natural sounding speech while 2 (16%) participants obtained rating of unnatural sounding speech in the recovered PWS group. Whereas, in the relapse group, 7 (78%)

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participants obtained rating for unnatural sounding speech and other 2 (22%) were rated for having natural sounding speech for the parameter effort. There was no significant association ($p>0.05$) found between the two PWS groups and parameter of effort in speech (Table 2). On equality of proportion test, there was a significant difference in equality of proportion ($p<0.01$) found between the two groups of PWS across their effort in speech (Table 3).

More number of participants i.e. 8 (89%) were rated as effortless and natural sounding speech and 1 (12%) participant was rated as effortful and unnatural sounding speech among recovered group of participants on 6 months post treatment. In relapsed group, 6 (60%) participants were rated as effortful and unnatural sounding speech whereas, 4 (40%) were rated as effortless and natural sounding speech. Results in Table 2 shows that there is no significant association ($p<0.05$) between recovered and relapsed group for parameter 3 i.e. effort in speech on 3 month and 6 month post treatment follow up respectively. Table 3, shows a significant difference in equality of proportion ($p<0.01$) for effort in speech of recovered and relapsed PWS.

4. Stress: During 3 months post treatment, all the participants 13 (100%) in the recovered group obtained a rating for natural sounding speech and no one (0%) was rated for having unnatural sounding speech. On the other hand, 6 (67%) participants in the relapsed group obtained a rating of stressful and unnatural sounding speech and the other 3 (33%) participants were rated as natural sounding on perceptual scale by the judges. Table 2, depicts a significant association between the two groups of participants on stress parameter and a significant difference in equality of proportion (<0.01) found between recovered and relapsed PWS groups across their stress in speech.

During 6 months post treatment, all 9 (100%) participants in recovered group were rated as natural sounding speech and no-one (0%) was rated as having unnatural sounding speech. In the relapsed group, 5 (50%) participants obtained a natural sounding speech rating and the other 5 (50%) participants were rated as unnatural and stressful speech by the listeners. There was no

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significant association ($p > 0.05$) found between both the groups on stress during 3 month post treatment whereas, a significant association was found during 6 months post treatment as shown in Table.3. Results of Equality of proportion test (Table 3) shows a significant difference in equality of proportion ($p < 0.01$) between parameter 4 and the two groups of PWS.

5. Intonation and rhythm: In the recovered group, 9 (69%) participants obtained rating as natural sounding speech and 4 (31%) were rated as unnatural with regard to parameter of intonation and rhythm in speech. In the relapsed group, 6 (67%) participants obtained rating for monotonous, dysrhythmic and unnatural sounding speech and other 3 (33%) participants were rated as natural sounding during 3 month post treatment. There was no significant association ($p > 0.05$) found between the two groups of PWS (Table 2) and no significant difference in equality of proportion ($p > 0.05$) found between the two PWS groups across their intonation and rhythm (Table 3). The results obtained may suggest that the speech of recovered and relapsed PWS sounds similar with respect to intonation and rhythm. Speech of recovered PWS can be monotonous and dysrhythmic as of the relapsed PWS group following treatment.

A total of 7 (78%) and 2 (28%) participants in recovered group were rated as natural and unnatural sounding speech respectively during 6 months post treatment evaluations. In the relapsed group, more number of participants i.e., 9 (90%) were rated as having unnatural sounding speech and 1 (10%) was rated as having natural sounding speech. As depicted in Table 2, there was no significant association ($p > 0.05$) found between intonation and rhythm parameter in the two groups during 3 months post treatment follow-up whereas, a significant association ($p < 0.05$) was observed between them during 6 months post treatment. Table.3, shows that there was no significant difference ($p > 0.01$) found between intonation and rhythm parameter and speech of recovered and relapsed PWS on 3 months post treatment whereas, a significant difference ($p < 0.01$) was found between the two on 6 months post treatment follow-up.

6. Articulation: In the recovered group, 12 (92%) participants obtained rating for natural sounding speech and 1 (8%) participant was rated as unnatural sounding on speech articulation. In the relapsed group, 5 (55%) participants were rated as natural and 4 (45%) participants as unnatural sounding by the judges. There was no significant association ($p>0.05$) found between the two groups of PWS on articulation (Table 2). During the 3 months post treatment, there was a significant difference of proportion ($p<0.05$) found between the two PWS group across their articulation in speech (Table 3).

During the 6 months post treatment, all 9 (100%) participants and 0 (0%) were rated as natural and unnatural sounding speech by the listeners for the recovered group respectively. Whereas, total 7 (70%) participants were rated as more natural sounding than 3 (30%) participants who obtained unnatural sounding speech on listener's rating for the relapsed PWS group. There was no significant association ($p<0.05$) found between both the groups ($p>0.05$) during both the follow-ups. On Equality of proportion test (Table 3) a significant difference ($p<0.05$) was found for articulation parameter between the two groups of PWS on 3 months post treatment whereas, there is no significant difference ($p>0.05$) was found between them during 6 months post treatment.

7. Breathing Pattern: During 3 months post treatment, all the 13 (100%) participants in the recovered group were rated as natural and no one (0%) was rated for having an unnatural breathing pattern for speech. On the other hand, 6 (67 %) participants in relapsed group were rated as unnatural and the other 3 (33%) obtained natural breathing pattern for speech. As shown in Table 2, a significant association ($p>0.01$) was found between the two group of PWS on the breathing pattern. Table 3, depicts that there was a significant difference in equality of proportion found between the two groups of PWS across their breathing pattern for speech.

All 9 (100%) participants in the recovered group were rated as having natural breathing pattern for speech and hence none i.e. 0 (0%) was rated as unnatural breathing pattern for speech during 6 months post treatment. In the relapsed group, 6 (60%) participants were rated as having

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unnatural breathing pattern for speech and other 4 (40%) participants were rated as natural. Results in Table 2 depicts that there is a significant association ($p < 0.05$) found between both the groups across breathing pattern for speech parameter during 3 months post treatment whereas, no significant association found ($p > 0.05$) between them during 6 months post treatment. Table 3 shows a significant difference in equality of proportion ($p < 0.01$) in breathing pattern for speech in the two PWS groups during 3 and 6 months post treatment follow ups.

Overall Speech Naturalness

From the above findings and Figure 1, it can be observed that recovered PWS showed higher mean naturalness score on all speech parameters as compared to relapsed PWS during 3 and 6 months post treatment follow-up. This suggests that participants of recovered group maintained their improved speech naturalness after successfully discharge from therapy. These findings are not consistent with Harold et al., (1986), and Onslow et al., (1992) who stated some unresolved outcome issues associated with prolonged speech treatments and reported that post-treatment speech is likely to sound unnatural and may be distinguished from the speech of those who do not stutter.

This difference in naturalness could be due to the fact that for the spontaneous speech task, speech naturalness is affected by speaker's intention to converse and emotional state which influences rate, continuity, effort, and stress pattern of utterances. The most likely reason that participants exhibited slow speech rates in the relapsed PWS in spontaneous speech, could be the effectiveness and regular practice of the techniques taught during therapy session to speak slow and chorally with the fluency shaping technique, which resulted in the maintenance of naturalness in speech on follow-up evaluations. It has been reported by some authors (Subtenly, Worth & Sakuda, 1966; Umeda, 1977) that effort in speech is consequently related to rate, stress and duration of speech sounds and it may vary with the position of a sound in the word, the rate and loudness of utterance, co-articulation and stress.

Speech of recovered and relapsed PWS group was found to be monotonous and dysrhythmic. Again, it may be due to using slow rate of speech while speaking. In the present study, speech naturalness ratings are found to be highly associated with the parameters of rate, stress, intonation, articulation and breathing pattern for the spontaneous speech. The results of present study are consistent with the findings of Onslow, Adams and Ingham (1992) and Packman, Onslow and Van Doorn (1994) who reported that the mean naturalness scores increased with increase in the rate of speech and decrease in percent dysfluency. This indicates that speech naturalness increases as the speech becomes stutter free and as its rate increases to a normal range.

Speech naturalness of recovered and relapsed PWS on post treatment follow-ups

Table 4 Results of independent t-test comparing mean naturalness of two groups

Post treatment follow-up	Groups	N	Mean	S.D	Sig.
After 3 months (N=22)	Relapsed	9 (41%)	2.44	1.87	.001**
	Recovered	13 (59%)	6.23	.83	
After 6 months (N=19)	Relapsed	10 (53%)	2.70	1.56	.001**
	Recovered	9 (47%)	6.55	.72	

** indicates significance at <0.01.; n indicates no. of participants in respective groups

Independent sample t-test was done to compare the mean naturalness of recovered and relapsed PWS, across all speech parameters for the 3 months and 6 months post treatment follow-up. There was a significant difference ($p < 0.01$) found between recovered and relapsed PWS on first follow-up i.e. 3 months post treatment. As shown in Table 3 and Figure 1, recovered PWS obtained higher mean naturalness than relapsed PWS on both the post treatment follow-ups. Also, there was a significant difference ($p < 0.01$) found between both the groups for second follow-up, after 6 months post treatment. However, there was no significant difference ($p > 0.05$) found on Paired t-test which was performed to compare the mean naturalness scores of two groups between the third and the sixth months post treatment follow-ups.

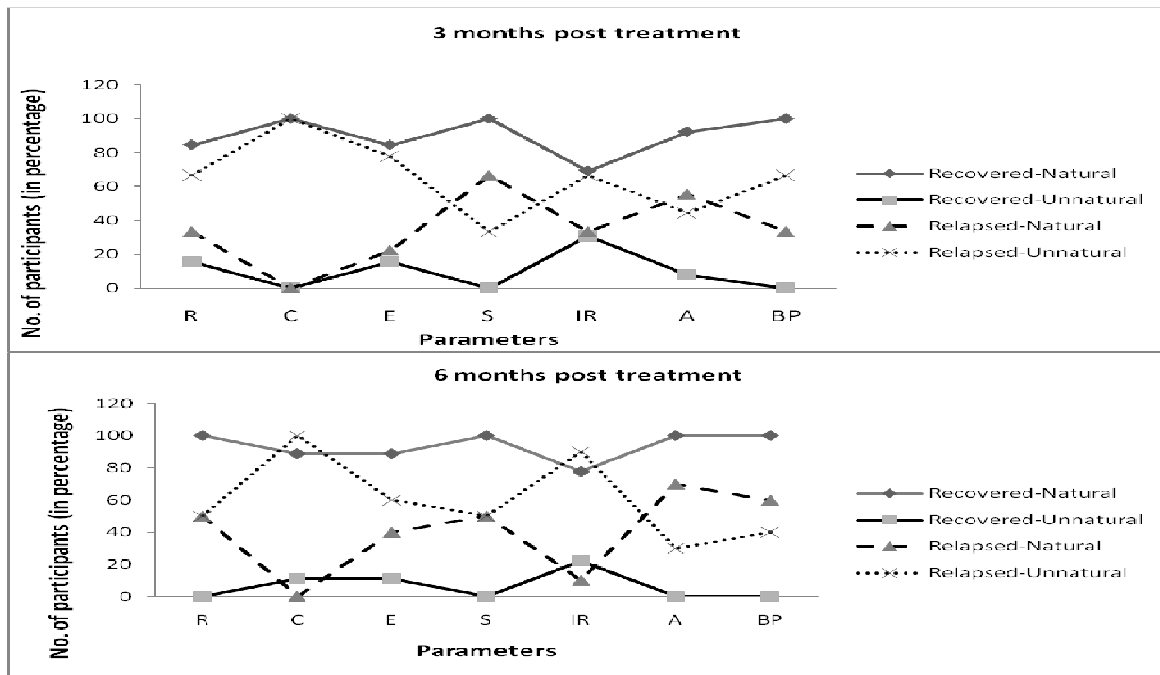


Figure 1 Speech naturalness across all parameters on 3 and 6 month post-treatment follow-ups

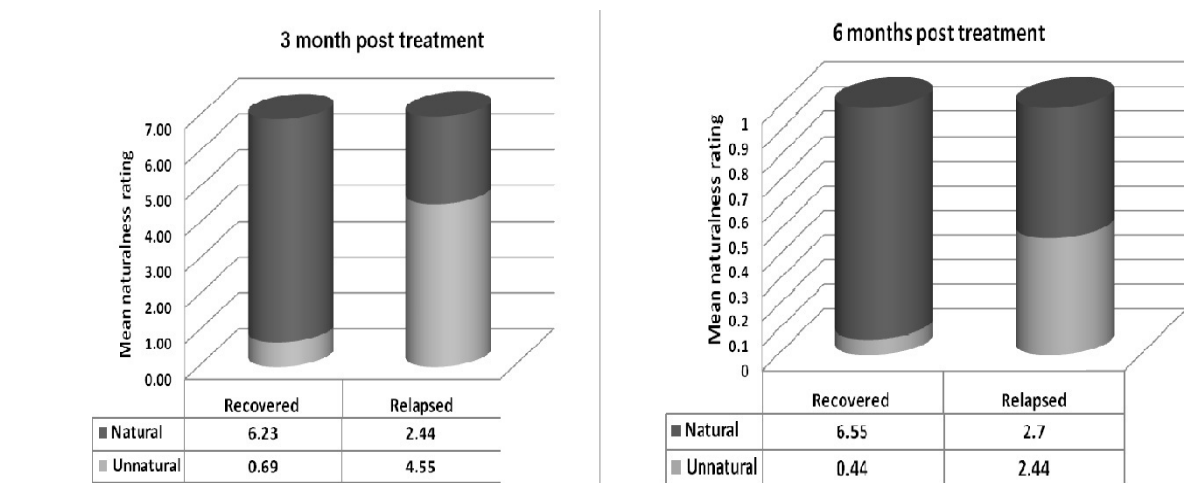


Figure 2 Comparison between two groups of PWS across mean values of speech naturalness in 3 and 6 months post treatment follow-up.

Conclusion

The results of present study shows that persons with stuttering (PWS) who maintained the recovery on 3 months and further 6 months post treatment follow-up shows higher mean naturalness in their speech from those, who experienced relapse following treatment on all the speech parameters. From the results obtained, it signifies parameters 1, 2, 4, 5 and 7 i.e. rate of speech, continuity, stress, intonation and rhythm and breathing pattern have significant association with the speech naturalness of both recovered and relapsed person with stuttering group following treatment.

The present study accomplishes that the rate, continuity, stress, intonation- rhythm, and breathing pattern during speech are the important speech parameters to compare between recovered and relapsed PWS. Also, it was observed that severity of stuttering in pre-and post-treatment evaluation has shown significant association between recovery and relapse following treatment. It may be concluded that the more severe stuttering in pre-therapy may lead to relapse of the problem and on contrary; persons with less severe stuttering at pre-treatment level could maintain their recovery after termination from treatment. The acceptable speech quality in stuttering therapy determines the treatment outcomes. Thus, it is very important to assess the naturalness of speech in stutterers after treatment. It would be even more important to assess whether the PWS who underwent treatment is able to maintain the same naturalness as in immediate post-treatment. Such information could be valuable for the evaluation of the fluent speech of treated PWS and has possible application for measuring therapeutic progress and determining dismissal criteria.

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Pravesh Arya, MSc. (SLP), Ph.D. candidate

Department of Speech Language Sciences
All India Institute of Speech and Hearing (AIISH)
Naimisham Campus, Manasagangothri
Mysore- 570006
Karnataka
India
Pravesh_arya_here@yahoo.co.in

Geetha Y.V., Ph.D. (Speech and Hearing)

Professor, Department of Speech Language Sciences
All India Institute of Speech and Hearing (AIISH)
Naimisham Campus, Manasagangothri
Mysore- 570006
Karnataka
India
geethayelimeli@gmail.com

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