The effect of different negative reinforcement on stuttering frequency

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Introduction

According to our experience, stuttering develops from preschool age and in most cases tends to exacerbate in consequence of different stressful agents and diseases. As far as stresses and diseases are almost unavoidable in child's life, it can expected stuttering to be more severe in adolescents in comparison with preschool age children. However, speech examination reveals a different degree of stuttering manifestation both among peers and different age children. In our practice we had observed severe stuttering in 2-3 years old children and mild forms in teenagers. Conversations with parents revealed a difference in their attitude towards stuttering: some of them disregarded disfluencies, waiting for a child to outgrow the problem. In these cases stuttering can develop without any barriers and restrictions, remaining at the same level for years at the best, but often aggravating after stressful events. Other parents actively intervened throughout the course of stuttering, correcting or/and making remarks, e.g.: "Speak slowly", "Speak louder", "Repeat it", "Breath and say that again". These remarks were not systematic, nevertheless, speech assessment of children from these families usually reveals mild stuttering. It is possible, that due to such intervention to speech, verbal remarks or repetition of words and sentences operated as a negative reinforcement thereby improving fluency capacities or preventing further deterioration of the disease. Most probably, that postulated by some authors the possibility of spontaneous recovery from stuttering (Yairi & Ambrose, 1999; Mansson, 2000; Ryan, 2001) to be connected with punishing properties of repetition or verbal remarks during parents' interventions in their child's speech. To verify the validity of the hypothesis that using repetition or remarks in family surrounding could prevent stuttering impairment and possibly improve fluency capacities we implemented the investigation where the repetition as self-correction used as a single treatment tool in one treatment group while verbal remarks - in another treatment group.

Method

In compliance with applied negative reinforcement, 36 subjects with mild to moderate stuttering (ages 2.6 to 7.10) with the ability to repeat short sentence fluently were assigned to three matched groups.

1. **"Repetition"** group (n=12). After every stuttering occurrence participants had to repeat the last sentence fluently. If the disfluent utterance consisted of one or two words, children had to construct (with parents' aid and prompts) a correct and complete sentence containing at least 3 words and repeat it fluently. This "punishment" must be applied during the entire treatment period or until the attainment of zero stuttering level. The treatment was conducted at home by parents with weekly clinic sessions for 3 months.
2. **"Verbal remarks"** group. During 3 months 12 children received verbal remarks in non-punitive tone after every stuttering episode, e.g.: "You said it bad", "It was bad".
3. Parents from **control group** (n=12) ignored disfluencies in child's speech.

In all subjects, short speech samples were audio-visually recorded before treatment, post-treatment, and at 6 month follow-up. Additionally, children from the "Repetition" group were audio recorded weekly during treatment sessions and at home before it. Collected recordings were analyzed to derive stuttering severity as the percentage of syllables stuttered (%SS). It is a measure of the proportion of syllables in a sample of speech which are associated with unambiguous stuttering (O'Brian, Packman, & Onslow, 2004; O'Brian, Packman, Onslow, & O'Brian, 2004). For each child, the mean percentage change in stuttering frequency from pre-treatment to 3 and 6 months post-treatment speech assessment was calculated. The combined %SS for home and clinic measurements was used for statistical analysis. Subsequently the findings indicated that treatment progress substantially depended on corrected/uncorrected disfluencies ratio. Based on weekly reports from parents we calculated the mean percentage of corrected disfluencies (%CD) for each child as relation of corrected disfluencies to all stuttering episodes. Treatment effectiveness was calculated as relation of residual between pre-treatment and post-treatment stuttering severity to pre-treatment meanings.

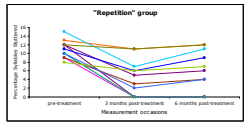
Together, 36 participants were included in the final data analysis: we evaluated the correlation between treatment effectiveness and other variables – stuttering severity, %CD, age, time since stuttering onset, and family history of the disease.

Results

"Repetition" group

"Punishing" of stuttering by means of utterance repetition led to significant speech improvement in 9 participants from first week of implementation. Statistical analysis revealed that treatment progress directly depended on corrected/uncorrected disfluencies ratio. The best results - complete recovery and maintaining fluent speech during 6 months after treatment onset demonstrated children who corrected up to 90% of all disfluencies. Participants correcting less than 90% of all disfluencies attained different level of improvement. Speech of children, who corrected only 35%-45% of all disfluencies, fluctuated at pretreatment level during the course.

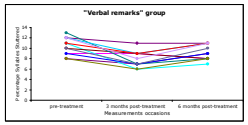
Fig. 1 demonstrates changes in stuttering frequency in all 12 participants from "Repetition" group pre-treatment, post-treatment and at 6 month follow-up.



"Verbal remarks" group

Verbal remarks slightly improved fluency capacities in 9 children during the first month of treatment. The attained speech level was maintained till the end of treatment period, but after the remarks were withdrawn, speech gradually worsened in all 9 subjects and returned to baseline level in 6 children by the 6 month follow-up. Speech of rest 3 children remained at pretreatment level till the last speech examination.

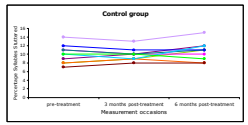
Fig. 2 demonstrates changes in stuttering frequency in all 12 participants from "Verbal remarks" group pre-treatment, post-treatment and at 6 month follow-up.



Control group

Children from the control group did not demonstrate meaningful alterations of fluency level during 3 months; to the 6 month follow-up the speech had negligibly worsened in 3 children.

Fig.3 demonstrates changes in stuttering frequency in 12 subjects from control group initially, after 3 and 6 months waiting time.



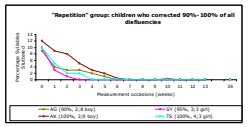
Results

"Repetition" group

Complete recovery

4 younger subjects with a lesser stuttering experience who repeated utterance in 90%-100% of all stuttering episodes got rid of stuttering during 3 months, and still demonstrated fluent speech at 6 month follow-up.

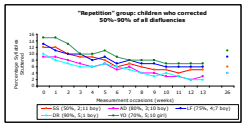
Fig. 4 shows the individual stuttering frequency in %SS with each data point representing weekly combined home/clinic measurement occasions for those children from "Repetition" group who corrected more than 90% of all stuttering episodes.



Speech improvement

In 5 participants from the "Repetition" group who corrected 50%-90% of all disfluencies statistical analysis showed a significant reduction of %SS ($p<0.05$). Decreases in stuttering were obtained with each of the subjects, but the degree of improvement was variable and correlated with % CD. After 6 months speech maintained at the same level in 3 subjects and worsened in two.

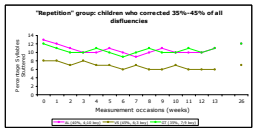
Fig. 5 shows individual stuttering frequency in %SS with each data point representing weekly combined home/clinic measurement occasions for children from the "Repetition" group who corrected 50%-90% of all stuttering episodes.



Speech without improvement

Three participants who corrected only 35%-45% of all stutters did not demonstrate significant alterations in speech rate neither during treatment, nor at the follow-up. Despite of certain positive dynamics in %SS in first treatment weeks, these alterations appeared non-persistent and statistically insignificant.

Fig. 6 represents individual stuttering frequency in %SS with each data point representing weekly combined home/clinic measurement occasions for children from the "Repetition" group who corrected 35%-45% of all stuttering episodes.

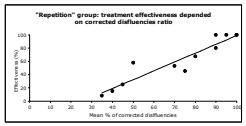


Results

Treatment effectiveness

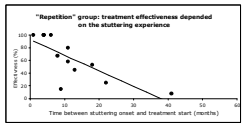
Treatment effectiveness depended on percentage of corrected disfluencies

Statistical analysis revealed significant correlation in the "Repetition" group between treatment effectiveness and percentage of corrected disfluencies ($r=0.94$, $p<0.0001$) (Fig. 7).



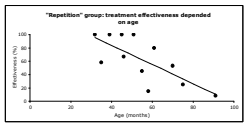
Treatment effectiveness depended on the stuttering experience

As to the time interval between stuttering onset and treatment start it has been shown that it negatively correlated with treatment effectiveness i.e. the shorter the previous period of stuttering, the more treatment gains were obtained. The correlation was significant ($r=-0.77$, $p<0.05$) but numerically lower than between effectiveness and %CD (Fig. 8).



Treatment effectiveness depended on age

The treatment effect was more apparently defined in smaller children: the mean age of children with complete recovery (3;3±0;12) was lower as compared with children with fluency improvement (4;1±1;9). The correlation between effectiveness and age was numerically lower than the one with %CD and stuttering experience ($r=-0.73$, $p<0.05$), but was statistically significant (Fig. 9).



Treatment effectiveness did not depend on stuttering severity

Treatment effectiveness did not depend on family history of stuttering

Conclusions

A comparable observation between three groups brings us to the conclusion that "punishment" of stuttering by way of utterance repetition is an effective procedure to reduce/eliminate stuttering in children. In the context where fluent utterance follows the stutter, repetition operates as a negative reinforcer. Applying this negative reinforcement up to 90 % of all disfluencies led to a complete recovery in 4 children. If the stuttering was "punished" intermittently, reinforcement was negative but stochastic. It leads to a considerable amelioration in speech, however even a significant improvement in the disease did not prevent the subject from further post-treatment aggravation, whereas the risk of relapse after a complete recovery is negligible. Applying negative reinforcement in less than 45% of all disfluencies did not influenced on stuttering severity; speech remained at the pre-treatment level without a positive or negative trend. The absence of any reinforcement did not lead to significant effect on speech, but seemed to have been unable to prevent possible aggravation. Verbal remarks are a more acceptable strategy towards stuttering speech, than neutral attitude, but are less effective than the repetition. Obtained results detected that treatment gains connected with time since stuttering onset: treatment effectiveness negatively correlated with stuttering experience. Additionally, younger children reach more progress in treatment than older ones. The results of current study provide experimental evidence and confirm advantages of the potential benefit of an early intervention for stuttering.

Thus, we consider the repetition as negative reinforcement being an effective procedure to reduce/eliminate stuttering and recommend it as a mode of behavior in families with stuttering children. It is simple enough to be employed by parents and moreover irreplaceable in stuttering therapy of early preschool children with undeveloped, limited or delayed speech-language abilities. Presented technique could be recommended for a mild and moderate stuttering correction also in clinics and preschool institutions as a component of early stuttering therapy programs. With the assumption of maximum control over the child's speech while almost all disfluencies must be corrected/"punished", it is possible to completely eliminate stuttering. By applying the repetition periodically, stuttering could be ameliorated and its probable subsequent aggravation be prevented.

For interested persons DVD recordings of recovered children before and after treatment are available.
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Acknowledgments

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