ASSESSING FLUENCY IN PERSONS WITH STUTTERING BY COMPLEX AUTOMATIZED AND NON-AUTOMATIZED DUAL-TASK CONDITIONS[1]

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1. Introduction

According to the main explanatory models on stuttering, specific cognitive functions are involved in speech planning and in fluency management. In general, they are based on cognitive architectures formed by modules, processes and function controls, aimed at resource management and regulation. Even when not explicitly stated, these models refer to the Supervisory Attentional System (SAS, Norman & Shallice, 1986) for speech management. As a result of this approach, the Hierarchical Modular Model (HMM) has recently been proposed to describe the interaction between the SAS and the specific language systems in stuttering and verbal fluency (D'Ambrosio, Bracco, Benso, 2013). This model is grounded on a three-level hierarchical modular approach (Moscovitch & Umiltà, 1990). According to the HMM, only the first level modules, the simplest ones, are similar to those described by Fodor, while the second and third level modules are less computationally encapsulated and are the result of SAS management. These modules can control learned automatic behaviours. This model acknowledges a relevant role of central and executive functions in fluency learning and regulation.

2. The research

According to HMM, we argue that Persons with Stuttering PWS could increase their fluency if involved in a dual task condition where the secondary task's characteristics would allow the SAS to assemble the modules. A secondary task without the proper rhythm and level of automatization could not be assembled with speech and would not grant any sensible improvement in fluency.

The performance of 18 PWS, adolescents and adults, was assessed in three conditions:

A. speech task;

B. speech task with a non-assemblable secondary task;

C. speech task with a secondary task affording the tasks' assembly.

Higher performance in condition A would demonstrate that every kind of secondary task could interfere with speech. Higher performance in condition B would demonstrate that a dysfunctional control of the executive system over fluency could be corrected by a distracting secondary task. This should confirm those hypotheses about the anticipatory anxiety distraction (Bajaj, 2007), the automatic speech mode shift (Arends, Povel, Kolk, 1988), and the inhibition of the hyper-vigilant monitoring system (Vasic & Wijnen, 2005). Higher performance in condition C would demonstrate that the assembly of the action patterns allows the SAS better control over fluency.

2.1. **Material and methods**

Participants - eighteen PWS participated to the research (12 males; 6 females), aged between 14 and 33, attending a single or group stuttering treatment. None of the participants previously followed training proposed in our experimental program. All the participants agreed to take part in the research and signed an informed consent form.

Procedure – All the participants underwent a preparatory session where they quietly read a short text (266 words) about the life of white bears three times. After this reading session, the participants underwent the three conditions listed above in a counterbalanced order. After each condition, they quietly read the text again in order to facilitate the recall of the contents.

Condition A. Participants described the contents of the text with a monologue of at least 55 words, without any other concurrent task.

Condition B. Participants described the contents of the text with a monologue of at least 55 words, and at the same time had to perform a complex motor activity, impossible to automate (to shuffle 55 poker cards with asymmetrical movements). We assume that in this condition, the SAS was mainly engaged in the management of the attentional shift.

Condition C. Participants described the contents of the text with a monologue of at least 55 words, and at the same time had to perform a coordinated and automatic complex motor activity (to turn one card onto the table for every word said). We assume that in this condition, the SAS was mainly engaged in managing the assembly of the two tasks in a single scheme.

2.2.Results and comments

For each condition, the amount of disfluencies produced in the first 55 words of the speech and the execution time form the first to the 55th word have been computed. As will later be shown, the amount of disfluencies was consistently different among conditions, while the execution time was relatively stable.

Concerning disfluencies, over a sample of 990 words in each condition, in condition A participants produced a total of 257 stuttered words; in condition B 209 stuttered words were produced; in condition C just 61 stuttered words were produced. Fluency accuracy increases by 76,27% in Condition C. Data distribution is close to normal, since the Kolmogorov Smirnov test is not significantly different for any of the three conditions (p=.914; p=.845; p=.506). In addition, the sphericity assumption for the three conditions is met (p=.655). The difference among the amount of disfluencies in conditions A, B and C is statistically significant, according to an analysis of variance (ANOVA) for k dependent samples: F (2,34) = 23,937; p <.0001. Partial Eta Squared = .585. A post hoc pairwise comparison (with Bonferroni correction) among conditions revealed that there is not a significant difference between condition A *vs* B (p =.327), but there a significant difference between condition A vs C (p < .0001), and condition B vs C (p < .0001). In other words, the fluency increase in condition C is unequivocally and significantly different from the other two conditions. In addition, comparing the performance of all the participants, it is possible to notice that all of them had an increase in the condition C, showing a fluency increase due to the assembly factor. In conditions A, B and C, the performance duration has been respectively 1229 s., 1485 s. and 1280 s., with a total amount of 990 words per condition. The analysis of variance for dependent samples showed that there is not a significant difference among the conditions (p =.159), confirming that the secondary motor task had a small interference on the primary task execution time (i.e., speech).

3. Conclusions

The research presented in this paper is a pilot study aiming at investigating the effects of a dual task over fluency control. It also proposes taking the dual-task paradigm out of the experimental domain to make it the ground for stuttering treatment trainings. This proposal has already been advanced by Bosshardt (2006), and partly accomplished by some training programs (D'Ambrosio,

2005, 2012). We argue that this trend should increase even more, taking to the development of training tasks more explicitly built on the dual-task paradigm. The present research was aimed at investigating the contribution of the secondary task in facilitating stuttering. Specifically, we demonstrated how fluency can be increased by involving the person in the coordination of the two tasks into a new executive scheme. This function is clearly regulated by the SAS, which intervenes in sustaining the newly learned processes until they are automatic and autonomous, increasing the fluency speed and the resource optimization. Obviously, at the beginning of the development process, the action is slowed down by the SAS intervention, whose primary aim is the accuracy in task execution. Subsequently, the consolidation of automatisms will free the SAS from the coordination, leaving it available for coping with unpredictable situations, emotional stress or more demanding conditions. Adding an already automatic secondary task to speech, we can let the SAS focus on assembling the actions into new schemes, "modularizing" the new skills over time (Karmiloff-Smith, 1992). The "modularization" is possible only if the secondary task involves automatic processes with a precise rhythm and compatible with speech. In our research, participants increased fluency without significantly increasing execution times. We rule out the possibility that the fluency increase in condition C has merely been due to the distraction provided by the secondary task, since we observed no fluency increase in condition B (which was based on shifting the attention between the two tasks).

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