# A Critical View of a Treatment Intervention for Stuttering Based on Video Games

# Uma visão crítica de uma intervenção de tratamento para Gaguez Baseado em Jogos de Vídeo

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**Abstract**

Stuttering is a fluency disorder etymologically multifactorial, characterized by intense psychological manifestations. Currently, traditional therapeutic interventions are mainly derived from neuropsychology, such as cognitive-behavioral therapy, focusing primarily in anxiety and social disorder symptoms. However, a significant number of these interventions have limited effectiveness. Therefore, new paradigms based on video games have been developed. Following this approach, the present opinion paper aim to review these new interventions for stuttering, suggesting that new methodological guidelines are needed to reach greater objectivity in the treatment.

**Keywords:** stuttering, video games, intervention, technology

**Resumo**

A gaguez é um distúrbio de fluência etimologicamente multifatorial, caracterizada por marcadas manifestações psicológicas. Atualmente, as intervenções terapêuticas tradicionais derivam principalmente da neuropsicologia tal como da terapia cognitivo-comportamental, com enfoque principalmente nos sintomas de ansiedade e de perturbação social. No entanto, um número significativo destas intervenções têm eficácia limitada. Portanto, têm sido desenvolvidos novos paradigmas centrados em jogos de vídeo. Seguindo esta abordagem, o presente artigo de opinião objetiva realizar uma revisão destas novas intervenções para a gaguez, sugerindo que novas orientações metodológicas são necessários para alcançar uma maior                objetividade                no                tratamento.

**Palavras-chave:** gaguez, jogos de vídeo, intervenção, tecnologia

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## Introduction

Serious video games and virtual reality devices have demonstrated a strong potential for increasing social, motivational, linguistic and educational skills (see Connolly et al., 2012, for a review on the subject). Moreover, they can provide benefits for human cognition and to other health domains, such as task coordination, perceptual/motor information processing and high-level cognitive skills. However, cognitive interventions based on video games are still in its beginning. They were initiated mainly by Lavender and Gromala (2012), who investigated the foundations of traditional therapeutic treatments. Therefore, this paper aims to point out the relevance of games-based interventions, by analysing it in the context of stuttering. Its main contributions are concepts and methodologies to elaborate a game-based intervention treatment for stuttering. These methodologies will be tested in future research in order to evaluate the effectiveness of this new approach.

Stuttering (also known as stammering or disfluency) has a broad definition in the scientific community. In this paper, we consider it as a fluency disorder characterized by occurrence of sudden stops in speech, prolongations, distortions, interlocutions, syllable repetitions and verbal circumlocutions, which are produced replacing complex words by other easy ones (Max et al., 2004; Walsh, Mettel, & Smith, 2015). These symptoms are typically accompanied by strong physiological[1] and psychological[2] components, which are associated with involuntary reactions, such as facial muscle contraction, body perspiration, palpitations, blushing, eye deviation, among others (Barry, 2014; Smith et al., 2014). In regard to prevalence, stuttering affects around 1% of the general population (Bloodstein, 1995) and its onset

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[1] Mainly sensorymotor synchronization and rhythmic processing .

[2] Fear, tension, anxiety, guilty, perfectionism, etc.

is relatively early; between 2 and 5 years of age (Fernández-Zúñiga, 2011). Contributions from epidemiology suggest that the first manifestation of stuttering occurs around 3 to 4 years old (Reilly et al., 2013, 2009). This disorder is more prevalent in males (Yairi & Ambrose, 2005; Ambrose, Cox, & Yairi, 1997; Felsenfeld et al., 2000), however it is known that in both sexes the difficulties may extend into adolescence and even into adulthood, becoming chronic (McAllister, Collier, & Shepston, 2013).

Several authors worked on mapping the brain circuitry and mechanisms underlying stuttering (Craig-McQuiade et al., 2014; Ciabarra et al., 2000; Rosenbek et al., 1978). For instance, Neef, Anwander and Friederici (2015) suggests that it is related to a pattern of reduced left hemisphere speech dynamics and enhanced right hemisphere involvement coupled with a right frontal overactivation. Moreover, differences in

white matter can be found in adults who stutter when compared with no-stutters. This is the most important difference in the diminished connection between insula and the inferior temporal gyrus and between inferior temporal and supramarginal gyrus (Cieslak, Ingham, Ingham, & Grafton, 2015). Even more precise brain signatures for stuttering as a state (induced fluency and disfluency in stutter) and as a trait (difference between subjects with and without stuttering) are being pinned.

## Related Work

Stuttering traditional treatment approaches derive mainly from speech therapy and behavioral psychology. These approaches are based on positive verbal feedback in patients who were receiving treatment (Antipova et al., 2008). Also, particularly neuropsychology and cognitive behavioral therapy were useful to expand the repertoire of existing treatments (Helgadóttir, Menzies, Onslow, Packman, & O'Brian, 2014). Cognitive-

behavioral psychotherapy was used to eliminate inconsistent and dysfunctional thoughts related to social perception and acceptance of stutterers (Reddy, Sharma, & Shivashankar, 2010; Beilby & Byrnes, 2012). In this sense, group therapy has proven to be effective for treatment of speech disorders, including stuttering (Liddle, James, & Hardman, 2011). However, results of effectiveness of behavioral treatment strategies are controversial. For example, Nye et al. (2013), suggested a lack of effectiveness of behavioral strategies and found no significant differences between several behavioral interventions used.

Effectiveness of traditional approaches are still questionable, therefore it is worth analysing other methods for treating stuttering. Recently, several research groups have been building methodologies and guidelines for creating serious games and/or behavioral interventions for therapeutic targets in clinical and health areas. For instance,

Baranowski et al. (2013) present a series of criteria on the construction of mechanics, story, interactivity, challenges, feedback mechanisms and incentives, which can be used to build a game to transfer gains. Umanski et al. (2008) evaluated the usability of a computerized intervention for motor skills training related to verbal production in children who stutter. Such work also suggested that video games demonstrate motivational effects for an appropriate therapeutic approach to stuttering. Moreover, Lavender and Gromala (2012), have been developing new treatment approaches based on serious video games, which we use as a methodology base and discuss along the paper.

Lavender and Gromala (2012) evaluated the use of video games for stuttering treatment using a prototype called "Audition, The Game", which was evaluated in 12 participants, seven of which were men. Participants were equipped with headphones and

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microphones. The galvanic skin response (a stress biomarker) was measured using specialised sensors in the tips of the fingers of the non-dominant hand. In this prototype, the game dynamics consists of controlling a character who must pass an audition or abandon his dream of becoming an actor. The character (controlled by the player with a computer mouse), before arriving at the hearing, must go through a myriad of challenges and obstacles along the way, with the aim of increasing stress and adrenaline. After this, the player is finally presented to a room in which it should read aloud, for 30 seconds, a tongue twister, preserving pace and harmony. If this challenge is successfully completed, it is repeated, increasing the difficulty and adjusting the exposure time, until the acting level is achieved. After 10 minutes of game experience, players were evaluated through questionnaires regarding gameplay, game difficulty, enjoyment and anxiety experienced during the game.

Lavender & Gromala article was an innovative protocol for stuttering treatment and it is one of the latest efforts in this regard. It is a pioneer work in inserting social communication components in video games, which is an important aspect of stuttering treatment. Another key aspect, indirectly evaluated by them, is social anxiety, one of the main clinical manifestations of this disorder. However, the authors did not take into account important theoretical and methodological concepts related to stuttering treatment and serious video game design. Therefore, it is important to define a set of guidelines for developing video games centered in the treatment of stuttering.

## Towards a Better Video Game Treatment Intervention

The hypothetical theatrical scenario proposed by the authors is not feasible in real life. We believe that this requires a wide range of social situations related to everyday's life (Kraaimaat et al., 2002;

van Dam-Baggen, & Kraaimaat, 1999), mainly situations that activate behaviors related to the disorder (Cream et al., 2010; Lowe et al., 2012; Plexico et al., 2009). There are also other illustrative examples of social situations that elicit avoidance behavior in people who stutter. It is important to highlight that the social situation created by Lavender and Gromala (2012) is appropriate to elicit feelings of insecurity associated with social evaluation, but it is uncommon. In this direction, we propose adding ecologically viable social situations, such as the context of a trade. It is known (Ezrati-Vinacour & Levin, 2004; Poulton & Andrews, 1994) that stutterers adopt behavioral patterns and specific strategies that are associated with avoidance in situations where verbal production is demanded. We explain this proposal in the context of virtual reality games for the treatment of substance abuse disorders.

Nemire, Biel and Swan (1999), and García-Rodríguez et al. (2012), employed virtual reality devices to treat substance abuse disorders. The authors presented different scenarios in which the character, controlled by the participant, must expose itself to stimuli that elicits additive responses, inducing search behaviors and substances usage (Paris et al., 2011). These evaluations based on virtual paradigms have demonstrated effectiveness in the treatment of addictions related to different drugs (e.g. cocaine, alcohol, nicotine). Fundamentally, these types of interventions are empirically supported by researches conducted through exposure therapy, which consists of controlled and repeated stimuli related to drug use exposure, in order to extinguish the responses associated with this substance (Lee et al. 2004; Bordnick et al., 2004, 2005, 2012). We suggest that future research should conduct a comparative study as performed by Klinger et al. (2005), which compared the clinical effectiveness of a virtual reality device with a cognitive-behavioral therapy

(traditional approach). We understand that, by employing a comparative methodology, the authors increased the inferential capacity related to the clinical effectiveness of a virtual therapeutic treatment.

Another important point we deeply debate is the methodology employed by Lavender and Gromala. The non-random sample used to develop their study was not composed of individuals who stutter, which represents a significant methodological difficulty for a proper evaluation of treatment effectiveness. Moreover, we consider that (i) the study loses objectivity and specificity in not registering psycho-emotional variables (e.g., anxiogenic responses, implicit cognitions). Instead, it registered stress responses in healthy students and not in stutterers, which (ii) leads to severe problems in the registry of the variables inherent in disfluent individuals. Therefore, (iii) the results become not generalizable. To the best of our

knowledge, the behavioral manifestations of stuttering are not limited to galvanic skin responses, because there are also other representative physiological measures of stress, such as dry mouth. Stuttering covers a broad spectrum of both anxiogenic and pathological stereotypic behaviors. Thus, it is associated with cognitive and behavioral symptoms of socio-cognitive disorders, such as phobia and social anxiety (Iverach & Rapee, 2014; see Craig & Tran, 2014 for a meta-analysis of this issue). These deficiencies affect the sensitivity of the device, so it is unclear whether measures were obtained to assess the usability of the device. In other words, the internal consistency of the software has not been evaluated. The usability of a product determines the practical value, in purposes of evaluating the construct (in this particular case, the pathology) (Baranowski et al., 2013). Moreover, it is not clear if the variables were calibrated or not.

In the virtual context proposed by Lavender and Gromala there were no common situations and interactions of everydays life. Their study employed a theatrical hearing scenario instead, in which the player appears and utters series of tongue-twisters. In our view, social dimension of stuttering is more complex than that, so we propose a new virtual approach that reflects the reality of persons who stutter. Tentatively, we propose three hypotheses of work, which face the new generation of interventional guidelines and will be implemented in future work. Together, these affirmative statements are based on the prevalence of socio-cognitive deficits associated with stuttering. First, a multiplayer mode in the therapeutic proposal of Lavender and Gromala solves the difficulties in social communication and interaction between the stuttering population inherent pairs. Second, verbal interaction prior to therapeutic intervention exacerbates anxiety levels and implicit cognitions related to pathology. This leads to the maximum performance on the protocol, increasing the reliability, validity and clinical specificity of the therapeutic device. Finally, the repeated and systematic exposure to various social scenarios in a virtual reality device increases feelings of safety and mitigates the typical anxiogenic activation and avoidant responses.

## Final Considerations

Therefore, we believe that the proposed therapeutic interventions are a significant advance towards building the foundations of approaches based on video games. Likewise, these interventions should be building with traditional approaches, as briefly mentioned before. The approximation of an etiologically multifactorial disorder, such as stuttering represents an important challenge that should be solved by forming a multidisciplinary team work, consisting of psychologists, speech therapists, linguists, neurobiologists, among others.

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