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Towards the Development of Criteria to Assess Stuttering Mobile Apps

Research-in-Progress

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Abstract

Speech disfluency is one of the kinds of speech disorders that can affect many aspects of a person's life and surroundings. They may experience bad reactions to stuttering and counters difficulty to communicate especially in significant situations. However, speech therapists may conduct speech therapy sessions as it is believed that through speech practice, stutterers can recover well and speaks fluently (each individual's progress might be different to one another). Recently, mobile applications (apps) to improve health especially in speech disfluencies are proliferating. However, before a doctor or speech therapist can recommend any stuttering apps to their patients, they need to have the clinical test evidence of the apps and be confident that the apps are capable in improving patients' speech disfluencies. Recently, speech therapists have started to ask the effectiveness of mobile health (m-health) apps towards improving speech problems and stuttering issues among society. Unfortunately, studies have revealed that most of stuttering m-health apps in the market were developed without any proper guideline from health practitioner. The main instruments used in this study are through the adaptation of the International Classification of Functioning, Disability and Health (ICF) framework and Overall Assessment of the Speaker's Experience of Stuttering (OASES) instrument. ICF provides an ideal framework for describing stuttering while OASES instrument provides validity assessment and scoring procedure in offering evidence for the treatment used (usage of stuttering m-health apps and its impact on patient's speech problems). Through this effort, it is hoped that the widespread use of m-health apps (i.e. focusing on speech disfluency for this study) developed with proper clinical guidance will enhance the quality of stuttering m-health apps thus leading towards quality healthcare in our society.

Keywords: stuttering, speech disfluency, mobile health apps, ICF, OASES, evaluation

Introduction

The rapid development of mobile communication devices such as smartphones and tablets has led to significant and creative innovations in the healthcare industry. The emergence of m-health application has also raised the number of m-health application to combat stuttering issues in the market. This type of apps' target audience are those whom suffer from speech disfluencies issues. Most of these stuttering apps in the market offers similar techniques and method for practicing speech therapy session at home. However, although app developers has provide positive review and claim about their own app, there is no clinical support or evidence from any speech therapists. Thus, this situation has drawn speech therapist's attention and concern as the quality of these apps are worrying them. Speech therapists have started to ask whether those apps are really effective and has proven impactful towards improving speech problems (Ferrero, N. A., Morrell, D. S., & Burkhart, C. N., 2013).

Besides that, there is no standard way that users, health professionals, and researchers could easily identify high quality stuttering m-health apps standard (Cummings, E., Borycki, E., & Roehrer, E., 2013). Besides, despite of the high star ratings of those apps which are published in the apps store, the

apps reviews are too subjective by nature and it may come from suspicious sources and indisputably not valid (Kuehnhausen, M., & Frost, VS. 2013). Other than that, selecting apps on the basis of popularity yields little or no meaningful information on app quality (Girardello A, & Michahelles F., 2010).

Furthermore, in the healthcare industry, it is very important for any m-health apps (including stuttering apps) to be tested for its impact before releasing to the market, as this could lead to negative impact towards user especially patients (Sedrati, H., Nejjarid, C., Chaqsaree, S. & Ghazala, H., 2016). Money could be wasted and the apps might not derive desired outcome (Sedrati, 2016). To avoid all these negative consequences, a standard way to evaluate the impact of stuttering m-health apps needs to be designed. Thus, the main aim of this research is therefore to develop as standard way to evaluate the impact of m-health apps particularly on speech disfluencies especially in ameliorating speech disfluencies among stutterers.

Literature Review

What is Speech Disfluency?

Speech disfluency is a disruption in the flow of speech such as repetitions of parts of words, prolongations, and blocks (Bloodstein & Bernstein Ratner, 2008). This situation happens to most people, as they produce some disfluencies during speaking such as repeated words and "um" or "uh" sounds. People tends to experience speech disfluencies when they feel stress, panic, excited or fatigued. All normal people produce disfluencies, which may include hesitations, such as silent pauses, interjections of word fillers and repetitions. These are generally considered to be non-stuttered disfluencies (Lambert, & Walden, 2014).

However, speech disfluencies can be a real problem when the person produce too many repeated words as it may lead to stuttering, one of the most common speech disfluencies. Stuttering is a communication disorder that can affect a person's life. In short, stuttering is a disorder of the rhythm or the flow of speech, in which the affected individuals knows exactly what they want to say, but are temporarily unable to say it because of repetitions, prolongations, or blocks in the flow of speech. Most of the time, stuttering can affect a person's daily activities such as talking on the phone and speaking in front of large group of people.

For normal people, stuttering's obvious effect is only disruption in the flow of speech. But for the stutterers, stuttering can involve more than only speech disfluencies (Manning, 2010; Mulcahy, Hennessey, Beilby, & Byrnes, 2008). Research study has confirm that stutterers may experience feelings of shame, embarrassment and anxiety due to the communicating difficulty and dissatisfaction feelings with their life (Craig, Blumgart, & Tran, 2009; Jezer, 2003; Klompas & Ross, 2004;; Manning, 2010; Yaruss & Quesal, 2006; Yaruss et al., 2002).

Types of Speech Disfluency

Stuttering is a condition that is characterized by mild or severe speech disfluency. Everyone has their moments of disfluency but not all of them are stutterers. There are difference between people who speaks normally and people who stutter. People who stutter experience more disfluencies than normal individuals, and they also experience different types of speech disfluencies. Some experts believe that the characteristic disruption of stuttering can be classified as blocks, repetitions and prolongations (Drayna, 2009).

Speech disfluencies can be categorized into two main different condition which are non-stuttered disfluencies and stuttered disfluencies, including: (1) Hesitations (pause while speaking), (2) Interjections (produce sounds such as "um", "uh", "er" in middle of communication), (3) Revisions in choosing word, (4) Word repetition, (5) Repetitions of multisyllabic whole words, (6) Repetitions of monosyllabic whole words, (7) Tension during non-stuttered disfluencies, (8) Changes in body language/movement and lastly (9) Repetitions of sounds or syllables. As for stuttered disfluencies, the individuals will experience the aforementioned criteria frequently and the struggle will increase with the durations of disfluencies. In certain cases, people who stutter may experience abnormal stoppages with no sound. In addition, stuttering disfluencies are usually accompanied by greater than average duration, effort, tension, or struggle to speak compared to normal people. Aspects that factor into perception of severity include frequency and type of stuttering and the ability of the person who stutters to communicate effectively.

The Need to Identify the Impact of Stuttering Mobile Health Application

Ever since the first smart phone was introduced in 1940s, the mobile phone user has grown and continues at an exponential rate until today (Boulus et al, 2014). The rapid development of smartphones, tablets and health-related apps provides users with an unprecedented opportunity to achieve their healthcare goals and improve their health condition. However, with such a vast array of mobile healthcare industry, it has also risen some concerns and risks towards healthcare patients. Surprisingly, there are relatively very limited studies and research that has been undertaken so far to investigate the impact and validity of these kind of m-health apps (Conn, J., 2012).

In supporting the above mentioned claim, Faculty of Health & Human Sciences, University of Plymouth (2014) has present several evaluation and validation studies exploring the diversity of medical health and healthcare-related apps which include stuttering app. Surprisingly, the accuracy and safety of the information provided by these apps were called into question. Of 94 microbiology-themed apps they surveyed, only 34% had stated medical professional involvement (Visvanathan, A., Hamilton, A. & Brady, R.R., 2012). The lack of medical professional and expert's involvement in the development of the majority of these apps, raise the questions concerning users' ability to be informed regarding those apps content and quality.

Besides that, a number of recent articles and studies have investigated the potential dangers and safety of these m-health apps aimed for doctors (but available to all), and whether they should be assessed and controlled by doctors and health officers (Wolf et al, 2013). The scenario above reveals the need to identify the impact of m-health apps including stuttering applications and thus provide specific guideline or framework that could facilitate developer in designing the apps specifically in stuttering area. However, as mentioned in the Introduction section, a very scarce research has been found and published that explains and provides guideline on how to actually explore the impact of stuttering m-health apps (Boulus et al, 2014).

Available Treatment for Stuttering

It is proven that people who stutter may overcome their speech disfluency through clinical treatment provided by speech language pathologist. They may conduct an appointment with any certified speech language pathologist in the hospital for an intensive treatment of several hours per day for every week. In fact, clinical evidence shows that treatment provided by speech language pathologists are one of the best ways in reducing stuttering problems among people who stutter (Sedrati, 2016).

Each pathologist has their own technique and method in ameliorating stuttering problems with their patients. Techniques that appear to have the greatest impact for reducing the frequency of stuttering in stutterers include those that change the timing of speech by slowing down or reduce physical tension during speaking (Yaarus, 2007). In addition, people may learn to start saying words in a slightly slower and when they learn to control speech rate, people often begin by practicing smooth, fluent speech at rates that are much slower than typical speech, using short phrases and sentences.

There are various approaches and treatments provided by speech therapists. Nonetheless, the main approaches are Delayed Auditory Feedback (DAF), Metronome, Mirroring and Stutter Rate (Yaruss, J.S., 2006).

World Health Organization's International Classification of Functioning, Disability, And Health (ICF) Framework

Figure 1. Schematized version of the Yaruss and Quesal (2004) adaptation of the World Health Organization's International Classification of Functioning, Disability, and Health (ICF, WHO, 2001)
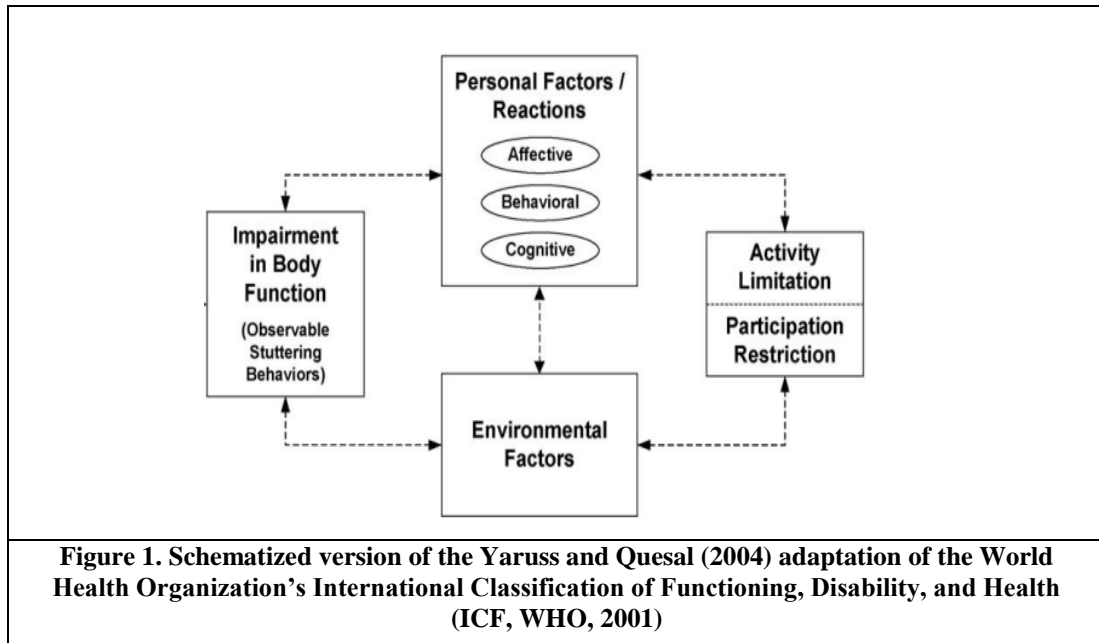
The WHO developed a revised framework, the International Classification of Functioning, Disability, and Health (ICF; WHO, 2001). In the ICF (refer Figure 1), it describes all health related experiences in terms of: (a) the structure and function of the body and (b) the activities a person might engage in during their participation in daily life. When a person experiences difficulties with body function or structure, they are termed impairments, and when a person experiences difficulties with activities or participation, they are termed activity limitations or participation restrictions. To account for individualized experiences of different people, the WHO has also added a parallel set of contextual factors to the framework. These personal and environmental factors describe the context, either within a person or surrounding the person that could affect the individual's ability to function effectively. The resulting framework has the capacity to describe all aspects of an individual's health experience, including both normal and disordered functioning. As such, the ICF holds considerable promise for helping clinicians and researchers consider the wide range of changes that might occur during the course of treatment for disorders such as stuttering.

By considering all of these components shown in Figure 1, each drawn directly from the WHO's ICF framework, clinicians and researchers can use it to gain a greater understanding of on how to evaluate the impact of stuttering m-health applications on speech disfluencies (Yaruss, J.S., 2007).

Because this framework (refer to Figure 1) describes the totality of the stuttering disorder in the context of the widely accepted ICF framework, it provides an ideal foundation for the development of a comprehensive measurement instrument that can be used both in daily treatment and in outcomes research (J.S. Yaruss, R.W. Quesal, 2006). Yaruss (2006) has presented such an instrument known as the Overall Assessment of the Speaker's Experience of Stuttering (OASES). OASES is a tool for supporting stuttering treatment research that is also suitable for assessing stuttering treatment outcomes (Yaruss, J.S., 2007).

How Oases Instrument Relates To ICF Framework

Basically, each components in the ICF framework gave a meaningful understanding on the observable characteristics of stuttering disorder and also the experience of stuttering from the perspective of stutterer itself. It defines the totality of the stuttering disorder in the context of ICF framework as it provides an ideal foundation for the development of a comprehensive measurement instrument that can be used both in daily treatment and in outcomes research. Thus, in supporting ICF framework,

OASES instrument has been developed as main tool in evaluating the impact of any stuttering treatment outcomes of a stutterer.

Development and validation of the OASES involved several stages, in which test items were individually evaluated, compared to one another, and refined. Most importantly, the OASES instrument was designed to maintain a strong connection to the ICF framework for describing stuttering experience of person who stutter. To facilitate the development of the OASES instrument, Yaruss (2004) has constructed a set of three individual tests of which targeted a specific component in ICF framework (refer Figure 1).

Methodology

As mentioned in Introduction, the main aim of this study is to develop an evaluation criteria that present ways to evaluate the impact of stuttering m-health apps on speech disfluencies. Therefore, ICF framework will be the theory and a starting place for this research to test it on technology usage which is the m-health apps for the case of this study. From our search in the literature so far, there is no study that has been conducted that apply ICF framework and OASES instrument to evaluate the impact of stuttering technology, such as mobile apps for stutterers (Pérez, B.M., 2013). Therefore, this study will be the first that look upon how ICF framework could guide clinicians in assessing the impact of stuttering m-health apps outcomes.

Participant Selection

In this study, about four experts will be selected as the participants of this study. These participants are selected from various stuttering centers in Malaysia which are shown in Table 1 below:

Table 1. List of Stuttering Centers Involved in Study		
No	Location	Address
1	Universiti Sains Malaysia (USM)	Universiti Sains Malaysia (USM) 11800 USM Penang, Malaysia.
2	Speech and Hearing Centres	Kuching, Sarawak
3	Pusat Perkhidmatan Pendidikan Khas	Pusat Perkhidmatan Pendidikan Khas, Kementerian Pendidikan Malaysia (KPM), Blok E8, Kompleks E, Pusat Pentadbiran Kerajaan Persekutuan, 62604 Putrajaya, Malaysia.
4	Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM)	Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM), Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.

Table 1. List of Stuttering Centers Involved in Study

These centers (refer Table 1) are selected because they provide specialized stuttering treatment expertise and they are respected as a second opinion center for previously unsuccessful treatments. Besides, they are also selected because they have dedicated clinicians who are the specialists and university researchers who provide stuttering treatment and clinical assessment to their patients. Most experts in the centers have experiences in dealing with stuttering patients. In this study, parents and caregivers of the stutterers might also be included as part of the participants if found necessary.

Procedures of Data Collection

In this study, researcher will be using the OASES (Yaruss & Quesal, 2006, 2010) measurement instrument to assess the adverse impact or negative consequences associated with stuttering during the study. Through OASES, a list of evaluation criteria will be extracted and listed in the questionnaires which will be given to the doctors during interview session. For the OASES instrument, the assessment will describe it in terms of the stutterer's general perceptions of the stuttering impairment; the stutterers' affective, behavioural, and cognitive reactions to stuttering; the impact of stuttering on a stutterers' functional communication in daily situations; and the impact of stuttering on the stutterers' overall quality of life (refer to Figure 1).

The OASES instruments consisted of 100 items, each scored on a Likert scale ranging from 1 to 5, with higher scores indicating greater negative impact of stuttering as in the original published OASES instruments, the adapted questionnaires were divided into 4 sections. Section I (General Information) contained 20 items pertaining to the stutterers' perceived fluency and speech naturalness, knowledge about stuttering and stuttering treatment, and overall perceptions about stuttering. Section II (Reactions) contained 30 items examining the stutterers' affective, behavioural, and cognitive reactions to stuttering. Section III (Communication in Daily Situations) contained 25 items assessing the degree of difficulty the stutterers have when communicating in general situations, at school, in social situations, and at home. Section IV (Quality of Life) contained 25 items assessing how much stuttering interferes with the stutterer' satisfaction with their ability to communicate, their interpersonal relationships, their ability to participate actively in life, and their overall sense of well-being.

Each participant needs to complete the OASES instruments within 20-30 minutes twice, which are: (1) Before using the stuttering m-health app (pre-test), and (2) After using the stuttering m-health app (post-test) for about 2 months. Both results will be compared to assess the impact on stutterer's level of stuttering based on the crucial criteria a) Observable characteristics of stuttering, (b) Affective, behavioural and cognitive reactions to stuttering, (c) Environment on stuttering and (d) Overall impact of stuttering on the stutterer's life. Based on the comparison made between the two completed questionnaires for both test group and control group, researcher could conclude any significant changes on participant's stuttering after m-health apps is used for speech therapy. Therefore, this could lead to knowing to whether the m-health app is impactful or otherwise.

It is important to note that the researcher will obtained ethical approval for this study through the requisite of Kementerian Pendidikan Malaysia. Researcher will also seek for consent from all participants and their parents or caregivers. At the initial stage, researchers will contact the parents or caregivers of the children stutterers based on speech pathologists' recommendation. The parents and caregivers will then be provided with information sheets and informed consent ethics forms. Speech pathologists will then need to discuss their participation with their son or daughter, who confirmed their willingness to participate further in this research.

Researcher will conduct the survey with each participant individually in a quiet room within the university clinic. Researcher will start with an initial 10-minute screening conversation to assess the level of stuttering of each participant. Within this time, researcher will record the conversation to elicit warm-up the session and establish rapport with all participants who stuttered. Then, the questionnaires session will start and administered by the researcher.

Procedures of Data Analysis

Based on the data collected from the questionnaires results, the first and second questionnaires for each participant will be compared. This means that the negative or positive impact associated with stuttering during pre-test and post-test using the m-health app will be compared to identify any significant changes happened. Researcher will fill in the OASES scoring summary form to evaluate the improvement in stuttering. From the OASES scoring form, all the raw scores will be converted to impact scores as per outlined by Yaruss & Quesal (2006).

For the data analysis, it can be divided into several stages. The first stage is to analyse the scoring form results done by all the participants during the pre-test and post-test. Basically, the scoring form consist of impact score for each four sections which are (a) General information, (b) Reactions to

stuttering, (c) Communication in daily situations and (d) Quality of life. Each sections carried their impact score and impact rating. Impact rating will be determined by the impact score. The impact score rating table is shown below in Table 2.

Table 2. Impact Rating vs Impact Score	
Impact Rating	Impact Scores
Mild	20.0-29.9
Mild-Moderate	30.0-44.9
Moderate	45.0-59.9
Moderate-Severe	60.0-74.9
Severe	75.0-100

Table 2: Impact Rating vs Impact Score

Through the Impact Rating vs Impact Score table shown above, the result for each participants can be concluded. Thus, it is important for each participants to answer the OASES instrument form properly as it might influence their end result. After that, a semi structured interview will be conducted with the participants (stutterer) and speech pathologist involved in this study. With stutterer's parents' permission, they will be interview and asked several questions towards validating their result scored at OASES instrument. Should researcher need any clarification from the stutterers' or doctors on the result produced, a follow up interview will be conducted later.

Conclusion

In recent years, there has been a growing discussion about the importance of having quality mobile apps in the field of speech language pathology (ASHA, 2005). However, there is no standard guidelines that could help health practitioners to evaluate whether the stuttering apps is off high quality and impactful. Therefore, it is critical for this research to develop a guideline to evaluate the impact of stuttering m-health apps on speech disfluency. Relatively, there are studies that explores the effectiveness of stuttering m-health apps. However, for stuttering and speech category, little and very scarce research has been found that looks into the impact of this type of apps on health (Boulus et al, 2014). This situation has recently questioned the effectiveness and reliability of stuttering m-health apps on stutterer's speech disfluencies (O'Neill, S. & Brady, R.R., 2012). Thus, this research is vital to find answers and to address this issue. Through the literatures, it is found that OASES instruments, does help in evaluating the outcomes of stuttering treatment and address the observable aspects of stutterer's fluency. It is believed that, through this research, the author will be able to evaluate the impact of stuttering m-health application on speech disfluency. Thus, at the end of this research, a guidelines on how m-health apps could be evaluated would help health practitioners and clinicians to verify a quality m-health app.

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