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Stammering Research

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Stammering Research

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Notice

The British Stammering Association is a UK-based charity which seeks to promote understanding into the causes, treatment and understanding of stammering. Its activities include research into stammering which it supports through its vacation studentship scheme (http://www.stammering.org/research_schol.html) and the publication of Stammering Research (provided free of charge to all-comers).

Stammering Research is intended to promote public understanding of high quality scientific research into stammering and allied areas

If individuals wish to make a donation to support either of these initiatives, they should forward a cheque (payable to the British Stammering Association) to The British Stammering Association, 15 Old Ford Road, London E2 9PJ, or call the BSA on 020 8983 1003 (+44 20 8983 1003 from abroad) with their credit card details. If they wish this to be used specifically for either the vacation studentship scheme or Stammering Research, they should mark it accordingly on the back of the cheque. For information on tax-effective ways to support the charity's research activities, please go to http://www.stammering.org/donations.html.

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‘Stammering Research’.
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Description

Stammering Research is an international journal published in electronic format. Currently it appears as four quarterly issues per volume (officially published March 31st, June 30th, September 30th and December 31st). The first issue of volume one will appear March 31st 2004. The journal is dedicated to the furtherance of research into stammering, and is published under the auspices of the British Stammering Association. It seeks reports of significant pieces of work on stammering and allied areas, such as other speech disorders and disfluency in the spontaneous speech of fluent speakers. The articles will include (though not be limited to) reviews in an area in which the author has produced eminent work and attempts to introduce new techniques into studies in the field. The journal will offer an opportunity to table topics where there are grounds for considering a major rethink is required, as well as detailing development and assessment of research-based techniques for diagnosis and treatment of the disorder. Submissions are encouraged that facilitate open access to scientific materials and tools. Articles are peer-reviewed, the role of reviewers being to ensure that accepted standards of scientific reporting are met, including correction of factual errors. Disagreements about interpretation of findings raised by reviewers will be passed on by the editorial board to the authors of accepted papers. These disagreements will not necessarily preclude publication of the article if they are judged to be topics that are suitable for open peer commentary. Once accepted, commentaries will be sought (actively and by self-nomination) from specialists within the field of communication disorder and its allied disciplines. These commentaries will be reviewed for style and content. The author’s responses will be reviewed in the same way. The article, open peer commentaries and author’s responses will be published simultaneously. Authors should contact the editor in the first instance with a short description of the topic area so that its general suitability can be assessed before full submission. Notification that a topic is suitable does not imply that the paper that is subsequently submitted will be accepted. Decisions about suitability will be made by the editorial board.

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1. Contact the editor with a brief outline of the proposed article. The editor and other board members make initial decisions only as to the suitability of the general area proposed. The primary function in this step is to ensure the topic is of sufficiently broad interest for, and within the remit of, the readership of Stammering Research. The intent behind this initial contact is to ensure authors do not spend time preparing articles on unsuitable topics. Review, empirical and theoretical work are all appropriate. Authors will be informed whether the judgement is that the proposed topic has a suitable, or too narrow, a focus. Indication that the scope is too narrow does not imply anything about the scientific standard of the proposed work. Neither does notification that a topic is suitable indicate that the submitted work will necessarily be accepted for publication (all submitted material has to go through the normal processes of peer review).
2. Submitted articles are peer reviewed in the normal way and an indication as to suitability of publication or not (possibly after revision) is notified to the author by the editor.
3. After an article has been accepted, the author cannot change the article. It is then made available for open peer commentary. Details how the accepted article can be accessed are posted on the British Stammering Association's website (www.stammering.org). Indications that the article is available for access are posted on http://www.mankato.msus.edu/dept/comdis/kuster/Internet/Listserv.html for ASHA members, the British Stammering Association's website (http://www.stammering.org, the stut-l list (stutt-l@listmail. temple.edu), the stutt-x mailing list (stutt-x@asu.edu), and on the stuttering home page (www.stutteringhomepage.com). The primary function in posting details about access available to an accepted article, is to alert potential commentators. A list of commentators is being drawn up and individuals are encouraged to submit their nominations (for themselves or others).
4. See the next page for precise details how to prepare a commentary and the timetable allowed for this. When preparing a commentary, authors might find it helpful to consult a recent issue of Stammering Research to see the range of comments that are appropriate, the style and format of commentary submissions.
5. All accepted commentaries are available to the author of a target article from receipt until two weeks invitations for commentaries has closed. In this time, the author can prepare a response to commentaries. The response will be peer-reviewed by the editorial board. Further details are given on the next page and authors should again consult a recent issue of Stammering Research to see the sorts of comments that are appropriate, style and formatting of a submission.
6. On completion of this process, the target article, commentaries and response to commentaries will be published together in the next issue of Stammering Research. Authors are responsible for preparing their articles according to the stipulated format. The current and previous issues of the journal are available as PDF files at http://www.speech.psychol.ucl.ac.uk/.

Notes about commentaries for Stammering Research
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Once a manuscript has been accepted as a target article, the authors cannot change it. The manuscript needs to be available for commentary before it is officially published so that commentaries and the author's responses can appear simultaneously.

Manuscripts are posted for commentary on http://www.psychol.ucl.ac.uk/ under *Stammering Research*. Commentators are alerted as indicated on the previous page.

Manuscripts will be available for peer commentary for six weeks. Commentaries have to reach the editor, or associate editor, responsible for the article within that time (late submissions will not be accepted). Commentaries should ordinarily not exceed a total (including references and other material) of 1,000 words. The commentaries have to conform to APA style conventions.

Commentaries should be sent by email as soon as possible within the six-week period the article is open for peer commentary. The commentary should appear within the body of the email text (not as an attachment) and be sent to psychol-stammer@ucl.ac.uk. Authors of target articles will receive commentaries as they are accepted and have two weeks from close of submission of commentaries to complete their responses.

Commentaries will be peer-reviewed and edited for style as well as content. Authors of commentaries need to establish the relevance of their submission to the target article at the outset, and preferably also show an awareness of the wider work of the target article's author.

If there are several commentaries which raise the same point, the editorial board reserves the right to group them together and prepare them as a single coauthored commentary. In this (probably rare) eventuality, the authors will have the opportunity to see the manuscript and decide whether they wish to be included on the list of authors.

Editing and revision of commentaries will be completed within two weeks of close of submission. Revisions that are not satisfactorily completed in this period, or that are received late, will not be published.

In exceptional circumstances, new commentaries may be considered as submissions for on-going commentaries that will appear in later issues of Stammering Research. These will be treated in the same way as initial commentaries (e.g. in terms of target authors responses).

Formatting Accepted Publications in Stammering Research

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Abstract. A short abstract summarizing the significant content and contribution of the paper should be included here. This page illustrates and describes the format for paper submissions. Authors are requested to adhere as closely as possible to this format once an article is accepted. The abstract should be in Times New Roman 9-point font, justified with left and right margins indented 1 cm in from the margins of the main text.

1. Introduction

Articles and commentaries should initially be submitted in APA format. After an article or commentary is accepted, it needs to be prepared according to the journal format as indicated next. Articles and commentaries must be in Word format. An article will typically be up to **15,000 words**. A commentary should preferably be up to **1,000 words**. Authors may submit longer articles or commentaries for consideration but these may be reduced in length by the editor. Articles with fewer than 15,000 words and commentaries with fewer than 1,000 words are acceptable if the author can demonstrate sufficient content and contribution. Typically commentaries will have an abstract, usually only a single section in the text headed so as to identify the target article, and will not use diagrams or photographs. However, if an author needs to use more than one section heading and diagrams or figures, then they should follow the same instructions as for preparation of a target article. Each page of an article should consist of single column, of single-spaced text in a 16cm x 24cm column using **A4** or **US Letter** settings on your word processor as illustrated in Figures 1 and 2. Figures should be numbered consecutively and appear close to the text where they are mentioned.

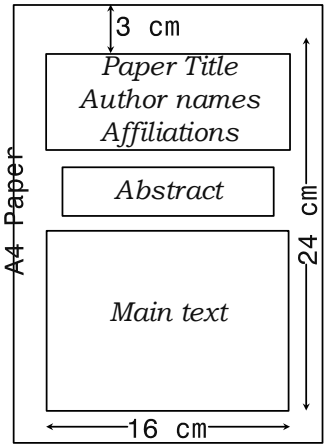

Figure 1: First page format

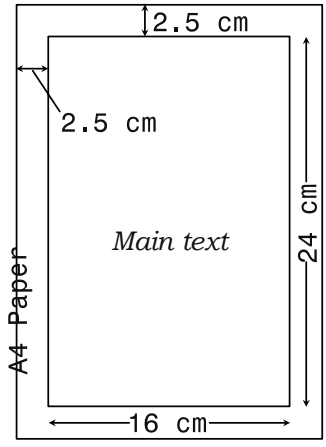

Figure 2: Subsequent page format

2. Detail of styles

The article or commentary title should be bold and centred using 14 point Times New Roman font. Authors' names, affiliations and email details should be centred using 10 point Times New Roman font. The author's affiliation should be italicized. The main text and the bibliographical references must be justified and single line spaced. The main text should be in 10 point Times New Roman font with numbered section headings in 11 point bold font.

All references should be cited using APA referencing styles. For example a publication which is referred to as support for a statement would be cited in the text this way (Howell & Sackin, 2002) whatever the number of authors. When an article is referred to directly in the text as in "… in the work of Howell and Sackin (2002) the …" only the year is placed in brackets. If there is more than one reference from the same authors in the same year then they are distinguished by using different letter designations after the year as in 1996a, 1996b etc. In the references below, examples are given of how a conference paper, a journal paper and a book would be listed. All references should be listed at the end of the paper using 9 point Times New Roman font.

All figures, and diagrams must be good quality black and white images suitable for readers to display and print. Colour illustrations or text can be used, but bear in mind readers who want to print articles may not have access to a colour printer. When an article is accepted, figures and pictures must be inserted in the word file in the exact position they will appear in the publication. Any format for figures, pictures and diagrams may be used provided they allow good quality reproduction for readers who wish to print off a copy.

References

Howell, P. (2002). The EXPLAN theory of fluency control applied to the treatment of stuttering by altered feedback and operant procedures. In E. Fava (Ed.), *Pathology and therapy of speech disorders (pp. 95 -118). Amsterdam: John Benjamins.*

Howell, P., & Sackin, S. (2002). Timing interference to speech in altered listening conditions. *Journal of the Acoustical Society of America*, *111*, 2842-2852.

Rosen, S., & Howell, P. (1991). *Signals and Systems for Speech and Hearing*. London and San Diego: Academic Press.

Stammering Research

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RESPONSE TO COMMENTARIES

Editorial for Stammering Research

The journal Stammering Research is an international journal dedicated to dissemination of a wide spectrum of opinion on topics in this field of research. Target articles on specific topics are published along with open peer commentaries and responses by the original authors. All submissions (target articles, peer commentaries and authors' responses) are reviewed for both style and content.

The motivation for establishing this journal is that research into stammering/stuttering has reached a point where there are hotly debated positions on many topics. The goal is to provide a forum for informed exchange of opinion on these topics. Currently no other journal in the field offers the possibility of airing these matters in an open manner regulated according to normal standards of scientific exchange.

Where there has been discussion, this has got bogged down in polemical positions where nothing gets resolved, as was the case in the school-based approaches in psychology in the 1950s and 1960s. Other journals encourage submitted comments about particular articles that have appeared, and are usually addressed at empirical topics. These notes have their usefulness in terms of methodological problems they highlight but they rarely resolve substantive arguments between protagonists. Indeed, as soon as an article appears, one can often predict whether it will elicit a reply and, more often than not, who the author of that reply will be and what will be said. This situation can hardly be regarded as advancing the discipline. These head-to-heads are usually limited to authorities in the area and are rarely open to others who may wish to shed new light on a particular topic.

There is also relatively little opportunity in extant journals for reviewing past research or introducing new topics that have relevance for the area of stammering. New technology has raised issues about research in the area, and there is expertise in other fields of which researchers in stammering should be aware. These include brain imaging, neural plasticity and language genetics. There are also professional issues to do with definition of the disorder, assessment (developmentally and as a result of treatment) and updates are needed from time to time about developments in techniques currently used in the field (e.g. operant conditioning). The area has also started to receive attention by authors wishing to develop theories about how stammering arises, how it relates to fluent speech (the Covert Repair Hypothesis, EXPLAN and the Vmax model). The tenets of these theories differ. Discussion here needs to focus on the pros and cons of the different positions, how alternatives can be tested and so on. The good thing about these theories is that there are properly articulated differences between them. I believe that strong alternative theoretical positions will help the field, and Stammering Research will afford an opportunity of holding such debate in the open and involve more extensive informed opinion. Put simply, this sort of exchange should be to the advantage of workers in the field.

There are methodological topics that would also benefit from open debate too. For instance, should researchers still be assessing the disorder and its severity by counting stuttering events like repetitions and prolongations, or is some new technique like the time interval procedure more appropriate? What events are, and are not, stammerings, and could the reliability of assessments be improved if assessors were given definitions of the events to assess?

Stammering Research will provide a forum for the exchange of such views. The success of the enterprise depends on as many people as possible in the area becoming involved. It seeks to stimulate open debate, encourage and involve the public in understanding scientific research into stammering.

Peter Howell
February 2004

TARGET ARTICLE

Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes

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Abstract. Numerous authors have commented the need for better treatment outcomes research in stuttering, particularly for treatments for adults who stutter, that address factors beyond fluency. This paper seeks to use the unique format of this journal to encourage a dialogue between clinicians, researchers, and people who stutter. Ten questions about treatment outcomes are raised, and answers are discussed from several perspectives. Questions address the identification of people who stutter, the goals of treatment, and how outcomes should be measured. The paper ends by issuing a challenge encouraging greater partnership between those with differing viewpoints to work together when studying stuttering treatment outcomes.
Key Words: Treatment Outcomes, Stuttering, Speech Therapy

1. Introduction

One of the most controversial topics in the field of fluency disorders has been the definition, measurement, and evaluation of treatment outcomes. Numerous authors, including those approaching the disorder from conflicting theoretical or philosophical perspectives, have emphasized the need for a better understanding of the results of stuttering treatment (e.g., Bothe, 2003; Blood, 1993; Blood & Conture, 1998; Conture, 1996; Conture & Guitar, 1993; Cordes, 1998; Ingham, 2003; Ingham & Riley, 1998; Onslow, 2003; St. Louis & Westbrook, 1987; Thomas & Howell, 2001; Yaruss, 1998a, 2001, in press). Indeed, the need for better treatment outcomes data is probably the one area in which proponents of differing treatment approaches for stuttering *can* agree.

Unfortunately, there are still numerous areas of major disagreement among clinicians and researchers interested in stuttering treatment outcomes. Examples include the appropriate means for collecting treatment outcomes data, the nature of the data that are collected, the value of existing data in the published literature, the role of the clinician and client in providing treatment outcomes data, and, ultimately, the interpretation of those data. Even basic issues such as the definition of stuttering and who should be considered a person who stutters have been the topic of considerable disagreement. In recent years, the rhetoric has risen to historic levels (Bothe, 2003; Finn, 2003; Ingham, 2003; Onslow, 2003), and, sadly, it seems unlikely that any compromise among the researchers engaged in this battle will be forthcoming.

To put it simply, we face a situation in our field where some authorities appear to assert that treatment options for stuttering should be restricted to include only those approaches that have previously been described in a set body of published literature which adheres to a set of criteria deemed to be appropriate for "evidence-based practice" (e.g., see the writings of Bothe, 2003; Ingham, 2003; Onslow, 2003; Power, 2002, all of whom strongly emphasize the benefits of evidence-based practice). Of course, as we will discuss in more detail below, we fully support the idea that the selection of treatment goals and strategies should be supported by empirical research (Yaruss & Quesal, 2002). Still, we fear that the discussion, as it has been played out so far, has been oversimplified and unnecessarily polarized, at least among some of the participants in the debate[1]. Indeed, it is, perhaps, noteworthy that the vast majority of the authorities touting the merits of evidence-based practice favor treatment strategies aimed primarily at the elimination of stuttering through modifications to speaking rate or speaking style (e.g., prolonged speech, adjustments to utterance length and complexity).[2] These approaches, and the learning theory upon which they are based, are the approaches that have been most

[1] It is worth noting that the debate may not be as much of an issue in some countries in which the *Journal*'s readership may reside; however, it is safe to say that in the United States, at least, this is an issue of significant present relevance.
[2] It is also noteworthy that very few, it any, of these authorities are actually people who stutter.

rigorously quantified and evaluated in the existing literature[3], so these are the approaches that are most often the focus of discussions about evidence-based approaches to treatment (again, see Bothe, 2003; Finn, 2003; Ingham, 2003; Langevin & Kully, 2003; Onslow, 2003).

Of course, it is difficult to argue with the evidence-based point of view. What rational clinician or researcher would state aloud that they use a treatment approach that has not been subjected to the rigors of empirical evaluation, replication, and peer-review? Still, there seem to be those who do exactly that—who choose to employ treatment approaches other than (or, more accurately, *in addition to*) those approaches that have been described in the existing treatment outcomes literature for improving speech fluency (Quesal, Yaruss, & Molt, in press; Yaruss & Quesal, 2002). Indeed, our field seems to be populated by individuals who, for decades, have argued that valid treatment strategies may be drawn from among a larger pool of techniques that are designed to go beyond changes to fluency alone (Bloom & Cooperman, 1999; Conture, 2001; Cooper & Cooper, 1991; 2003; Dell, 1993; Guitar, 1998; Gregory, 2003; Healey & Scott, 1995; Manning, 1999, 2001; Ramig & Bennett, 1995, 1997; Rustin & Cook, 1995; Rustin, Cook, & Spence, 1995; Shapiro, 1999; Van Riper, 1973; Williams, 1957). These clinicians have also incorporated approaches designed to change the way a person stutters, to reduce negative emotional and cognitive reactions to stuttering, and to minimize the impact of stuttering on the person's life—in addition to the specific changes in fluency that may occur. (Note that the issue of developing broad-based treatments applies primarily to older children and adults who stutter, and not to very young children who stutter. Of course, the debate about evidence-based practice also affects treatment for preschool children, but we will not be addressing that population in this paper.)

Evidently, these clinicians and researchers are suggesting, through their selection of broad-based treatment approaches, that valid treatment outcomes for older children and adults who stutter may include factors *other than* fluent speech alone. Further, they seem to be suggesting that support for the use of these approaches may include factors *other than* the currently existing published research base (which again, focuses primarily on speech changes alone). Why would they do this? What could be the reason that knowledgeable and skilled clinicians would eschew a sizable literature that focuses primarily on speech fluency in favor of long-standing and well-accepted treatment approaches that are not well-documented in peer-reviewed journals? Without reliable, published, empirical evidence, how can they justify their treatments to third-party payers, other clinicians, researchers, and, perhaps most importantly, people who stutter? There are, in all likelihood, numerous answers to these questions, and several potential explanations have already been offered, mostly by proponents of the "evidence-based" fluency-shaping approaches (e.g., Onslow, 2003). Rather than to offer explanations or excuses, however, the purpose of this paper is to offer a different perspective that may lead us more constructively to a solution. Specifically, this paper focuses on a particular source of guidance for defining the goal of treatment for older children and adults who stutter, and for evaluating the outcomes of that treatment, that has seemingly been ignored in many recent discussions about stuttering treatment outcomes—*the person who stutters* (Quesal, 1989).

It may sound odd to suggest that people who stutter have not been involved in the debate about the outcomes of treatment for their communication disorder, particularly given the fact that, historically, many clinicians researchers in this field have themselves been people who stutter (except see footnote #1). Nevertheless, until recently, there have been very few studies of the "preferred outcomes" people who stutter may have for their therapy experiences. Perhaps it has simply been assumed that people who stutter would "obviously" want to eliminate their stuttering. Perhaps there is some discomfort or hesitancy among certain clinicians about the value or importance of considering the opinions and experiences of people who stutter (Gregory, 1997; Onslow, 2003; Wingate, 2002). Or, perhaps there are other explanations for why people who stutter have not traditionally been involved in the debate about the validity of different treatment approaches for the disorder they possess. Regardless of the reasons for their exclusion, however, the fact remains that there are few research studies designed to systematically survey people who stutter regarding the goals *they* have for speech therapy, *their* desired outcomes from treatment, and which approaches to treatment *they* prefer.

2. Partnership Between Clinicians, Researchers, and People Who Stutter: Some Challenges

In recent years, the present authors and colleagues have sought to bring people who stutter back into the treatment outcomes equation (Yaruss & Reeves, 2002; Yaruss et al., 2002; Yaruss, Quesal, & Murphy, 2002). Unfortunately, for several reasons, this is not easy to do. First, it is not at all clear that the population of people who stutter can reasonably be considered a homogeneous group. The

[3] It is worth pointing out, of course, that these are also the approaches that are based primarily (or entirely) upon an easily quantifiable metric: the frequency of disfluencies exhibited by the speaker.

preferences of one group of people who stutter probably do not adequately represent the preferences of another group of people who stutter. The sheer number of different treatment approaches that have evolved over the years (see Bloodstein, 1993, 1995) can be taken as at least partial testimony to the fact that different people seem to want different things from therapy. Second, the fact that different individuals have different experiences in treatment complicates the process of surveying people about what they want from therapy, for the opinions people have about "ideal" treatment outcomes are likely to be affected by their own prior experiences. Thus, those who have experienced success with a certain approach are likely to feel that the approach is best, while those who have not experienced success are likely to feel that the approach is less valuable. Finally, it is not trivial to consider exactly *how* a suitably representative sample of people who stutter might be identified. Of course, researchers can certainly recruit individuals who are participating in various treatment programs; however, this strategy introduces questions about possible bias among researchers, the length of time that treatment gains may last, and uncertainty about whether some changes associated with treatment (e.g., improvements in communication attitude) may develop *after* the completion of formal therapy (Manning, 1999). More importantly, it is difficult to identify and recruit people who stutter who have not recently (or ever) participated in treatment as a comparison or control group. Although there are estimated to be approximately 3 million people who stutter in the United States, the vast majority of them are not in treatment at any given time. Whether these individuals feel that they do not need treatment, whether they want treatment but do not have access to it, or whether they have simply given up on treatment due to prior experiences is simply not known. The bottom line is that it is difficult to recruit these individuals, for researchers and clinicians do not have ready access to them. Without the ability to assess the opinions of a broad, representative sample of people who stutter, our field will continue to try to evaluate treatment outcomes without truly understanding the varied goals and objectives of the population we are trying to serve. As a result, debates about treatment outcomes will continue to be based primarily on the opinions of researchers and a small fraction of the target population.

3. Partnership Between Clinicians, Researchers, and People Who Stutter: Some Signs of Hope

Regardless of the challenges facing researchers in identifying and recruiting people who stutter for studies on the preferred outcomes of treatment, this is still an important goal for improving our understanding of stuttering and the evaluation of treatment outcomes. Fortunately, during the past few years, there have been a number of notable attempts to develop and increase the dialogue between clinicians, researchers, and people who stutter. For example, on-line discussion groups such as *Stutt-L* have fostered a growing dialogue between various groups of individuals interested in stuttering (Starkweather, 1995). On a more personal level, support groups for people who stutter have become increasingly prominent, through the rise of organizations such as the European League of Stammering Associations (ELSA) and the International Stuttering Association (ISA), as well as the dozens of member associations worldwide (Krall, 2001). These groups have been remarkably successful in bringing together groups of people who stutter to share experiences and discuss topics of importance, such as the evaluation of treatment outcomes (Weidig & Yaruss, in press).

Similarly, groups representing people who stutter have become increasingly visible within professional organizations such as the International Fluency Association (IFA), the American Speech-Language-Hearing Association (ASHA), and, particularly, the ASHA Special Interest Division for Fluency Disorders. In the United States, the National Stuttering Association (NSA) support group has sought to directly forge partnerships between people who stutter and researchers, through events such as the first "joint symposium for scientists and consumers" hosted by the NSA in 2001 (Yaruss & Reeves, 2002). The NSA also created a research committee that serves as a liaison between researchers and potential study participants within the membership of the NSA (Yaruss et al., 2001). In Great Britain, the British Stammering Association (BSA) has established a research committee that supports the dissemination of research on stuttering through its website—and, importantly, through the very journal in which this article appears. Indeed, *Stammering Research* has, as one of its core audiences, people who stutter—in addition to clinicians and researchers. Because of the multiple audiences targeted by this journal, and because the format allows for commentary by a wide variety of participants, *Stammering Research* provides a unique forum for discussions about a variety of topics, including the role of people who stutter in evaluating treatment outcomes. It is our hope to use this paper and this forum to foster a broad-ranging discussion about the nature of stuttering and the goal of stuttering outcomes assessment research.

4. Partnership Between Clinicians, Researchers, and People Who Stutter: Fostering a Dialogue

As mentioned above, several important issues have been discussed by clinicians and researchers over the years, though people who stutter have not generally been invited to participate formally in the discussions in any substantive way. The purpose of this paper is to encourage such a dialogue by raising 10 key questions that are relevant to understanding stuttering and evaluating stuttering treatment outcomes. We will briefly review some of the more prominent opinions that have been offered in the literature over the years, and we invite readers to provide commentaries with their own input, based on their unique perspectives as researchers, clinicians, parents, and, of course, people who stutter. We hope that by establishing such a dialogue, we can create a situation where we will all learn from each others' experiences and come to a deeper understanding of the goals and processes of stuttering therapy.

The specific questions we have selected for this discussion are designed to cover a variety of topics relevant to the documentation of stuttering treatment outcomes. Issues range from the definition of stuttering and the identification of people who stutter to the proper means for defining treatment goals and measuring change during treatment. Of course, many of these issues overlap, so there is some expected redundancy in our responses below. Still, it can be useful to consider the issues separately, as far as possible, in order to identify the specific factors that may differ, depending upon whether one is taking the perspective of researcher, clinician, or person who stutters. For each question, we will point out some of the more consistent themes that are present in the literature, yet raise some questions that must still be addressed if we are to improve our assessment of stuttering treatment outcomes. Finally, we will offer some suggestions about how our field might successfully overcome the challenges associated with evaluating stuttering treatment outcomes, and we will invite readers to prepare commentaries about their views on the future of stuttering treatment research.

5. Some Key Questions about Stuttering Treatment Outcomes Research

5.1 What is stuttering? Who decides?

To define "stuttering" it may be helpful to invoke one of the most frequently quoted phrases for describing elusive qualities like beauty, influence, leadership, and vision: "It's hard to define, but you know it when you see it." [4] Many individuals have attempted to define stuttering over the years. Some of these definitions have focused primarily on the observable behaviors associated with stuttering (e.g., the repetitions and prolongations that often characterize stuttered speech), while other definitions have focused more on the experience of the disorder from the perspective of the speaker (or occasionally, the clinician).

For example, the World Health Organization has defined stuttering/stammering as "disorders in the rhythm of speech, in which the individual knows precisely what he wishes to say, but at the time is unable to say it because of an involuntary, repetitive prolongation or cessation of a sound." (WHO, 1992). This definition focuses on the observable behaviors while attempting to explain at least some of the underlying experience of disfluencies. Other definitions have focused more specifically on presumed underlying causes. Johnson (1955, p. 14) said, "…stuttering consists of the reactions made by the stutterer in an effort not to stutter." Later, he said, more simply, "Stuttering…is what the stutterer does trying not to stutter" (1961, p. 68). According to Sheehan, "stuttering is a disorder of the social presentation of the self. Basically, stuttering is not a speech disorder but a conflict revolving around self and role, an identity problem" (1970, p.4). Van Riper (1982) spent an entire chapter attempting to define stuttering, before finally summarizing with "...when the forward flow of speech is interrupted by a motorically disrupted sound, syllable, or word, or by the speaker's reactions thereto."
A somewhat different approach was taken by Perkins (1990), who included the "feeling of loss of control" as a critical element in his definition of stuttering. Indeed, through his research (e.g., Moore & Perkins, 1990), Perkins demonstrated that the speaker's feelings were a critical factor in determining whether a particular speech disruption would be considered by the speaker to be "stuttered."

Finally, many readers are familiar with Wingate's (1964, p. 488) "standard" definition, which included seven separate but related elements in three primary categories, as follows:

> "I. (a) Disruption in the fluency of verbal expression, which is (b) characterized by involuntary, audible or silent, repetitions or prolongations in the utterance of short speech elements, namely:

[4] Oddly, this definition actually traces back to the United States Supreme Court's definition of pornography.

> sounds, syllables, and words of one syllable. These disruptions (c) usually occur frequently or are marked in character and (d) are not readily controllable.
>
> II. Sometimes the disruptions are (e) accompanied by accessory activities involving the speech apparatus, related or unrelated body structures, or stereotyped speech utterances. These activities give the appearance of being speech-related struggle.
>
> III. Also, there are not infrequently (f) indications or report of the presence of an emotional state, ranging from a general condition of 'excitement' or 'tension' to more specific emotions of a negative nature such as fear, embarrassment, irritation, or the like. (g) The immediate source of stuttering is some incoordination expressed in the peripheral speech mechanism; the ultimate cause is presently unknown and may be complex or compound"

On the surface, of course, stuttering consists largely of the repetition and prolongation of words and sounds in speech (element "b" in Wingate's definition above). If it were that simple, however, then defining the disorder would be easy. The subtle and not-so-subtle differences in the definitions presented above reflect, to a large extent, the aspects of stuttering believed to be most important to the authors. Johnson, Sheehan, and Van Riper, for example, focused their definitions largely on the experience of the speaker. Wingate, on the other hand, included these "beneath the surface" aspects, but only as element (f) in a definition that otherwise focuses mostly on observable characteristics. As for the "loss of control" definition offered by Perkins, it seems reasonable to say that the definition captures the very essence of the experiences reported by many people who stutter.[5] The problem, of course, is the fact that it is very difficult, if not impossible, for researchers and clinicians to consistently identify the occurrence of this loss of control by simply observing a client's speech (Moore & Perkins, 1990).

This review includes just a few of the definitions of stuttering that have been offered over the years. Still, it highlights the fact that the definition of stuttering that is selected is strongly affected by the perspective one takes. Many clinicians and researchers appear to be more comfortable with definitions based on observable characteristics, while people who stutter may be more interested in definitions that describe the experience of the person who stutters. To us, it seems that further attempts to define stuttering will be enhanced by an approach that attempts to take into account a variety of different perspectives. It is hoped that the commentaries that follow this article will provide such an opportunity.

5.2 Who is a "person who stutters?" Who decides?

If we extend from the "definition" problems above from the behavior to the person, we rapidly see that many of the same issues relate to determining whether someone is a *person who stutters*. On the one hand, someone whose speech is excessively disfluent, either in terms of the number or severity of disruptions, is likely to be considered by others to be a person who stutters. Nevertheless, some people who are highly disfluent do not consider themselves to be people who stutter (and, if they do not experience any difficulties associated with their speech or communication, it would be difficult to say, without qualification, that they are experiencing a "disorder"). On the other hand, some people who are relatively fluent on the surface *do* consider themselves to be people who stutter (perhaps because they experience significant anxiety and fear about speaking situations, or because their occasional disfluencies are severe in nature, or because they know that they *would* stutter if they did not engage in speech modifications or avoidance strategies designed to prevent stuttering). For these people, it is much easier to say that they are experiencing a communication disorder, even if it is difficult to measure it in terms of observable speech characteristics. Finally, studies of people who view themselves to have recovered have shown that at least some "recovered" people who stutter continue to speak with some disfluency (e.g., Anderson & Felsenfeld, 2003; Finn, 1996). Thus, it does not seem possible to determine who should be considered a person who stutters simply by examining the surface fluency behaviors

One way to resolve this issue might be to incorporate measures *other* than surface fluency behaviors to determine whether or not someone should be called a person who stutters. A potential problem with this approach, though, is that some type of objective determination of whether or not one exhibits stuttering is critical to many forms of research (particularly genetics research, which is highly dependent upon the presence of a certain phenotype within a target population). Nevertheless, because the number and types of disfluencies can have a considerable range, and because people's reactions to

[5] We often use the analogy of walking on an icy surface to help people who do not stutter understand this notion. If one is afraid of losing control and falling, one will walk differently than if on a dry surface. The gait may be stiffer, more tense, more controlled. Similarly, the person who stutters "walks on ice" when talking. The "coping behaviors" observed when people stutter can be seen as a very natural evolution of the experience (or fear) of the loss of control.

stuttering can also vary widely, it seems reasonable to say that the person experiencing the stuttering should play a major role in identifying him- or herself as a person who stutters. Although this might complicate research, it would have the benefit of providing insight into the speaker's beliefs about his or her speech for judging treatment outcomes.

Once again, then, we must move under the surface – to the *experience of stuttering* for any particular person – to decide the factors that determine whether someone should be said to be a person who stutters. A problem arises, however, in deciding exactly which aspects of a person's life should be considered in making such determinations. In our prior writings, we have argued in favor of a broad-based view of stuttering, with a flexible means of determining who should be considered a person who stutters. Specifically, based in part on the World Health Organization's original *International Classification of Impairments, Disabilities, and Handicaps* (ICIDH; WHO, 1980, 1993), and the more recent *International Classification of Functioning, Disability, and Health* (ICF; WHO, 2001), the present authors have developed a framework for viewing stuttering that incorporates several levels of the speaker's experience of the disorder (e.g., Yaruss, 1998b; Yaruss & Quesal, 2004). This framework includes not only the surface characteristics (described as an "impairment in body function," using the terminology of the ICF), but also resultant affective, behavioral, and cognitive reactions to stuttering (so-called "personal factors"), the reactions of those in the speaker's environment ("environmental factors"), and the overall impact of stuttering on the speaker's life (described as limitations in daily activities or restrictions in desired participation levels).

The goal of this model is to provide a comprehensive but flexible definition of stuttering, as individuals who stutter can experience impact in any one, or all, of the four components of the stuttering disorder. As we extend this framework to the determination of who should be considered a person who stutters, then, we can say that the individual himself or herself should certainly play an important role in making this decision. In all likelihood, this would be based on the experiences they have in one or more of these four domains. Of course, the determination of whether or not a person stutters continues to be relatively straightforward for the person who exhibits a notable impairment in speech fluency. The person who stutters "covertly" (or completely under the surface), on the other hand, could still be identified using the model because of the adverse affective, behavioral, or cognitive reactions or the negative impact stuttering has on the person's ability to perform daily activities. An issue remains, though, about how objectively each of the domains can be measured (and, indeed, as noted above, we feel that the subjective judgments of the speaker should carry significant weight in determining whether he or she should be considered a person who stutters). Thus, we believe that the model can continue to be refined. Still, we presented it here as a starting place for this discussion, and we welcome input from the different perspectives of clinician, researcher, and person who stutters.

5.3 What are the goals of treatment? Who decides?

As noted at the outset of this paper, debates about the goals of therapy have raged for decades (see reviews in Bloodstein, 1993, 1995). Some clinicians have proposed that the purpose of stuttering therapy is to help the speaker learn to speak fluently and eliminate stuttering, while others have proposed that the purpose of stuttering therapy is to help speakers communicate more easily, regardless of whether or not they continue to stutter. Still others have advocated a combination of the two goals. Which approach is right? How do we know? Unfortunately, there are no easy answers.

More than fifteen years ago, Baer (1988, 1990) suggested that the definition of an effective treatment program is one that addresses "the client's complaint." This sensible definition would seem to leave little room for doubt about what the goals of treatment should be. If the client's complaint is that he or she stutters, then the treatment should obviously be dedicated to eliminating that stuttering. And, as noted above, a substantial body of literature has been devoted to the description and evaluation of treatment programs aimed at reducing or eliminating stuttering.

Problems begin to arise, however, when we consider three basic issues (see, e.g., Quesal et al., in press; Yaruss, 1998; Yaruss et al., 2002): (a) not every person who stutters has, as their primary complaint, the mere fact that they stutter; (b) not every person who stutters experiences success with treatment programs aimed at reducing or eliminating their stuttering; and (c) people's goals in therapy may change over time depending upon their experiences, both in and out of therapy. More specifically, some people who stutter report that their primary difficulty lies not in the fact that they stutter, but in the fact that they experience other aspects of the stuttering disorder. Examples include anxiety and fear about entering speaking situations; avoidance of words, sounds, or situations where they may need to talk; tension and struggle during moments of stuttering; etc. In fact, as noted above, some people who experience a stuttering disorder actually produce relatively few overt speech disfluencies, so speech modifications designed to increase their fluency would obviously not address their primary complaint. Furthermore, although many people do gain improved fluency as a result of treatment aimed at

modifying their speech, the high relapse rates associated with such treatments suggest that such modifications are difficult to maintain over the long term (see review in Craig, 1998).

Of course, proponents of fluency-based therapies point out that individuals will not maintain their success in treatment if they do not maintain their practice routines, and this is no doubt a key factor in determining long-term success (Boberg, 1981). Regardless of the cause for the relapse, however, the fact remains that not everybody achieves optimal long-term outcomes from speech therapy. (Note that this is true for all approaches to therapy, not just those focused on speech fluency.) Ultimately, as people continue to experience difficulty or failure with one set of treatment goals, their goals for treatment may change. They may move from wanting to minimize stuttering to wanting to minimize their negative reactions to stuttering. Indeed, this may also happen for people who do experience success in treatment—as they make progress in improving their fluency, their goals may shift to other aspects of the disorder that continue to trouble them.

As a result, we must be very careful in defining exactly what the nature of the client's complaint is when developing treatment goals. Obviously, many people who stutter will want to reduce the occurrence of stuttering as a result of treatment; however, the fact that this is not necessarily the only complaint that speakers may have means that clinicians must be prepared to work with their clients to determine the specific nature of their complaints. An important corollary of this statement is the fact that clinicians on both sides of the debate must be careful not to inject their own beliefs or biases into the client's decision-making process determining the goals of treatment. Thus, clinicians who believe that fluency should be the primary goal of therapy (e.g., Ryan, 1974; Ryan & Ryan, 1996) should probably be cautious about making statements that "every person is capable of normal fluency," for this has not been the experience of many clinicians or people who stutter. Just as importantly, clinicians who prefer broad-based treatments focused on factors other than just speech fluency should be cautious about making statements that complete recovery from stuttering is impossible, and that clients simply need to accept the fact that they stutter. As Cooper often pointed out (e.g., Cooper, 1993), we don't necessarily know how fluent a person can become through therapy (or through efforts outside of therapy) and we must be open to progress as well as plateau in tracking a client's progress.

Of course, the idea that clinicians should take their clients' needs and wishes into account when planning treatment would seem to be quite sensible in this age of person-centered treatment. Oddly, however, some researchers and clinicians seem reluctant to consider non-fluency goals as viable alternatives (or adjuncts) to the primary goal of improved fluency, even when people who stutter say that this is what they want. The differing viewpoints on stuttering have contributed to some rather strong debates between proponents of various approaches to stuttering treatment, dating back for decades (see several chapters in Gregory, 1979). Authorities on both sides of the issue have argued that "their" approach for determining treatment goals is the right one. Indeed, it seems likely that this "one size fits all" approach to identifying viable therapy alternatives has contributed to the proliferation of different treatment options. In all likelihood, this attitude has also increased the dissatisfaction that many people who stutter have expressed regarding stuttering therapy.

One possible solution to this dilemma is for clinicians and researchers to adopt a broad-based view of the stuttering disorder, which includes multiple components, such as the model adapted on the ICF as described above. Using this framework, we can see that some, if not most clients will have goals primarily in the impairment domain (i.e., goals for improving speech fluency). Other clients will have goals in domains other than, or in addition to, the impairment level. Examples include goals for reducing negative affective, behavioral, or cognitive reactions, goals for reducing the impact of stuttering on daily activities, or goals for minimizing the impact of the environment on speech fluency. If we allow for the fact that different individuals who stutter experience their disorder in different ways, then we can allow for different treatment goals that are specifically designed to meet the needs of those individuals. We will discuss this issue in more detail below.

In the end, we believe that clients do have a role to play in determining the goals of treatment, for they are the ones who will ultimately select whether or not they will participate in treatment at all and, if they do, which clinician they will work with. Again, as noted above, the sheer number of different treatment approaches is testament to the fact that different people want different things, and some people who stutter seem to be quite willing to "shop around" until they find a treatment approach that is consistent with their goals (or, put differently, until they find a treatment that "works" for them). Still, there appears to be reluctance on the part of some potential clients to interview clinicians and verify whether or not they agree with the approach being presented. Fortunately, support groups such as the NSA have been encouraging their members to do exactly that – to make sure that the clinician they select offers a treatment program that is consistent with their own personal goals. Clinicians can facilitate this process by being willing to listen to their client's needs and being flexible when designing individualized treatment programs. Furthermore, clinicians can support clients in attaining

varying goals in therapy by familiarizing themselves with varying approaches to treatment and being willing to draw upon different strategies for achieving different goals. This brings us to the next question, about which specific techniques or strategies should be selected.

5.5 Which treatment approach is "best?" Why?

Even a brief examination of the stuttering literature will reveal many different approaches to stuttering treatment that have been offered by clinicians and researchers over the centuries (Bloodstein, 1995; Guitar, 1998; Van Riper, 1982). Available treatment approaches differ not only in terms of the goals they seek to achieve, as discussed above, but also in the specific strategies used to achieve them. Thus, within the category of treatments aimed at improving speech fluency, we see strategies such as easy beginnings, continuous phonation, gentle onsets, prolonged speech, gradual increases in utterance length, and electronic devices. Similarly, within the category of treatments aimed at improving communication attitudes (which also includes reducing anxiety about stuttering and minimizing tension during disfluencies), we see strategies such as pseudostuttering, purposeful self-disclosure, cancellation, pull-out, bouncing, and easy stuttering.

Given the wide variety of techniques that are available, it is no wonder that clinicians approaching the disorder report that they feel overwhelmed and under-prepared (Brisk, Healey, & Hux, 1997; Cooper & Cooper, 1985, 1996; Kelly et al., 1997; St. Louis & Durrenberger, 1993). People who stutter also report bewilderment about the number of treatment options that are available, and confusion about which treatment approach they should try (Yaruss et al., 2002). (As noted above, clinician proclamations about the value of their own treatment approaches probably contribute to this confusion and the frustration people who stutter often report about their treatment options.)

Still, it is reasonable to wonder why so many different treatment approaches have developed over the years. Earlier in this paper, we argued that a key factor behind the diversity of treatments is the diversity of people who stutter. Put simply, different people want different things from their lives and from their therapy, so different treatment approaches are "best" for different people. Therefore, any discussions about the evaluation of treatment outcomes must be tempered by the caveat that "one size does not fit all." In other words, it does not make sense, in our opinion, to talk about which treatment approach is best overall, but to talk about which treatment approach provides a best fit for a particular client at a particular time in his or her life.

Taking such an approach does *not* mean, however, that the sky is the limit. Just as it does not seem reasonable to suggest that everybody should receive the same treatment (see below), it also does not seem reasonable to say that any treatment that seemed to provide relief for a single individual who stutters should be considered as viable as all the others. In fact, we believe that the variability among treatment programs makes it even more important that clinicians (and people who stutter) adhere to the principles of scientific practice to ensure that they are not just trying different treatment approaches at random without considering whether the treatments actually work.

5.5 Should everybody receive the same treatment? Why or why not?

In reviewing the preceding discussion, it is clear that several key facts continue to influence our thinking : (a) no single treatment has been shown to be effective for all people who stutter; (b) different people stutter in different ways; (c) different people who stutter have different reactions to their stuttering. Based on these factors alone, it is reasonable for us to assume that treatments should be tailored to individual client needs. Still, not all seem to share this view, for there are those who apparently advocate more formally programmed therapy approaches for most, if not all, people who stutter (Ryan, 1974). Of course, all would agree that even if one adopts a single approach to treatment, that treatment may need to be modified for individual client needs (Bothe, 2002). Rather than adhering to a specific approach to treatment, others have adopted more of a "framework" for treatment (e.g., Williams, 1957; see review by Quesal and Yaruss, 2000). In these types of treatments, a basic treatment philosophy is introduced, then modified based on how the client reacts to certain elements in the framework.

To us, it seems counterproductive to force clients into a treatment that does not work for them. Some individuals who are proponents of a single treatment model even seem to blame the client or therapist if the treatment does not work (Ryan & Ryan, 1996). That also seems to be counterproductive. In our minds, the solution to this is simple: clinicians should be honest with themselves and their clients and admit that their treatments may not work in all cases. Further, they must be willing to either modify their treatments or refer their clients elsewhere if their treatments do not appear to be working for a particular individual.

On the other hand, we agree with those authors, cited previously, who say that if we are to claim that our treatments "work," we should have evidence that those things we target in therapy are, in fact changing as a result of treatment. We (Yaruss, 2001; Yaruss & Quesal, in press) are developing such outcome measures, and others are available (e.g., Andrews & Cutler, 1974; Erickson, 1969; Woolf,

1967). Just as clinicians collect fluency data, they should also collect data that reflect changes in the speaker's entire experience of stuttering. We will comment more on this below in our discussion on how the outcomes of treatment might be measured.

5.6 Why do people hold such strong views about treatment?

Not surprisingly, people who stutter are more likely to believe in the treatments that have helped them. (It is worth noting, too, that many people who stutter who have not been helped by any treatment may feel negatively toward speech therapy in general.) Unfortunately, this can sometimes lead to thinking that "since it worked (or did not work) for me, it will work (or not work) for everyone." Many web sites are little more than testimonials to individuals' experiences in therapy, generalized to everyone who stutters. Many clinicians believe in the treatments that they learned from their mentors. They may also believe in the treatments that they are the most comfortable delivering (e.g., those with which they have had the most experience).

Some individuals have a financial stake in their treatments. If a clinician's livelihood depends on the profits derived from treatment, it is logical to assume that one would feel strongly about it. Of course, one of the key requirements of valid treatment outcomes research is the notion that research findings must be replicated by *independent* scientists who do not have a financial stake in the outcomes. In the field of fluency disorders, it is safe to say that relatively little independent verification of research findings has been completed, and this will continue to be the case in the coming years.

It also may be reasonable to suspect that some hold strong views about treatment because their treatments have been attacked by others – it is normal to defend oneself against attacks. Often the more one is attacked, the stronger one defends what one believes. We will say more about our concerns regarding the nature of such attacks in the conclusion of this paper.

Finally, because most treatments work for some people, but not for all, it is necessary to consider *why* treatments work better for some people than for others and how clients might best be matched with a treatment approach that is appropriate for them. By more closely examining the people for whom treatments do and do not work, we may be better able to match treatments and people who stutter. That is certainly more productive than blindly defending one treatment as the only one, and it would seem to be a fruitful avenue for future research on treatment outcomes. Indeed, during the recent NSA-sponsored research symposium for researchers and people who stutter (Yaruss & Reeves, 2002), a key theme identified by participants was how to determine which treatment approaches should be used for which people. Clearly, this is an area in need of further discussion.

5.7 How should the outcomes of treatment be measured?

Like many of the questions we are trying to address in this paper, this one is not easy to answer. Many people have written on the topic of treatment outcomes measurement, and a wide variety of opinions have been offered. We cannot hope to provide any type of definitive word on the subject; however, we would like to offer our thoughts as a starting point for further dialogue.

Put simply, our view is that the stuttering disorder consists of far more than just stuttering behaviors. To us, many other factors are involved, including the intrinsic factors (Manning 2001), such as emotional and cognitive reactions; behavioral reactions, such as tension, avoidance, and struggle; the negative impact stuttering has on a speaker's ability to communicate; and the overall impact of stuttering on the person's quality of life. We have attempted to model the broad-based nature of the stuttering disorder using the WHO's ICF, as described above. In our opinion, this multi-component model provides the flexibility that we need to allow us to consider the multiple levels of the client's experience, while accounting for the differences between individuals and the differences between treatment approaches.

Using the model as a guide, then, we would suggest that treatment outcomes measurement should be conducted for all of the levels of the disorder: the impairment in fluency (observable characteristics of stuttering), the person's affective, behavioral, and cognitive reactions to stuttering (often discussed in terms of communication attitudes), the reactions of those in the speaker's environment (including factors such as teasing and bullying and communication pressures), and the impact of stuttering on the person's ability to participate in daily activities (which we discuss in terms of functional communication difficulties and overall quality of life). We have collected these various measures into a single instrument which we call "Overall Assessment of the Speaker's Experience of Stuttering (OASES)", and validation of the instrument is currently underway (Yaruss & Quesal, in press). In our opinion, adopting such a comprehensive strategy to treatment outcomes measurement provides a thorough examination of all of the ways that stuttering can affect an individual, and allows for the vast differences between and among people who stutter.

We recognize, of course, that some researchers, who focus their treatment more directly on the client's speech fluency, may prefer that measurement be restricted to what we would call the level of the impairment (i.e., the observable disruptions in speech). We have to acknowledge that this approach

has certain advantages, for it is somewhat easier to measure and count moments of stuttering (or intervals of speech that may contain stuttering) than it is to capture changes in the intrinsic aspects of stuttering (difficulties with the reliability of stuttering measures notwithstanding, e.g., Cordes, 1994; Cordes & Ingham, 1994). Still, we would argue that just because something is easy to measure, this does not necessarily mean that it is the most *important* thing to measure. And, we would also point out that the measurement strategy described above does include measurement of the surface characteristics of stuttering. Rather than being the primary measure of interest, however, we believe that this measure should take its place alongside other measures that are also valuable for describing the speaker's experience of stuttering.

5.8 How long should treatment gains last in order for treatment to be considered "successful?"

The answer to this question probably should be "forever," though this has not been the experience for many people who stutter. In our opinion, it is reasonable to expect a treatment to provide *some* long-lasting benefit in order to be considered "successful." As such, treatments that result in fluency that lasts only a few weeks or months should probably not be considered to be successful. Conversely, a treatment that does not result in noticeable change in fluency, but that results in a long-term change in the speaker's life (e.g., career change for the better, increased opportunities at school, reduced avoidance, etc.) could be considered successful, at least by our definitions offered above (e.g., Yaruss et al., 2002).

Once again we find ourselves debating the issue of "what is important" to a particular speaker (rather than what is important to those in the speaker's environment). Obviously, if the person who stutters believes that fluency is the only acceptable outcome of treatment, then long-term fluency is the only "successful" outcome in his or her mind. If, however, the client believes that treatment can be beneficial even if substantial gains in fluency do not result but other changes occur under the surface, then a long-term change in quality of life (e.g., satisfaction with communication, sense of fulfillment in life, etc.) would be counted as a success – at least in the mind of the speaker. And, again, we are arguing that it is the *speaker's* judgment that should be given the greatest consideration.

Several other problems present themselves. First, relapse in therapy has been well-documented (Craig, 1998; Kuhr & Rustin, 1985), both in terms of changes in fluency *and* change in attitude. Thus, the level of "success" that one reaches immediately on termination of treatment may be a somewhat inflated measure. In our opinion, it is a good idea to inform clients that relapse is a possibility and to prepare them for that eventuality. In fact, a treatment that prepared a client to deal with relapse would seem to be more likely to lead to long-term success. Still, it is difficult to determine how this preparation for relapse should be accounted for in treatment outcomes research.

Even more importantly, we know that some of the "below the surface" changes evolve over a long period of time (Manning, 1999). This can make it even more difficult to determine whether a client has been successful based on measures that are made immediately following the conclusion of treatment. Note that this dilemma, too, applies both to broad-based treatments that are focused, in part, on changes in a speaker's communication attitudes *and* to fluency-based treatments that anticipate improvements in communication attitudes at some point after fluency gains are experienced.

As a result of these and other difficulties, it seems that standard pre-post research protocols, single-subject design with limited withdrawal phases, and even standard clinical trials without long-term follow-up will all fall short in determining whether a speaker has achieved the desired changes over a sufficiently long[6] period of time. For these reasons, we believe that it is up to the individual clinician to follow their clients over a period of time (through periodic "check-in" meetings or long-term participation in a support group) and to foster an environment where clients feel comfortable coming back to treatment when necessary (e.g., for a "tune-up" or refresher, in either the domains of speech fluency or attitudes, depending upon what is needed). Many treatment programs already incorporate such ongoing maintenance into their treatment protocols (in addition to detailed maintenance programs. See Andrews, Guitar, & Howie, 1980); the question is how to account for this in treatment outcomes research.

5.9 What about treatments that appear to be effective for some, but not all, people?

It should be immediately clear that this is a trick question. There is no treatment that has been proven to be effective for all people. Therefore, this question actually applies to all of the treatment approaches that have been developed over time, including those treatment approaches that have been

[6] As to "how long is long enough," the question will still remain unanswered. Of course, different individuals will be satisfied by different outcomes, so again, the client's views must be taken into account when considering "how long is long enough."

described thoroughly in the literature, as well as those that have not. Still, in the introduction to this paper, we commented on the fact that there are some clinicians who stubbornly continue to use treatment approaches for stuttering that have not been thoroughly subjected to the rigors of peer review. These approaches, though used in clinics around the world for decades, simply have not had sufficient outcomes data published in the scientific literature. What is to be done about these treatments? Should clinicians be allowed to use them? Should clients be encouraged to try them?

In our opinion, it is not realistic, at this point, to say that every treatment must have previously been submitted to empirical validation prior to its use with a clinical population. Nevertheless, there appear to be some researchers who have suggested this course of action (Power, 2002). At the same time, however, we do not think it is appropriate to say that any treatment, no matter what the nature of that treatment, should be considered valid simply because it was anecdotally reported to have worked for somebody. Clearly, there is a fine line to be drawn here. How to define that line, and how much data constitutes enough data to indicate that a treatment option is viable, are questions that are not easily answered.

Still, it appears to us that the answer will be forthcoming if we as a field are serious about engaging in a partnership between researchers and the population of people who stutter, for people who stutter can provide the most meaningful metric for determining whether a treatment is viable. Specifically, if people who stutter are aware of the data that exist (or do not exist) in favor of (or against) a particular treatment approach, and if they still choose to engage in such treatment, then they are saying through their actions that the database is sufficient for them to make the very personal decision about whether they will participate in the treatment. Of course, this situation has already been taking place – people who stutter have been choosing, through their participation in treatment (or lack thereof), a wide variety of different approaches. In the real world, it seems that the empirical literature is just a start. Human factors, as well as market forces, ultimately determine whether people will choose to participate in a particular treatment.

Of course, for this situation to work well, people who stutter must become savvy consumers, at least in those countries where they do indeed have a choice about which clinician they will seek to work with. They must learn to ask questions about therapy prior to enrolling, they must learn to be assertive about what they want from therapy, and they must learn to provide feedback to their clinicians about whether they are getting what they want. Just as importantly, clinicians must learn to present, honestly and accurately, the amount and nature of data that exist relative to their treatment programs. And, these data must address aspects of treatment other than just the frequency of disfluencies, if that is what people who stutter want to see. Earlier in this paper, we described the aspects of the stuttering disorder that we feel should be included in such descriptions, though we recognize there is likely to be some disagreement about what factors are most important. Again, we believe that it is going to be the population of people who stutter who will dictate ultimately which data should be presented. As consumer organizations become stronger, and as people who stutter become more assertive and educated advocates, they will begin to ask more sophisticated questions, not only about the nature of the treatment they are investigating, but also about the nature of the data that support that treatment. When that occurs, we will have a significant and most valuable source of independent data to supplement empirical research on the outcomes of treatment.

5.10 Is the existing evidence in the peer-reviewed literature sufficient for selecting treatment strategies?

As we bring this discussion about issues related to treatment outcomes measurement in stuttering to a close, we also wish to consider the current state of the empirical literature. Do we know everything we need to know? Have we collected all of the information we are likely to collect, or is there more fruitful work that remains to be done? As we have mentioned, there currently exists a sizable literature demonstrating that people who stutter can modify their speech production so they speak more fluently. For some clinicians and researchers in the field, this appears to be enough, as discussed above. And, for those individuals who have benefited from such treatment, the existing research base is probably sufficient. For others, however, particularly those who have experienced little success—or only temporary success—with such treatments, it is probable that the existing research base is not yet complete.

On the other end of the spectrum, there also appear to be some advocates of broad-based treatment who have lamented the fact that it may not be possible for science to adequately account for the changes people experience during the course of therapy (Starkweather & Givens-Ackerman, 1997). The strong form of this statement would suggest that the existing treatment outcomes literature is sufficient, not because it tells us everything we need to know, but because it tells us everything is *can* tell us. A change in a person's frequency of disfluencies easily lends itself to measurement; a change in the person's attitudes about those disfluencies does not. Therefore, it could be argued that we should

consult the published literature for the information it contains, but not expect it to provide insight in areas that it cannot readily address.

To us, neither of the preceding answers is entirely satisfactory. We firmly believe that empirical analysis of treatment outcomes is one of the most important factors that can be used to determine whether a treatment approach is valid (though not the only factor). And, we are concerned about the continued proliferation of treatment approaches that appear to have little or no empirical data supporting their use. Therefore, we are sympathetic to the arguments of those who call for a careful, scientific analysis, including peer review, of the outcomes of *all* treatment programs recommended by professionals in our field. At the same time, however, we believe firmly that the empirical literature does not yet tell us everything we need to know. We view the literature as a "work in progress" – a growing body of evidence, rather than a static snapshot of what is right and what is wrong. Therefore, we believe that further research *will* provide new insights about the validity of all types of treatment. Indeed, we believe that some of those insights will actually provide new information about some very old treatment approaches, and as the literature grows, we will have an ever-larger pool of empirically validated techniques to choose from.

As to whether that research will be able to capture what is important about stuttering, this is still a question that awaits an answer. Again, we sympathize with those who have expressed concern about how adequately some of the most important aspects of the stuttering disorder can be measured in the laboratory. Still, we are not ready to give up. For the past few years, we have worked to build upon the existing literature that describes various means for documenting changes in less tangible factors such as communication attitudes. Specifically, we have sought to develop a means of assessing the speaker's affective, behavioral, and cognitive reactions to stuttering, as well as the impact of stuttering on their ability to communicate, and on their overall quality of life (often viewed in terms of satisfaction with various aspects of life, see Yaruss & Quesal, in press). Thanks to a partnership with the National Stuttering Association in the United States, our initial efforts have seemed to us to be quite promising. It is our hope that future research will lead us to a point where we will see evidence of treatment outcomes, using a broad-based measurement strategy, for a number of different treatment approaches, including those focused on a variety of different goals and using a variety of different techniques. Then, and only then, will clinicians (and people who stutter) truly have a means for comparing different treatment approaches on an equal footing. Then, and only then, will we be able to examine how different treatments might be helpful for different people who stutter.

Ultimately, we foresee a future where clinicians can work with each and every one of their clients, on an individual basis, to determine the specific nature of that client's complaint. Then, the clinician can turn to a robust and comprehensive empirical literature to select from among a variety of different treatment techniques, each one tailored to the specific goals a client might have. Then, again working with the client, the clinician can build an individualized, research-based treatment program that includes multiple components, each designed to address different facets of the client's experience of stuttering. Clearly, if we are to achieve this goal, there is much work to be done. Still, we would like to believe that the field is indeed on that path, and that increasing the partnership between scientists, clinicians, and people who stutter, is a significant step in the right direction for making that future become a reality.

6.0 Conclusion: A challenge for our field

In assessing the outcomes of treatment for people who stutter, our field faces a number of interesting questions that are not always easy to answer. A wide variety of opinions have been presented in the literature over the years, and it seems clear that the debate will not see a resolution in the near future. Still, we believe that progress can be made if clinicians, researchers, and people who stutter work together to share ideas and viewpoints about the goals of stuttering therapy.

At the same time, however, we believe that our field faces—and will continue to face—a number of significant roadblocks to achieving our common goal of improved treatment outcomes data. In our opinion, it seems that foremost among these roadblocks is the contentious and argumentative tone the debate has taken at various times. We are not referring only to the historical conflicts between the self-help community and the professional community, but rather, to current conflicts between and among present-day researchers, clinicians, and people who stutter. We recognize that people have differences of opinion and that people tend to feel strongly about those positions. Still, we fear that for so long as the arguments continue, our field will be unable to make progress in addressing the critical issues that face us. Therefore, we believe that the challenge is to move beyond controversy and work to find commonality, to learn from one another and work with one another in our quest to better define, document, and evaluate the goals and procedures of stuttering treatment. In that spirit, we hope readers coming from different viewpoints and different perspectives will use this article as a starting point to

develop an honest discussion about the future of treatment outcomes research in our field. In the preceding pages, we have offered our own opinions about the answers to these questions, and we have suggested that people who stutter should play a major role in furthering this debate. We welcome thoughtful commentary on our views, and we look forward to the opportunity to learn from those with differing perspectives, whether they be clinicians, researchers, or, importantly, people who stutter.

References

Anderson, T. K., & Felsenfeld, S. (2003) A thematic analysis of late recovery from stuttering. *American Journal of Speech-Language Pathology*, 12, 243-253.

Andrews, G., & Cutler, J. (1974). Stuttering therapy: The relation between changes in symptom level and attitudes. *Journal of Speech and Hearing Research, 39,* 312-319.

Andrews, G., Guitar, B., & Howie, P. (1980). Meta-analysis of the effects of stuttering treatment. *Journal of Speech and Hearing Disorders, 45,* 287-307.

Baer, D.M. (1988). If you know why you're changing a behavior, you'll know when you've changed it enough. *Behavioral Assessment, 10,* 219-223.

Baer, D.M. (1990). The critical issue in treatment efficacy is knowing why treatment was applied: A student's response to Roger Ingham. In L.B. Olswang, C.K. Thompson, S.F Warren, & N. Minghetti (Eds.), *Treatment efficacy research in communication disorders* (pp. 31-39). Rockville, MD: American Speech-Language-Hearing Foundation.

Blood, G.W. (1993). Treatment efficacy in adults who stutter: Review and recommendations. *Journal of Fluency Disorders, 18,* 303-318.

Blood, G.W., & Conture, E.G. (1998). Outcomes measurement issues in fluency disorders. In C. Frattali (Ed.), *Outcome measurement in speech-language pathology.* (pp. 387-405). New York: Thieme Medical Publishers.

Bloodstein, O. (1993). *Stuttering: The search for a cause and a cure.* Boston: Allyn & Bacon.

Bloodstein, O. (1995). *A handbook on stuttering* (5th ed.). San Diego, CA: Singular Publishing Group.

Bloom, C, & Cooperman, D. (1999). *Synergistic stuttering therapy: A holistic approach.* Boston, MA: Butterworth-Heinemann.

Boberg, E. (1981). *Maintenance of fluency.* New York: Elsevier.

Bothe, A.K. (2002). Speech modification approaches to stuttering treatment in schools. *Seminars in Speech and Language, 3,* 181-186.

Bothe, A.K. (2003). Evidence-based treatment of stuttering: V. The art of clinical practice and the future of clinical research. *Journal of Fluency Disorders, 28,* 247-258.

Brisk, D.J., Healey, E.C., & Hux, K.A. (1997). Clinicians' training and confidence associated with treating school-age children who stutter: A national survey. *Language, Speech, and Hearing Services in Schools, 28,* 164-176.

Conture, E.G. (1996). Treatment efficacy: Stuttering. *Journal of Speech and Hearing Research, 39,* S18-S26.

Conture, E.G. (2001). *Stuttering; Its nature, diagnosis, and treatment.* Needham Heights, MA: Allyn & Bacon.

Conture, E.G., & Guitar, B.E. (1993). Evaluating efficacy of treatment of stuttering: School-age children. *Journal of Fluency Disorders, 18,* 253-288.

Cooper, E.B. (1993). Chronic perseverative stuttering syndrome: A harmful or helpful construct? *American Journal of Speech-Language Pathology, 2,* 11-15.

Cooper, E.B., & Cooper, C.S. (1985). Clinician attitudes towards stuttering: A decade of change (1973-1983). *Journal of Fluency Disorders, 10,* 19-33.

Cooper, E.B., & Cooper, C. (1991). A fluency disorders prevention program for preschoolers and children in the primary grades. *American Journal of Speech-Language Pathology, 1,* 28-31.

Cooper, E.B., & Cooper, C.S. (1996). Clinician attitudes towards stuttering: Two decades of change. *Journal of Fluency Disorders, 21,* 119-136.

Cooper, E., & Cooper, C. (2003). *Cooper Personalized Fluency Control Therapy-Third Edition.* Austin, TX: Pro-Ed.

Cordes, A.K. (1994). The reliability of observational data: I. Theories and methods of speech-language pathology. *Journal of Speech and Hearing Research, 37,* 264-278.

Cordes, A.K. (1998). Current status of the stuttering treatment literature. In. A.K. Cordes, & R.J. Ingham (Eds.), *Toward treatment efficacy in stuttering: A search for empirical bases* (pp. 117-144). Austin, TX: Pro-Ed.

Cordes, A.K., & Ingham, R.J. (1994).The reliability of observational data: II. Issues in the identification and measurement of stuttering events. *Journal of Speech and Hearing Research, 37,* 279-294.

Craig, A. (1998). Relapse following treatment for stuttering: A critical review and correlative data. *Journal of Fluency Disorders, 23,* 1-30

Dell, C.W. (1993). Treating school-age stutterers. In R.F. Curlee (Ed.), *Stuttering and related disorders of fluency* (pp. 45-67). New York: Thieme Medical Publishers.

Erikson, R.L. (1969). Assessing communication attitudes among stutterers. *Journal of Speech and Hearing Research, 12,* 711-724.

Finn, P. (1996). Establishing the validity of recovery from stuttering without formal treatment, *Journal of Speech, Language, and Hearing Research, 39*, 1171-1181.

Finn, P. (2003). Evidence-based treatment of stuttering: II. Clinical significance of behavioral stuttering treatments. *Journal of Fluency Disorders, 28,* 209-218.

Gregory, H.H. (1979). *Controversies about stuttering therapy.* Baltimore, MD: University Park Press.
Gregory, H.H. (1997). The speech-language pathologist's role in stuttering self-help groups. *Seminars in Speech and Language, 18,* 401-410.
Gregory, H.H. (2003). *Stuttering therapy: Rationale and procedures.* Boston: Allyn & Bacon.
Guitar, B. (1998). *Stuttering: An integrated approach to its nature and treatment* (2nd ed.). Baltimore, MD: Williams & Wilkins.
Healey, E.C., & Scott, L. (1995). Strategies for treating elementary school-age children who stutter: An integrative approach. *Language, Speech, and Hearing Services in Schools, 26,* 151-161.
Ingham, J.C. (2003). Evidence-based treatment of stuttering: I. Definition and application. *Journal of Fluency Disorders, 28,* 197-207.
Ingham, J.C., & Riley, G. (1998). Guidelines for documentation of treatment efficacy for young children who stutter. *Journal of Speech and Hearing Research, 41,* 753-770.
Johnson, W. (1961). *Stuttering and what you can do about it*. Danville, IL: Interstate Publishers.
Johnson, W. (Ed.) (1955). *Stuttering in children and adults*. Minneapolis: University of Minnesota Press.
Kelly, E.M., Martin, J.S., Baker, K.E., Rivera, N.I., Bishop, J.E., Kriziske, C.B., Stettler, D.B., & Stealy, J.M. (1997). Academic and clinical preparation and practices of school speech-language pathologists with people who stutter. *Language Speech and Hearing Services in School, 28,* 195-212.
Krall, T. (2001). The international stuttering association – objectives, activities, outlook: our dreams for self-help and therapy. In H-G. Bosshardt, J.S. Yaruss, & H.F.M. Peters (Eds.), *Fluency Disorders: Theory, Research, Treatment, and Self-Help (Proceedings of the Third World Congress on Fluency Disorders)* (pp. 30-40). Nijmegen, The Netherlands: Nijmegen University Press.
Kuhr, A., & Rustin, L. (1985). The maintenance of fluency after intensive in-patient therapy: Long-term follow-up. *Journal of Fluency Disorders, 10,* 229-236.
Langevin, M. & Kully, D. (2003). Evidence-based treatment of stuttering: III. Evidence-based practice in a clinical setting. *Journal of Fluency Disorders, 28,* 219-236.
Manning, W. (1999). Progress under the surface and over time. In N. Bernstein Ratner, & E.C. Healey (Eds.). *Stuttering research and practice: Bridging the gap* (pp. 123-130). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Manning, W.H. (2001). *Clinical decision making in fluency disorders*. (2nd ed.). San Diego: Singular Publishing.
Moore, S.M., & Perkins, W.H. (1990). Validity and reliability of judgments of authentic and simulated stuttering. *Journal of Speech & Hearing Disorders*, 55, 383-391.
Onslow, M. (2003). Evidence-based treatment of stuttering: IV. Empowerment through evidence-based treatment practices. *Journal of Fluency Disorders, 28,* 237-245.
Perkins, W.H. (1990). What is stuttering? *Journal of Speech & Hearing Research*, 55, 370-382.
Power, M. (2002, April). Research based stuttering therapy. *Perspectives on Fluency and Fluency Disorders 12*(1).
Quesal, R.W. (1989). Stuttering research: Have we forgotten the stutterer? *Journal of Fluency Disorders, 14,* 153-164.
Quesal, R.W., & Yaruss, J.S. (2000). Historical perspectives on stuttering therapy: Dean Williams. *Contemporary Issues in Communication Science and Disorders*, *27*, 178-187.
Quesal, R.W., Yaruss, J.S., & Molt, L. (in press). Many types of data: Stuttering treatment outcomes beyond fluency. *Proceedings of the Fourth World Congress on Fluency Disorders.*
Ramig, P.R., & Bennett, E.M. (1995). Working with 7-12 year old children who stutter: Ideas for intervention in the public schools. *Language, Speech, and Hearing Services in Schools, 26,* 138-150.
Ramig, P.R., & Bennett, E.M. (1997). Clinical management of children: Direct management strategies. In R.F. Curlee & G.M. Siegel (Eds.), *Nature and treatment of stuttering: New directions* (2nd ed.). Boston, MA: Allyn & Bacon.
Rustin, L., & Cook, F., (1995). Parental involvement in the treatment of stuttering. *Language, Speech, and Hearing Services in Schools, 26,* 127-137.
Rustin, L., Cook, F., & Spence, R. (1995). *The management of stuttering in adolescence: A communication skills approach.* London: Whurr.
Ryan, B.P. (1974). *Programmed stuttering therapy for children and adults.* Springfield, IL: Thomas.
Ryan, B.P., & Ryan, B.V. (1996). The rise and fall of operant programs for the treatment of stammering. (Letter to the editor). *Folia Phoniatrica et Logopaedica, 48,* 309-312.
Shapiro, D. (1999). *Stuttering intervention: A collaborative journey to fluency freedom.* Austin, TX: Pro-Ed.
Sheehan, J.G. (1970). *Stuttering: Research and Therapy*. New York: Harper and Row.
St. Louis, K., & Westbrook, J. (1987). The effectiveness of treatment for stuttering. In L. Rustin, D. Rowley, & H. Purser (Eds.), *Progress in the treatment of fluency disorders* (pp. 235-257). London: Taylor and Francis.
St. Louis, K.O., & Durrenberger, C.H. (1993, December). What communication disorders do experienced clinicians prefer to manage? *Asha, 35,* 23-31.
Starkweather, C.W. (1995). The electronic self-help group. In C.W. Starkweather & H.F.M. Peters (Eds.), *Stuttering: Proceedings of the First World Congress on fluency disorders* (pp. 499-503). The Netherlands: Nijmegen University Press.
Starkweather, C.W., & Givens-Ackerman, J. (1997). *Stuttering.* Austin, TX: Pro-Ed.
Thomas, C., & Howell, P. (2001). Assessing efficacy of stuttering treatments. *Journal of Fluency Disorders, 26,* 311-333.
Van Riper, C. (1973). *The treatment of stuttering.* Englewood Cliffs, NJ: Prentice-Hall.
Van Riper, C. (1982). *The nature of stuttering* (2nd ed.). Englewood Cliffs, N.J.: Prentice-Hall.

Weidig, T., & Yaruss, J.S. (in press). How can consumer associations support stuttering research and researchers? *Proceedings of the Fourth World Congress on fluency disorders.*

Williams, D.E. (1957). A point of view about 'stuttering.' *Journal of Speech and Hearing Disorders, 22,* 390-397.

Wingate, M. E. (1964). A standard definition of stuttering. *Journal of Speech and Hearing Disorders, 29,* 484-489.

Wingate, M.E. (2002). *Foundations of stuttering*. San Diego: Academic Press.

Woolf, G. (1967). The assessment of stuttering as struggle, avoidance, and expectancy. *British Journal of Disorders in Communication, 2,* 158-171.

World Health Organization. (1980). *International Classification of Impairments, Disabilities, and Handicaps: A manual of classification relating to the consequences of disease.* Geneva: World Health Organization.

World Health Organization. (1992). *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10). Geneva: World Health Organization.

World Health Organization. (1993). *International Classification of Impairments, Disabilities, and Handicaps: A manual of classification relating to the consequences of disease.* (With forward). Geneva: World Health Organization.

World Health Organization. (2001). *The International Classification of Functioning, Disability, & Health*. Geneva: World Health Organization.

Yaruss, J.S. (1998a). Treatment outcomes in stuttering: Finding value in clinical data. In A. Cordes & R. Ingham (Eds.), *Toward treatment efficacy in stuttering: A search for empirical bases* (pp. 213-242). Austin, TX: Pro-Ed.

Yaruss, J.S. (1998b). Describing the consequences of disorders: Stuttering and the International Classification of Impairments, Disabilities, and Handicaps. *Journal of Speech, Language, and Hearing Research, 49,* 249-257.

Yaruss, J.S. (2001). Evaluating treatment outcomes for adults who stutter. *Journal of Communication Disorders, 34* (1-2), 163-182.

Yaruss, J.S. (in press). Documenting Individual Treatment Outcomes in Stuttering Therapy. *Contemporary Issues in Communication Science and Disorders.*

Yaruss, J.S., & Quesal, R.W. (2002). Research based stuttering therapy revisited. *Perspectives on Fluency and Fluency Disorders, 12 (2)*, 22-24.

Yaruss, J.S., & Quesal, R.W. (2004). Stuttering and the International Classification of Functioning, Disability, and Health (ICF): An update. *Journal of Communication Disorders, 37 (1)*, 35-52

Yaruss, J.S., & Quesal, R.W. (in press). Overall Assessment of the Speaker's Experience of Stuttering (OASES). *Proceedings of the Fourth World Congress on Fluency Disorders.*

Yaruss, J.S., & Reeves, L. (2002*). Pioneering stuttering in the 21st century: The first joint symposium for scientists and consumers.* (Summary Report and Proceedings). Anaheim, CA: National Stuttering Association.

Yaruss, J.S., Caruso, A.J., Lewis, F., & McClure, J.A. Molt, L., Quesal, R.W., and Reeves, L. (2001, June). *The National Stuttering Association Research Committee.* Poster presented at the Annual Convention of the National Stuttering Association, Boston, MA.

Yaruss, J.S., Quesal, R.W., & Murphy, W. (2002). National Stuttering Association Members' opinions about stuttering treatment. *Journal of Fluency Disorders*, *27*, 227-242.

Yaruss, J.S., Quesal, R.W., Reeves, L., Molt, L., Kluetz, B., Caruso, A.J., Lewis, F., & McClure, J.A. (2002). Speech treatment and support group experiences of people who participate in the National Stuttering Association. *Journal of Fluency Disorders*, 27, 115-135.

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RESEARCH COMMENTARIES

Commentary on Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes by J. Scott Yaruss and Robert W. Quesal

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Abstract. Yaruss and Quesal's (2004) arguments about how to bring clinicians, researchers and people who stutter into partnership with respect to evaluating treatment outcomes are considered.
Keywords: People who stutter, treatment outcome.

1. Comments on Yaruss and Quesal (2004)

A dialogue on the important issue of treatment outcomes is a welcome step toward reaching a consensus on how to effectively treat stuttering. This is of the highest priority because the opposing philosophies and conflicting treatment approaches that people who stutter are subjected to hinder their ability to benefit from therapy.

It is very surprising that the authors are seeking "to bring people who stutter back into the treatment outcomes equation" (p.2). Haven't the desires and needs of the people we treat always been the focal point of all that we do? In any case, the comments that follow are based on the empirical results of therapy that include measures of fluency, speech naturalness ratings (Dahm & Kaplan, 2000) self-ratings by clients of speech satisfaction related to affective, cognitive and behavioral issues, as well as anecdotal reports.

The authors are trying to determine the nature of stuttering. However, they have simply rehashed the long-standing debate between the "fluency faction" and the "feelings faction" in the stuttering community, and have suggested that people who stutter should judge which one is correct. This does not advance the treatment of stuttering, because both the stuttered speech and the experiences of the speaker who stutters are products of a more fundamental condition of which even the people who stutter are not always aware.

In the hope of getting beyond this continuing debate, it is necessary to look at the emerging definitions of stuttering that are based on system models of speech production. Conture (2000) suggests "stuttering is either related to disruptions in *planning for* or *executing of* speech-language production or some complex combination of the two" (p.14). Recent brain imaging studies suggest that stuttering may be associated with a dysfunction of neural systems (Ingham, 2003; Ludlow, 2003).

Instead of defining stuttering by its symptoms, it is time to move on by defining stuttering as a central processing dysfunction that, to a great extent, is determined by the thoughts, behaviors, and attitudes of the speaker (Dahm, 1997). Distortions in the basic processes of speech production that include conceptualizing, formulating a linguistic structure, and motor programming result in a variety of symptoms that are associated with stuttering, including (but not necessarily) stuttered speech. By approaching stuttering as a processing disorder, the questions that the authors pose are answered.

Central processing theory answers the question of who stutters by examining neural functions instead of assessing symptoms. According to Levelt (1989), automaticity (sic) …. is a main condition for the generation of uninterrupted fluent speech". The diagnosis of stuttering is made when it is ascertained that the processes for generating speech are being controlled. Control can be found on a range of levels. (See Table 1).

Central Process	**Normally Fluent Speech**	**Stuttering**
Conceptualizing a message	Receives constant attention	Receives partial attention
Phonological encoding	Subconscious	Planned consciously to some degree

Grammatical encoding	Subconscious	Planned consciously to some degree
Phonation	Subconscious and relaxed	Tense and distorted
Articulation	Subconscious	Conscious, controlled and effortful

Table 1. Levels of control involved in speech for normally fluent and stuttered speech.

Any speaker who distorts or has a tendency to distort the normal processes for generating speech would be considered a person who stutters. In turn, the goals of therapy for all people who stutter must be to change the manner in which the brain generates speech. The central processing goals can be summarized as follows:

§ To focus on the general ideas that you want to express [not on the specific words that represent these ideas].

§ To allow the generation of syllable segments [not whole words] in your head [with no effort to "get them out"].

§ To send energy to the vocal folds in a way that allows for continuous and effortless phonation with normal intonation.

§ To use a completely subconscious and automatic mode for articulation

Achieving these goals is not a simple task. Although there are exercises that clarify how to achieve them, it is not a matter of simply learning a technique. It requires changing ones behavior, perspective of speech, stuttering, self and, in some cases, the nature of relationships with others. However, it is important not to confuse therapeutic goals with treatment techniques. Once we are certain of what needs to be changed, as a profession, we can go forward and determine the best way for achieving and maintaining these goals.

The question of whether people who stutter want to speak fluently or feel better about communicating is totally irrelevant. When a person generates speech normally, the result is, of course, normally fluent speech and a normal ability to communicate. Both of these conditions need to be part of an evaluation of treatment outcomes.

References

Conture, E.G. (2000). Dreams of our theoretical nights meet the realities of our empirical days: stuttering theory and research. In Bosshardt, H.G., Yaruss, J.S. and Peters, H.F.M. (Ed). Fluency Disorders: Theory, Research, Treatment and Self-Help, *Proceedings of the Third World Congress of Fluency Disorders* (3-20). International Fluency Association, Netherlands: Nijmegen University Press.

Dahm, B.L. (1997). Generating fluent speech: A comprehensive speech processing approach. In Healy, E.C. and Peters, H. (Ed). *Stuttering: Proceedings of the Second World Congress on Fluency Disorders* (286-290). International Fluency Association, Netherlands: Nijmegen Press.

Dahm, B.L and Kaplan, Y. (2000). Speech naturalness of stutterers following generating fluent speech therapy. In Bosshardt, H., Yaruss, J.S. & Peters, H. (Ed), *Fluency disorders: theory, research, treatment and self-help: Proceedings of the Third World Congress on Fluency Disorders* (361-366). International Fluency Association, Netherlands: Nijmegen University Press.

Ingham, R.J, Ingham, J.C., Finn, P & Fox, P.T. (2003) Towards a functional neural systems model of developmental stuttering. *Journal of Fluency Disorders*, *28*, 297-317.

Levelt, W. (1989). *Speaking: From intention to articulation*. Cambridge, Mass: M.I.T. Press.

Ludlow, C. L. and Loucks, T. (2003). Stuttering: a dynamic motor control disorder, *Journal of Fluency Disorders*, 28, 273-295.

Yaruss, J. S., & Quesal, R. W. (2004). Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research*, *1*, 1-15.

Broadening the stuttering research base: the possible merits of a conversation analytic perspective

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Abstract. The arguments in the target article in support of a more broad-based approach to stuttering research are to be welcomed, as are the authors' views regarding partnerships between clinicians, researchers and people who stutter. However, this commentary draws attention to the limited nature of current research strategies in the field of stuttering and suggests that conversation analysis has the potential to bridge some of the gaps in the literature identified by Yaruss and Quesal (2004).
Keywords: Stuttering; Conversation Analysis; Qualitative research; Treatment Outcomes.

1. Comments on Yaruss and Quesal (2004)

It is difficult to argue with core sentiment underpinning Yaruss and Quesal's (2004) article, namely that clinicians, researchers, and people who stutter should work together in a spirit of cooperation in order to achieve the goal of improved treatment outcomes data. Indeed, given the complex nature of stuttering and the wide diversity of treatment approaches on offer, it would seem prudent to draw upon as wide a range of knowledge, insights and ideas as possible. However, the field of stuttering has traditionally restricted itself to a relatively narrow view of research, relying heavily on experimental designs and quantitative analysis (Tetnowski & Damico, 2001). This is puzzling considering the evident gaps in our understanding of stuttering and the obvious potential of alternative, mainly qualitative, methodologies to bridge these gaps. Although Yaruss and Quesal have raised a number of extremely important issues in their article, it is not possible to address all of these through this particular forum. Consequently, in this brief response I will restrict the bulk of my comments to the last of their ten questions, and in doing so, highlight the possible contribution that a conversation analytic approach may make to the existing research base.

In their critique of the existing literature, Yaruss and Quesal, conclude that 'this does not yet tell us everything we need to know' and question whether future research will be 'able to capture what is important about stuttering'. Throughout the article they identify many of the key problems that beset treatment outcomes evaluation and make a convincing case for broadening the focus of research to take full account of the wide diversity of features encompassed by the term stuttering. While I support the general thrust of Yaruss and Quesal's arguments, including their appeal for a greater emphasis on the person who stutters, I want to make the case here for adopting a specifically conversation analytic perspective on some of these issues.

An understanding of the specific nature of the client's complaint is, as Yaruss and Quesal (2004) indicate, a prerequisite of any kind of meaningful evaluation of treatment outcomes. However, while the person who stutters can certainly provide important information on this, I would suggest that they are not in a position to provide a detailed account of what actually happens during problematic episodes of talk, primarily because it is simply not available to them in the same way that it would be to someone who has access to repeated viewings of recordings of interaction. In order to gain a better understanding of a particular person's stuttering-related behaviour, and of stuttering in general, we need to find out precisely what goes on in interaction. Unfortunately, because of the way in which stuttering research has developed this kind of detailed information is not available, and conversation analysis, with its emphasis on the fine-grained analysis of recordings of naturally occurring conversations is ideally placed to supply it.

While it is not possible to provide a detailed introduction to the conversation analytic enterprise[1] here, it is important to point out that the analysis is based on audio or video recordings of naturally occurring interactions and that any claims that are made need to be grounded the empirical data and shown to be oriented to by co-participants in the interaction. In this respect the task of the analyst is to document, describe and explicate the ways in which conversationalists produce and display the

[1] Those seeking an introduction to conversation analysis may find the following sources useful (Drew 1994; Goodwin and Heritage 1990; Heritage 1984; Hutchby and Woofit 1998; Psathas 1995; West and Zimmerman 1982)

orderliness that permeates naturally occurring interactions (West & Zimmerman 1982). Although such an approach clearly shifts the focus of research more heavily towards the person who stutters, it does so in a very different way from that envisaged by Yaruss and Quesal in the target article. Moreover, it also carries things a stage further by emphasising the collaborative nature of conversation and seeking to take account of the overall interactional context within which stuttering occurs.

There are a variety of potential payoffs from this type of research strategy, some of which are directly related to the challenges identified by Yaruss and Quesal. It may help to us to sharpen and refine our definition of stuttering in a number of ways. While the literature does consider the impact of disfluency on other people (e.g in terms of their attitudes and emotional reactions towards the person who stammers) there is little examination of the implications of different stuttering phenomena for the development of the ongoing conversational interaction. It is also possible that the kind of detailed analysis of talk-in-interaction carried out by conversation analysts may put us in a better position to explain why stuttering has such a negative impact on a person's identity. Moreover, the ability of conversation analysis to 'investigate rigorously and empirically the disparate social and cognitive phenomena constituted through interaction' (Goodwin & Heritage 1990) suggests that this approach may provide a useful methodological counterbalance to the subjective judgments of the person who stutters prioritised by Yaruss and Quesal (2004). Finally, given much of the foundational work that has been carried out within conversation analysis (e.g. on turntaking, sequence organization, repair, preference organization), it is possible that this kind of research may highlight some of the commonalities between people who stutter rather than their idiosyncrasies.

While conversation analytic procedures have been successfully applied to the study of aphasia in recent years (e.g Copeland, 1989; Goodwin, 1995; Laasko & Klippi, 1999; Lindsay & Wilkinson; Milroy & Perkins, 1992; Perkins, 1995; Simmons-Mackie & Damico 1996, 1997; Wilkinson 1995), it is not clear why these have not been employed to the same extent by those engaged in stuttering research. As a starting point, I would urge readers of this journal to familiarize themselves with the foundational work that has been carried out to date on ordinary conversation. These findings have been strikingly 'cumulative and interlocking' (Heritage, 1987), and shed light on a wide range of topics of direct relevance to the study of speech disfluencies. There are many aspects of stuttering that this methodology is not in a position to address, and Yaruss and Quesal's appeal for a more comprehensive approach to stuttering research is extremely welcome. However, I believe that conversation analysis has the potential to redefine the problem of stuttering, and by employing the body of knowledge that has accumulated within the field over the last 30 years we may be able to add one more piece to the increasingly complex stuttering jigsaw.

References

Copeland, M. (1989). An assessment of natural conversation with Broca's aphasics. *Aphasiology, 3*, 301-306.

Drew, P. (1994). Conversation Analysis. In R.E. Asher (Ed.) *Encyclopedia of Language and Linguistics* (pp749-754). Oxford: Pergamon Press.

Goodwin, C. (1995). Co-constructing meaning in conversations with an aphasic man. *Research in Language and Social Interaction*, *8*, 233-260.

Goodwin, C. & Heritage, J.C. (1990). Conversation Analysis. *Annual Review of Anthropology, 19*, 283-307.

Heritage, J.C. (1984). *Garfinkel and Ethnomethodology.* Cambridge: Polity Press.

Heritage, J.C. (1987). *Ethnomethodology*. In A Giddens & J. Turner (Eds.) *Social Theory Today* (pp.224-272). Cambridge: Polity Press

Hutchby, I. and Woffitt, R. (1998). *Conversation Analysis: Principles, Practices and Applications*. Cambridge: Polity Press.

Laasko, M. & Klippi, A. (1999). A closer look at the "hint and guess" sequences in aphasic conversation. *Aphasiology*, *13*, 345-363.

Lindsay, J. & Wilkinson R. (1999). Repair sequences in aphasic talk: a comparison of aphasic-speech/language therapist and apahsic-spouse conversations. *Aphasiology*, 13, 305-325.

Milroy, L. & Perkins, P. (1992). Repair strategies in aphasic discourse: toward a collaborative model. *Clinical Linguistics and Phonetics*, 6, 27-40.

Perkins, L. (1995). Applying conversational analysis to aphasia: clinical implications and analytic issues. *European Journal of Disorders of Communication*, *30*, 372-383.

Psathas, G. (1995) *Conversation Analysis: The Study of Talk-in-Interaction*. Thousand Oaks, CA: Sage.

Simmons-Mackie, N.N. & Damico, J.S. (1996). The contribution of discourse markers to communicative competence in aphasia. *American Journal of Speech-Language Pathology*, *5*, 37-43.

Simmons-Mackie, N.N. & Damico, J.S. (1997). Reformulating the definition of compensatory strategies in aphasia. *Aphasiology*, *11*, 761-781.

Tetnowski, J.A., & Damico, H.L. (2001). A demonstration of the advantages of qualitative methodologies in stuttering research. *Journal of Fluency Disorders, 26*, 17-42.

West, C & Zimmerman, D.H. (1982). Conversation Analysis. In K.R. Scherer & P. Ekman (Eds.) *Handbook of Methods in Nonverbal Behaviour* (pp. 506-541). Cambridge: Cambridge University Press.

Wilkinson, R. (1999). Aphasia: conversation analysis of a non-fluent aphasic person. In M.Perkins & S. Howard (Eds.) *Case studies in clinical linguistics* (pp.271-292) London: Whurr.

Yaruss, J.S. & Quesal R.W. (2004). Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research, 1*, 1-15.

Indications by parents of 'environmental' factors that differ between children who stutter and controls

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Abstract. Yaruss and Quesal's (2004a) article proposes that a number of factors should be examined to provide an impression of a speaker's experience of the disorder. Recently a survey has been conducted about the general health of children who stutter and fluent controls that included assessment of one of Yaruss and Quesal's factors – 'the reactions of those in the speaker's environment'. Parents served as respondents as they are often the other party in their child's interaction environment. Two questions concerned whether the child had behavioural problems or not and how the parent rated their child's behaviour relative to his or her fluent peers. Parents of children who stutter indicated their child had significantly a) more behavioural problems, and b) they rated their child's behaviour worse.
Keywords: Developmental stuttering, environmental factors.

1. Comments on Yaruss and Quesal (2004a)

Yaruss and Quesal (2004a) describe the framework they have developed which views stuttering as incorporating several levels of the speaker's experience of the disorder (see also Yaruss, 1998; Yaruss & Quesal, 2004b). As they put it, the framework "includes not only the surface characteristics (described as an "impairment in body function," …), but also resultant affective, behavioral, and cognitive reactions to stuttering (so-called "personal factors"), the reactions of those in the speaker's environment ("environmental factors"), and the overall impact of stuttering on the speaker's life (described as limitations in daily activities or restrictions in desired participation levels)." (p. 6). This commentary examines an aspect of the environmental factors, namely the impact of the disorder on those he or she is interacting with. Yaruss and Quesal reserve their comments for older children and adults, who might be supposed to have a greater degree of insight into their problem than younger children. However, the need to know whether speakers are affected close to the onset of stuttering on *all* the components in Yaruss and Quesal's framework is widely recognised. Establishing whether children are affected on all components in the framework raises specific difficulties. For instance, how adequately can a child evaluate the surface characteristics of his or her disorder? Parents are the obvious people to assist as they have detailed knowledge about their child and are likely to be motivated to communicate this knowledge. Parents, as significant others in the child's environment, are likely not only to have this knowledge to share at a personal level but also to have observed, the child's interactions with his or her peers.

The Child Health Questionnaire (CHQ-PF50; Landgraf, Abetz & Ware, 1999) was filled in by 33 parents of children who stutter and fluent control children (aged between 8 and 16), questions were asked about health in general that also included specific questions about behaviour. On all questions, parents were required to rate the behaviour of their child relative to other children of the same age. While the answers to the questions about general health highlighted very little (statistically speaking) to suggest differences between speakers who stutter and controls, the responses to the questions about behaviour were more revealing. The background for thinking that children who stutter might have a problem on environmental factors (indicated in the patterns of their interaction with others) is given, followed by a description of the results of the questions that address behaviour.

2. Grounds for thinking environmental factors influence stuttering in children

Studies on the consequences of normal psychological well being have found that if societies stigmatize an illness, this can have a negative effect on the person or influence others in the community into making the occasion of the illness or disability more difficult (Allon, 1982; Frable, Platt & Hoey, 1998; Garske & Stewart, 1999; Smart & Wegner, 1999). Research has shown that individuals with disabilities can be affected by depression, lower academic ability, social isolation and, perhaps understandably, low self esteem (Abe & Zane 1990; Nolen Hoeksema & Girgus, 1994; Spencer, Steele & Quinn., 1999; Steele, 1999; Steele & Aronson, 1995). In some communities stuttering is seen as a stigmatizing condition so children with the condition are vulnerable in society. The vulnerability of the children and the fundamental desire to fit in to a social group can have major effects on a child's perceptions and feelings.

Studies have shown fairly convincingly that persons with a stutter often try to conceal their disorder (Bloodstein, 1995; Guitar, 1998; Shapiro, 1999; Van Riper, 1982). Such concealment can be identified in a child by observing whether they modify their speech by substituting simple words for more difficult ones. Obviously this can have an adverse effect on the child's speech and language development. Due to such substitutions, intended meanings can be hidden and can result in the child being misperceived as having low intelligence. If a child conceals a problem, this can then hinder the child's development even further (Newman, 1987).

Though these results suggest that the disorder will be manifest in 'environmental factors' (to use Yaruss and Quesal's term), the small amount of literature that there is seems to point to the opposite conclusion. Thus, Blood, Blood, Tellis and Gabel (2001) examined 48 adolescents who stuttered. The study showed that 65% of adolescents did not perceive their condition as a stigma. However, the younger adolescents in this study had a more negative view on their condition than the older adolescents. One interpretation of this is that the older respondents have grown to accept the stigma and do not then perceive it as unusual. While this interpretation raises interesting issues about how people accommodate to stuttering, it also suggests that children's behaviour in interaction with their parents may reveal 'environmental' difficulties that are less apparent at later ages.

3. Behavioural characteristics assessed on the General Health questionnaire

We approached the issue whether environmental factors affect behaviour from a different perspective to Blood et al. (2001). It was considered that the problem might be manifest more in social interactions in home (i.e. mainly involving interactions between the parent and child). The survey included questions, as stated above, about behavioural problems and how the parent would rate the behaviour of their child relative to others their age. As the survey was completed by parents of the children who stutter as well as parents of fluent children, biases seem unlikely to lead to differences between the groups. For instance, responses about children of this age are not likely to have affected the results as any such influences would apply equally to the fluent controls. Also, the question which is cause and which is effect between the stutter and the negative feelings about the child, would not seem likely as no differences were found about general health where a similar problem might have arisen (again both sets of parents were judging how the health of their child compared to others).

Behavioural problems differed significantly by Mann-Whitney U test at $\underline{p} < 0.030$ between the group of parents whose children stuttered and parents of controls. 87% of controls reported no behavioural problems compared with 72.3% of the controls. The traits that were most commonly observed by the parents were that their child argued a lot and had difficulties concentrating or paying attention. When parents were asked to rate the behaviour of their child relative to others their age, again there was a significant difference between the children who stutter and controls by Mann-Whitney U test ($\underline{p} = .045$).

The CHQ-PF50 also includes a sub-scale that measures emotional suffering to the parent caused by health and behaviour, from which answers specifically to the behavioural items were extracted. This showed a significant difference between responses of parents of children who stutter and parents of fluent controls by Mann-Whitney U test ($\underline{p} = .049$). This was in the direction that parents of children who stutter reported more emotional suffering due to their child's behaviour than parents of controls.

While the general health of children who stutter is not considered to differ between children who stutter and fluent controls in judgements made by parents, the responses to behavioural questions presents a different story. Children who stutter do appear to behave differently in their environment as judged by parents and Yaruss and Quesal (2004a) appear to be right to emphasize such factors in their target article. On the other hand, the lack of significance between groups when questions about physical health were addressed, suggests there is no support for 'impairment in body functions' (a factor Yaruss and Quesal also stress) aside from speech control (as revealed by the fact that the children stutter).

References

Abe, J. S., & Zane, N. W. S. (1990). Psychological maladjustment among Asian and White American college students: Controlling for confounds. *Journal of Counseling Psychology, 37*, 437-444.

Allon, N. (1982). The stigma of overweight in everyday life. In B. B. Wolman & S. DeBerry (Eds.), *Psychological Aspects of Obesity: A Handbook* (pp.130-174). New York: Van Nostrand Reinhold.

Blood, G., Blood, I., Tellis, G., & Gabel, R. 2001. "Communication Apprehension and Self-perceived Communication Competence in Adolescents who Stutter." *Journal of Fluency Disorders, 26*, 161-178.

Bloodstein O. *A handbook on stuttering*. 5th ed. London: Chapman & Hall, 1995.

Frable, D. E. S., Platt, L., & Hoey, S. (1998). Concealable stigma and positive self-perceptions: Feeling better around similar others. *Journal of Personality and Social Psychology*, *74*, 909-922.

Garske, G. G., & Stewart, J. R. (1999). Stigmatic and mythical thinking: Barriers to vocational rehabilitation services for persons with severe mental illness. *Journal of Rehabilitation*, *65*, 4-8.

Guitar, B. (1998). *Stuttering: An integrated approach to its nature and treatment* (2nd ed.). Baltimore: Williams and Wilkins.

Landgraf, J.M., Abetz, L. and Ware, J.E. (1999) *The CHQ Users Manual*. Boston, MA: HealthAct

Newman, B. (1987). The effect of punishment on repetitions and the acquisition of stutter like behaviors in normal speakers. *Journal of Fluency Disorders*, *12*, 51-62.

Nolen-Hoeksema, S. and Girgus, J.S. (1994) Achievement, depression, and gender differences in children and adolescents. In *Explanatory Style*. Buchanan, G. and Seligman, M.E.P. (eds.). Hillsdale, N.J.: Erlbaum Publishing Co.

Shapiro, J.A. 1999. Genome system architecture and natural genetic engineering in evolution. In Molecular Strategies in Biological Evolution, L. Caporale, ed., *Annaals of the. New York Academy of. Scences., 870*, 23-35.

Smart, L., & Wegner,D. M. (1999). Covering up what can't be seen: Concealable stigma and mental control. *Journal of Personality and Social Psychology, 77*, 474-486.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, *35*, 4-28.

Steele, C. M. (1999). Thin ice: Stereotype threat and Black college students. *Atlantic Monthly*, *August issue*. pp. 44-54.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African-Americans. *Journal of Personality and Social Psychology*, *69*, 797-811.

Van Riper, C. (1971). *The nature of stuttering*. Englewood Cliffs, N.J.,: Prentice-Hall.

Yaruss, J.S. (1998). Describing the consequences of disorders: Stuttering and the International Classification of Impairments, Disabilities, and Handicaps. *Journal of Speech, Language, and Hearing Research, 49,* 249-257.

Yaruss, J. S., & Quesal, R. W. (2004a). Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research*, *1*, 1-15.

Yaruss, J.S., & Quesal, R.W. (2004b). Stuttering and the International Classification of Functioning, Disability, and Health (ICF): An update. *Journal of Communication Disorders, 37*, 35-52

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CLINICAL NOTES AND COMMENTS

Commentary on Partnerships between Clinicians, Researchers and People who Stutter in the Evaluation of Stuttering Treatment Outcomes

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Abstract. The role of the person who stammers in evaluating treatment outcomes is key, as highlighted in Yaruss and Quesal's article. This commentary describes the role of the person who stammers in further depth whilst also elaborating on issues related to choice of treatment approaches, the long-term goals of therapy, outcome measure tools and the ultimate vision for the provision of adult stammering therapy services.
Keywords: Person who stammers, stammering.

1. Comments on Yaruss and Quesal (2004)

I would like to congratulate Yaruss and Quesal on their comprehensive and thought-provoking article, which will inspire many researchers, clinicians and people who stammer to respond on the important issues raised.

As a clinician and person who stammers, I particularly appreciated the emphasis on the importance of the client in all aspects of the treatment process. Stammering is indeed a complex disorder with many questions still to be answered; one thing we can be sure of is that when discussing stammering, the person who stammers and their point of view are crucial. With this in mind, I would like to comment on a number of issues in the article. The sections of Yaruss and Quesal's (2004) article that my comments apply to are indicated.

2. What is stuttering? Who decides? (section 5.1)

Yaruss and Quesal provide a useful summary of a range of definitions of stammering and call for an 'approach that attempts to take into account a variety of different perspectives'. This is beyond doubt the most desired outcome; if a definition based purely on observable characteristics is used, then many people presenting with an interiorised/covert stammer would be excluded and refused treatment. This has regrettably happened in the past and we must ensure that it does not happen in the future.

3. Who is a person who stutters? Who decides? (section 5.2)

My person reaction to this question may be considered simplistic: I believe that the person who stammers is the one to decide whether they stammer or not. I welcome the introduction of the framework developed by the authors as a tool to help the clinician and person who stammers to reveal the full complexity of the condition and to measure change, but believe such a framework is not necessary to determine whether someone stammers or not.

4. What are the goals of treatment? Who decides?; Which treatment approach is best? Why?; Should everybody receive the same treatment? Why or why not? (sections 5.3, 5.4 and 5.5)

Yaruss and Quesal again quite rightly place the person who stammers at the centre of the debate when discussing these issues. They also make the point that somebody's goals for treatment may change and that 'there is not one treatment that suits everybody'. I believe that people who stammer have the right to be fully informed of the treatment approaches available to them (as laid out in the document entitled 'The Rights and Responsibilities of People who Stutter' produced by the International Fluency Association and the International Stuttering Association) and the research data on each treatment approach, before making a decision. I also believe that different treatment approaches might be suitable for the same person at different stages of their life and that they should be encouraged to take what is most useful to them from each approach. An important long-term goal of therapy should be for the person who stammers to become their own therapist, drawing on the skills they have learned from possibly more than one treatment approach. One treatment approach may complement another and it is therefore essential that clinicians and other sources providing stammering therapy work together (please see my comments on 5.10 below).

5. Why do people hold such strong views about treatment? (section 5.6)

The point 'it is necessary to consider why treatments work better for some people than for others and how clients might best be matched with a treatment approach that is appropriate for them' is a highly important one and without further work in this area, it is difficult for clinicians to help their clients make informed decisions regarding treatment approaches. I fully support further work in this area.

6. How should the outcomes of treatment be measured? (section 5.7)

Fluency measures naturally have their place when considering outcome measures; however the variability of stammering needs to be taken into account when considering the validity of these measures: a person who stammers may show a significant reduction in the frequency of disfluencies in one particular situation but may not exhibit the same reduction in other situations.

There are two current ways of measuring affective, behavioural and cognitive changes are the S24 (Andrews & Cutler, 1974) and the Wright and Ayre Stuttering Self-Rating Profile (Wright & Ayre, 2000). Both have the advantage of being self-assessments, therefore ensuring that the speaker's judgement is given the greatest consideration.

7. What about treatments that appear to be effective for some, but not all, people? (section 5.9)

Under this point, Yaruss and Quesal describe the involvement of people who stammer in helping to determine the research data required for a treatment approach. Member organisations have a role to play here, by encouraging people who stammer to become more assertive and educated advocates. Clinicians can also assist in this respect by giving their clients the opportunity to develop a more robust identity as people who stammer. At the City Literary Institute in London, for example, we run courses based on ideas taken from the social model of disability, with the long-term goal that the clients attending will take the ideas presented to them further as a group.

8. Is the existing evidence in the peer-reviewed literature sufficient for selecting treatment strategies? (section 5.10)

Yaruss and Quesal's ultimate vision as outlined in the final paragraph of 5.10 may be achieved slightly differently to the way described. It may not be feasible for one clinician to provide the client with all the different components of a treatment programme; for example group therapy might be considered necessary but the clinician may not be in a position to offer this. A person who stammers may be able to access the treatment they need over a period of time by turning to a range of sources: local therapy services, regional therapy services, privately run courses, self-help organisations and groups and others. It would therefore be important for these different sources of adult stammering therapy to collaborate, for the benefit of the client.

References

Andrews, G. & Cutler, J. (1974). S-24 Scale. Stuttering therapy: The relations between changes in symptom level and attitudes. Journal of Speech and Hearing Disorders, 39, 213-319.

Wright, L. & Ayre, A. (2000). WASSP: Wright and Ayre Stuttering Self-Rating Profile, Winslow Press

Yaruss, J. S., & Quesal, R. W. (2004). Partnerships between Clinicians, Researchers and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. Stammering Research, 1, 1-15.

'The Rights and Responsibilities of People who Stutter' produced by the International Fluency Association and the International Stuttering Association

Comments on the implications of Yaruss and Quesal (2004) on seeking, and measuring outcomes of therapy from the perspective of an adult covert stammerer

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Abstract. Yaruss and Quesal (2004) wish to engage in dialogue with persons who stammer in order to incorporate their views into the 'stammering experience'. I would describe myself as a recovering covert stammerer, not currently in therapy. Given this qualification, I take up Yaruss and Quesal's invitation and examine their views in the light of my own past experience.
Keywords: Covert stammering, treatments for stammering.

1. Stammering Credentials

These comments are from the perspective of someone who has been a lifelong and mostly covert stammerer. However I have also spent a great deal of my working life organising and analysing data related to health and social issues and so will be commenting from this perspective as well. Finally I am actively involved in the British Stammering Association, being currently a trustee and the chair of the Research Sub-Committee, and also facilitate a self-help group.

Even the term covert does not fully describe how I view myself as a stammerer these days; the term I would choose is 'recovering covert stammerer'. This means that to people around me I may sometimes appear to stammer more, because I am taking more risks, but the compensation for me is that the personal and environmental factors to which Yaruss and Quesal (2004) refer in 5.2 now have much less of a negative effect on my total quality of life. The change in attitude to my stammer has not been brought about by direct therapy but by changes in my behaviour. Firstly by gradually becoming involved in a greater variety of activities which contain speaking challenges and secondly by increasingly practising self-disclosure (see 5.4 in target article). I have found self-disclosure to be a particularly valuable strategy, both in social interaction and in the area of employment. Thus these days if I meet someone new whom I am likely to encounter on a regular basis, I mention the issue of stammering. In my working life I have twice within the past year mentioned the fact on application forms and have felt far more relaxed in the ensuing interview as a result.

This is not to say that I reject formal therapy and in fact later in this commentary I shall include some thoughts about issues for mature stammerers in seeking therapy. In many ways my behavioural changes could be regarded as a form of treatment, albeit self-prescribed. These changes are also probably the long-term product of attendance at various courses aimed at people who stammer but not involving any teaching of a speech technique – for example 'Assertiveness for Stammerers' and 'Challenge for Change'.

2. Seeking Therapy

Whether or not to seek further therapy is probably a question which a lot of people who stammer wrestle with. As a reasonably fluent speaker in a range of situations I am clear about what I would not require from therapy. Thus primarily I would not want a technique which undermined my personality or made me speak in a way which sounded unnatural. Yaruss and Quesal do not mention the possibility of prescribed medication as a possibility for treatment. However I have read about clinical trials being carried out at the University of California on the efficacy of olanzapine and risperidone in the reduction of stammering. Given that the usual application of these drugs is to control the effects of schizophrenia, one assumes that the benefit to stammerers lies in dulling down both the impact of the world around them and their reaction to it. This again is not something I would seek from therapy.

Not withstanding all this I would not personally want to close the doors on the possibility of further therapy. Why? Probably a lot to do with preparation for the third age and wanting to enter that better prepared in speech terms than I entered my working life. In 5.3 the authors ask what are the goals of treatment. For me they are never to avoid situations and challenges ahead of me because of fear of stammering. Contained in this thinking is the realisation that post-retirement one can no longer rely on one's work identity to help in the generation of sense of self – everything will be much less structured and the need for self-motivation that much greater. A further reason to seek therapy is that my dysfluencies, as with many stammerers, are highly situational. I would like to understand more about what triggers my dysfluencies and find a means of dealing more effectively with these situations.

Finally, having taken more risks and gradually become more satisfied with the outcomes, there is the heightened sense of self-disappointment when fluent speech breaks down.

As Yaruss and Quesal point out in 5.4, the range of treatments is considerable. It would seem that a number of factors will affect the decision, eg previous experiences of therapy, severity of condition, availability of treatments, stage in life cycle etc. In my own decision process, until recently I had assumed that techniques based on costal breathing would not be acceptable to me because they would modify the sound of my speech. This attitude is now under review. Another approach which appeals, in the sense that it is analytical and does not need to be linked solely to stammering but can apply to wider communication issues, is that of neuro-linguistic programming.

I cannot comment directly on why younger people might reject therapy. Practitioners might be pleased to hear that the majority of the younger people who attend my self-help group seem to be prepared to carry on experimenting with various therapies. Some of these are very much self-help, for example at least two people have mentioned to me that their fear of stammering on the telephone is much reduced by having to face this very situation repetitively as a part of their job. However the foregoing may be more a comment on those who are prepared to engage with a self-help group than young people who stammer in general. Whichever, the membership of organisations such as the British Stammering Association and members of self-help groups would make a rich source of attitudes on this topic.

3. Measuring Outcomes and Comparing Treatments

It has long seemed to me that merely counting dysfluencies in an experimental situation is a very inadequate way to measure treatment outcome for most people who stammer. There is firstly the artificiality of the situation and secondly the multi-faceted nature of stammering, as described in the framework which Yaruss and Quesal propose in 5.2 of their article. I am very happy to subscribe to this framework as being more realistic for the measurement of outcomes. The adequacy of any external measurement of fluency is even more tenuous when viewed from the perspective of the covert stammerer. Thus I am aware that there are hesitations in my speech which would appear similar to an observer, whereas to me some of them cause me emotional discomfort because they are blocks whereas others cause no pain because I am merely sorting out what to say as a result of lack of preparation.

The question then arises as to how precise a measurement can be achieved. To me it seems reasonable to postulate that any attempt is doomed without the co-operation of the person who stammers in monitoring their own performance in day to day situations. If this co-operation were taken as a given then various scales could be developed. For example the scale could be personalised by weighting each factor according to the importance which the individual places upon it. There would need to be an element of recording each 'challenge' (eg performance in a meeting, in a social encounter etc) in terms of each factor. It is quite possible that technology could help in what might otherwise seem an impossibly onerous chore (maybe a further development of the mobile phone?). Date stamping and information regarding refresher therapy would need to be part of the measurement process. Flagging of declining or improving performance could be built into the system as Howell (2004) discusses in connection with the Hector aid. These approaches have already been implemented to monitor athletes in training for example.

Similarly there are statistical techniques which could assist in comparing efficacy of treatments. Logistic regression is a method widely used in studying health outcomes; this method answers the question 'which factors are the predictors of success for certain treatments?' Its application in the field of speech therapy would rest upon firstly identifying factors which seem worth recording (these might be factors such as severity of condition, age, gender, educational attainment, access to social support, economic activity, history of therapies, most recent therapy type, success rating etc) and then collecting a body of data based on these factors. In order to generate results of reasonable reliability, power calculations show it would be necessary to collect information on several hundred subjects for each type of therapy.

References

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Yaruss, J. S., & Quesal, R. W. (2004). Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research*, *1*, 1-15.

AUTHORS' RESPONSE TO COMMENTARIES

The Best Way For Clinicians To Learn What Their Clients Want From Treatment Is To Ask Them What They Want From Treatment

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Abstract. The authors offer responses to commentaries by Dahm, Acton, Gooding & Davis. Everard, and Osborne. Main points from the original article are highlighted, including the value of considering individual differences in the goals of treatment and in the response to various techniques in treatment. The authors conclude by suggesting that it may be fruitful for researchers, clinicians, and consumers to continue in their efforts to find common ground in acknowledging the critical differences between and among people who stutter, and that these differences be used as a starting place, rather than as the exception, in considering stuttering treatment outcomes.
Key Words: Treatment Outcomes, Stuttering, Speech Therapy

1. Introduction

We are grateful for the opportunity to respond to the commentaries offered by Barbara Dahm, Ciaran Acton, Samantha Gooding & Stephen Davis, Velda Osborne, and Rachel Everard. We were pleased to see the general agreement with our position that people who stutter should play an important role in determining and evaluating the outcomes of stuttering treatment. To us, this is just the starting point for further study of treatment efficacy, and there is, of course, much more work to be done. All of the commentaries acknowledged this in some fashion, and we appreciated the suggestion for other ways of incorporating individual preferences into the study of treatment outcomes. That said, we have a couple of thoughts that we would like to offer in response.

2. Response to Dahm: Taking into account the client's perspective means taking into account the client's perspective.

We found it interesting that Dahm's commentary focused not on the role that people who stutter can or should play in evaluating treatment outcomes, but rather on her own theory of the presumed cause of the stuttering disorder itself. Indeed, she wrote "the question of whether people who stutter want to speak fluently or feel better about communicating is totally irrelevant" (Dahm, 2004). Unfortunately, we would have to disagree. As we pointed out in our initial paper, different people appear to want different things from treatment, and different people have differing degrees of success in treatment (Yaruss et al., 2002). Thus, to say that these preferences and experiences are irrelevant is to again deny the valid role of the individual speaker in determining the course and outcomes of his or her treatment.

Nevertheless, for Dahm, issues related to the cause and definition of the disorder seem to take precedence over delineation of treatment paradigms and the direct evaluation of treatment results. This is fine, for we all have different areas of emphasis. Still, one of our primary arguments in our initial paper was to point out that people who stutter should also have a role to play in describing and defining the disorder. Dahm, evidently, would not agree, based on her belief that "both the stuttered speech and the experiences of the speaker who stutters are products of a more fundamental condition *of which even the people who stutter are not always aware*" (Dahm, 2004; emphasis added). Thus, she seems to be stating that we can sidestep the evaluation of treatment outcomes by simply redefining stuttering as errant linguistic processing.

Unfortunately, although we are quite familiar with the literature on linguistic formulation and speech production, we find no compelling evidence to support the suggestion that stuttering is related to the degree of control exerted by an individual at various stages of the language planning process. Furthermore, we found her definitions of what stuttering is, who is to be considered a person who stutters, and how stuttering should be treated, to be more than a little oversimplified. We applaud

Dahm's attempts to understand stuttering in terms of a broader model of speech/ language planning and production. Still, we would hope that empirical study, rather than conjecture, would guide further discussions of what is truly going on in the mind of the speaker prior to and during moments of stuttering.

Finally, Dahm's approach to defining the goals of treatment confuses us, because it effectively removes the speaker's preferences and experiences from the equation. She stated, "the goals of therapy for all people who stutter must be to change the manner in which the brain generates speech" (Dahm, 2004).This is exactly the approach which we were arguing against by stating that "one size does not fit all." As much as we would like to believe that speech therapy – regardless of whether it is based on "generating" fluent speech, or on fluency shaping, or even on stuttering modification – should work for everybody, the experiences of people who stutter suggest otherwise (Yaruss et al., 2002). Therefore, the individual speaker must be taken into account when selecting the goals of treatment, when planning the procedures used in treatment, and, ultimately, when evaluating the outcomes of that treatment.

Thus, to reiterate one of the main points from out initial paper, we submit that clinicians and researchers should be cautious in talking about what people who stutter (a) experience while talking and (b) want from treatment. Ms. Dahm appears to have disregarded both of these admonitions in redefining the disorder based on a seemingly arbitrary definition of what is and is not available to the conscious mind and by effectively eliminating the speaker's opinions and goals from the evaluation of stuttering treatment outcomes.

3. Response to Acton: Novel methodologies hold considerable promise

We appreciate Acton's conclusion that there are a number of methodologies that are under-utilized in stuttering research today. While proponents of so-called Evidence-Based Practice tend to emphasize techniques such as single subject design and clinical trials for establishing and enhancing the evidence, we find ourselves in agreement with Acton that conversational analysis and other qualitative techniques can yield useful information to supplement that obtained through more traditional experimental approaches. We think this is particularly relevant in the study of stuttering, where different individuals report such vastly different experiences as the result of treatment. To be sure, this issue definitely faces other aspects of the field of communication disorders, as well, as Acton pointed out. Still, we believe that stuttering seems to be uniquely well-suited to the exploration of techniques such as conversational analysis. We would like to encourage the use of this approach, as well as other techniques, for documenting and evaluating a wide variety of possible outcomes from stuttering therapy.

4. Response to Gooding & Davis: Stuttering as an "impairment in body function"

We find little to disagree with in the commentary by Gooding and Davis. We, too, value the input of parents in considering young children's experience of stuttering, and we applaud the authors on their research involving the behaviours of young children and adolescents who stutter. Thus, in our response, we would simply like to clarify a couple of minor points. First, it is important to note that the framework we presented is not simply of our own design. In creating the OASES, and the model upon which it is based, we drew heavily on the work of many others. Most notable among these would be the World Health Organization (WHO), which is the primary source of terminology such as "impairment in body function" and "environmental factors," as described in the *International Classification of Functioning, Disability, and Health* (ICF; WHO, 2001). We would also point out that the ICF is designed to describe all aspects of the human condition (described by the WHO as "health status" – and that stuttering is just one very small part of the overall classification scheme). Still, to clarify the use of the ICF terminology, we would highlight the fact that the impairment experienced by children who stutter does not involve "physical health" (as suggested in the commentary) – according to the WHO, the impairment in body function experienced by children who stutter is simply the fact that they stutter. The difficulty with producing fluent speech is, in and of itself, an impairment, and the classification system does not imply or require any other difficulty with health or health status other than the production of speech disfluencies. We hope this will clarify the issue raised by Gooding and Davis at the end of their review. Ultimately, though, regardless of these minor issues regarding terminology, we found the comments by Gooding & Davis to be an excellent example of how complicated stuttering really is, and why it is important to consider the disorder at multiple levels (rather than just as a language processing disorder, as suggested by Dahm).

5. Response to Everard and Osborne: Peoples' experiences of stuttering really do matter

These last two commentaries, written by people who stutter, show how the individual experiences of different speakers have a significant impact on how the disorder is viewed. We find little to disagree with in either commentary. In fact, these commentaries, reflecting first-hand and personal experience, clearly show that the many ways in which stuttering is experienced by the speaker comprise a large – and most significant – part of the disorder. Unfortunately for researchers, these experiences are difficult to quantify, but this does not mean that researchers should attempt to pigeonhole peoples' experiences into easily quantifiable categories, as has so often been the case.

As the commentaries suggest, the surface features of stuttering are but a small part of a much more involved disorder. This is true not only for assessment, but also for treatment. What is needed, then, is a flexible framework for viewing the disorder that allows for a broad variety of definitions, experiences, reactions, and goals that characterize people who stutter. And, such a framework must allow people who stutter to play a central role in defining their own experience of the disorder, determining their preferred outcomes and goals for treatment, and, as Everard pointed out, amassing the resources needed to achieve their own goals. This is a principle that has guided our research and our attempts to understand stuttering, and this is what we have tried to present in our article. Certainly, there is room for improvement, and we appreciate the writers' specific suggestions for improving outcomes assessment in stuttering. Moving forward, we welcome the views of others as we undertake this challenging task in the future.

6. Conclusion: One size still does not fit all.

In conclusion, we would like to again thank the reviewers for their commentaries and for the opportunity to discuss our views about the importance of individuals who stutter in defining and evaluating treatment outcomes. Though we may not always agree about the goals or procedures of research, we find considerable value in the process of exchanging ideas and debating the finer points of our shared interests. In fact, we would like to end by again issuing a call for greater participation and greater cooperation between and among clinicians, researchers, and individuals who stutter in considering the ideal outcomes of therapy, the preferred techniques for achieving those outcomes, and the appropriate methods for evaluating those outcomes. Working together, we stand a far better chance of understanding this puzzling disorder; working apart, we will continue to see the type of dichotomous thinking ("fluency faction" vs. "feelings faction" as described by Dahm) and straw-man argumentation that has plagued the field for years.

References

Acton, C. (2004). Broadening the stuttering research base: the possible merits of a conversation analytic perspective. *Stammering Research, 1,*18-20.

Dahm, B. (2004). Commentary on Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes by J. Scott Yaruss and Robert W. Quesal. *Stammering Research, 1,* 16-17.

Everard, R. (2004). Commentary on Partnerships between Clinicians, Researchers and People who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research, 1,* 24-25.

Gooding, S., & Davis, S. (2004). Indications by parents of 'environmental' factors that differ between children who stutter and controls. *Stammering Research, 1*, 21-23.

Osborne, V. (2004). Comments on the implications of Yaruss and Quesal (2004) on seeking, and measuring outcomes of therapy from the perspective of an adult covert stammerer. *Stammering Research, 1,* 26-27.

World Health Organization. (2001). *The International Classification of Functioning, Disability, & Health*. Geneva: World Health Organization.

Yaruss, J.S., Quesal, R.W., Reeves, L., Molt, L., Kluetz, B., Caruso, A.J., Lewis, F., & McClure, J.A. (2002). Speech treatment and support group experiences of people who participate in the National Stuttering Association. *Journal of Fluency Disorders*, 27, 115-135.

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TARGET ARTICLE

Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering

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Abstract. It has been known for at least a hundred years that the speech of a person who stammers becomes more fluent when alterations are made to the speaking environment. Alterations that lead to an improvement in fluency include a) noises that prevent a speaker hearing his or her own voice, and b) manipulations to the sound of a speaker's voice before it is heard. Examples of manipulations that have been made are introducing a delay, and shifting the voice up or down in frequency. The influences all these alterations have on fluent speakers and speakers who stammer, that have been established over the last century, are reviewed. In addition, the ways in which these phenomena have been explained for both fluent speaker and speakers who stammer are outlined. Several previous findings have potential significance for ways in which the fluency-enhancing effects of these alterations in speakers who stammer could be employed in clinical settings. These are highlighted and discussed, mainly in connection with the SpeechEasy™ prosthetic device for treating stammering.
Keywords: Altered auditory feedback, delayed auditory feedback, frequency shifted feedback, EXPLAN, mirror neurons, SpeechEasy™.

1. Motivation for this review

Interest in the effects of altering the speaking environment of speakers who stammer is currently at an all-time high. This is largely due to the publicity that the SpeechEasy™ in the ear stammering aid has received: The fluency-enhancing effects of this aid have been demonstrated to dramatic effect on the Oprah Winfrey show, and the device has featured on the front page of USA today. SpeechEasy™ alters the sound of the speaker's voice before he or she hears it in one of two ways: 1) by delaying it, or 2) by shifting the speech spectrum (frequency shifting). The former creates a speaking situation like that in an echoey auditorium, and the latter gives the speaker the impression of speaking at the same time as another speaker (either one with a deeper voice or one with a higher voice, depending on which way the speech spectrum is shifted). Examination of these effects in speakers who stammer was initiated by Lee (1951) for delaying, and by Howell, El-Yaniv and Powell (1987) for frequency shifting.

The favorable storm of publicity has met with a more cautious response by some professionals involved in delivering treatment. For instance, the paucity of research about the device led Roger and Janis Ingham to point out in a recent letter to the American Speech Language and Hearing Association's leader magazine that there is no evidence-based practice that SpeechEasy™ "produces any sustained and satisfactory improvements in fluency". In a response to this letter, Greg Snyder raised the issue of whether it is appropriate to delay introduction of the device until such time-consuming and costly research has been conducted. The rights and wrongs of each of these positions is not one that will be quickly resolved so, though it has been aired here, it will not feature directly in the remainder of this review. As currently there are such strongly held positions about fluency-enhancing aids, the time seems right to review their history, comment on their pros and cons, see how they might be integrated with other forms of treatment and speculate about the ways in which use of such aids may advance in the near future.

2. Definitions

As described above, the SpeechEasy™ equipment is a portable device that implements procedures known to improve the fluency of people who stammer. Delaying and frequency shifting are two techniques often referred to generically as altered auditory feedback procedures. Auditory feedback is a value-laden term that carries the implicit idea that speakers listen to the sound of their voice and send the result of this processing back through the brain to a level where this information can be compared with the production the speaker intended to produce. If the sound heard was the one intended, then

speech was fluent. If the intended sound was different to what the speaker heard, an error has crept into the process of speech production. Corrective action can then be taken. This whole process is one of negative, or compensatory, feedback. The overall process (using feedback to determine whether an error has occurred, and then acting on it) is referred to as monitoring. Though it is conceivable that the process of speech control works like this, other explanations are possible. To admit these possibilities, a more neutral term is needed. Hence, 'alterations to recurrent auditory information' (ARAI) is used in preference to 'altered auditory feedback'. ARAI covers both feedback and non-feedback interpretations of the effects that occur when the auditory environment is altered. This term will be used when referring to the several methods of making alterations. The terms delayed auditory feedback (DAF) and frequency shifted feedback (FSF) also beg the question of whether the effects are a result of feedback or not. However these terms will be employed in this review because they are so widely used in the literature.

3. Structure of the review

There is no doubt that if the listening conditions change in the ways mentioned above while a person who stammers is speaking, their speech control improves. Investigation into the effects of such ARAI can be divided roughly into four historical stages, characterized in terms of what equipment was available. The stages are: 1) before any equipment was effectively available; 2) electrical hardware; 3) cheap programmable computers; and 4) portable microelectronic devices. The overriding questions at each historical stage are: 1) whether the advantageous effects of artificially manipulating what speakers who stammer hear can be employed in treatment (practice); and 2) what this indicates about the nature of stammering (theory). While the discussion in the first three stages seems fairly uncontroversial, the theory section in stage four selects two theories developed to account, inter alia, for why FSF improves the speech of speakers who stammer. One of these theories is EXPLAN that was developed by the author of this article. The other theory (authored by a group at East Carolina University) offers a contrasting account of some of the same effects that are addressed by EXPLAN. "Stammering Research" is intended to promote discussion on practical and theoretical topics about stammering and allied issues. Thus in this part of stage four, I argue against the East Carolina theory and present evidence in favor of the 'home theory' (EXPLAN). Undoubtedly, the Carolina group, as well as other interested parties, will wish to address alternative positions through the open peer commentary format of the journal. The article finishes off with some speculation about future prospects concerned with ARAI.

4. Stage 1

Empirical observations on the effects of speaking in noise by people who stammer. Work on ARAI started with the observations, made by people who stammer, that speaking in noisy environments improved their voice control. This result must have been startling as there was no literature that would allow them to understand how a speech production problem could be affected by what you hear. These effects were only experienced adventitiously by isolated individuals as there was no equipment available that allowed the effects to be manipulated and investigated in a controlled way. In the first published experimental study that I have been able to locate, Kern (1932) used a Barany drum as a noise source to study this phenomenon.

One issue that was addressed as a result of these early observations was that if stammering is a result of a hearing deficit, the problem should stop if hearing is lost. Contrary to this prediction studies at this time showed loss of hearing to be associated with onset (not cessation) of stammering in some individuals (Albright & Malone, 1942; Backus, 1939).

Empirical observations on the effects of speaking in noise in fluent speakers. One other topic that predated experimental work on ARAI that is relevant for later, concerns the influence of speaking when the voice is amplified (Fletcher, Raff & Parmley, 1918) or when noise is present (Lombard, 1911). Speakers who stammer change their voice level in the same direction as fluent speakers when noise is present and when their voice is amplified or attenuated (Howell, 1990). When voice level is amplified, speakers reduce their voice level and when voice level is reduced, speakers increase their voice level (called the Fletcher effect). Conversely, when noise level increases, speakers increase their voice level and when noise level reduces, speakers reduce their voice level (called the Lombard effect). It is possible that these compensations could be the result of a negative feedback mechanism for regulating voice level. If speakers need to hear their voice to control it but cannot do so, either because noise level is high or voice level is low, they compensate by increasing level. Speakers would compensate in the opposite way if their speech is too loud (low noise level or when the voice is amplified). Note, however, that explanations other than a feedback account, are also possible (see, for instance, Lane and Tranel, 1971 who discuss the view that voice level changes are made so that the audience, rather than the speaker himself or herself, does not receive speech at too high or too low a level).

5. Stage 2

Empirical observations on the effects of speaking under echo in fluent speakers. In the 1950s, the rapid growth in telephone use caused engineers to become interested in how alterations affected fluent speakers' speech control. Telephones can transmit a limited range of frequencies, the equipment can introduce delays and the voice can be masked by noise, and voice level changes can occur. Thus telephones create ARAI and telephone companies needed to know how speech was affected. Most attention at this time and subsequently has been on the effects of delay (CCITT, 1989a, 1989b) and is an on-going problem since the introduction of cellular phones and satellite technology. Speaking along with a delayed version of the voice (DAF) caused drawling (usually on the medial vowels), led to a Lombard effect (increased voice level), while pitch became monotone, speech errors arose and messages took longer to complete than messages produced in normal listening conditions (Fairbanks, 1955).

Theoretical accounts of the effects of speaking under echo in fluent speakers These observations led to various versions of 'feedback' theory (Black, 1951; Lee, 1950). The essential feature of these theories is that the current speech output is sent back to a sensing device that controls future output (Brown & Campbell, 1948). The information that arises at this sensing device is used to correct an activity when it exceeds predetermined limits. In the case of DAF procedures, the sound of a speaker's voice is transformed by delaying before it reaches the sensing device, so the segment of speech that is heard at a particular time is different from the segment that the speaker intended to produce at that time. A feedback monitoring explanation maintains that this discrepancy is detected and the corrections the speaker then makes, introduce, rather than remove, errors. If this interpretation is correct, then the delays at which errors are observed, indicate what segments are involved in speech control. The notion behind this is that a delay equal to the length of the unit used for output, results in the speaker getting feedback about the preceding segment when he or she is producing the next segment. Using this idea, Black (1951) argued that since a delay of 200 ms is most disruptive on speech control and that as this corresponds roughly with the length of a syllable, then the unit used by speakers to monitor feedback is the syllable.

Empirical observations on the effects of speaking under echo in speakers who stammer. When DAF was presented to people who stammer, fluency was found to improve (as had been reported earlier when a noise masked these speakers' speech). Researchers who investigated the fluency-enhancing effects of DAF on people who stammer in the 1950s and 1960s include Nessel (1958), Soderberg (1960), Chase, Sutton and Rapin (1961), Lotzmann (1961), Neelley (1961), Goldiamond (1965), Ham and Steer (1967) and Curlee and Perkins (1969). Stimulated by the findings of these early investigators, several portable maskers and DAF devices were developed.

Following the pioneering work of Goldiamond (1965), DAF was introduced into an influential treatment program by Ryan (1974). DAF was initially presented with a delay long enough to produce slowing of speech (based on the work on fluent speakers mentioned above, most slowing would occur when speech is delayed by 200 ms). The delay was faded over a series of test sessions so that rate was reestablished to normal limits, hopefully with some retention of the fluent patterns established when speech rate was slow. As recently as 1993, Costello-Ingham also maintained that the only function of DAF was to control speech rate. As she put it: "The functional variable in regard to the reduction of stuttering is not DAF, but prolonged speech, and the latter can be produced without reliance on a DAF machine" (Costello-Ingham, 1993, p.30).

Other techniques for treating stammering, not involving ARAI, were investigated at this time. One that deserves special mention is the Lidcombe learning procedure, because of its current popularity and some comments are made under "future possibilities" about how DAF or FSF could feature in a modification of such an operant procedure. Onslow, Andrews and Lincoln (1994) describe the technique as follows. It "is an operant treatment that incorporates parental verbal contingencies for stuttered speech and stutter-free speech. The contingencies for stutter-free speech are praise and tangible reinforcement, and the contingencies for stuttering are that the parents identify a stuttered utterance and request the child to correct the utterance."

A further important claim that was made at this time that was embraced by several eminent workers was that DAF produces similar effects in fluent speakers to those that people who stammer ordinarily experience – in particular drawling and speech errors. This prompted Lee (1951) to refer to DAF as a form of "simulated" stammer. In an extension of this point of view, Cherry and Sayers (1956) used DAF as a way of simulating stammering in fluent speakers to establish the basis of the problem. They extracted two different sources of sound that are heard whilst speaking normally (the sound transmitted over air and that transmitted through bone). They then examined which of these 'feedback' components led to increased stammering rates in fluent speakers when each of them was delayed. The bone-conducted component seemed to be particularly effective in increasing 'simulated' stammering' and

they proposed that this source of feedback also led to the problem in speakers who stammer. They then designed a therapy that involved playing noise to speakers who stammer that was intended to mask out the problematic bone-conducted component of vocal 'feedback'. They reported that fluency improved when the voice was masked in this way.

In another particularly imaginative study, Sutton and Chase (1961) manipulated when noise was on or off using a voice-activated relay while subjects read aloud. They compared the fluency-enhancing effects of noise that was on continuously, noise that was presented only while the speaker was speaking and noise presented only during the silent periods between speech. They found all these conditions were equally effective. It appears from this that the operative effect is not simply masking as there is no sound to mask when noise is presented during silent periods. However, Webster and Lubker (1968a) pointed out that voice-activated relays take time to operate and so some noise would have been present at the onset of words. Therefore a masking effect cannot be ruled out.

Theoretical accounts that suggested a sensory deficit in people who stammer. Theorists at this time were proposing that malfunction in different parts of the auditory system might offer an account of stammering. Webster and Lubker, (1968b) for instance, postulated that middle ear muscle contraction in speakers who stammer disrupts the auditory feedback that they receive. Whenever the middle ear muscles contract, the middle ear system increases impedance to sound transmission. The muscles contract prior to vocalization, resulting in attenuation and low-pass filtering of the speech (Teig, 1973). Shearer (1966) reported that the timing of this muscle activity is abnormal in speakers who stammer. According to Webster and Lubker's theory, the abnormal contraction and relaxation of the middle ear muscles of the person who stammers would produce abnormal speech feedback of fluctuating intensity that leads to speech control problems. The positive effects of DAF on speakers who stammer could then arise because this form of ARAI keeps the muscles constantly contracted and removes the fluctuating auditory feedback that created the problem.

6. Stage 3

Conceptual and empirical problems for a feedback account of fluent speech control. Though in the previous period Lee, and Cherry and Sayers were interested in speech control of fluent speakers and speakers who stammer, the 1970s and 1980s started to see some division between people interested in fluent speech control and those interested in stammering. Generally speaking, a 'feedback' process as candidate for explaining speech control was dropped in fluent speech, but was retained by people interested in how people who stammer control their voice. Thus, work on fluent speech, including papers by Borden (1979), Howell, Powell and Khan (1983), and Lane and Tranel (1971), began to question feedback interpretations of the effects of ARAI, and alternative accounts were proposed. There were both conceptual and empirical objections that led to rejection of the view that ARAI is used as sensory feedback to linguistic planning mechanisms.

Borden (1979) discussed several conceptual issues for a feedback point of view. One question she raised was how quickly information can be recovered from the auditory signal. Auditory processing time is estimated to take around 100-200 ms. Auditory output from any segment around this duration would reach the feedback mechanism too late to be used for control of its own segment. A second question she raised was based on the observation that speakers with hearing impairment, who had established language before they sustained their loss, can continue to speak. This suggests that speech can proceed without sensory feedback.

A further conceptual problem is that the amount of phonetic information a speaker can recover about vocal output is limited because bone-conducted sound masks a speaker's phonetic output (see Howell and Powell, 1984 for a study on this issue and Howell, 2002, for an extended discussion of the problems this raises for feedback accounts). Degradation of the sound of the voice would limit the usefulness of the feedback that a speaker can recover by listening to his or her own voice, making it an unlikely source of information for use for feedback control.

One question that arises if the sound of the voice does not contain phonetic information, is whether the delayed sound during DAF has to be speech to produce the disruptions to fluent speakers' speech? Howell and Archer (1984) addressed this question by transforming speech into a noise that had the same temporal structure as speech, but none of the phonetic content. Then they delayed the noise sound and compared performance of this with performance under standard DAF. The two conditions produced equivalent disruption over a range of delays. This suggests that the DAF signal does not need to be a speech sound to affect control in the same way as observed under DAF, and indicates that speech does not go through the speech comprehension system before it can be used as feedback. The disruption could arise, however, if asynchronous inputs affect operation of lower level mechanisms involved in motor control.

Revisions in theory in response to the problems for a feedback account of fluent speech control. The above arguments and Howell and Archer's (1984) experimental evidence, undermine the case for

auditory feedback monitoring in fluent speakers. There have been several reactions: 1) Some have argued for an auditory feedback processing mechanism that operates at the prosodic level (Donath, Natke & Kalveram, 2002; Kalveram, 2001; Kalveram & Jaencke, 1989). Prosodic processes operate over long time periods. Thus, the problem of obtaining auditory feedback early enough would not be such a problem if prosodic units are used for feedback control as it is for the view that syllables are the unit that is used. 2) Borden (1979) argued that auditory feedback is used in circumscribed situations. These include when language is being acquired (either developmentally or as a second language in adulthood), and when the speaker's voice is altered. 3) Howell et al., (1983) developed a non-feedback account of the particular effects of DAF. Lane and Tranel (1971) offered a non-feedback account of the effects of alterations to voice level that were described earlier in this review. 4) Some authors adopted feedforward, instead of feedback, models (Kawato, Furakawa & Suzuki, 1987). These models maintain that movement errors are continuously computed and used (when they arise) as correction signals. They get round the problem of feedback being slow by doing the work in advance of the movement. Such a model has been applied to one of the situations Borden (1979) regarded as reliant on auditory feedback (developmental speech acquisition) by Guenther (2001).

Howell et al.'s (1983) account has particular relevance to the effects of ARAI on speakers who stammer because it involved DAF that improves the fluency of these speakers. It is worth giving a little of the background detail of this account (their disruptive rhythm hypothesis, DRH). The basic issue addressed by DRH was how to account for the disruptive effects of DAF if, as Howell and Archer's (1984) results indicate, ARAI does not send information through the speech perception system to provide information to reinitiate speech when it is in error. From a rhythmic perspective, DAF involves speaking one utterance while hearing another that is out of synchrony with it (in contrast with normal listening where the sound that is heard has a rhythm in synchrony with speech). Howell et al. (1983) considered two situations involving voice control to argue that synchronous activities are easy to perform and asynchronous ones are difficult. Canon singing is easy (as shown by the fact that it is one of the first forms of song that children are taught). There is also a form of medieval song, called hoquetus, that involves each singer producing a note synchronized to the offset of another singer's note. This form of singing is difficult to master. Canon singing points to the fact that it is easy to produce synchronous activities whether or not those activities contain any information about the speaker's own speech. The case of hoquetus shows that asynchronous activities (again, whether or not those activities contain any information about the speaker's own speech) are difficult and, by analogy, suggests that this is why DAF causes difficulties in speech control. In hoquetus, one singer's note finishes as the next singer's note commences. This would correspond to the DAF situation in which speech is delayed by the length of the note, which would be the length of a syllable for notes a syllable in length. As observed earlier, a delay equal to the length of a syllable is maximally disruptive in DAF. DRH suggests that this delay is most disruptive because of the rhythmic relationship between what is heard and what is spoken, rather than because feedback about the wrong syllable is sent when this delay is used (as in traditional accounts).

Practical development of ARAI devices for speakers who stammer and some limitations about the fluency of the speech produced when using these devices. Part of the growth in popularity of DAF as parts of treatment programs stemmed from the early claim by Lee (1951) (also endorsed by Cherry and Sayers, 1956), that DAF has the opposite effect on fluency between people who stammer and fluent speakers. This implies that DAF produces fluent speech in people who stammer. Considering first the effects of DAF on fluent speakers, the most notable effect is lengthening of medial vowels. Though these seem superficially similar to the prolongations people who stammer show, there are two differences that indicate this is more apparent than real: First, speakers who stammer have problems on consonants, not vowels (Howell, Wingfield & Johnson, 1988). Second, the consonants are in the initial position in an utterance (Wingate, 2002), not the medial position that the vowels occupy. The difference in distribution and phoneme type of the sounds that are elongated between DAF-speech in fluent speakers and prolongations that people who stammer produce, undermines the claim for complementarity between these two forms of speech.

A further point investigated at this time was whether people who stammer only lose disfluencies or whether they also show effects like fluent speakers. Howell et al. (1988) reported that people who stammer lose disfluencies under DAF but they also elongate the vowels (as do fluent speakers under DAF). These effects can be ameliorated by, for example, using short DAF delays (Kalinowski, Stuart, Sark & Armson, 1996), though standard equipment at this time usually limited the alterations that could be made to long delays. The difference between 'DAF-simulated', and true, stammering undermines the explanatory basis of Cherry and Sayers' (1956) work that led to masking therapy (though not the effectiveness of masking therapy itself). If Costello-Ingham's (1993) point of view that DAF is just a way of slowing speech that reduces stammering, and if DAF can be faded out (as in

Ryan, 1974, 2001) the side effects of DAF would not matter. However, other authors such as Novak (1978) have reported that the after-effects of DAF (vowel lengthening) persist into post treatment speech, so would affect speech communication adversely. One other objection about DAF is that it presents no sound at word onset, which is mostly the place where people who stammer have problems (Wingate, 2002). Lack of an altered sound at onset of syllables may explain why DAF has more effect on the medial vowels than initial consonants.

In the UK, development of two portable devices that included sensible design ideas was taking place. These were, 1) the Edinburgh masker pioneered by the stammering research unit at Edinburgh University (Dewar, Dewar, Austin & Brash, 1979) and, 2) the Hector aid designed and built by Ron Turrell and Graham Parkhouse with support from the forerunner of the British Stammering Association.

The Edinburgh masker consists of a microphone that is held on the larynx by a velcro band, a control box that is discretely hidden by the user (e.g. in the pocket) which is connected by plastic tubing to ear tips that the speaker inserts into the ear canal. The throat microphone detects voiced sounds, the control box triggers the masking noise (a low frequency buzz) that is delivered to the speaker's ears. The device has the advantage that the masking sound only occurs while the speaker is speaking, thus limiting the occasions on which the aid operates to the periods where the speaker may have problems. However, there are several drawbacks. First, the attachment of the microphone and the ear-inserts are somewhat unsightly and may be cosmetically unacceptable to wearers (particularly adolescents). Second, as the manufacturers of the device acknowledge in their instructions for users, the laryngeal microphone does not always trigger on initial parts of sounds, as for instance in words starting with low amplitude voiceless sounds. As most stuttering occurs on the initial sounds in an utterance (Wingate, 2002), the device does not always operate at the point at which speakers need assistance. As noted above, this was also a problem in Sutton and Chase's (1961) onset masker. The manufacturers of the Edinburgh masker suggest that speakers prelude speech attempts by saying 'm', 'er' or 'ah' that triggers the device to deliver a masking noise. However, the advisability of doing this is questionable as this strategy would substitute one unusual pattern of speech for another. This would be problematic in that work with DAF suggests that some of the odd patterns that arise with this ARAI persist into post-treatment speech (Novak, 1978) and the same could apply to speech produced under masking. Also, if the crucial factor that leads to DAF effects is delayed rhythm (Howell et al., 1983), then the Edinburgh masker with its inbuilt delay would work like DAF and produce speech with unwanted side effects. Third, again as the manufacturers acknowledge, the device produces a Lombard effect (a raising of the voice level). Once again this leads to unnatural sounding, in this case shouted, speech. Fourth, the insert earphones prevent speakers hearing outside sounds and this could potentially be dangerous if, for example, the masker is worn in the street (this is also a problem for the SpeechEasy™ device).

The Edinburgh masker was more popular, and its effects on fluency studied more extensively (Dewar et al., 1979), than the Hector aid. However, the Hector aid had some revolutionary characteristics behind its design that current ARAI technology ought to take on board (see future prospects for ideas on how this could be achieved). As far as I am aware, there has been no formal report describing the device or reporting on its effectiveness, apart from a single case study by Celia Levy who worked with a client over a period of eight weeks. This description relies mainly on that report and my own recollections of the device. The device consisted of a box with audio inputs and a vibrator output. The electronics measured speech rate using the audio input. The vibrator switched on if speech rate was outside acceptable speech rate ranges and signaled the speaker to slow speech down. Presumably the imposed speech rate is the "bullying" which gave the aid its name 'Hector'. Though rate control is not a form of ARAI, it is a form of feedback. Its primary attraction is that it targeted its indications that a speech rate change is needed on the episodes where stammering rate is likely to be highest, i.e. the fast rate sections (Howell, Au-Yeung & Pilgrim, 1999). This takes the idea of targeting feedback on sections that are problematic (Howell, El-Yaniv & Powell, 1987) a step further. Furthermore, if alterations are made intermittently (as in the Hector aid), they would cause less of a problem when worn in everyday speaking situations (see the above discussion about wearing the Edinburgh masker or SpeechEasy™ device in the street). Whether Hector works or not depends on the assumption that rate control is behind the problem that a person who stammers experiences (as Costello-Ingham, 1993, argued). As with the Edinburgh masker, the device has drawbacks. First, to be worn discretely, some adjustment to clothing was necessary (as noted in Levy's report of work with her patient). Second, when I made some measurements on the device in the 1980s, it did not track speech rate very accurately.

Empirical work rejecting theoretical accounts that suggested a sensory deficit in people who stammer. As indicated, some workers proposed that stammering could arise as a result of an auditory

(pure sensory) deficit at stage two. The two specific proposals made were that people who stammer have problems in dealing with bone-conducted sound (Cherry & Sayers, 1956) or that problems arise because the middle ear structures of speakers who stammer cannot transmit sound in the same way that those of fluent speakers do (Webster & Lubker, 1968b).

Cherry and Sayers' argument for problems in the bone-conducted route was based on the assumed similarity of stammered speech to DAF-speech in fluent speakers. Empirical studies that show that this is not so were reviewed above. Therefore, there is no basis to conclude that because sound delayed and transmitted through bone is more disruptive to fluent speakers than sound delayed and transmitted through air, speakers who stammer have problems dealing with sound transmitted through bone. Also, Howell and Powell (1984) compared Cherry and Sayers (1956) bone-conducted sound with actual bone-conducted sound and found marked differences. Cherry and Sayers' experimental manipulation created a sound that, though successful at disrupting fluent speech control, was nothing like bone-conducted sound. Once again this result shows that there are no grounds for concluding that speakers who stammer have problems in dealing with sound transmitted through bone.

The proposal that speakers who stammer have problems in transmitting sound through the middle ear system also failed empirical tests. Shearer's (1966) original work included very limited amounts of data. In an extensive study, Howell, Marchbanks and El-Yaniv (1986) were unable to find differences in middle ear operation between people who stammer and fluent controls (both during listening tests and during vocalization). Abnormal middle ear muscle operation seems, then, an unlikely basis for explaining the disorder.

7. Stage 4

Empirical work when technology allowed an increased range of ARAI. The advent of cheap computer power opened up possibilities for extending the type of alterations that can be made. The SpeechEasy™ device drew on the results of this work in terms of the alterations that it includes (DAF and FSF that improve fluency) and the operating ranges (delays and frequency shifts it is possible to make). These and other alterations that were explored are summarized next.

Howell and co-workers began to examine the implications of DRH for the effects of new forms of ARAI in people who stammer. They investigated the effects of various forms of synchronous and asynchronous rhythms on the speech of people who stammer. One investigation on synchronous rhythms by Howell and El-Yaniv (1987), examined a metronome click that was automatically triggered by speech so that it was located at the onset of each syllable in the spontaneous speech of speakers who stammer. They found such a speech-synchronous metronome click was as effective at increasing fluency as an externally paced metronome. This suggests the effect of this novel metronome stimulus is not due to rate pacing (the speaker is free to adopt whatever rate he or she is comfortable with) and may be a result of having a click in synchrony with speech.

Howell et al. (1983) in the paper that introduced the DRH, pointed out that interrupting speech (by gating it on and off) produced asynchronous ARAI similar in some respects to what they considered to occur under DAF (disruption to rhythm, without any part of speech being delayed). They found some similarities between speech performance under interruption and DAF in fluent speakers. This manipulation remains to be investigated in people who stammer, but DRH predicts that it would lead to similar effects on fluency as DAF.

Howell, El-Yaniv and Powell (1987) created a frequency-shifted version of the speaker's voice that was synchronous with the speaker's voice. These authors used a speed-changing method (that produces a frequency shift in the same way that playing a tape recorder at different speeds does). To avoid the altered sound getting out of synchrony with speech when speech was shifted down in frequency (equivalent to a lower tape speed), the last bit of the buffer was rejected when sampling of the next buffer commenced. The resultant sound was low-pass filtered to remove any distortion brought about by truncating the replay buffer. Importantly, buffer length was only 10 ms so that when speech was shifted down an octave (only the first half of the buffer used for replay), samples could be out of synchrony by 5 ms maximum, meaning the shifted version was presented virtually in real time. Other features to note about FSF are that the signal level in the shifted version varies with speech level (when speakers produce low intensity sounds, the FSF is also low in intensity, and vice versa). Also, no sound occurs when the speaker is silent (the latter is a feature that is shared with the Edinburgh masker). The two preceding factors limit the noise dose the speaker receives.

The effects on fluency of this (almost real time) ARAI was a marked improvement in fluency in people who stammer even when speakers were instructed to speak at normal rate. Howell, El-Yaniv and Powell's (1987) first study showed that FSF resulted in more fluent speech than DAF or the Edinburgh masker. Later studies have argued that FSF does not produce speech that is superior to DAF speech at short delays (Kalinowski, Armson, Roland-Mieszkowski, Stuart, & Gracco, 1993; Macleod, Kalinowski, Stuart & Armson, 1995). However, these studies have used fast Fourier transform (FFT)

techniques to produce frequency shifts. These techniques produce significant delays and the delays are somewhat variable (Howell & Sackin, 2002). Therefore, the studies that claim FSF has the same effect on fluency as DAF have compared FSF plus a short delay, with short-delay DAF. Thus the delay they include under FSF may account for why these studies failed to find a difference between it and DAF whereas Howell et al. (1987) did. (The importance of exact synchrony between altered and recurrent sounds is returned to later where observations about SpeechEasy™ are made.)

A second important point about the Howell, El-Yaniv and Powell (1987) study was that, as mentioned, the effects on fluency were observed even though speakers were told to speak at a normal rate. Therefore, to the extent to which they obeyed instructions, the effects of FSF seem to be independent of rate. This argues against Costello-Ingham's (1993) view that ARAI techniques (DAF in particular) work because they slow overall speech rate. Direct tests of whether fluency-enhancing effects occur when speech rate is varied were made by Kalinowski et al. (1996) for DAF, and by Hargrave, Kalinowski, Stuart, Armson and Jones (1994), and Natke, Grosser and Kalveram (2001) for FSF. These studies reported that fluency was enhanced whether or not rate was slow (relative to normal speaking conditions). One proviso about the Kalinowski studies is that a global measure of speech rate was taken. It is possible for speakers to speed up global (mean) speech rate while, at the same time, reducing rate locally within an utterance. See Howell and Sackin (2000) for an empirical study that shows fluent speakers display local slowing in singing and local and global slowing under FSF. Also see Howell (2004) for an extended discussion of rate change and its effect on stammering. Until local measures are taken under FSF in people who stammer, it cannot be firmly concluded whether fluency changes are associated with rate change or not, since the speakers might have increased global rate but reduced local rate around the points where disfluencies would have occurred (Howell & Sackin, 2000).

In Howell, El-Yaniv and Powell's (1987) fourth experiment, the effects of presenting FSF just at sound onset (where speakers who stammer have most problems) were compared with those in continuous FSF speech. The effects on fluency did not differ significantly between the two conditions, suggesting that just having FSF at sound onset was as effective as having it on throughout the utterance. This shows that it may be possible to get as much enhancement in fluency when alteration is made just to selected areas in an utterance compared with when alteration is made to the whole utterance. This effect is akin, in some ways, to targeting sections where rate is too high in the Hector aid.

These initial studies suggested that FSF increases fluency and has few secondary effects on speech control (it has little effect on speech rate). Subsequent studies have shown that FSF also has little effect on voice level (it produces a small Fletcher effect rather than a Lombard effect) (Howell, 1990). There is incomplete compensation for shifts in frequency of voice pitch in fluent speakers (Burnett, Senner & Larson, 1997), for upward shifts in speakers who stammer (Natke et al., 2001) and no compensation at all for downward shifts in people who stammer (Natke et al., 2001). Kalinowski's group claims the paucity of secondary effects makes FSF acoustically 'invisible' (and they maintain the same applies to short-duration DAF). They also claim that the minimal changes in speech control under these two forms of ARAI lead speakers to produce fluent, or near fluent, speech (Kalinowski & Dayalu, 2002).

Kalinowski's group has investigated how FSF operates in more natural situations such as over the telephone (Zimmerman, Kalinowski, Stuart, & Rastatter, 1997), or when speakers have to speak in front of audiences (Armson, Foote, Witt, Kalinowski, & Stuart, 1997). They reported that, in both these situations, there are marked improvements in fluency and, therefore, that these procedures may operate in natural environments.

The most recent achievement of the Kalinowski group has been the development of the SpeechEasy™ device which can be worn in the ear and used away from the clinic. This freedom will change the role of the therapist. A move towards delivering therapy outside the clinic has also been taken by those working on the Lidcombe operant therapy (Onslow et al., 1994). It should be noted, however, that application of the Lidcombe program outside the clinic is carefully regulated, the team giving strict guidelines as to what can be done and strictly monitoring that these guidelines are being adhered to.

While Kalinowski and colleagues have stressed how close short delay DAF is to fluent speech, others have noted that even short delays have effects on speech output. For instance, Kalveram and his colleagues at Dusseldorf have established that DAF with short delays, comparable to those used in the SpeechEasy™ device, has effects on the duration of stressed vowels. They report that stressed vowels are prolonged by between 10 and 40% (depending on speech rate and delay) (Kalveram, 2001; Kalveram & Jaencke, 1989).

ARAI produced by the Speech Easy™ device. Given the rapid introduction and growth in popularity of the Speech Easy™ device, it seems appropriate to take a critical look at the alterations such devices make, and in particular to examine the impact they may have on speech control if they are

used in the long term. First, devices that use FFT methods to produce the frequency shift will introduce a timing delay, and this delay may have deleterious effects on speech control, as mentioned above (Novak, 1978). In a technical description of the SpeechEasy™ device (Stuart, Xia, Jiang, Jiang, Kalinowski, & Rastatter, 2003), no details of the temporal delay associated with FSF were given though, based on Howell and Sackin's (2002) observations, these delays may not be negligible. If there are significant delays in the device that carry over into speech when the device is not used, it ought to be redesigned to minimize delay using a speed changing method (such as that used in Howell et al.'s, 1987, original work).

Second, the compression of the speech spectrum by the SpeechEasy™ device, destroys some of the spectral structure when speech is shifted down (Stuart et al., 2003). This would lead to a down-shifted version to be more like noise than the ordinary voice (and possibly an upward-shifted version). This could induce a Lombard effect (increased voice level).

Third, shifting the spectrum shifts the speech formants that carry information about the speech sound spoken. Houde and Jordan (1998) report that long-term exposure to spectrally-shifted speech results in the speaker making compensatory changes so that the speech heard has formants closer to those the speaker intended to produce. The SpeechEasy™ device could also result in vowel quality changes if used in the long term.

The fourth point that should be mentioned is based on the claim of some workers who have disputed whether all speakers have a consistent response to FSF (Ingham, Moglia, Frank, Costello-Ingham & Cordes, 1997). Ingham and colleagues ran two experiments, only the first of which is relevant to the consistency claim. In this study, they tested four subjects under FSF and claimed the effects were not consistent over all their subjects. Though this might raise reservations about general use of FSF there are some procedural details that undermine their statement about the consistency of the FSF effect. Their subject E.S., for instance, reported that "he could speak more easily during the FSF conditions", but Ingham et al. (1997) did not include him in their second study because they were not able to detect this improvement. The procedure they used was a time-interval procedure on 5-sec long intervals. Virtually all 36 of E.S.'s 5-sec intervals were judged stammered presumably because he had a severe problem), resulting in a ceiling effect with and without FSF (all 36 intervals judged stammered). However, if they had used a shorter interval they would have avoided the ceiling effect and the analysis would probably have resulted in detection of the improvement E.S. reported under FSF (see Howell, Staveley, Sackin, & Rustin, 1998, for further discussion of these and other problems associated with time interval techniques). In fact there are indications with regards to the Ingham et al. paper (from personal reports of their participants and by inspection of the data obtained) that the speech of all four of their speakers improved under FSF. The details of this study do not support the authors' views about whether the effects of FSF are consistent over speakers.

Besides these effects with the frequency shifts created by the SpeechEasy™ device, there are also reasons for supposing that short-delay DAF would affect speech. For instance, the work of Kalveram's group (discussed above) suggests that stressed vowels are lengthened under short-delay DAF.

Theoretical accounts of DAF and FSF. In this section, two contrasting accounts of why short-delay DAF and FSF produce marked improvement in the fluency of people who stammer and fluent speakers are considered. Coverage of theories is not, then, comprehensive and, as indicated under 'structure of the review', weighted towards the author's EXPLAN theory. The two theories were selected because they propose that these alterations affect different locations in the central nervous system (CNS). Kalinowski's group maintains that these forms of ARAI operate at high levels in the CNS in speakers who stammer. Howell's group suggest that ARAI operates on low level (probably cerebellar) timekeeping processes in all speakers.

Points made by Kalinowski and co-workers in support of their theory are:

1) DAF at short delays and FSF allows speakers who stammer to produce fluent speech (Kalinowski & Dayalu, 2002). Prolonged speech methods, that also improve fluency (Costello-Ingham, 1993) lead to speech that is not fluent.
2) ARAI works because it presents a second speech signal via perception (Kalinowski & Dayalu, 2002). This second signal creates a situation that is analogous in some ways to choral speech (that is also known to elicit fluent speech). In support of the view that choral speech is fluent, studies have shown that brain image patterns of people who stammer under choral speaking conditions are almost indistinguishable from fluent speakers' patterns.
3) The central mechanism that is affected by ARAI is one that links production with perception (the mirror neuron system, Kalinowski & Saltuklaroglu, 2003). Mirror neurons discharge when an action is either performed or is observed (i.e. motor and sensory properties coexist in the same neuron). Mirror neurons could affect fluency, as they are found in Broca's speech motor area (Nishitani & Hari, 2000).

4) The mirror neuron system is, according to Kalinowski, important in early development (children's imitations). It appears to be used less as speakers get older. However, the second signal under ARAI activates the mirror neuron system. This assists production and allows fluency to be regained in speakers who stammer.
5) The changes in fluency in people who stammer occur passively when ARAI is presented (Saltuklaroglu, Dayalu & Kalinowski, 2002) and these passive changes occur because the central mirror neuron system is affected directly. This contrasts with the changes that arise with techniques like prolonged speech that requires the speaker to make an active change. Such active changes can eventually affect the same system that passive changes influence. This could account for cases where speakers who stammer are successfully treated by techniques like prolonged speech.

Several observations are now made about points 1) – 5):

1) The hypothesis that speech under ARAI produces fluent speech predicts that there will be no differences between fluent material and ARAI material. Statistically speaking, this is a situation where the null hypothesis is predicted which is against a fundamental principle of statistics. The work of Kalinowski's group actually establishes that ARAI leads to high levels of stutter-free speech that, it is claimed, sounds natural. Even though ARAI speech is closer to the speech produced by fluent speakers than the end-product of prolonged speech regimes, it still may not be fluent as the studies in the previous section indicate. Also, methods of measuring various aspects of voice control are constantly being improved and these improved measures may reveal important, yet subtle, effects on fluency. For example Kalveram and colleagues duration measurements of stressed vowels has found effects of short-delay DAF. There are reasons for supposing that speakers may change the position of the articulators when FSF is delivered (Houde & Jordan, 1998). It can be inferred from Houde and Jordan's (1998) study that such changes in articulator position are subtle and would not be easily detectable by perceptual assessment alone. An appropriate technique for establishing whether these occur would be formant frequency analysis and no such studies have been reported to date on stammered speech after exposure to FSF. Generally speaking, these two examples illustrate that there are grounds for considering that differences in fluency between ARAI and fluent speech that are hard to detect using simple measures may be detectable when improved techniques are employed.
2) There are 'second signals' (to use Kalinowski's term) that affect the fluency of people who stammer that are not speech. One example, discussed above, is Howell and El-Yaniv's metronome signal where a click is triggered by the speaker's speech (not at a pre-set pace). It is hard to imagine how this signal could be used by the mirror neuron system as it bears no relation at all to speech, yet it improves the fluency of people who stammer.
3) The Howell and Archer (1984) study on fluent speakers showed that the effects of ARAI arise at a lower level in the CNS than mechanisms involved in speech perception. This would show that central perceptual processes are not involved in the case of DAF, assuming Howell and Archer's (1984) result applies to people who stammer under DAF as well as to fluent speakers. Other problems for accounts that maintain that ARAI influences central levels involved in perception have been extensively discussed recently (Howell, 2002; Howell, in press).
4) To work, the mirror neuron system has to have some input from perception to reflect into production at the time the speech is being produced. However, as indicated earlier, commercially available ARAI techniques that improve the fluency of people who stammer produce perceptual information after production. Thus, there is an inherent delay between production of a sound and when the altered sound is received with DAF; the Edinburgh masker has a lag too and there are grounds for supposing that this also applies to the SpeechEasy™ device. It is, of course, possible to modify the mirror neuron concept. For instance, the mirror neurons could be made more flexible both in terms of, a) how closely timed speech events and the perceptual events they give rise to need to be, and b) how similar the perceptual events need to be relative to the linguistic events they reflect. Though it is appropriate to postulate such flexibility, neurological data would be needed to support such temporal and linguistic flexibility before they are taken as fact. Finally, endowing mirror neurons with too much flexibility seems inadvisable. There needs to be some delimitation of the range of what perceptual events trigger activity in these neurons otherwise they lose their selectivity in linking actions with the perceptual events that gave rise to them.
5) ARAI is supposed to affect the mirror neuron system directly. Techniques that train speakers to relearn motor patterns, operate at the motor level initially and, only when the patterns have been established, can they be transmitted to the mirror neuron system. Kalinowski's group proposes, these techniques then affect this system in a similar way to ARAI. Therefore, ARAI and learning techniques operate initially on different mechanisms (ARAI affects speech "passively", by-passing

the peripheral level). An implication of this position is that there is no single factor that explains both how ARAI and motor processes affect fluency (underlined by their dismissal of Costello-Ingham's, 1993, proposal that rate underlies ARAI and prolonged speech procedures). Consistent with the Kalinowski group's view, there do seem to be grounds for considering that the time courses of ARAI and operant procedures differ (e.g. the Lidcombe program). ARAI affects fluency 1) in the short term, and 2) these effects are restricted mainly to the periods during which ARAI is presented. In contrast, the Lidcombe program 1) does not have dramatic effects short term, but 2) the effects on fluency are reported to be maintained for longer (and in some cases result in fluency being permanently regained). However, though the different timecourses of the effects would be consistent with the two procedures affecting different CNS locations, the proposal that ARAI (just central) works in a different way to operant procedures (peripheral and central) is not parsimonious.

Howell and co-workers' EXPLAN model has been reviewed extensively in recent publications (Howell, 2002, 2004; Howell & Au-Yeung, 2002). It is a general model of spontaneous speech control that attempts to explain: 1) developmental changes in patterns of stammering, and 2) how stammering relates to fluent speech, as well as 3) the effects of ARAI. Detailed review of the first two topics is beyond the scope of this article, but some background information is necessary. The basic idea behind the EXPLAN model is that cognitive-linguistic planning (PLAN) processes are independent of motor execution (EX) processes. The role of the planning processes is to supply a plan for an utterance when the motor execution processes have finished producing the previous utterance. Disfluencies arise when the plan is not ready at this time. In a phrase like "I split it", the comparatively complex word "split" is likely to be the one that is not ready in time for execution. If this is the case speakers may do one of two things: First, they may repeat or hesitate on the prior word (producing, for example, "I, I, split it"). Howell (2004) refers to these events as stalling disfluencies. Second, since plans are assumed to be generated left to right, speakers can commence "split" using the plan for the first part of the word which is available. Planning continues while this first part is being uttered, as this process is independent of execution. The remainder of the plan may be generated in the time taken to execute the first part. However, the plan can run out and result in disfluencies involving just the first part of the word (e.g. "sssplit","s.s.split"). Howell (2004) refers to these as advancing stutterings. The latter are characteristic features of adult stammered speech in a variety of languages (Au-Yeung, Vallejo Gomez & Howell, 2003; Dworzynski, Howell, Au-Yeung & Rommel, in press; Howell, Au-Yeung & Sackin, 1999).

This account implies that the adult pattern of stammering is a result of attempting to produce speech locally at too fast a rate. EXPLAN proposes that this pattern can be avoided in two ways. First, speakers can change speech execution rate using a timekeeper that changes execution rate directly (Howell, 2002). Second, speakers can change the way the chaining process between planning and execution operates without involving the timekeeper (Howell, 2004). Stallings and advancings are different ways of changing the operation of the chaining between planning and execution processes when the plan for the following word is not ready. Stalling repeats a plan (uses a pre-existing plan) or interrupts speech to gain more time and does not involve the problem word at all. This option is frequently used by fluent speakers (Howell, Au-Yeung & Sackin, 1999), so it does not have deleterious effects on long-term fluency. Advancing gambles that execution time is long enough to generate the remainder of the plan. Advancing is problematic as it can fail (as indicated by the fact that it can lead to disfluencies on part of a word). Though the mechanisms involved differ, both execution rate and one of the two ways of changing the chaining between planning and execution are, generically speaking, ways of changing speech rate.

EXPLAN contrasts with Kalinowski's account on all five of the points outlined above. The contrasts, and data that support the EXPLAN view, are as follows:

1) ARAI produces fluent speech by affecting a timekeeping process that controls execution rate directly. Other ways of affecting timing (whether using the timekeeping mechanism or not) improve fluency by gaining extra planning time for 'problem' words. According to this principle, learning procedures control rate in the planning-execution chain. These procedures alert speakers to situations where they are adopting a maladaptive way of dealing with speech when its plan is not complete. The different mechanisms and mode of achieving rate control involved with operant procedures could explain why they take longer to affect fluency than ARAI. Though operant procedures take longer, the way they achieve fluency is the same as in ARAI.
2) ARAI does not so much produce a "second signal" that is speech, as introduce a second rhythmic signal. This second rhythmic signal affects speech control (particularly when it is slightly out of

synchrony), by changing operation of the timekeeper. See Howell and Sackin (2002) for evidence that supports the view that DAF affects a timekeeping process in the cerebellum.

3) ARAI is not effective because it affects a central process that links speech perception and production. Many ARAI manipulations that affect fluency of people who stammer are not speech sounds. Examples include Howell and Archer's (1984) noise stimulus, Howell and El-Yaniv's (1987) metronome signal positioned at syllable onset, and even a flashing light (Kuniszyk-Jozkowiak, Smolka & Adamczyk, 1996).
4) Synchronous and delayed asynchronous signals all affect operation of the timekeeper (Howell & Sackin, 2002). A speech signal is not needed in advance to prime production (Howell & Archer, 1984). The EXPLAN process does not fail because perceptual information is not available prior to, or even during, production (as required by the mirror-neuron system).
5) Rate control takes place (albeit in different ways) for ARAI and motor-learning procedures (see Howell, 2004, for a detailed description of how the two interrelate). Possibilities are opened up (see the next section), given that these two procedures have the common basis of gaining planning time.

Table 1. Comparison of Kalinowski and Howell's model's with respect to the level (left-hand column) where different fluency-enhanciong effects operate (body of the table).

Level	Kalinowski	EXPLAN
Linguistic	AAF	
Linguistic- motor		Operant
Motor	Motor learning e.g operant procedures	ARAI

The theory of Kalinowski's group and EXPLAN were selected as contrasting views about what level of speech control is affected by ARAI. Other theories in the area either do not include accounts of the fluency-enhancing effects of FSF (Neilson & Neilson, 1991) or maintain that there are influences at both peripheral and central areas of the central nervous system (Kalveram, 2001; Kalveram & Jaencke, 1989). Both these have similarities and differences with respect to EXPLAN. The similarities in Kalveram's model, for example, concern the planning phase for serialisation of speech units (words, syllables, phonemes) that must be prepared in advance of motor execution. A dissimilarity concerns whether speakers use acoustic-phonetic information in the control of speaking (Dusseldorf group), or whether the control system crashes until timing recovers if planning and execution do not match (EXPLAN).

8. Summary and future possibilities

The fluency-enhancing effects of ARAI are indisputable. Short delay DAF and synchronous alterations (FSF) produce speech that sounds very nearly fluent. Devices like SpeechEasy™ have obvious attractions to a person who stammers because they produce at least temporary fluency. The main question to be addressed here is whether the aid ought to be used continuously or intermittently (grounds are given for supposing that intermittent presentation might promote carry-over of fluent patterns). Before that question is addressed, it should be noted in passing that even if the device only works while speech is altered continuously (i.e. there is no carry-over of the fluency-enhancing effects), it would still be useful (over the phone, with an audience or in other situations the owner chose to use it).

My group's theoretical perspective (EXPLAN) suggests that rate control lies behind the effectiveness of these devices. However, dramatic slowing (as with prolonged speech techniques) is unnecessary; slowing only needs to occur in the local vicinity of a difficult word. Also, having ARAI on all the time might not promote transfer of the fluent behavior induced. As stammering occurs intermittently throughout speech, 'rate' (understood in the general sense used earlier) only needs to be altered in the vicinity of these episodes. This suggests that ARAI ought to be targeted only on or around problematic sounds. Targeting particular episodes in a similar way is a feature of operant treatment procedures.

Looked at from the point of view of continuous delivery of ARAI sounds, it does not appear to be sensible to present these alterations on episodes within a stammerer's speech which are fluent, for several reasons. Transfer would not be promoted. It is not certain that FSF and short-delay DAF produce absolutely fluent speech, and these residual nonfluent behaviors could be transferred to post-

treatment speech (Novak, 1978). There may be long-term effects of FSF (Houde & Jordan, 1998) not evident in the current short-term studies that impact on long-term fluency. Any procedure that restricts exposure to ARAI while at the same time maintaining high rates of fluency may be advantageous (see the above discussion of the Hector aid and Howell et al., 1987, experiment 4).

Targeting disfluencies for a dose of ARAI also opens up possibilities that allow effects (known in the animal operant literature) that should produce maintenance of fluent behaviors, to be exploited. A partial reinforcement schedule retains response behaviors for longer than responses that are continuously reinforced. If techniques were available that allowed regions that contain disfluent episodes to be targeted for ARAI, schedules of reinforcement could be manipulated to see whether this applies to part-presentation of ARAI. Though ARAI and operant procedures have been used jointly in treatments, to date there has been no study that administers ARAI on a partial reinforcement schedule. One reason for this may be that training under partial reinforcement protocols takes a long time. Nevertheless, until such studies have been completed, the possibility that ARAI could lead to long-term recovery cannot be ruled out. One possible way that alterations could be targeted on regions that are disfluent (or are at high risk of being so) would be to use speech rate as in the pioneering work on the Hector aid.

References

Albright, M. A. H., & Malone, J. Y. (1942). The relationship of hearing acuity to stammering. *Exceptional Children*, *8*, 186-190.

Armson, J., Foote, S., Witt, C., Kalinowski, J., & Stuart, A. (1997). Effect of frequency altered feedback and audience size on stuttering. *European Journal of Disorders of Communication*, *32*, 359-366.

Au-Yeung, J., Vallejo Gomez, I., & Howell, P. (2003). Exchange of disfluency from function words to content words with age in Spanish speakers who stutter. *Journal of Speech, Language and Hearing Research*, *46*, 754-765.

Backus, O. (1939). Incidence of stuttering among the deaf. *Annals of Otology, Rhinology and Laryngology*, *47*, 632-635.

Black. J. W. (1951). The effect of delayed sidetone upon vocal rate and intensity. *Journal of Speech and Hearing Disorders*, *16*, 56-60.

Borden, G. J. (1979). An interpretation of research on feedback interruption in speech. *Brain & Language*, *7*, 307-319.

Brown, G. S., & Campbell, D. P. (1948). *Principles of servomechanisms*. New York: Wiley.

Burnett, T. A., Senner, J.E., & Larson, C. R. (1997). Voice F0 responses to pitch-shifted auditory feedback: A preliminary study. *Journal of Voice*, *11*, 202-211.

CCITT (1989a). Interactions between sidetone and echo. CCITT – International Telegraph and Telephone Consultative Committee, Contribution, com XII, no BB.

CCITT (1989b). Experiments on short-term delay and echo in conversation. CCITT – International Telegraph and Telephone Consultative Committee, Contribution, com XII, no AA.

Chase, R. A., Sutton, S., & Rapin, I. (1961). Sensory feedback influences on motor performance. *Journal of Auditory Research*, *1*, 212-223.

Cherry, C., & Sayers, B. (1956). Experiments upon the total inhibition of stammering by external control and some clinical results. *Journal of Psychosomatic Research*, *1*, 233-246.

Costello-Ingham, J. C. (1993). Current status of stuttering and behavior modification – 1. Recent trends in the application of behavior application in children and adults. *Journal of Fluency Disorders*, *18*, 27-44.

Curlee, R. F., & Perkins, W. H. (1969). Conversational rate control for stuttering. *Journal of Speech and Hearing Disorders*, *34*, 245-250.

Dewar, A., Dewar, A. W., Austin, W. T. S., & Brash, H. M. (1979). The long-term use of an automatically triggered auditory feedback masking device in the treatment of stammering. *British Journal of Disorders of Communication*, *14,* 219-229.

Donath, T. M., Natke, U., & Kalveram, K. T. (2002). Effects of frequency-shifted auditory feedback in voice F_0 contours in syllables. *Journal of the Acoustical Society of America*, *111*, 357-366.

Dworzynski, K., Howell, P., Au-Yeung, J., & Rommel, D. (in press). Stuttering on function and content words across age groups of German speakers who stutter. *Journal of Multilingual Communication Disorders*.

Fairbanks, G. (1955). Selected vocal effects of delayed auditory feedback. *Journal of Speech and Hearing Disorders*, *20*, 333-345.

Fletcher, H., Raff, G. M., & Parmley, F. (1918). Study of the effects of different sidetones in the telephone set. Western Electrical Company, Report no. 19412, Case no. 120622.

Goldiamond, I. (1965). Stuttering and fluency as manipulatable operant response classes. In L. Krasner & L. Ullman (Eds.), *Research in behavior modificaton*. Pp106-156. New York: Holt, Rhinehart and Winston.

Guenther, F. (2001). Neural modeling of speech production. In B. Maassen, W. Hulstijn, R. Kent, H. F. M. Peters & P.H. M. M. van Lieshout (Eds.). *Speech motor control in normal and disordered speech*. Pp 12-15. Nijmegen: Uttgeverij Vantilt.

Ham, R., & Steer, M. D. (1967). Certain effects of alterations in auditory feedback. *Folia Phoniatrica*, *19*, 53-62.

Hargrave, S., Kalinowski, J., Stuart, A., Armson, J., & Jones, K. (1994). Effect of frequency-altered feedback on stuttering frequency at normal and fast speech rates. *Journal of Speech and Hearing Research*, *37*, 1313-1319.

Houde, J., & Jordan, M. I. (1998). Adaptation in speech production. *Science, 279*, 1213-1216.

Howell, P. (1990). Changes in voice level caused by several forms of altered feedback in normal speakers and stutterers. *Language and Speech*, *33*, 325-338.

Howell, P. (2002). The EXPLAN theory of fluency control applied to the treatment of stuttering by altered feedback and operant procedures. In E. Fave (Ed.). *Pathology and therapy of speech disorders*. Amsterdam: John Benjamins.

Howell, P. (2004). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communicative Sciences and Disorders, 39*, 122-139.

Howell, P., & Archer, A. (1984). Susceptibility to the effects of delayed auditory feedback. *Perception & Psychophysics*, *36*, 296-302.

Howell, P., & Au-Yeung, J. (2002). The EXPLAN theory of fluency control and the diagnosis of stuttering. In E. Fava (Ed.), *Current Issues in Linguistic Theory series: Pathology and therapy of speech disorders* (pp.75-94). Amsterdam: John Benjamins.

Howell, P., Au-Yeung, J., & Pilgrim, L. (1999). Utterance rate and linguistic properties as determinants of speech dysfluency in children who stutter. *Journal of the Acoustical Society of America, 105*, 481-490.

Howell, P., Au-Yeung, J., & Sackin, S. (1999). Exchange of stuttering from function words to content words with age. *Journal of Speech, Language and Hearing Research*, *42*, 345-354.

Howell, P., & El-Yaniv, N. (1987). The effects of presenting a click in syllable-initial position on the speech of stutterers: Comparison with a metronome click. *Journal of Fluency Disorders*, *12*, 249-256.

Howell, P., El-Yaniv, N., & Powell, D.J. (1987). Factors affecting fluency in stutterers when speaking under altered auditory feedback. In H. Peters and W. Hulstijn (Eds.), *Speech Motor Dynamics in Stuttering*, 361-369. New York: Springer Press.

Howell, P., Marchbanks, R.J., & El-Yaniv, N. (1986). Middle ear muscle activity during vocalisation in normal speakers and stutterers. *Acta Oto-Laryngologica*, *102*, 396-402.

Howell, P., & Powell, D. J. (1984). Hearing your voice through bone and air: Implications for explanations of stuttering behaviour from studies of normal speakers. *Journal of Fluenc Disorders*, *9*, 247-264.

Howell, P., Powell, D.J., & Khan, I. (1983). Amplitude contour of the delayed signal and interference in delayed auditory feedback tasks. *Journal of Experimental Psychology: Human Perception and Performance*, *9*, 772-784.

Howell, P., & Sackin, S. (2000). Speech rate manipulation and its effects on fluency reversal in children who stutter. *Journal of Developmental and Physical Disabilities*, *12*, 291-315.

Howell, P., & Sackin, S. (2002). Timing interference to speech in altered listening conditions. *Journal of the Acoustical Society of America*, *111*, 2842-2852.

Howell, P., Staveley, A., Sackin, S., & Rustin, L. (1998). Methods of interval selection, presence of noise and their effects on detectability of repetitions and prolongations. *Journal of the Acoustical Society of America*, *104*, 3558-3567.

Howell, P., Wingfield, T., & Johnson, M. (1988). Characteristics of the speech of stutterers during normal and altered auditory feedback. In W. A. Ainsworth and J. N. Holmes (Eds.). *Proceedings Speech 88*, Vol. 3, (7th Federation of Acoustical Societies of Europe conference, Edinburgh 1988), 1069-1076. Edinburgh: Institute of Acoustics.

Ingham, R. J., Fox, P. T., & Ingham, J. C. (1997). An $H_2{}^{15}O$ positon emission tomography (PET) study on adults who stutter. In W. Hulstijn, H. F. M. Peters and P. H. H. M. van Lieshout (Eds.). *Speech Production: Motor Control, Brain Research and Fluency Disorders* (pp. 293-305). Amsterdam: Elsevier.

Ingham, R. J., Moglia, R. A., Frank, P., Costello-Ingham, J., & Cordes, A, (1997). Experimental investigation of the effects of frequency-altered feedback on the speech of adults who stutter. *Journal of Speech, Language and Hearing Research*, *40*, 361-372.

Kalinowski, J., Armson, J., Roland-Mieszkowski, M., Stuart, A., & Gracco, V. (1993). Effects of alterations in auditory feedback and speech rate on stuttering frequency. *Language and Speech, 36*, 1-16.

Kalinowski, J., & Dayalu, V. (2002). A common element in the immediate inducement of effortless, natural-sounding, fluent speech in stutterers: "The Second Speech Signal". *Medical Hypotheses*, *58*, 61-66.

Kalinowski, J. & Saltuklaroglu, T. (2003). Speaking with a mirror: Engagement of mirror neurons via choral speech and its derivatives induces stuttering inhibition. *Medical Hypotheses*, *60*, 538-543

Kalinowski, J., Stuart, A., Sark, S., & Armson, J. (1996). Stuttering amelioration at various auditory feedback delays and speech rates. *European Journal of Disorders of Communication*, *31*, 259-269.

Kalveram, K. Th. (2001). Neurobiology of speaking and stuttering. In H. G. Bosshardt, J. S. Yaruss & H. F. M. Peters (Eds.), *Fluency Disorders: Theory, Research, Treatment and Self-help. Proceedings of the Third World Congress of Fluency Disorders*. Pp. 59-65. Nijmegen, Nijmegen University Press.

Kalveram, K.Th. & Jaencke, L.(1989). Vowel duration and voice onset time for stressed and nonstressed syllables in stutterers under delayed auditory feedback condition. *Folia Phoniatrica*, *41*, 30-42.

Kawato, M., Furakawa, K., & Suzuki, R. (1987). A hierarchical neural-network model for control and learning of voluntary movement. *Biological Cybernetics*, *57*, 169-185.

Kern, S. H. (1932). Der einfluss des horens auf das stottern. *Archiv Psychiatrischer Nervenkrankheiten*, *97*, 428-450.

Kuniszyk-Jozkowiak, W., Smolka, E., & Adamczyk, B. (1996). Effect of acoustical, visual and tactile reverberation on speech fluency of stutterers. *Folia Phoniatrica & Logopedics*, *48*, 193-200.

Lane, H. L., & Tranel, B. (1971). The Lombard sign and the role of hearing in speech. *Journal of Speech and Hearing Research*, *14,* 677-709.

Lee, B. S. (1950). Effects of delayed speech feedback. *Journal of the Acoustical Society of America*, *22*, 824-826.

Lee, B. S. (1951). Artificial stutter. *Journal of Speech and Hearing Disorders*, *15*, 53-55.

Lombard, E. (1911). Le signe de l'elevation de la voix. *Annales des Maladies de l'Oreille, du Larynx, du Nez et du Pharynx*, *37*, 101-119.

Lotzmann, G. (1961). Zur Anwedung variierter verzogerungszeiten bei balbuties. *Folia Phoniatrica & Logopedics*, *13*, 276-312.

Macleod, J., Kalinowski, J., Stuart, A., & Armson, J. (1995). Effect of single and combined altered auditory feedback on stuttering frequency at two speech rates. *Journal of Communication Disorders*, *28*, 217-228.

Natke, U., Grosser, J., & Kalveram, K.T. (2001). Fluency, fundamental frequency, and speech rate under frequency shifted auditory feedback in stuttering and nonstuttering persons. *Journal of Fluency Disorders*, *26*, 227-241.

Neelley, J. N. (1961) A study of the speech behaviors of stutterers and nonstutterers under normal and delayed auditory feedback. *Journal of Speech and Hearing Disorders Monograph*, *7*, 63-82.

Neilson, M. D., & Neilson, P. D. (1991). Adaptive model theory of speech motor control and stuttering. In H. F. M. Peters, W. Hulstijn & C. W. Starkweather (Eds.), *Speech motor control and stuttering*. Pp. 149-156. Amsterdam: Excerpta Medica.

Nessel, E. (1958). Die verzogerte Sprachruckkopplung (Lee Effect) bei Stotteren. *Folia Phoniatrica*, *10*, 199-204.

Nishitani, N., & Hari, R. (2000). Temporal dynamics of cortical representation for action. *Proceedings on the National Academy of Sciences of the United States of America*, *97*, 913-918.

Novak, A. (1978). The influence of delayed auditory feedback in stutterers. *Folia Phoniatrica*, *30*, 278 -285.

Onslow, M., Andrews, C., & Lincoln, M. (1994). A control/experimental trial of operant treatment for early stuttering. *Journal of Speech and Hearing Research*, *37*, 1244-1259.

Ryan, B. (1974). *Programmed stuttering therapy for children and adults*. Springfield: C. C. Thomas.

Ryan, B. (2001). *Programmed stuttering therapy for children and adults*. (2nd ed.). Springfield: C. C. Thomas.

Saltuklaroglu, T., Dayalu, V. N., & Kalinowski, J. (2002). Reduction of stuttering: The dual inhibition hypothesis. *Medical Hypotheses*, *58*, 67-71.

Shearer, W. M. (1966). Speech behavior of middle ear muscles during stuttering. *Science*, *152*, 1280.

Stuart, A., Xia, S., Jiang, Y., Jiang, T., Kalinowski, J., & Rastatter, M.P. (2003). Self-contained in-the-ear device to deliver altered auditory feedback: Applications for stuttering. *Annals of Biomedical Engineering*, *31*, 233-7.

Soderberg. G. A. (1960). A study of the effects of delayed side-tone on four aspects of stutterers' speech during oral reading and spontaneous speech. *Speech Monographs*, *27*, 252-253.

Sutton, S., & Chase, R. A. (1961). White noise and stuttering. *Journal of Speech and Hearing Research*, *4*, 72.

Teig, E. (1973). Differential effect of graded contraction of middle ear muscles on the sound transmission of the ear. *Acta Physiological Scandinavica*, *88*, 387-391.

Webster, R. L., & Lubker, B. (1968a). Masking of auditory feedback in stutterers' speech. *Journal of Speech and Hearing Research, 11*, 221-222.

Webster, R. L., & Lubker, B. (1968b). Interrelationships among fluency-producing variables in stuttered speech. *Journal of Speech and Hearing Research*, *11*, 754-766.

Wingate, M. (2002). Foundations of stuttering. New York: Academic Press.

Zimmerman, S., Kalinowski, J., Stuart, A., & Rastatter, M. P. (1997). Effect of altered auditory feedback on people who stutter during scripted telephone conversations. *Journal of Speech, Language, and Hearing Research*, *40*, 1130-1134.

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Editor's comment on the structure of the commentaries and responses to Howell (2004) target article

Dr Stephen Davis had editorial responsibility for this article as it was written by the Editor of *Stammering Research*. Nine commentaries on the Howell (2004) target article were accepted for publication after peer review. These were received from authors who fall into three groups: 1) Researchers involved in developing accounts as to why alterations to the speaking environment improve the speech control of speakers who stammer (papers by Neuman and Euler, Pfordresher, Davis, Reed and Lowit and Brendel); 2) Practitioners interested in the best way of delivering such alterations for maximum clinical effectiveness (Ryan, Skotko, and Bartles and Ramig); 3) A contribution from a speaker who stammers (Miller). The commentaries are organized in two sections (research commentaries and clinical notes and comments) followed by Professor Howell's responses.

References

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

RESEARCH COMMENTARIES

Are alerts sufficient to smooth speech?

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Abstract. Howell (2004) raises the question whether alterations of recurrent auditory information (ARAI) operate at a high or a low central nervous system level to achieve fluency enhancing effects in persons who stutter. Recent neuroimaging findings on stuttering treatment effects support both assumptions. FMRI-findings from non-stuttering people during delayed auditory feedback (DAF) indicate an effect of delay, rather than of speech rate, on cerebral activation. A continuous external rhythm is not necessarily required to smooth speech, but just an alert at the critical utterance.
Keywords: Persistent developmental stuttering, altered auditory feedback, delayed auditory feedback, fMRI, fluency shaping therapy.

1. Comments on Howell (2004a)

Recent neuroimaging and structural findings may be pertinent for the different hypotheses the author of the target article (Howell, 2004a) posted about the level of speech control in the central nervous system (CNS) which is affected by ARAI or chronology-restoring mechanisms. Our fMRI data, as well as those from other laboratories, indicate that different CNS levels, a higher one (Kalinowski & Saltuklaroglu, 2003) as well as a lower one, for instance cerebellar level (Howell, 2002; Howell, 2004b: Howell & Au-Yeung, 2002), could be involved in timekeeping processes which improve the speech fluency of stuttering subjects.

Higher CNS structures, in particular those of the premotor, auditory, and speech motor systems, appear to be involved in a sequencing disturbance of speech production in stuttering subjects, but also in a spontaneous compensation and in synchronising therapy effects after fluency shaping therapies. In particular, recent neuroimaging studies showed (1) a failure of temporal lobe activation during speech (Ingham, 2001), (2) a reversed speech processing sequence with an initiation of the articulatory routines preceding activation of the phonological output codes (Salmelin, Schnitzler, Schmitz, & Freund, 2000), and (3) a white matter disconnection of the left precentral cortex (premotor) with temporal and frontal language areas (motor) (Sommer, Koch, Paulus, Weiller, & Büchel, 2002). Accordingly, right-hemisphere overactivations could reflect compensation. In an fMRI study with 16 male adult stuttering and 16 non-stuttering subjects we detected an overactivation of the right frontal operculum (RFO) during a speech motor task in all stuttering, and in no non-stuttering, subjects (Preibisch et al., 2003). As responses in the RFO were correlated *negatively* with the severity of stuttering, also in a linguistic task, we hypothesised that the overactivation in the RFO reflected a compensation process. Because the RFO is the right homologue of Broca's area it seems plausible that it compensates for a deficient signal transmission between Broca's area and left-sided articulatory motor representations (Sommer et al., 2002), or for a dysfunctional Broca's area itself, by an automatic take-over of disturbed functions. The compensation mechanism can be active already during early steps of speech processing, and can correct the reversed processing sequence between articulatory programming and motor preparation described by Salmelin et al. (2002).

After a successful fluency shaping therapy, which introduces an external timekeeping mechanism to the speech system, this right-hemispheric compensation network seems to be replaced by a neuronal network which works more effectively and is more left-sided. After therapy we detected more widespread brain activations than before, with a shift to the left hemisphere (Neumann et al., 2003). A bilateral temporal activation seen after but not before therapy concurs with reports that fluency-inducing manoeuvres increase temporal activations (Fox et al., 1996) and strengthens the assumption that temporal regions are part of a cortical and subcortical fluency-generating system. Especially interesting are our post-treatment findings of overactivations around left sensorimotor cortex regions where Sommer et al. (2002) detected disturbed white matter connections. The alteration of the

activation profile in both speech motor and auditory cortical regions, together with an improved fluency after therapy, could be associated with an improved communication between Broca's area and the speech motor cortex, and should therefore correct the chronological order in the steps leading to speech production. Further electrophysiological experiments are desirable to confirm this hypothesis.

The view of the Kalinowsi group of a central working mechanism of DAF is supported by the findings of Hashimoto and Sakai (2003) who employed fMRI to compare brain activations of fluent speakers during oral reading under real-time auditory feedback at different speech rates with those elicited after DAF with a 200-ms delay. They found significant bilateral activations in the temporo-parietal system during DAF compared to the non-delayed speech conditions. Because they did not find differences among the activations at different speech rates in these regions they excluded an influence of speech rates or enhanced attention to altered speech-sound. The authors suggested that the temporo-parietal regions function as a conscious self-monitoring system to support an automatic system. Moreover, they detected a positive correlation between the delay effect on fluency and the activation of the bilateral temporal regions, which shows that the activation in these regions is a good indicator of the DAF effect.

Our fMRI data so far do not support the dual inhibition hypothesis of Saltuklaroglu, Dayalu and Kalinowski (2002), as applied to therapy effects. The dual inhibition hypothesis suggests a passive inhibition of stuttering symptoms by ARAI compared to an active inhibition by fluency shaping therapies which should become more passive when the speech pattern becomes automated. After two years of follow-up, when the speakers who stutter we examined showed a high level of naturalness in their speech and a low stuttering rate indicating a certain degree of automaticity of the newly learned speech pattern, the subjects kept widespread post-treatment overactivations, compared to the brain activations before therapy, with only a slight reduction compared to the recordings immediately after therapy (Neumann et al., 2003). Thus, there is no indication in fMRI data that an automatisation of a new speech pattern goes along with an increased passivity of the speech system.

The hypotheses of Howell (2002; 2004; 2004b) concerning involvement of subcortical CNS structures in timekeeping processes which improve fluency are supported by several neuroimaging and pharmacological findings. The dopaminergic system of the basal ganglia and the cerebellum can both be implicated in stuttering (Anderson et al., 1999; Burns et al., 1978; De Nil, Kroll, & Houle, 2001; Maguire et al., 2000). Thereby, it seems that the frequency of speech pacing could determine the region of motor control (Wildgruber et al., 2001). In our own data we assessed the relation between severity of stuttering and activity in the basal ganglia in untreated speakers who stutter (Giraud et al., 2003). After a successful fluency shaping therapy we detected an overactivation in the putamen, together with a weak cerebellar activation which we did not find before therapy (Neumann et al., in press). These findings are compatible with the hypothesis that a pacer has not necessarily to be a speech signal or a signal which has to be perceived at a higher level of the CNS. Rather, a simple trigger at the critical utterance instead of an external synchronous or asynchronous rhythm seems sufficient to make speech fluent.

References

Anderson, J. M., Hughes, J. D., Rothi, L. J., Crucian, G. P., & Heilman, K. M. J. (1999). Developmental stuttering and Parkinson's disease: The effects of levodopa treatment. *Journal of Neurology, Neurosurgery, and Psychiatry*, *66*, 776-778.

Burns, D., Brady, J. P., & Kuruvilla, K. (1978). The acute effect of haloperidol and apomorphine on the severity of stuttering. *Biological Psychiatry*, *13*, 255-264.

De Nil, L. F., Kroll, R. M., & Houle, S. (2001). Functional neuroimaging of cerebellar activation during single word reading and verb generation in stuttering and nonstuttering adults. *Neuroscience Letters, 302*, 77-80.

Fox, P. T., Ingham, R. J., Ingham, J. C., Hirsch, T. B., Downs, J. H., Martin, C., Jerabek, P., Glass, T., & Lancaster, J. L. (1996). A PET study of the neural systems of stuttering. *Nature, 382,* 158-162.

Giraud, A. L., Neumann, K., Bachoud-Levi, A. C., Wolff von Gudenberg, A., Euler, H. A., Lanfermann, H., & Preibisch, C. (2003). Severity of stuttering correlates with basal ganglia activity. Paper presented at the 9th Annual Meeting of the Organization for Human Brain Mapping, New York, June 18-22.

Hashimoto, Y., & Sakai, K. L. (2003). Brain activations during conscious self-monitoring of speech production with delayed auditory feedback: An fMRI study. *Human Brain Mapping, 20*, 22-28.

Howell, P. (2002). The EXPLAN theory of fluency control applied to the treatment of stuttering by altered feedback and operant procedures. In E. Fava (Ed.), *Pathology and therapy of speech disorders (*pp. 95-118). Amsterdam: John Benjamins.

Howell, P. (2004a). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Howell, P. (2004b). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communicative Sciences and Disorders, 39*, 122-139.

Howell, P., & Au-Yeung, J. (2002). The EXPLAN theory of fluency control and the diagnosis of stuttering. In E. Fava (Ed.), *Pathology and therapy of speech disorders* (pp. 75-94). Amsterdam: John Benjamins.

Ingham, R. J. (2001). Brain imaging studies of developmental stuttering. *Journal of Communication Disorders, 34,* 439-516.

Kalinowski, J., & Saltuklaroglu, T. (2003). Speaking with a mirror: Engagement of mirror neurons via choral speech and its derivatives induces stuttering inhibition. *Medical Hypotheses*, *60*, 538-543.

Maguire, G. A., Riley, G. D., Franklin, D. L., & Gottschalk, L. A. (2000). Risperidone for the treatment of stuttering. *Journal of Clinical Psychopharmacology, 20*, 479-482.

Neumann, K., Euler, H. A., Wolff von Gudenberg, A., Giraud, A.L, Lanfermann, H., Gall, V., & Preibisch, C. (2003). The nature and treatment of stuttering as revealed by fMRI: A within- and between-group comparison. *Journal of Fluency Disorders*, *28,* 381-410.

Neumann, K., Euler, H. A., Preibisch, C., & Wolff von Gudenberg, A. (in press). A within- and between-subject fMRI experiment before and after a fluency shaping therapy. *Proceedings of the 4th World Congress on Fluency Disorders*, Montreal, August 11-15.

Preibisch, C., Neumann, K., Raab, P., Euler, H. A., von Gudenberg, A. W., Lanfermann, H., & Giraud, A. L. (2003). Evidence for compensation for stuttering by the right frontal operculum. *NeuroImage, 20*, 1356-1364.

Salmelin, R., Schnitzler, A., Schmitz, F., & Freund, H.-J. (2000). Single word reading in developmental stutterers and fluent speakers. *Brain, 123,* 1184-1202.

Saltuklaroglu, T., Dayalu, V. N., & Kalinowski, J. (2002). Reduction of stuttering: The dual inhibition hypothesis. *Medical Hypotheses*, *58*, 67-71.

Sommer, M., Koch, M. A., Paulus, W., Weiller, C., & Büchel, C. (2002). Disconnection of speech-relevant brain areas in persistent developmental stuttering. *The Lancet, 360*, 380-383.

Wildgruber, D., Ackermann, H., & Grodd, W. (2001). Differential contributions of motor cortex, basal ganglia, and cerebellum to speech motor control: Effects of syllable repetition rate evaluated by fMRI. *NeuroImage*, *13,* 101-109.

Can altered auditory information affect planning? Evidence from music performance

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Abstract. In the EXPLAN architecture (target article), altered recurrent auditory information (ARAI) is presumed to influence the execution but not planning of speech. This conclusion stems from evidence that the influence of ARAI is limited to timing relationships between perception and action. However, recent evidence documents disruption of musical keyboard performance from certain manipulations of perceived pitches, even when sounds are synchronized with key presses. These results lead to a proposed extension of EXPLAN.
Keywords: EXPLAN, altered recurrent auditory information, delayed auditory feedback, frequency shifted feedback, EXPLAN.

1. Comments on Howell (2004a)

The EXPLAN model proposed by Howell (2004) in the target article and expanded on elsewhere (Howell, 2002; 2004b; Howell & Au-Yeung, 2002), makes a parsimonious claim about the role of sound during sequence production: When producing a sequence, people are sensitive to timing relationships between perception and action but are insensitive to whether the planned contents resulting from actions (categories of sound, e.g., phonemes or musical pitches) match perceived contents in resulting auditory information. This claim stems from past research that demonstrated disruption from delayed auditory feedback (DAF), even when the contents of auditory information failed to resemble the contents of planned events (i.e., speech, Howell & Archer, 1984). Based on this logic, people should *not* be affected by altered recurrent auditory information (ARAI) manipulations that alter the contents of sound while maintaining synchrony between actions and sound. This commentary discusses two findings from the domain of musical keyboard performance that do demonstrate sensitivity to the contents of sound during production.

Many studies have demonstrated commonalities across music and speech production, suggesting that results from one domain may inform the other. For instance, evoked potentials reveal similar responses to structural deviations in music and speech (Besson & Schön, 2001; Patel, 1998), serial ordering errors follow similar patterns in speech and music (Palmer & Pfordresher, 2003), and recent neuroimaging research has revealed activation in "speech" areas during music listening (Levitin & Menon, 2003). Moreover, ARAI yields similar patterns of disruption across music and speech production tasks (see Pfordresher, 2003, for a review).

One recent finding demonstrates that ARAI can disrupt music performance when only the contents of auditory information are altered (Pfordresher 2003, Experiment 2). In that experiment, ARAI was synchronous with each key press but presented a pitch that had been produced one, two or three events in the past (implemented using FTAP, Finney, 2001). Because this disruption resulted neither from altered onset synchrony between perception and action, nor from hearing multiple sounds, it is not comparable to the effects of DAF or FSF summarized by Howell (target article).

A second relevant finding comes from an earlier study by Finney (1997), who examined performances of Bach pieces by trained pianists, under conditions of DAF (delay of 200 ms), and with ARAI that presented randomized pitches in synchrony with key presses. Randomized pitches did not disrupt production, whereas DAF did, as predicted by EXPLAN. However, combinations of DAF and randomized pitch produced *less* disruption than DAF on its own. Pfordresher (2003, Experiment 3) also found reduced disruption when both contents and onset times of auditory events were altered relative to produced actions. Reduction of disruption in these conditions contrasts with the results of Howell and Archer (1984), and again suggests that performers are sensitive to the contents of auditory information.

What implications do these results have for EXPLAN? They suggest that ARAI can affect planning, given that alterations of contents on their own can disrupt production. However, the emerging story is too complex for feedback-control theories that were used to connect ARAI with planning in the past (Black, 1951). A feedback-control theory would predict similar disruption from manipulations of

contents implemented by Pfordresher (2003) and Finney (1997). Obviously, a more complex approach to planning is required.

One framework that may account for these data proposes that perception and action share a common incremental representation. Much research on perception and action suggests that both behaviors share a common hierarchical representation (Hommel, Müsseler, Aschersleben & Prinz, 2001; MacKay, 1987). Incremental plans characterize the use of hierarchical representations in real time (e.g., during planning). During incremental planning, the activation (mental accessibility) of sequence events is not limited to the current event, but also includes surrounding events (e.g., the range model of planning, Palmer & Pfordresher, 2003; cf. Lashley, 1951). Thus, it is likely that speakers both plan and perceive real-time auditory sequences in an incremental fashion during production, having access to past, present, and future events at any given point in time.

If perception and action share a common incremental representation, then the time course of action planning may be disrupted when performers hear auditory events intended for other sequence positions (as in Pfordresher, 2003). In such situations, feedback events would match accessible events in the plan other than the current event. The result would be that activation is added to unintended sequence events, disrupting the distribution of event activations. Alternatively, randomized pitches (Finney, 1997), and contents transformed to match a different kind of signal (Howell & Archer, 1984), would yield nebulous influences on planning because they do not match accessible events.[1]

The incremental planning account summarized above, however, does not account for the fact that ARAI that combines DAF with randomized pitches reduces disruption relative to DAF alone (Finney, 1997). The two-tiered framework of EXPLAN can help here. Perhaps production is maximally disrupted when ARAI differs from production with respect to either planning (via alterations of contents), or execution (via alterations such as DAF), but not both. This possibility receives some support from differences found with respect to different measures of disruption. Although Howell (2004a) focuses on how ARAI affects production rate (e.g., global slowing), many experiments document increases in error rates from ARAI (e.g., in speech, Fairbanks & Guttman, 1958; MacKay, 1968; 1970; Robinson, 1972). Moreover, analyses of different types of disruption can prove illuminating. For instance, Pfordresher (2003) found that asynchronous ARAI (similar to DAF) slowed production rate, whereas alterations of contents increased error rates.[2] It is possible that this dissociation in measures of disruption results from interactions between planning and execution components in EXPLAN.

To summarize, these results suggest that alterations of auditory feedback can disrupt the process of planning if the alterations disrupt sequential relationships between perception and action, and that these kinds of alterations may lead to increased errors in production. It is not presently known whether these results generalize to speech, or to individuals with disorders such as stammering. If these results do generalize, a reassessment of EXPLAN's architecture may be in order in which feedback contents interact with the incremental planning of actions, and performers respond to perception/action similarity based on interacting timing and sequential information.

References

Besson, M., & Schön, D. (2001). Comparison between language and music. In R. J. Zatorre & I. Peretz (Eds.), *The Biological Foundations of Music.* Annals of the New York Academy of Sciences, 930, 232-258.

Black, J. W. (1951). The effect of delayed side-tone upon vocal rate and intensity. *Journal of Speech and Hearing Disorders, 16*, 56-60.

Fairbanks, G. & Guttman, N. (1958). Effects of delayed auditory feedback upon articulation. *Journal of Speech and Hearing Research, 1*, 333-346.

Finney, S. A. (1997). Auditory feedback and musical keyboard performance. *Music Perception, 15*, 153-174.

Finney, S. A. (2001). FTAP: A linux-based program for tapping and music experiments. *Behavior Research Methods, Instruments & Computers, 33*, 65-72.

Hommel, B., Müsseler, J., Aschersleben, G., & Prinz, W. (2001). The theory of event coding (TEC): A framework for perception and action planning. *Behavioral and Brain Sciences, 24*, 849-937.

Howell, P. (2002). The EXPLAN theory of fluency control applied to the treatment of stuttering by altered feedback and operant procedures. In E. Fava (Ed.), *Pathology and therapy of speech disorders (*pp. 95-118). Amsterdam: John Benjamins.

Howell, P. (2004a). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Howell, P. (2004b). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communicative Sciences and Disorders, 39*, 122-139.

Howell, P., & Archer, A. (1984). Susceptibility to the effects of delayed auditory feedback. *Perception & Psychophysics, 36*, 296-302.

Howell, P., & Au-Yeung, J. (2002). The EXPLAN theory of fluency control and the diagnosis of stuttering. In E Fava (Ed.), *Pathology and therapy of speech disorders* (pp. 75-94). Amsterdam: John Benjamins.

Lashley, K. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior* (pp. 112-136). New York : Wiley.

Levitin, D. J., & Menon, V. (2003). Musical structure is processed in "language" areas of the brain: A possible role for Brodmann Area 47 in temporal coherence. *Neuroimage, 20*, 2142-2152.

MacKay, D. G. (1970). How does language familiarity influence stuttering under delayed auditory feedback? *Perceptual and Motor Skills*, *30*, 655-669.

MacKay, D. G. (1987). *The organization of perception and action*. New York: Springer-Verlag.

Palmer, C., & Pfordresher, P.Q. (2003). Incremental planning in sequence production. *Psychological Review, 110,* 683–712.

Patel, A. D. (1998). Syntactic processing in language and music: Different cognitive operations, similar neural resources? *Music Perception, 16,* 27-42.

Pfordresher, P.Q. (2003). Auditory feedback in music performance: Evidence for a dissociation of sequencing and timing. *Journal of Experimental Psychology: Human Perception and Performance, 29,* 949-964.

Pfordresher, P. Q. (in preparation). The role of pitch contents and skill in disruption from altered auditory feedback during music performance.

Robinson, G. M. (1972). The delayed auditory feedback effect is a function of speech rate. *Journal of Experimental Psychology, 95*, 1-5.

Footnotes

[1] Recent unpublished research has combined the randomized pitch condition of Finney (1997) with alterations used by Pfordresher (2003) in the same session, to confirm that differences between experiments do not account for the dissociation. This recent work has furthermore demonstrated the dissociation for individuals without formal piano training in a simplified music production task (Pfordresher, in preparation).

[2] The manipulations of ARAI used in this experiment differed somewhat from standard DAF and allowed a cleaner separation of ARAI influences on timing versus contents.

What sort of cerebellar processing problem do people who stutter have?

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Abstract. Howell (2004) promotes his EXPLAN theory as an account of why alterations to the listening environment lead to improvements in speech control in speakers who stammer. While other commentators have raised questions about planning (Pfordresher, 2004), and whether imaging data support the cerebellum as the site of problems in people who stammer (Neumann & Euler, 2004), neither of these commentaries raised questions about the functional role of Howell's proposed cerebellar process in stammering. Issues associated with cerebellar functioning are raised in this article.
Keywords: Altered auditory feedback, delayed auditory feedback, frequency shifted feedback, EXPLAN.

1. Comments on Howell (2004)

Howell (2004) argues: 1) that DAF affects low level timing processes in the cerebellum; 2) that fluency breakdown occurs when plans are not ready in time for execution; 3) that stammering involves a particular way of dealing with such fluency breakdowns; 4) that the site where planning and execution of speech output interact is the cerebellum. All these aspects are concerned with the cerebellar process he describes.

Howell (2004) did not amplify much on some of these points in his paper for the understandable reason that the focus of the article was on practical matters associated with prosthetic devices for treating stammering. However, given that he considers the balance of evidence comes down in favor of his own theory, some consideration of these topics seems warranted.

I am interested in reading Howell's responses to questions I have about each of these topics: On topic one, why does behavioral evidence support a cerebellar site for the effect of DAF (Howell & Sackin, 2002), whereas the one imaging study on sites affected by DAF (Hashimoto & Sakai, 2003) does not? On topic two, what are the grounds for arguing fluency breakdown is a timing problem rather than, say, because the wrong word is selected and this affects fluency control (Kolk & Postma, 1997)? On the third topic, I agree that stammering involves a high proportion of prolongations and part-word repetitions (an example of each of these types of disfluency is given in what Howell, 2004, refers to as 'advancings'). Is there evidence (e.g. imaging data) that shows that when fluency breakdowns like these occur, cerebellar processes are affected? On the final topic, can more details be given about the planning-execution operations in the cerebellum? For instance, what plans are supplied for execution, what are the motor acts that are organized? How does the process that interfaces planning and execution malfunction during stammering (e.g. is it structural or functional)?

References

Hashimoto, Y., & Sakai, K. L. (2003). Brain activations during conscious self-monitoring of speech production with delayed auditory feedback: An fMRI study. *Human Brain Mapping, 20*, 22-28.

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Howell, P., & Sackin, S. (2002). Timing interference to speech in altered listening conditions. *Journal of the Acoustical Society of America*, *111*, 2842-2852.

Kolk, H., & Postma, A. (1997). Stuttering as a covert repairs phenomenon. In Nature and treatments of stuttering: New directions. Curlee, R. F., & Siegel, G. M. (Eds.). Pp. 182-203. Needham Heights, MA: Allyn & Bacon.

Neumann, K., & Euler, H. A. (2004). Are alerts sufficient to smooth speech? *Stammering Research*, *1*, 48-50.

Pfordresher, P. Q. (2004). Can altered auditory information affect planning? Evidence from music performance. *Stammering Research*, *1*, 51-53.

Altered Recurrent Auditory Information and Stammering: Contributions from Learning Theory

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Abstract. The literature on altered auditory feedback and its role in intervening to improve stammering is discussed by Howell (2004). However, little reference is given to an alternative strategy involving concepts derived from learning theory. The importance of several of these topics to AAF treatments, and their improved intervention efficacy, is discussed in this reply. In particular, the notion of response-independent outcomes and partial reinforcement are mentioned, and related to the comments made by Howell (2004). The possibilities for an integrated approach are welcomed.
Keywords: Learning theory, altered auditory feedback, delayed auditory feedback, frequency shifted feedback.

1. Comments on Howell (2004)

Howell's (2004) target article demonstrates that there exists a very well developed literature on the effects of altered recurrent auditory information (ARAI) on stammering. This literature approaches the topic from a variety of theoretical perspectives, mainly drawn from the cognitive approach, and Howell demonstrates that these accounts have produced a variety of different intervention strategies. From the review it is clear that these strategies have met with some success, although, as with all interventions, there is some debate as to the degree and generality of the success. In the target article, another extensive literature related to stammering is not touched upon; that is, the work derived from the operant field. Of course, the question that springs to mind is why should there be any need to generate a dialogue between these two approaches? Both approaches have had their successes, and failures, without much reference to the other.

The advantages of developing such an integrated approach are alluded to in Howell's target article both in terms of the practicality of the ARAI intervention, and the development of a theoretical understanding of stammering. The first of these issues is discussed by Howell particularly in relation to the need continually to deliver the ARAI to alleviate stammering. Beyond this issue of practicality, there are further areas where a brief consideration of learning theory may help to develop ARAI technology. There is the issue of the long-term effectiveness of the treatment. From Howell's review, it appears that ARAI techniques are obviously effective immediately, within the parameters of the intervention, but there is still the need to assess the long-term effectiveness of wearing such ARAI devices. Questions which arise are, for instance, does stammering return when the device is withdrawn? Does the fluent speech of the wearer suffer as a consequence of the continual ARAI input? Finally, does the effect of the ARAI habituate over time? From a theoretical viewpoint, it would seem to be important to explore from all perspectives how such ARAI devices work, as this issue may allow the development of even more effective interventions.

Two areas derived from Howell's target article illustrate the benefits from developing an integrated approach to understanding the effectiveness of the ARAI technology. Both examples require that the terminology of the ARAI intervention be re-cast to some degree; in that the speech episode (fluent or disfluent be considered as a response, and the ARAI as a consequence). Of course, this particular recasting is not the only possible one (see Reed & Howell, 2000), but it will serve to demonstrate the possibilities of a joint approach.

In respect to the issue of targeting disfluent speech episodes with ARAI, instead of all speech, learning theory has a wealth of evidence bearing on the topic. If speech can be divided into classes of speech response (or act), and there are two or more distinct types of response being made (e.g., fluent speech categories, and disfluent speech categories), then targeting the ARAI intervention on only one of those categories (i.e. the disfluent speech episodes) will promote acquisition of this response to a much greater extent than if reinforcement is given both to disfluent and fluent speech categories. This effect has been shown in nonhumans when two responses are scheduled for reinforcement as opposed to one (Herrnstein, 1970), and when one response is reinforced against a background of response-independent reinforcers (Dickinson & Charnock, 1985; Harper & McLean, 1992). There is some evidence that it also occurs with humans in conditioning experiments (Edwards, 1979), and humans in

contingency judgment experiments when the outcome following a response is not a biological reinforcer, as is the case with ARAI (see Dickinson & Shanks, 1985, for a review). A note of caution is worth sounding. If the rate of reinforcement is very low, then extra response-independent outcomes (and it may be that any ARAI delivered to fluent speech is perceived by the stammerer to be delivered independently from the occurrence of disfluent speech) may elevate response levels (Burgess & Wearden, 1986). That is, with low rate stammering, the ARAI could actually act to increase rates of stammering.

The second issue to arise from a reading of the target article concerning ARAI interventions concerns their long-term effectiveness when the intervention is withdrawn. It may be that withdrawal of the ARAI would cause immediate return to stammering; which is not an optimal outcome for an intervention. The continual delivery of ARAI may contribute to this problem, and the targeting of ARAI to disfluent speech may help. However, it may be that not all disfluencies need to result in an ARAI episode. The received wisdom from learning theory is that partial reinforcement prolongs responding in extinction after training in discrete trial procedures. This is called the Partial Reinforcement Extinction Effect (PREE). The literature is extensive (see Amsel, 1992; Mackintosh, 1974), and it is found in many species including humans (see Morley, 1979, for a review). There is, however, a question as to whether the same results are found after training on free-operant schedules of reinforcement, which speech constitutes. Reanalysis of some data, especially that involving free-operant responding, has thrown some doubt on this matter after it was found that behaviour appeared more resistant to extinction after continuous reinforcement (Huang, Krukar, & Miles, 1992; Nevin, 1988). Having noted this, partial reinforcement is a technique widely used in an attempt to prolong responding after behaviour modification (see, Kazdin & Polstner, 1973, for a review) in which context it is called "thinning" (Sarafino, 1996). Responding initially maintained by variable as opposed to fixed schedules are especially resistant to extinction (Grace, Bedell, & Nevin, 2002). Thinning has been used also in a field close to speech therapy - the treatment of elective mutism, in which children will not speak in particular contexts (Baldwin & Cline, 1991, for a review).

These are just a couple of areas where the application of evidence drawn from learning theory about the effects of delivering a consequence to behaviour could be applied to the ARAI technology. From a behavioural perspective, the development of an integrated approach to the treatment of stammering is to be welcomed, and Howell's target article shows the beginnings of such recognition and development of an integratory move.

References

Amsel, A. (1992). *Frustration theory: An analysis of dispositional learning and memory*. New York: Cambridge University Press.

Baldwin, S., & Cline, T. (1991). Helping children who are selectively mute. *Educational and Child Psychology*, *8*, 72-83.

Burgess, I. S., & Wearden, J. H. (1986). Superimposition of response-independent reinforcement. *Journal of the Experimental Analysis of Behavior*, *45*, 75-82.

Dickinson, A., & Charnock, D. J. (1985). Contingency effects with maintained instrumental reinforcement. *Quarterly Journal of Experimental Psychology: Comparative and Physiological Psychology*, *37B*, 397-416.

Dickinson, A., & Shanks, D. R. (1985). Animal conditioning and human causality judgment. In, L-G. Nilsson & T. Archer (Eds), *Perspectives on learning and memory*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Edwards, R. P. (1979). Behavioral contrast in humans with response-independent reinforcement. *Journal of General Psychology*, *100*, 159-160.

Grace, R. C., Bedell, M. A., & Nevin, J. A. (2002). Preference and resistance to change with constant- and variable-duration terminal links: Independence of reinforcement rate and magnitude. *Journal of the Experimental Analysis of Behavior*, *77*, 233-255.

Harper, D. N., & McLean, A. P. (1992). Resistance to change and the law of effect. *Journal of the Experimental Analysis of Behavior*, *57*, 317-337.

Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior*, *13*, 243-266.

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Huang, I., Krukar, J. D., & Miles, S. P. (1992). Effects of reinforcement schedules on rats' choice behavior in extinction. *Journal of General Psychology*, *119*, 201-211.

Kazdin, A. E., & Polstner, R. (1973). Intermittent token reinforcement and response maintenance in

extinction. *Behavior Therapy*, *4*, 386-391.
Mackintosh, N.J. (1974). *The psychology of animal learning*. Oxford: Academic Press.
Morley, S. (1979). Partial reinforcement in human biofeedback learning. *Biofeedback and Self Regulation*, *4*, 221-227.
Nevin, J. A. (1988). Behavioral momentum and the partial reinforcement effect. *Psychological Bulletin*, *103*, 44-56.
Reed, P., & Howell, P. (2000). Presentation of frequency-shifted feedback to sustain long-term improvements in fluency in people who stutter. *European Journal of Behaviour Analysis*, *1*, 89-106.
Sarafino, E. (1996). *Behavior Modification: Understanding Principles of Behavior Change*. New York: Mayfield.

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The response of patients with Parkinson's Disease to DAF and FSF

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Abstract. Increased speech rate is a common symptom of Parkinson's Disease (PD) and can have serious effects on a speaker's communicative ability. Rate reduction is therefore a primary target for therapy. Various behavioral techniques are in common use, but they often result in unnatural speech and have not been evaluated for long-term effectiveness. Instrumental feedback devices maintain speech naturalness, however, they have variable success rates. Our work has investigated how treatment based on instrumental feedback affects various aspects of speech control in these speakers. We raise the question whether similar patterns of response to these two forms of altered auditory feedback apply across stammering and PD subjects. First results indicate that there are no differences concerning susceptibility to delayed auditory feedback (DAF) between speakers who stammer and for speakers with PD, for those with low and high intelligibility (LPD and HPD, respectively). Similar to the speakers who stammer, the speech of the PD patients is more natural in the FSF condition compared to the DAF.
Keywords: Parkinson's Disease, altered auditory feedback, delayed auditory feedback, frequency shifted feedback.

1. Introduction

Howell (2004) describes the effects of DAF and FSF on the speech control of speakers who stammer. He describes how DAF at short delays and FSF have subtle effects on speech rate control in these speakers, but marked effects on their fluency. Our recent work on Parkinson's Disease (PD) patients has used DAF and FSF as ways of controlling speech rate in these speakers. The question we want to raise in response to Howell's (2004) target article is whether similar patterns of response to these two forms of altered auditory feedback apply across stammering and PD subjects.

As there is some indication in the literature for different susceptibility depending on the severity of the speech disorders in patients with PD (Rousseau & Watts, 2002), we divided the PD group into speakers with high and low intelligibility (HPD and LPD, respectively). Some of the characteristics of speech timing of PD subjects and rate control procedures used with these speakers are described, followed by a brief description of our results.

2. Speech timing of PD subjects

Speakers with PD frequently present with faster than normal rates or experience problems of acceleration during utterances. Even if rate is within normal limits, it is often too fast for the speaker to cope with the reduced range of muscular movement which is also a frequent symptom of their dysarthria. This combination of motor impairment and fast speech rate results in unintelligible speech and has a major impact on the person's communication skills and quality of life. Rate reduction is therefore one of the primary treatment aims for these speakers, as is the case with some programs of treatment applied to speakers who stammer (Ryan, 1974, 2001). There are a variety of available techniques used with PD patients to reduce someone's speaking rate, which range from a simple instruction to speak slower (sometimes with specific targets such as "half as fast as normal") to pacing techniques supported by a metronome, an alphabet board or a pacing board which again have parallels in treatments for speakers who stammer. The technique of instructing PD patients to change speech rate can have varying success, as PD speakers can have problems with internal representations that control movements or actions (Downes et al., 1993, Ackermann et al., 1997). The other techniques (metronome, pacing board, alphabet board) usually succeed in slowing a speaker down, however, they frequently have the undesirable effect of rendering speech unnatural as they do not conform to the speech rhythm of English and create unnatural pauses between words.

Researchers have investigated delayed auditory feedback (DAF), in particular, to see whether it is a better way of controlling speech rate in PD patients. A number of papers have reported "dramatic improvement on intelligibility" (Downie et al., 1981: p.135, Hanson & Metter, 1983). Yorkston et al (1999: p. 434) concluded on the basis of their own and earlier studies that "…DAF appears to have many advantages for selected speakers over other rate control strategies. DAF effectively slows

speaking rates without extensive training, it improves intelligibility while maintaining a somewhat faster speaking rate than other rate control techniques, and it preserves, and may even improve, the overall naturalness of speech in severely disordered speakers (less disordered speakers show some of the same side effects of DAF as fluent speakers). However, success of DAF is also reported to be variable and effects of PD on speech, such as a reduced length of utterance, can influence a speaker's response to the device. Not all speakers with PD are thus susceptible to DAF and it is important for clinicians to know which factors can influence this susceptibility in order to formulate effective treatment plans and, potentially, to design procedures that work with a wider range of speakers.

One research group at the University of South Alabama (Dagenais and co-workers) has been working on the hypothesis that the cognitive skills of speakers with PD, in particular their attentional capabilities under dual task situations, determine how well they respond to DAF. However, despite a number of investigations into dual-tasking abilities of these speakers (Dagenais et al., 2000), as well as their performance under various DAF conditions (Dagenais et al., 1998, 1999, Rousseau et al., 2002), the researchers have so far been unable to pinpoint exactly why certain clients seem to experience problems with DAF. In addition, there is no consistent pattern regarding which speaker groups respond best to DAF, e.g. Dagenais et al. (1999) found that speakers with moderate PD responded poorly, whereas Rousseau et al (2002) indicated that the low intelligibility group responded better to altered feedback. Also, little data is currently available on how speakers with PD respond to the other feedback manipulations that are known to be effective with stammering, in particular FSF (Howell, El-Yaniv & Powell, 1987).

3. Speech timing of PD subjects under DAF and FSF

Our research has been addressed at the response of PD patients and control speakers to DAF (147 ms delay) and FSF (1/2 octave higher) in a reading condition. Up to today, 16 speakers with varying degrees of Parkinson's Disease (3 female, 13 male; 59-75, mean: 66.6) and 11 control speakers (3 female, 9 male; 61-77 years, mean: 66.8) participated in our study.

In this report we focus on the analysis of intelligibility, naturalness, articulation rate and fluency characteristics. These measures were derived for all three speaking conditions (no altered feedback (NAF), DAF and FSF). Intelligibility and naturalness ratings were gained with the Direct Magnitude Estimation technique (DME; Weismer & Laures, 2002). Articulation rate was determined through acoustic analysis of syllable duration, fluency measures represent a perceptual count of stuttering events expressed as a percentage of all syllables.

On the basis of the intelligibility rating for the NAF condition the PD group was divided in two subgroups: speakers with intelligibility within the normal range, subsequently referred to as the high intelligibility group (HPD, n=6) and speakers with scores below the normal range, i.e. the low intelligibility group (LPD, n=10).

Overall, the two PD groups and the control speakers were affected in similar ways by the altered feedback conditions. However, there were significant differences between LPD and control speakers and to a lesser degree also between LPD and HPD across all speaking conditions. The HPD group performed more like the control subjects.

Contrary to expectation, an overall decline in intelligibility in the DAF compared to the NAF condition could be observed which was significant for the control and the HPD speakers. The results for the LPD group were not significant as speakers responded more variably to DAF, i.e. increases, decreases as well as no change in intelligibility could be observed in this condition. Only three of the LPD speakers showed indications of improved intelligibility with DAF. However, as with most other PD speakers, they simultaneously showed a decline in naturalness, thus suggesting an intelligibility-naturalness trade-off in this condition. In the control groups there was no significant decline regarding the naturalness score.

Similar to the speech of persons who stammer the level of naturalness rose again under the influence of FSF and was not significantly different to the NAF condition in any of the groups. All group had a higher intelligibility score under the FSF condition, which was not significant for the LPD group. FSF was thus more beneficial to subjects than DAF, as similar increases in intelligibility were not offset by parallel decreases in naturalness.

In relation to changes in articulation rate under altered feedback, all groups showed similar effects both in the direction as well as the extent of observable change. More specifically, all speaker groups spoke significantly slower in the DAF condition. The FSF task also showed slower rates for all speakers than NAF, however, the decrease was not as extensive as for DAF. These between task differences were significant for all speaker groups.

Regarding fluency, there were insufficient incidents of stuttering behavior in the PD group to identify whether the neurological type of stammer in this group behaved similar to altered feedback as

the more widely researched developmental type of stammer. However, an interesting finding was that neither of the speaker groups showed any stammering events in the FSF condition.

4. Conclusions

In conclusion the current results concerning intelligibility were unexpected, as most of the patients showed deterioration rather than the previously reported dramatic improvements in intelligibility. In addition, the overall lack of difference between HPD and LPD group contradicts the trends identified by Rousseau et al (2002). As intelligibility is not a measurement parameter that has been examined in relation to severity of stammering, no comparison can be made in this case.

Similar to persons who stammer, FSF evoked a performance closer to the no feedback state, i.e. the higher naturalness score compared to DAF and FSF resulted in the greatest benefits for PD speakers when both intelligibility and naturalness were considered together.

The data showed that all speakers reduced articulation rate to the same degree, which is the primary purpose of altered auditory feedback. In the light of these results, it appears as though PD speakers show similar effects of altered feedback as the healthy controls as well as persons who stammer in relation to articulation rate. This indicates that the control of speech rate, although impaired in PD speakers, is still affected by similar factors as for healthy controls.

The amount of dysfluencies present in the DAF condition in the normal group was too small to make any comments on whether the PD speakers were affected similarly or not in this respect. A positive trend could be identified in that the FSF condition contained the lowest total of dysfluencies events in both groups, thus suggesting that it might elicit the smoothest speech performance from subjects.

In the light of these results, it appears as though PD speakers in the present study showed similar effects of altered feedback as the healthy controls as well as persons who stutter. However, there are currently too few speakers who showed improvements in intelligibility from altered feedback to make reliable comments on how these results relate to the benefits identified in persons who stammer. There are also still unanswered questions in relation to the effects of altered feedback on PD speakers compared to persons who stammer, such as whether they show a Lombard effect with DAF but not FSF (Howell, 1990), or whether the speech improvements are maintained when speakers are asked to speak at different rates (Kalinowski et al., 1993). In addition, more reports on differences between speakers with varying degrees of stammering would be helpful to identify whether they concur with the reports on PD speakers with mild versus high severity of dysarthria.

References

Ackermann, H., Konczak, J., & Hertrich, I. (1997). The temporal control of repetitive articulatory movements in Parkinson's Disease. *Brain and Language*, 56, 312-319.

Dagenais, P.A., Southwood, M.H., & Lee, T.L. (1998). Rate reduction methods for improving speech intelligibility of dysarthric speakers with Parkinson's Disease. *Journal of Medical Speech-Language Pathology*, 6, 143-157.

Dagenais, P.A., Southwood, M.H., & Mallonee, K.O. (1999). Assessing processing skills in speakers with Parkinson's Disease using delayed auditory feedback. *Journal of Medical Speech-Language Pathology*, 7, 297-313.

Dagenais, P.A., Smith, M.S., & Southwood, M.H. (2000). Dual tasking abilities of speakers with Parkinson's Disease. *Paper presented at the 8th Meeting of the International Clinical Phonetics and Linguistics Association, Edinburgh*, 16-19 August 2000.

Downes, J.J., Sharp, H.M., Costall, B.M., Dagar, H.J., & Howe, J. (1993). Alternating fluency in Parkinson's Disease: Evaluation of the attentional control theory of cognitive impairment. *Brain*, 116, 887-902.

Downie, A.W., Low, J.M., & Lindsay, D.D. (1981). Speech disorders in parkinsonism. Use of delayed auditory feedback in selected cases. *British Journal of Disorders of Communication,* 16, 135-139.

Hanson, W.R., & Metter, J.M. (1983). DAF speech rate modification in Parkinson's Disease: a report of two cases. In: W.R. Berry (Ed.) *Clinical Dysarthria*. Boston: College Hill Press, pp. 232-251.

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 31-46.

Howell, P. (1990). Changes in voice level caused by several forms of altered feedback in normal speakers and stutterers. *Language and Speech*, *33*, 325-338.

Howell, P., El-Yaniv, N., & Powell, D.J. (1987). Factors affecting fluency in stutterers when speaking under altered auditory feedback. In: H. Peters and W. Hulstijn (Eds.), *Speech Motor Dynamics in Stuttering*, 361-369. New York: Springer Press.

Kalinowski, J., Armson, J., Roland-Mieszkowski, M., Stuart, A., & Gracco, V. (1993). Effects of alterations in auditory feedback and speech rate on stuttering frequency. *Language and Speech, 36*, 1-16.

Rousseau, B., & Watts, C.R. (2002). Susceptibility of speakers with Parkinson Disease to delayed feedback. *Journal of Medical Speech-Language Pathology*, 10, 41-49.

Ryan, B. (1974). *Programmed stuttering therapy for children and adults*. Springfield: C. C. Thomas.
Ryan, B. (2001). *Programmed stuttering therapy for children and adults*. (2nd ed.). Springfield: C. C. Thomas.
Weismer, G., & Laures, J.S. (2002). Direct Magnitude Estimates of speech intelligibility in dysarthria: Effects of a chosen standard. *Journal of Speech, Language, and Hearing Research*, 45, 421-433.
Yorkston, K.M., Beukelman, D.R., Strand, E.A., & Bell, K.R. (1999). *Management of Motor Speech Disorders in Children and Adults* (2nd ed.). Pro-Ed: Austin, Texas.

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CLINICAL NOTES AND COMMENTS

Programmed Stuttering Therapy for Children and Adults using ARAI

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Abstract. Comments on Howell (2004) include positive responses to the article's comprehensive content on various feedback theories. Reference is made the author's own experience with DAF-prolongation, in the clinic, most of which was positive.
Keywords: Altered auditory feedback, delayed auditory feedback, programmed stuttering therapy.

1. Comments on Howell (2004)

I found this article to be both very comprehensive and helpful in its coverage of the history of DAF, FSF, DRH, ARAI and their definition. Of especial interest is their relationship to known and future feedback devices to help people who stutter. My only "pure" research on feedback was my Master's thesis in 1957 in which the finding was that DAF affected normally spoken speech more than whispered speech. My related treatment efficacy research and evidence-based clinical practice experiences, over the years, in the 1970's and 1980's, were mostly with DAF-prolongation (Ryan, 2001, pp. 93 –111). Related to the Howell (2004) article, I did observe that some of my clients became automatically, extremely, normally fluent at 150 ms of delay and we had one client use a miniature, portable DAF device outside the clinic with mixed success (Craven & Ryan, 1984; Ryan, 2001, p. 105). Of special relationship to the Howell article are the data on 149 clients who had been on DAF-prolongation treatment, which indicated a reduction in stuttering from 9.8 to 0.3 stuttered words per minute (SW/M, similar to, but less than % stuttering, Ryan, 2001, p. 45) with a commensurate change in words spoken per minute (WS/M) of 106.5 to 73.3, respectively, in an average 6.3 hours of training. We believed that the immediate positive change in fluency was due to two factors: (a) slowing the speech rate (in agreement with Costello-Ingham, 1993) and (b) the teaching by us and learning by the client to use a slow, prolonged fluent "pattern" (continuous, monotone phonation at approximately 40 WS/M). Throughout transfer activities, the client eventually self-sped up to a posttransfer mean 134.0 WS/M (Ryan, 2001, p. 139) with naturalness ratings of a mean 1.7 (pp. 157-158) ending in follow-up at approximately 4 years with 1.7 SW/M and 150 WS/M, (Ryan, 2001 p. 144). These were similar to the respective means (1.2, 150.2) for 90 normally fluent male and female speakers aged 3 to 63 (Ryan, 2001, p. 42). We inferred at that point that the factor of the client gradually self-speeding up the "pattern" was responsible for the final positive normal fluency. These results were achieved in the context of operant conditioning principles of small steps with immediate positive reinforcement or punishment throughout the phases of establishment (in-clinic, acquisition), transfer (out-of-clinic, generalization), and maintenance (over time). Exactly how our clinical results may be explained by the theories of feedback discussed by Howell in this article is not clear to me. I would offer that the final test of any theory, including altered feedback, about treatment is its performance in carefully designed treatment efficacy research throughout establishment, transfer, maintenance, and follow-up which is eventually peer-reviewed and published in a reputable journal. Unfortunately, these published data are missing on the speech devices discussed in Howell (2004) and/or presently on the market.

References

Costello-Ingham, J. C. (1993). Current status of stuttering and behavior modification – 1. Recent trends in the application of behavior application in children and adults. *Journal of Fluency Disorders*, *18*, 27-44.

Craven, D. C., & Ryan, B. P. (1984). The use of a portable delayed auditory feedback unit in stuttering therapy. *Journal of Fluency Disorders*, *9*, 237-243.

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*,31-46.

Ryan, B. (2001). *Programmed stuttering therapy for children and adults*. (2nd ed.). Springfield, IL: C. C. Thomas.

Experience of a speech pathologist providing clients with the SpeechEasy™ device

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Abstract. In this article, I describe my experiences as a clinician fitting the SpeechEasy™ device. I offer some observations, based on my experience, about the settings clients prefer to use and the effect on their speech control. I also consider issues in using the device in everyday listening situations, and make some comments about Howell's (2004) ideas about how the device could be used in long-term treatment.
Keywords: Altered auditory feedback, delayed auditory feedback, frequency shifted feedback, SpeechEasy™.

1. Background experience with the SpeechEasy™ device

I have about 25 years' experience as a practising speech-language pathologist and I am an American Speech-Language-Hearing Association supported Board Recognized Fluency Specialist (of which there are fewer than 300 in the USA). In that time, I have not followed any one program of therapy. In December 2002 I trained to provide the SpeechEasy™ anti-stuttering device. Howell's (2004) article prompted me to recount some of my practical experience with clients using the SpeechEasy™ device though it should be noted that I can only give impressionistic data on commercially-sensitive matters.

I believe that it is important that people knowledgeable in stuttering, program and adjust the settings on the device. Several children I have seen who received the device, have been returned by their school speech-language pathologist to their previous programs. These programs must have previously been judged not effective enough (or I would not be seeing them to provide a device). These children return with more serious stuttering than when they first saw me! Some have returned to speaking incredibly slowly and monotonously and still have disfluencies, others have developed additional secondary symptoms, while others still try to control their breathing in ways that do not facilitate fluent speech.

2. General details about experience in fitting the SpeechEasy™ device and the assessments developed

Clients attend for an initial fitting session which is based on the training I received and my experience in treating fluency disorders. The first session explains how the device works, evaluates and measures the disfluencies the client is producing, then proceeds to programming settings for DAF, FAF, gain, and frequency shaping. I believe that in order for all these to be done thoroughly, approximately three hours with the client is necessary. The client usually brings an earmold impression and a basic audiogram when they attend this session. The person who stutters is taped while reading for two minutes and in a two-minute monologue. While these recordings are being made, I note types and numbers of disfluent moments, accessory behaviours, etc. The tape is usually kept as a record of progress and as it includes suggestions from me for better use of the device. The same measurements and observations are repeated when the settings on the device have been decided. The tape is given to the client for them to use for reference both in terms of progress and so they can refresh their memory regarding my suggestions. Frequently a parent has called me to say they think their child is regressing. At that time I ask them to listen to the tape and to call me back. Invariably they tell me that they had literally 'forgotten' what their child's stutter used to be like. They are encouraged to contact the clinic if they feel they need ongoing advice or if they think that an adjustment to the settings of the device is necessary.

When I receive the device that has been customized for the client, a second ("follow-up") appointment is made to determine if the 'fit' is correct (i.e., fits snugly in the ear canal with no pain or discomfort) and if the settings are appropriate now that the device is actually inserted in the canal; the settings can be adjusted after the device has been made. I have found priming for use of the device to be very effective for training transition from an interjection into a fluent word. After initial insertion, the client is asked to say "ah-one," "ah-two," up to "ah-ten." Clients report that this eases them into speaking with the device. I then use these productions as examples of using an interjection (ah) with no break between it and the next word (in this case, the number), i.e., to make the two components together sound like a single word. Some find this very easy, even if they do not tend to use fillers in

their stuttered speech. Others have such difficulty with this, that I am seeking alternative ways to help propel them into what might otherwise have been a stuttered word.

I have put together a package of exercises which I introduce and quickly demonstrate, so that the speaker who stutters, and parents or significant others, understand the goal toward which the client is aiming. This goal is to capture the essence of the comfortable, effective communicator via the use of reading materials, with the exercises I have selected for them, and the support I offer. Some parents have told me they have never seen their children (young or adult) work so hard and enjoy so much any previous practices or exercises.

In the following sections, details are given about setting up the device, its use in everyday listening environments and the possibilities for long-term use of fluency aids.

3. Settings used with the SpeechEasy™ device with clients

DAF. Howell (2004) argues that short delays should be used under DAF because longer delays produce side effects like vowel-drawling. In the target article, he does not specify what delays he considers 'short', but Lotzmann (1961) suggests a delay of 50 ms is optimum for speakers who stutter. None of my clients have found their comfort levels and maximum fluency using delays under 50 ms. Most choose delays between 58 and 75ms. The choice is based on client's self-perception, analysis of audiotapes and counts of disfluent moments during program settings.

Individuals who received intensive treatment in the past that relied heavily on speaking rate reduction, report being unable to 'find' adequate control over disfluent moments unless the delay is over 70ms. Even though some of these clients have tried using a delay setting as short as 58ms during the initial periods where they are trying out the device, the majority ultimately call to request a DAF increase "at least for a while". The same applies even to clients who start with somewhat longer delays. Though it is perhaps understandable that people with past experience using techniques that require rate reduction choose DAF-delays that slow their speech, it is more surprising that even those with moderate disfluency or those whose stuttering is covert, choose comparable DAF-delay settings.

FAF/FSF. I initially present FAF that is shifted up 500Hz. Larger shifts affect clarity, and tolerance appears to suffer. A sizeable minority do not report improved fluency at a shift down of 500Hz, although they sometimes say that they enjoy the sound of their voice more. It is possible to set a 0 Hz frequency shift which means no alteration to frequency. The vast majority of clients who have tried this prefer this to their normal speech. All but one of the clients who have gone away from the initial fitting session with a 0 Hz setting, have subsequently requested that the setting be changed to a shift up of 500Hz. Recently, SpeechEasy™ providers received notice indicating that up 500Hz should be used, as it is usually found to be the best setting. A more flexible range of settings (in terms of the number of possible changes) for FAF on the SpeechEasy™ seems desirable, because clients find a comfort level at different settings than just shifting up 500Hz. I think that more finely graded settings in the region currently available would help both the client's comfort level and lead to increased fluency. Personally, I would like a better understanding of how best to use gain and frequency shaping, for the ultimate goal of tailoring the device to the individual client.

4. Use of the device in everyday listening environments

The device increases ambient background noise, introduces a noise associated with the equipment as well as the effect it has on the sound of the speaker's own voice. Some clients report that the device is not comfortable to use due to the changes in the ambient noises in the background. The equipment produces (according to clients' reports) a noise similar to the hiss as when a quiet tape is playing. This almost "white noise" is reported to be more intrusive (and bothersome) to some clients than others. When this noise causes too much discomfort, it can sometimes be reduced by changes in gain and frequency settings or, failing that, it can be damped out by the manufacturer.

I recently received instructions about an exercise clients should perform each day to improve the effectiveness of the device. The client should phonate the "ah" sound at a loud level for 60 seconds before inserting the device, then immediately insert the device and repeat the procedure with "ah" phonated at the same level. This should be repeated twice each day.

In terms of long-term support, a scheduled follow-up visit is advised to ensure maintenance and to note progress. I offer a user-friendly email system for clients to contact me with problems that can be solved by phone or for support during difficult times and for that positive reinforcement that can be lacking in their environment.

5. Long-term use of prosthetic devices for fluency enhancement in practice

The idea of employing different reinforcement schedules to promote transfer of fluent behaviors (Howell, 2004; Reed & Howell, 2000) is an interesting research topic but not one immediately relevant to the therapy I currently provide. In terms of intermittent use, I advise my clients to use the device only when needed (turning it on and off via the volume control knob available on the behind the ear (BTE) and in the canal (ITC) versions of the device). An important aside to adjusting volume and using

on selective occasions is that this helps to prevent auditory insult, and may promote transfer potential, given that conversational exchanges are likely to occur while the device is off.

An issue not discussed by Howell (2004) is the changing role of the pathologist when prosthetic treatment devices are used. In intensive therapy, or therapy given during regular clinical appointments, the therapist does not walk out the door with the person who stutters, whereas the device does. I have witnessed setbacks with users of SpeechEasy™ because there is no speech-language pathologist available for immediate help. There needs to be better understanding about what users need to learn about how the device can best be used outside the clinic. Confidence in their new fluency, in themselves, and in the device suffers greatly if they are not prepared for setbacks. Those who are prepared seem to handle the setbacks well.

6. Conclusions

Hopefully the dialog between researchers and practitioners that has been set off by Howell's (2004) article will continue. This should lead to more research data and case study reports becoming available with regard to the several issues raised in this article.

References

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*,31-46.

Lotzmann, G. (1961). On the use of varied delay times in stammerers. *Folia Phoniatrica*, *17*, 276-310.

Reed, P., & Howell, P. (2000). Presentation of frequency-shifted feedback to sustain long-term improvements in fluency in people who stutter. *European Journal of Behaviour Analysis*, *1*, 89-106.

Disclaimer

The comments of Janet Y. Skotko, M.Ed., CCC, Speech/Language Pathologist and Board Recognized Fluency Specialist, represent her personal view. They do not represent Janus Development, East Carolina University or any of their researchers who developed the SpeechEasy™ device, or StutterFree, LLC.

Clinical Research into use of the SpeechEasy™ device

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Abstract. The beneficial effects of altered auditory feedback on stuttering have been well documented over the last several decades. In June 2001 the SpeechEasy™ device (combining DAF and FAF) was introduced on the American market and was quickly hailed "the cure for stuttering" by the media. University of Colorado at Boulder researchers are exploring the objective and measurable effects of a SpeechEasy™ fitting under various conditions on stuttering behaviors, and comparing participants' perceptions of their stuttering before and after experiencing the device. Results are tentative. The researchers make a call for more practical studies to understand whom the device helps.
Keywords: Altered auditory feedback, delayed auditory feedback, frequency shifted feedback, SpeechEasy™.

1. Comments on Howell (2004)

A research project investigating the effects of a fitting with the SpeechEasy™ device is currently underway at the University of Colorado at Boulder. A small number of adults who stutter agreed to participate in a fitting session, where 12 speech samples were taken under 3 different conditions. Importantly, our population of participants is primarily those who have had extensive conventional stuttering treatment, and who reported that such treatment has not provided satisfactory results. We have read more than 40 research articles, referred to at least a dozen chapters, and spoken with or emailed five certified speech-language pathologists about the device and the phenomena of DAF, FAF, and masking on stuttering. Though our speech samples are still being analyzed for any differences in stuttering severity at the time of the fittings, our conclusions thus far are that Dr. Kalinowski et al. make a very strong argument for the 'second speech' signal providing adequate feedback to improve or eliminate stuttering. The "why" of this effect is less our concern at this time than to simply and practically attempt to verify, disprove or at least call for more scientific, peer-reviewed data on the SpeechEasy™.

The statistical claims for the success of the device made by Dr. Kalinowski, his team of researchers, and Janus Marketing are impressive and there is no doubt that some people have responded positively to the device. Yet there is no question that research on a grand scale must be done to determine exactly whom the device helps (in terms of stuttering severity, types of stuttering behaviours, and possibly previous speech treatment) and how much it helps. And then, of course, it will be necessary to come to a consensus as to WHY it helps certain speakers.

It is important also to accept that the technology (DAF and FAF) in the SpeechEasy™ may not affect overt stuttering behaviors, but instead provide some wearers with greater confidence (*read: less angst*). We hope to obtain some insight into that area through self-perception surveys given before and after subjects were fitted with the device.

References

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*,31-46.

Effects of using an Edinburgh masker for a period of 25 years

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Abstract. One of the concerns that is commonly voiced about ARAI is that there is no information about the effects on speech control of being subjected to altered sound. I have used an Edinburgh masker for 25 years. I offer my impressions about the continuing effectiveness of the masker.
Keyword: Edinburgh masker.

1. Comments on Howell (2004)

Howell's (2004) article raised the question about how effective ARAI devices will prove with long term use. I offer these observations about my experience with the Edinburgh masker that I have been using continuously for about 25 years. My stammer began in 1969, at the age of 36. I found my previous fast, but fluent, speech was interrupted by a need to pause or hesitate. Within a few weeks, the hesitation had become a stammer. This was confirmed by a speech therapist (physical causes were exclude by an Ear, Nose and Throat specialist). I received several forms of treatment over a period of 10 years. None of these treatments were successful.

In 1979, I discovered the Edinburgh Masker. I fairly quickly obtained one with the help of my General Practitioner, a Speech Therapist and an Ear, Nose and Throat consultant. As Howell (2004) describes is the case with DAF and FSF, the Edinburgh masker was an immediate success. Twenty five years later it is still effective. Gradually, however, over these 25 years, the masker's effectiveness has diminished though my speech without the masker has deteriorated faster and to a greater degree. My stammer reappears (even when I am wearing the masker) when I have to answer the telephone or when I am required to give my name and address in a shop. The pattern of use has been pretty consistent over this time. For example, a typical working day throughout this period would involve wearing the masker all day at the office.

References

Howell, P. (2004). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*,31-46.

AUTHOR'S RESPONSE TO COMMENTARIES

Response to commentaries on 'Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering'

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Abstract. Each of the nine commentaries is responded to. There was a consensus across the commentaries that attention ought to be given to squaring behavioral and imaging findings with respect to a) what CNS structures ARAI affects, b) what CNS structures operate differently in speakers who stammer when they are fluent and when they are disfluent. A better understanding of how ARAI devices control the fluency of speakers who stammer was also deemed necessary. Specific issues to address in this connection are what parameters a) facilitate transfer, b) are optimal for speech rate control, and c) are most acceptable to clients. All these issues require evidence-based practice drawn from studies of clients using the device.
Keywords: Altered auditory feedback, delayed auditory feedback, frequency shifted feedback, EXPLAN, mirror neurons, SpeechEasy™.

1. Introduction

The commentaries that my target article (Howell, 2004a) attracted addressed the effects of altered recurrent auditory information (ARAI) from a wide variety of different, and highly informative, perspectives. I will consider each of the commentaries in turn before drawing together the general lessons that I believe need to be drawn about the effects of ARAI in practical treatments and research questions that need to be addressed.

As many commentaries were addressed at EXPLAN, it is appropriate to quote the brief description from Howell (2004a):

> "The basic idea behind the EXPLAN model is that cognitive-linguistic planning (PLAN) processes are independent of motor execution (EX) processes. The role of the planning processes is to supply a plan for an utterance when the motor execution processes have finished producing the previous utterance. Disfluencies arise when the plan is not ready at this time. In a phrase like "I split it", the comparatively complex word "split" is likely to be the one that is not ready in time for execution. If this is the case speakers may do one of two things: First, they may repeat or hesitate on the prior word (producing, for example, "I, I, split it"). Howell (2004b) refers to these events as stalling disfluencies. Second, since plans are assumed to be generated left to right, speakers can commence "split" using the plan for the first part of the word which is available. Planning continues while this first part is being uttered, as this process is independent of execution. The remainder of the plan may be generated in the time taken to execute the first part. However, the plan can run out and result in disfluencies involving just the first part of the word (e.g. "sssplit","s.s.split"). Howell (2004b) refers to these as advancing stutterings."

2. Response to commentaries

Neumann and Euler

Neumann and Euler (2004) discuss imaging data pertinent to points raised by Howell (2004a). They start by considering changes in brain image patterns after successful fluency shaping therapy. Howell's (2004a) EXPLAN account was only applied in the target article to how ARAI leads to fluent speech in speakers who stammer, and changes under ARAI were reasoned to result from operation of structures in the cerebellum. Elsewhere, Howell (2002) has discussed how operant procedures work on structures other than cerebellar timekeeping processes in EXPLAN (in particular by influencing the chaining between planning and execution that would draw on structures responsible for planning) and similar things may apply to fluency shaping therapies. The fact that Neumann and Euler (2004) see changes in cerebral, rather than cerebellar, activity after fluency shaping is not, then, inconsistent with EXPLAN (Howell, 2002). Neither is it, as Neumann and Euler noted, inconsistent with the view of Kalinowski's group.

A second point Neumannn and Euler (2004) make about fluency shaping is specifically inconsistent with the views of Kalinowski's group. They argue that ARAI is a passive process that is achieved by mirror neurons whereas fluency shaping is an active process achieved in motor structures. It would be expected, therefore, that different central nervous system (CNS) areas would be activated when ARAI and fluency shaping procedures are applied. However, Neumann and Euler do not see any evidence in support of Kalinowski's view that ARAI affects processing in a different way to fluency shaping procedures.

With respect to my own EXPLAN hypothesis, Neumann and Euler (2004) again provide evidence that supports some aspects of the proposed view but does not support other aspects. The aspect supporting my view is that in people who stammer, "subcortical CNS structures in timekeeping processes which improve fluency are supported by several neuroimaging and pharmacological findings." Against my view, Neumann and Euler (2004) suggest (based on an interpretation of imaging work by Hashimoto and Sakai, 2003) that DAF affects the tempero-parietal, but not the cerebellar, system. The aspect not consistent with EXPLAN is that no cerebellar activity was observed under DAF. On the other hand, the activity that was observed in the tempero-parietal system is consistent with the general region that Kalinowski suggested is affected by DAF (though the findings do not necessarily support the view that mirror neurons are involved). My response to Dr Davis (below) voices some reservations I have about the Hashimoto and Sakai's (2003) procedures and summarizes other support for my view that DAF affects cerebellar timing mechanisms. These points together, suggest it would be premature to reject EXPLAN based on the Hashimoto and Sakai (2003) study.

While each theoretical position I discuss in the target article can take some comfort from the imaging findings, neither view can be unequivocally favored over the other. Furthermore, in fluency-enhancing tasks the imaging evidence is sparse and does not present a definitive picture. I would conclude that further imaging work is needed to establish whether both the cerebral and the cerebellar sites are active, or just one of them.

Pfordresher

The principal component of EXPLAN theory that was described in the target article (Howell, 2004a), was how it addresses the effects of ARAI on speech control. In particular, why does speech control of speakers who stammer, improve when speech sounds are altered? Pfordresher (2004) raises some more general questions about EXPLAN, based on his work on the effects of ARAI on music performance. He is particularly interested in whether the content of actions affect their performance. EXPLAN maintains that there only has to be a change to timing, not content, of speech sounds during ARAI for speech control to be affected (i.e. it does not matter what you hear while you speak, only where the sound associated with vocalisation is placed relative to the original speech). The work on music that Pfordresher reviews suggests that the content of ARAI can affect a performance. The only related work on speech is that originally reported by Houde and Jordan (1998) who showed that if speech feedback is manipulated so that a speaker thinks he or she is producing a different vowel sound to the one intended (i.e. a change in content), the speaker changes vowel articulation so that the intended vowel is heard, suggesting content does matter. John Houde pointed out to me that the alterations he makes in his procedure have to be sustained for an appreciable time for the effects to become established. Therefore, they are not likely to be served by the same mechanism as that which affects speech fluency in people who stammer when the listening environment is altered where the effects are immediate.

Another point I would make is that speech and music production may rely on different processing mechanisms (notwithstanding the parallels Pfordresher points to). Musical responses have an arbitrary relation with the actions that led to them (Howell, Powell & Khan, 1983). In music one action (e.g. pressing one particular key on a synthesiser) can lead to different sounds (chords and different instrument settings). A single speech sound, on the other hand, can be produced in various different ways (e.g. as occurs in speech in which the lips are, or are not, restrained, Riordan, 1977). The fact that music production involves a one-response-to-many-sound-output relation whereas speech exhibits the opposite relation (many-responses-to-one-sound-output), suggests that the production of these different classes of sound may be controlled by different mechanisms. Another important point is that learning to perform music occurs later in development than performing language so the learning processes behind speech production may be different from those behind music performance.

Also, the types of task that EXPLAN addresses and those that are usually studied in music are very different. Howell (2004b) points out that spontaneous speech is the appropriate form of speech to study the inter-relationship between speech planning and execution, as these two aspects have to be done concurrently. In this regard, spontaneous speech control presents a situation very different from reading, where part of the plan is supplied by the text. Performing a highly-practised piece of music is more akin to writing than spontaneous speech. Findings about music performance may not, therefore,

be directly applicable to models developed to account for the specific requirements involved in spontaneous speech control.

Pfordresher also makes the case that planning of music involves speakers having access to adjacent sounds in the musical stream (i.e. its context). The case can be made that planning of speech also extends over greater extents than elements such as single words and syllables (e.g. because of documented influences of prosodic and syntactic factors on speech control). Accepting the view that there are syntactic influences on speech control does not necessarily mean that shorter elements cannot be delivered for execution by a chaining process and, in particular, that late delivery of those elements will disrupt fluency. Thus in probably the best-known psycholinguistic model that has an explicit hierarchical control structure (Levelt, 1989), the last stage in planning involves filling up a serial phonetic buffer that is then sent to articulation. Planning (and, indeed, execution, see comments about Davis's commentary below) will receive more detailed specification as the EXPLAN model is refined. The general structure of the model at present is that sub-stages in planning may overlap but the output that drives motor execution has to be supplied as a series of segmental specifications. This series of segments chains to provide input (delivered in series) to the motor execution stage.

Davis

Dr Davis (a member of UCL's speech research group of which I am also a member) dealt with the editing of this manuscript. He raises points that occurred to him which were not addressed in the target article which did not arise in any of the commentaries accepted for publication. Davis's (2004) comments complement Pfordresher's in some respects: Whereas Peter Pfordresher wanted expansion of how planning is envisaged to take place in EXPLAN (and he made some suggestions about how this could arise), Davis wanted amplification on the motor processes and how they interact with planning. He wanted mechanistic details and asked for empirical support for these ideas. He also called on me to evaluate come of the evidence that appears to be inconsistent with EXPLAN (such as why the behavioural findings point to cerebellar involvement whereas the imaging data of Hashimoto and Sakai, 2003, do not). I will respond to Davis's comments using the same four topic headings as he used.

1. Cerebellar activity under DAF. My grounds for arguing that the DAF signal produces extra input to a timekeeper in the cerebellum are, a) that the parameter representing such activity in the timekeeper using the analysis technique introduced by Wing and Kristofferson (1973), increases when DAF is presented (Howell & Sackin, 2002), and b) that the timekeeper parameter is known to be mediated by the lateral cerebellum, as lesions in this region selectively lead to massive increases in this parameter (Ivry, 1997). Sackin and I have replicated our original finding and feel confident about the conclusions under point a). While this points to cerebellar involvement under DAF, the scanning study of Hashimoto and Sakai (2003), mentioned earlier, which examined which brain regions were activated by DAF in fluent speakers did not report activity in the cerebellum. Thus the behavioral and imaging data appear to be at odds with each other. The imaging data in the Hashimoto and Sakai (2003) study were obtained from scans made in the silent periods when the speaker was not articulating. This procedure was followed so that the imaging data were not affected by motion artifacts. While this is a commendable procedure, it is possible that the collection protocols render the data insensitive to short latency activity. As was pointed out by Howell (2004a), ARAI has short-lasting effects on fluency and, if these are mediated by cerebellar mechanisms, activity in the cerebellum associated with this activity might quickly dissipate and not be spotted by Hashimoto and Sakai's imaging procedure.

2. Could fluency fail because the speaker makes errors rather than because the plan is not ready in time? In recent publications, I have argued the case that timing disruption is much more commonly associated with fluency failure than is production of errors (Howell, 2004b). Errors, defined as a phone in the wrong position to complete a word (as in the word 'cuff' in the phrase 'cuff of coffee'), occur very rarely in spontaneous speech (Garnham, Shillcock, Brown, Mill & Cutler, 1981). Also, many of the events associated with stammering do not conform to this definition (repeats of parts of words, whole words or short phrases and prolongations are not errors according to the definition). Thus fluency failure in stammered, and non-stammered, speech appears to involve temporal disruption rather than malfunction that results in error. EXPLAN attempts to offer an account of stammering and its development over age groups based on temporal disruption (see for example, Howell 2002, Howell and Au-Yeung, 2002 and Howell, 2004b, for further discussion). Kolk and Postma (1997) are still of the opinion that stammering results from underlying errors, and readers who are interested might consult this as an 'antidote' to the EXPLAN point of view.

3. Is there evidence for cerebellar involvement in stammering? There are both imaging and behavioral data pertinent to this question and they are considered in that order. There are several studies that have examined cerebellar activity in speakers who stammer. The imaging data (and also pharmacological evidence) are neatly summarized in Neumann and Euler's (2004) commentary and

there is consensus that cerebellar activity changes when fluency is induced in speakers who stammer. One note of caution that ought to be raised about some of the imaging data, though, is that they may be affected by movement artifacts (see the description of Hashimoto and Sakai's, 2003, experiment above where it was noted that they were careful to control for such artifacts).

There is also behavioral evidence (Howell, Au-Yeung & Rustin, 1997) that shows cerebellar performance is affected in children who stammer, that uses the Wing and Kristofferson (1973) procedures. As noted earlier, the measures that result are known to be associated with cerebellar structures (Ivry, 1997). Recently Max and Yudman (2003) failed to find any cerebellar processing deficit in adults who stammer. Furthermore they argued that this conclusion is suggested by the majority of studies. They do not appear to have examined the procedures used in the studies they review very critically, as one of the studies they included on which they drew their conclusion yielded estimates that were impossible according to the Wing and Kristofferson (1973) model that was used to process the data. In the study, these impossible estimates were then arbitrarily changed to acceptable values. The implication is that Max and Yudman should not have cited this study as consistent with their conclusion.

There are also procedural problems in Max and Yudman's (2003) own study that undermine the interpretation of their findings. These have been raised by Howell (2004c) and responded to, although not satisfactorily, by Max and Yudman (2004). For example, the Wing and Kristofferson (1973) task presents a set of regularly-spaced entrainment clicks that are switched off when the participant is making isochronous responses around that rate. Max and Yudman quibble about the function of the 'entrainment phase' in justification of their view that it is not necessary for the experimenter to judge whether the participants had settled into their responses before collecting test data. Anyone who has worked with the Wing-Kristofferson task knows that some novice participants on some occasions produce rhythms other than isochronous ones (e.g. galloping rhythms) and the rhythms produced involve more than errors on isolated elements in a sequence (Max and Yudman do appear to remove sequences where errors were made on isolated responses). Max and Yudman emphasize that they do not judge whether their subjects were entrained in this sense (they appear to think this would require the experimenter to judge sounds to millisecond accuracy). Max and Yudman's results have very little meaning if they included such atypical sequences in their analysis as they appear to have done. There are other problems such as the fact that they instruct their participants to do the task using acoustic responses but then do an analysis of articulatory responses where previous literature indicates there would be differences (a point Max and Yudman acknowledge). In my note (Howell, 2004c), I also pointed out that their equipment and analysis procedure would affect the timing values, and it is essential that calibrations are reported. Until these are available the Max and Yudman results are not meaningful. All in all, Max and Yudman's study and their subsequent defence of this study, is selective in the literature it uses in support of their argument. Their own data that they report is highly questionable until checks are made that their participants were actually producing isochronous sequences and until calibration of the temporal response of their equipment has been performed. Also, it is not consistent with the imaging and pharmacological data that indicate cerebellar involvement in stammering. In my opinion their study does not contribute to our knowledge about timing processes in people who stammer and about cerebellar involvement in particular and I think the pharmacological, neurological and behavioural evidence all point to cerebellar activity being involved in control of the speech of individuals who stammer.

4. Specification of the basis of the problem in the cerebellum. Davis asks: "what plans are supplied for execution, what are the motor acts that are organized? How does the process that interfaces planning and execution malfunction during stammering (e.g. is it structural or functional)?"

Some consideration about the planning representations has been given in my responses to Peter Pfordresher's commentary where it was pointed out that planning could involve overlapping hierarchically-organized control processes but where the final step is conversion into some serial output form. The final serial output could be a traditional representation employing segmental units (Levelt, 1989) or a more abstract representation such as a nonlinear phonological representation. Whatever the representations are, they need to be converted into forms appropriate to control motor output structures. Some general properties of the process whereby plans are converted into executable forms follows.

First there are grounds for considering that stammering is a functional, not a structural, problem. Ingham, Fox, Ingham, Zamarripa, Martin, Jerabek, & Cotton (1996) provide evidence that brain functioning in people who stutter is normal when they are at rest and, given the extensive areas of the brain investigated, this would apply to planning as well as execution processes. This suggests that stammering is not associated with any particular CNS lesion and that the problem is most likely functional. Stalling (as in "I, I split it") and advancing (as in " I sssplit it") that were described in Howell (2004a) are functional processes that, according to EXPLAN, arise when speakers do not have

the plan ready in time for execution. If the structures that are responsible for organizing output are damaged (according to EXPLAN, the cerebellum), this does not mean that the affected individuals will then stammer but rather that these lesions would have catastrophic effects on speech output because the structures responsible for coordinating speech plans with executed forms are absent. Consistent with this, there is a wealth of literature that various types of dysarthria result from different types of lesions in the cerebellum, but no reports of stuttering associated with cerebellar lesion sites.

The functional problem may or may not be specific to speech. This depends how general the task of organizing plans for output is, as it is possible that other motor processes use the mechanism that regulates output plans as a motor sequence. The generality issue could be answered empirically by seeing whether the same patterns of performance breakdown occur in sequential motor tasks (including music) as occur in speech (stalling and advancing) (a specific version of the general claim Palmer and Pfordresher, 2003, make).

Reed

Reed raised the questions of why stammering returns when ARAI devices are switched off and whether this need necessarily be so. The EXPLAN proposal is that ARAI operates directly on a cerebellar timing process and is effective when, and only when, the ARAI occurs. It is a good question as to whether the fluent speech of speakers who stammer is affected by these devices when they are subjected to ARAI. David Miller in his above commentary, reports that he has used an Edinburgh Masker for some 25 years. He does not note any effects on his fluent speech, only on his stammered speech.

Reed's (2004) commentary also allows me to air a common confusion about what we mean when we talk about ARAI in general (and FSF in particular) having an ubiquitous response in the vast majority of speakers who stammer that we have tested. ARAI is delivered to the ears at a similar level to the sound of the voice in normal listening conditions, and in this situation a very high proportion of speakers become immediately fluent. This is to be distinguished from effects that carry over after the ARAI is switched off. With the standard way of presenting ARAI in which the alteration is delivered to fluent and stammered sections of speech, there is very little, if any, carry over of the fluent pattern observed while the alteration was on.

Reed (2004) raised the important question of whether the lack of carry-over is due to the procedure of delivering ARAI to fluent, as well as stammered, sections (see also Reed and Howell, 2000). Reed points out, 1) that this is not what is done in operant procedures where the behavioral contingency is presented as near as possible to the target behavior, 2) if ARAI is delivered on the target behavior, besides any influences of targeting the contingency *per se*, other schedules of delivering the contingencies could be explored. He recommends investigating whether presenting ARAI as a contingency on stammers according to an intermittent ('partial reinforcement') schedule would be effective at inducing fluency and whether the fluency so induced would persist after ARAI ceases. This prediction is based on studies where animals on partial reinforcement schedules maintain their response rate (more commonly known as the partial reinforcement extinction effect). This issue is one that Reed and I are addressing in empirical work.

Lowit and Brendel

Lowit and Brendel report their findings on use of DAF and FSF on people with Parkinson's disease. Their comments are particularly pertinent to the concerns of Bartles and Ramig and my responses on Lowit and Brendel's paper are presented when I respond to the latter authors' commentary.

Ryan

Bruce Ryan's (2004) commentary is the first of the clinical notes and commentaries. This draws readers' attention to how he uses DAF from a learning-theoretic perspective in his 'programmed stuttering therapy for children and adults'. Ryan's detailed programme and the assessments of the programme he has conducted over the years are exemplary pieces of work. Reed proposed using learning-theory principles in a different way to Ryan, but the ethos of their approaches is shared. For both of them, ARAI is used to elicit required behaviours that can then be shaped in ways that learning theory suggests will make the elicited fluent behaviour stick. Ryan has used DAF to slow speech and learning theory to maintain the responses. Reed proposes to use ARAI to elicit fluent speech and reinforcement schedules to maintain the fluent responses that arise.

Ryan uses DAF-delays that are long enough to affect speech rate (in particular, to slow speech down). He is using DAF, then, in a mode that Kalinowski's group refer to as an 'active' change. He does not agree that DAF with these delays produces speech that differs from that produced with FSF or short-delay DAF (which Kalinowski's group refers to as true fluent speech brought about by passive changes). Neumann and Euler (2004) also found nothing to commend the view that there are two processes (active and passive) by which fluency can be achieved.

It would be easy to stop at this juncture and conclude that the leading competitor to my EXPLAN model as an account of ARAI, Kalinowski's mirror neuron model, lacks support from behavioural, neurophysiological (Neumann & Euler, 2004) and clinical outcome (Ryan, 2004) data. The question ought to be raised, however, as to whether EXPLAN itself is consistent with these data. In EXPLAN, there is one principle that governs whether speech is fluent or not – whether speech planning is or is not appropriately synchronized with execution (Howell, 2002; Howell, 2004b). From this perspective, rate control is paramount in ensuring whether speech is fluent or not. There are, however, different ways in which speech rate can be adjusted, a) execution rate can be slowed, or b) the planning-execution chain itself can be stalled. Howell (2002) argued that the Howell and Sackin (2002) study showed ARAI affects execution processes by directly influencing timekeeping processes. Howell (2002) also argued that operant procedures, on the other hand, can be used to manipulate rate in the planning-execution chain in ways that can obviate disfluencies. Operant procedures can be used to, a) reinforce certain behaviors which makes them more likely to be used in the future, or b) extinguish behaviors. Howell (2002) has argued that reinforcement (a, above) is appropriate to administer to stalling behaviors. To this end, Howell and Sackin (2001) have developed operant procedures that increase stalling behaviors (only examined, to date, in fluent speakers). These will be used to reinforce stalling behavior in speakers who stammer, as stalling is a feature of fluent speakers' speech control (unlike the problematic advancings). Stallings and advancings are mutually exclusive ways of dealing with situations where a plan is not ready in time for execution. The prediction is, therefore, that increasing stalling will decrease the incidence of the advancings. From this perspective, time-out procedures (basically stopping speech for a short period of time when a disfluency has occurred) interrupt the planning-execution chain. Another approach that follows the same logic is to attempt to extinguish (b, above) the advancings directly by timing speakers out when these occur. Some success has been reported with this procedure in conjunction with reinforcement of stallings (Howell, Au-Yeung, Charles, Davis, Thomas, Reed, Sackin, & Williams, 2001).

In summary, although the goal of fluency-enhancing procedures is always rate control, there are different ways this goal can be achieved (by affecting execution time, using stalling and to stop using advancing). Though the different ways of achieving appropriate rate control operate on different mechanisms, they all result in fluent speech that is equivalent in its characteristics. This equivalence implies that there is only one form of fluent speech after treatment by any of these procedures in speakers who stammer. That is, the distinction between passive fluent forms (induced by ARAI) and active fluent forms (induced by prolonged speech techniques) does not apply in EXPLAN and no behavioral (Ryan, 2004) or neurophysiological (Neumann & Euler, 2004) differences would be expected after treatment, as has been observed. It seems, therefore, that EXPLAN is more consistent with Ryan's (2004) and Neumann and Euler's (2004) observations than is the mirror neuron view of Kalinowski and colleagues.

Though I do not necessarily think that the end-product after, say, DAF-treatment with long delays is reflected in speech whose control is mediated by lower motor (active) mechanisms whereas FSF-speech is mediated by more central (passive) mirror neuron mechanisms, I do think some attention needs to be given as to whether ARAI alteration needs to be sustained (see Reed's commentary and my response to it). Put simply, alterations only need to be made in regions where speech control breaks down and the alterations need to slow speech rate in these regions (see Howell, Au-Yeung & Pilgrim, 1999; Howell & Sackin, 2000 for support for the view that disfluencies arise where local speech rate is high). Thus, I would agree with the concern that long-delay DAF presented continuously to speakers who stammer, might produce strangely-timed speech and that it is not necessary to use ARAI with these parameters to establish fluency control (which is a weak version of the idea that led Kalinowski and his group to distinguish active and passive fluent speech).

Skotko

Skotko cannot provide as much detail as I would have liked about assessments and numbers of patients tested because of a) lack of resources, and b) commercial considerations concerning SpeechEasy™. In addition, a lot of the information appears to have been collected informally, and systematic studies to provide evidence-based treatment of stuttering with this device are still required as several of the commentators have noted (as well as Howell, 2004a). Skotko does have 'tuning up' sessions as Yaruss and Quesal (2004) advocate.

Skotko (2004) makes some important observations that hopefully will be substantiated by research. The first two concern DAF settings. First, clients using the device appear to prefer long delays even though there is an increased chance of their speech sounding drawled. Second, she makes the suggestion that previous experience may account for the preference for long delays. If there is this link between ARAI and therapies that require speaking rate reduction, then this, once again (see Neumann & Euler, 2004), raises questions about Saltuklaroglu, Dayalu and Kalinowski's (2002) dual inhibition

hypothesis which suggests they affect different mechanisms in the brain and would, therefore, be expected to operate in independent and different ways.

The next two points concern FSF settings. First, we learn that the manufacturers of SpeechEasy™ are currently advocating using an upward shift (most acceptable to clients), although the research findings suggest that up and down shifts are equally effective in terms of fluency (Stuart, Kalinowski, Armson, Strenstrom & Jones, 1996). The reason for this inconsistency between the controlled research study and practice is not apparent. Second, and of more concern are the effects of extraneous noises. The 'white noise' Skotko described sounds like quantization noise that occurs with digital devices (see Rosen & Howell, 1991 for an elementary description of how such noise arises). We learn that this and ambient noise can cause problems to users of the device. This would be expected from audiological observations. 'Noise annoyance' (a term used in connection with environmental noise) is a problem commonly experienced by hearing aid users. The real question to address is how can an altered sound be presented in a way that avoids background noise. The earlier observation about the effects of these noise sources, suggests the FSF manipulation is retaining cues that permit sound segregation (separate references are made to background noise, white or quantization noise, and the speaker's own voice). Other manipulations on the signal could be made that are designed a) to integrate all sound sources into a single fused image, b) to remove the cues to locale that these signals include, and c) to activate the resulting ARAI only when speech is being produced. This would result in one noise source synchronized to vocalisation that can then be shifted in frequency. There are other things that could be examined as well as such manipulations on the signal. For instance, there are many possible ways of preparing the salient sound source (the speaker's own voice) for delivery, before or after it has undergone the desired signal processing changes.

Bartles and Ramig

Bartles and Ramig plan to establish whether the usefulness of FSF and DAF with speakers who stammer depends on the severity of the disorder. This is an issue that Lowitt and Brendel (2004) have already begun to address with Parkinson's disease (PD) patients. If there are parallels between people who stammer and PD patients, the answer is that FSF and DAF have their effects irrespective of how severely speech is affected. One should add two provisos to this conclusion, however. Although Lowitt and Brendel see DAF and FSF as improving speech control of PD patients because they allow control of speech rate (a point of view Costello-Ingham, 1993, has proposed in stammering), empirical findings and other observations have questioned whether this is why these manipulations affect the fluency of people who stammer (Howell, El-Yaniv & Powell, 1987). Thus, there may be differences in the speech responses of patients with PD and speakers who stammer. Second, Reed (2004) points out that "with low rate stammering, the ARAI could actually act to increase rates of stammering." (p.55). This suggests that there might be very different responses from people with mild and more severe stammers. At present it is an open question whether people who stammer respond equivalently to DAF and FSF whatever the severity of their disorder (as appears to be the case with PD patients, Lowitt and Brendel, 2004).

Miller

David Miller offers us an important insight into his experience as to the long-term effectiveness of the Edinburgh masker (EM). From Miller's description, his non-aided speech is deteriorating at a much more rapid rate than the drop-off in fluency when he uses the EM. Indeed, it could be argued that the EM is equally effective in terms of the proportion of disfluencies it works on, but as his speech deteriorates, there is an increased chance of disfluencies 'getting through' to speech output. This personal report does not supply the data which Bruce Ryan (and I suspect all the rest of us too) desire concerning evidence-based practice, but it does at the very least suggest that the devices may be successful long-term. This does not undermine the point I made about the need for investigating the best way of presenting intermittent feedback that might effect more permanent improvements in fluency. Nor does it, at present, provide us with information about rate control and, thereby, whether cerebellar/basal ganglia, or high, level CNS processes are affected when such devices are operating.

3. Lessons drawn about the effects of ARAI in practical treatments and research questions that need addressing

The target article culminated in description of the SpeechEasy™ device, raised some issues pertinent to its use in practice and considered two alternative explanations that have been developed to explain, *inter alia*, why ARAI improves the speech control of speakers who stammer (Kalinowski's mirror neuron proposal and Howell's EXPLAN theory).

Probably the major theme that arose in the target article and the commentaries concerned whether ARAI affects speech timing, or this and other aspects of speech control (e.g. does ARAI lead speakers to produce errors?). Though Pfordresher made a case a) for an analogy between speech and music, b) that musicians produce errors under ARAI, and c) that more needs to be known about how errors arise

when planning music (and, by implication, speech), there is also a recognition in his commentary concerning the importance of timing. The only other commentary that may be taken to imply that processes other than those involved in speech-timing may be important in leading to stammering is Neumann and Euler's. These authors noted abnormalities in cerebral patterns of activity in speakers who stammer. Though they did not explicitly identify these activations with error-producing processes that then led to stammering, the results they mention certainly do not rule this source of the problem out.

Within these and the remaining commentaries, emphasis is placed on timing control as being the basis of the person who stammer's problem. This emphasis comes in different guises – e.g. from the effects of timing control in treatment programmes (Ryan, 2004; Skotko, 2004) and issues raised about CNS structures responsible for controlling timing (Davis, 2004). Perhaps the main point that arose was that neurological (Neumann & Euler, 2004) and clinical (Ryan, 2004) data were against Kalinowski's two-process, active and passive, view that lead, respectively, to pseudo-fluency and true fluency. These commentators argue that speakers who stammer do not achieve fluent speech control by engaging either the active mechanism (changing control of motor processes) or the passive mechanism (changing the mirror neuron system).

Though I would not submit to all steps in the active-pseudofluent-motor control versus passive-fluent-mirror neuron routes, there are areas of agreement between Kalinowski's views and my own. There do appear to be qualitative differences between the speech timing that results under long-delay DAF (what Howell, 2002, refers to as global timing changes and Kalinowski would consider the result of his active process) and the more subtle effects on timing of synchronous FSF (what Howell, 2002, refers to as local timing and Kalinowski would consider the result of his passive process). It seems to me that you can have manipulations that affect different aspects of timing but you do not need to maintain that the end-product will be different (in Kalinowski's terms, pseudo-fluent or fluent). Rather both could lead to fluent speech. The observations of Neumann and Euler (2004) and Ryan (2004) confirm my view that people who stammer have a normal CNS system which can be reprogrammed in different ways (change to global or local timing) that then leads to a CNS system that works in a way that is not distinguishable from the operation of the CNS systems of fluent speakers. The fluent speech control that is the final result of therapy does not appear to be maintained by different CNS processes depending on what therapy was received (according to Kalinowski, the tempero-parietal system when passive procedures are used, but some motor level when active procedures are used).

A second important theme that emerged was that we need to know more about processes involved a) in coordinating high level plans with motor execution forms, and b) the processes of motor execution themselves (Davis, 2004). My own EXPLAN theory has located the site of these two components in the cerebellum. The evidence raised in connection with commentaries and my response to different commentators raises important questions often associated with inconsistencies between behavioural and imaging data. For instance, Howell and Sackin's (2002) behavioural data provide clearcut evidence for cerebellar involvement when DAF is manipulated whereas Hashimoto and Sakai's (2003) imaging study finds no evidence of involvement of this area. We do not know whether the Hashimoto and Sakai (2003) findings are firm, as we only have a single study that used one particular imaging procedure. Though the Howell and Sackin (2002) behavioural findings have been replicated, the replication used exactly the same procedure as the original study. Thus the same reservation about paradigm-specific findings that was levelled at Hashimoto and Sakai could be raised in connection with Howell and Sackin's (2002) results.

The evidence about cerebellar involvement in stammering seems to be strongly supported by pharmacological and imaging data (summarised by Neumann and Euler) and by behavioural evidence (Howell, Au-Yeung & Rustin, 1997). Max and Yudman's (2003) minority view that is an exception to these findings should be noted.

The third and final major theme concerns translation of ARAI into practical systems and the difficulties this raises. There seems to be a general view that more investigation should be made about ways of restricting exposure to ARAI (Howell, 2004a; Reed, 2004; Ryan, 2004) and into ways in which ARAI can be used to elicit fluent speech in ways that promote transfer of this speech to situations where the aid is not employed. Intriguingly, in this connection, preference has been expressed by clients for upward shifts in FSF settings while the research literature suggests that there should not be any preferred direction (Skotko, 2004), and clients appear to prefer settings like long DAF-delays (Skotko, 2004) that research suggests should have a negative effect on speech control. This mismatch between research findings and clinical experience needs to be resolved. A related theme amongst the clinicians and end-users is the need for more evidence-based practice associated with the devices. Finally, questions have been raised as to whether the SpeechEasy™ device benefits all clients

(Reed, 2004) and whether the ideal that some researchers set (speech without an aid) is regarded by sufferers as a necessary goal (Miller, 2004) as Reed and I assume.

References

Bartles, S., & Ramig, P. R. (2004). Clinical research into use of the SpeechEasy™ device. *Stammering Research*, *1*, 66.

Cherry, C., & Sayers, B. (1956). Experiments upon the total inhibition of stammering by external control and some clinical results. *Journal of Psychosomatic Research*, *1*, 233-246.

Davis, S. (2004). What sort of cerebellar processing problems do people who stutter have? *Stammering Research*, *1*, 54.

Garnham, A., Shillcock, R. C., Brown, G. D. A., Mill, A. I. D., & Cutler, A. (1981). Slips of the tongue in the London-Lund corpus of spontaneous conversation. *Linguistics*, *19*, 805–817.

Hashimoto, Y., & Sakai, K. L. (2003). Brain activations during conscious self-monitoring of speech production with delayed auditory feedback: An fMRI study. *Human Brain Mapping, 20*, 22-28.

Houde, J., & Jordan, M. I. (1998). Adaptation in speech production. *Science*, *279,* 1213-1216.

Howell, P. (2002). The EXPLAN theory of fluency control applied to the treatment of stuttering by altered feedback and operant procedures. In E. Fava (Ed.), *Pathology and therapy of speech disorders*. Pp. 95-118. Amsterdam: John Benjamins.

Howell, P. (2004a). Effects of delayed auditory feedback and frequency-shifted feedback on speech control and some potentials for future development of prosthetic aids for stammering. *Stammering Research*, *1*, 1-16.

Howell, P. (2004b). Assessment of some contemporary theories of stuttering that apply to spontaneous speech. *Contemporary Issues in Communicative Sciences and Disorders, 39,* 122-139.

Howell, P. (2004c). Cerebellar activity and stuttering: Comments on Max and Yudman (2003). *Journal of Speech, Language and Hearing Research*, *47*, 101-104.

Howell, P., & Au-Yeung, J. (2002). The EXPLAN theory of fluency control and the diagnosis of stuttering. In E Fava (Ed.), *Pathology and therapy of speech disorders* (pp. 75-94). Amsterdam: John Benjamins.

Howell, P., Au-Yeung, J., Charles, N., Davis, S., Thomas, C. Reed, P., Sackin, S., & Williams, R. (2001). Operant procedures that increase function word repetition used with children whose speech had not improved during previous treatment. In H-G Bosshardt, J. S. Yaruss & H. F. M. Peters (Eds.). *Fluency Disorders: Theory, Research, Treatment and Self-Help. Proceedings of the Third World Congress of Fluency Disorders*. Pp. 133-137. Nijmegen: Nijmegen University Press.

Howell, P., Au-Yeung, J., & Pilgrim, L. (1999). Utterance rate and linguistic properties as determinants of speech dysfluency in children who stutter: *Journal of the Acoustical Society of America*, *105*, 481-490

Howell, P., Au-Yeung, J., & Rustin, L. (1997). Clock and motor variance in lip tracking: A comparison between children who stutter and those who do not. In W. Hulstijn, H. F. M. Peters & P. H. H. M. van Lieshout (Eds.). *Speech Production: Motor Control, Brain Research and Fluency Disorders*. Pp. 573-578. Amsterdam: Elsevier.

Howell, P., Powell, D. J., & Khan, I. (1983). Amplitude contour of the delayed signal and interference in delayed auditory feedback tasks. *Journal of Experimental Psychology: Human Perception and Performance*, *9*, 772-784.

Howell, P., & Sackin, S. (2000). Speech rate manipulation and its effects on fluency reversal in children who stutter. *Journal of Developmental and Physical Disabilities*, *12*, 291-315.

Howell, P., & Sackin, S. (2001). Function word repetitions emerge when speakers are operantly conditioned to reduce frequency of silent pauses. *Journal of Psycholinguistic Research*, *30*, 457-474.

Howell, P., & Sackin, S. (2002). Timing interference to speech in altered listening conditions. *Journal of the Acoustical Society of America*, *111*, 2842-2852.

Ingham, R. J., Fox, P. T., Ingham, J. C., Zamarripa, F., Martin, C., Jerabek, P., & Cotton, J. (1996). Functional-lesion investigation of developmental stuttering with Positron Emission Tomography. *Journal of Speech and Hearing Research*, *39*, 1208-1227.

Ivry, R. (1997). Cerebellar Timing Systems. In J. Schmahmann. (Ed.). *The Cerebellum and Cognition*. Pp 555-573. San Diego: Academic Press.

Kolk, H., & Postma, A. (1997). Stuttering as a covert repairs phenomenon. In Nature and treatments of stuttering: New directions. Curlee, R. F., & Siegel, G. M. (Eds.). Pp. 182-203. Needham Heights, MA: Allyn & Bacon.

Lee, B. S. (1951). Artificial stutter. *Journal of Speech and Hearing Disorders*, *15*, 53-55.
Levelt, W. J. M. (1989). *Speaking: From Intention to Articulation*. Cambridge MA: Bradford Books.
Lowit, A., & Brendel, B. (2004). Response of Parkinson's Disease patients to DAF and FSF. *Stammering Research*, *1*, 58-61.
Max, L., & Yudman, E. M. (2003). Accuracy and variability of isochronous rhythmic timing access motor systems in stuttering versus nonstuttering individuals. *Journal of Speech, Language and Hearing Research*, *46*, 146-163.
Max, L., & Yudman, E. M. (2004). *Journal of Speech, Language and Hearing Research*, *47*, 105-113.
Miller, D. (2004). Effects of using an Edinburgh masker for a period of 25 years. *Stammering Research*, *1*, 67.
Neumann, K., & Euler, H. A. (2004). Are alerts sufficient to smooth speech? *Stammering Research*, *1*, 48-50.
Palmer, C., & Pfordresher, P.Q. (2003). Incremental planning in sequence production. *Psychological Review, 110,* 683–712.
Pfordresher, P. Q. (2004). Can altered auditory information affect planning? Evidence from music performance. *Stammering Research*, *1*, 51-53.
Reed, P. (2004). Altered recurrent auditory information and stammering: Contributions from learning theory. *Stammering Research*, *1*, 55-57.
Reed, P., & Howell, P. (2000). Presentation of frequency-shifted feedback to sustain long-term improvements in fluency in people who stutter. *European Journal of Behaviour Analysis*, *1*, 89-106.
Riordan, C. J. (1977). Control of vocal-tract length in speech. *Journal of the Acoustical Society of America*, *22*, 807-820.
Rosen, S., & Howell, P. (1991). *Signals and Systems for Speech and Hearing*. London and San Diego: Academic Press.
Ryan, B. (2004). Programmed stuttering therapy for children and adults using ARAI. *Stammering Research*, *1*, 62.
Saltuklaroglu, T., Dayalu, V. N., & Kalinowski, J. (2002). Reduction of stuttering: The dual inhibition hypothesis. *Medical Hypotheses*, *58*, 67-71.
Skotko, J. Y. (2004). Experience of a speech pathologist providing clients with the SpeechEasy™ device. *Stammering Research*, *1*, 63-65.
Stuart, A., Kalinowski, J., Armson, J., Strenstrom, R., & Jones, K. (1996). Fluency effects of frequency alterations of plus/minus one-half and one-quarter octave shifts in auditory feedback of people who stutter. *Journal of Speech and Hearing Research*, *39*, 396-401.
Wing, A. M., & Kristofferson, A. B. (1973). Response delays and the timing of discrete motor responses. *Perception & Psychophysics*, *14*, 5-12.
Yaruss, J. S., & Quesal, R. W. (2004). Partnerships between Clinicians, Researchers, and People Who Stutter in the Evaluation of Stuttering Treatment Outcomes. *Stammering Research*, *1*, 1-15.

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