International Conference on Virtual Rehabilitation 2011
Rehab Week Zurich, ETH Zurich Science City, Switzerland, June 27 - 29, 2011

The role of visual feedback in conventional therapy and future research

Birgit I. Molier, MSc; Gerdienke B. Prange, PhD; Jaap H. Buurke, PT, PhD
Roessingh Research and Development
Enschede, the Netherlands
b.molier @rrd.nl

Abstract—**Application of virtual reality in stroke rehabilitation indicates a beneficial effect on motor learning. We performed a literature search into the application of feedback in experimental therapeutic sessions. We gained more insight into the application of different feedback modalities in current therapy in an observational study. We also studied the effectiveness of different feedback modalities in research settings in a literature search. In current clinical practice mainly verbal feedback is provided, while in research combined use of auditory and visual, or sensory and visual feedback is provided.**

Keywords-virtual reality; feedback; stroke; visual; therapy, upper arm

I. INTRODUCTION

The application of virtual reality in stroke rehabilitation indicates a beneficial effect on motor learning. [1-3] These virtual environments have the advantage of giving the opportunity to incorporate several essential elements of therapy (intensive, task-specific, active-initiation, motivation, and feedback) in an environment which can be adjusted to the personal abilities of the patient. [4, 5]

With upcoming innovative technologies in research settings, increasing possibilities for the application of feedback are present. However, in current clinical practice feedback is often applied without specific visual cues and has a different nature then is possible with advanced virtual environments. Also other types of feedback are used in current clinical practice, such as verbal comments, corrections by means of touch, or visually.

The objective of this paper is to gain more insight into the application of different feedback modalities in current therapy in an observational study, and to study the effectiveness of different feedback modalities in research settings in a literature search.

II. METHODS

A. Observational study

To obtain insight into the application of different feedback modalities in current clinical practice, we performed an observational pilot study. Different modalities of feedback in conventional therapy were recorded. Videos were recorded from conventional physical and occupational therapy sessions focusing on improving the function of the hemiparetic arm of subacute stroke survivors. The recorded videos were annotated by means of the software package ELAN. The feedback provided by the therapist during the therapy was categorized into different kinds of feedback modalities, in accordance with the literature search. Examples of feedback possibilities provided by the therapist are by means of showing (*visual*) things, telling (*auditory*), or touching (*sensory*).

B. Literature search

The literature search was performed on the effect of different feedback modalities in experimental therapeutic sessions for the hemiparetic arm after stroke. A literature search of the scientific literature was performed in the Pubmed database, using the following key words (and their synonyms): stroke, upper extremity, auditory, sensory, visual, feedback. Articles were included if the study involved a therapeutic intervention using augmented feedback and if stroke survivors participated in the training. Studies with usage of augmented feedback for purposes other than therapeutic (e.g. design studies or validation studies) were excluded. Augmented cues provided in therapy were categorized into *auditory*, *visual*, or *sensory* feedback. Also the observed training effect in the study on motor activities was monitored.

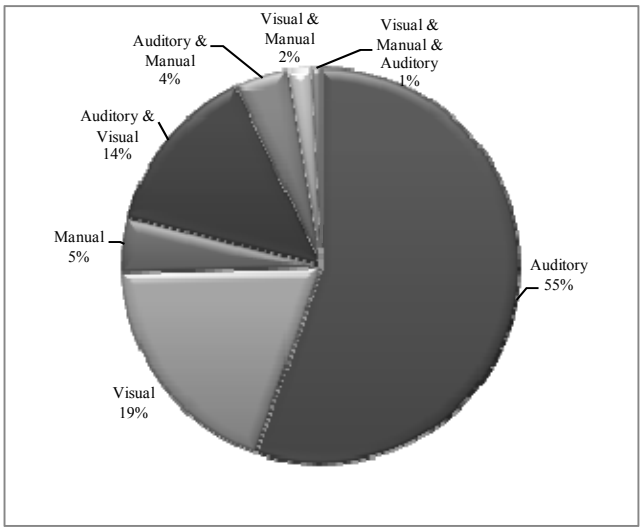

Figure 1. Distribution of the total amount of provided feedback during a conventional therapy session.

This material was the result of work supported by the Ministry of Economic Affairs (EZ), Overijssel and Gelderland, the Netherlands, grant 1-5160.

978-1-61284-474-9/11/$26.00 ©2011 IEEE

III. RESULTS

A. Observational study

A total of fourteen recorded physical and occupational therapy sessions were analyzed. From the analysis it was observed that therapists provide mostly verbal (auditory) feedback to the patient, over 50 percent of the total amount of feedback provided. Nineteen percent of the provided feedback was visual feedback, and only four percent was provided manually by the therapist. A combination of verbal comments and visual feedback was provided for fourteen percent of the total amount of feedback provided (figure 1).

B. Literature search

From the literature search seventeen studies were included that met the inclusion criteria. From these studies it can be observed that experimental therapeutic sessions always make use of visual feedback, alone or combined with sensory or auditory feedback. In the seventeen studies which used visual feedback alone (3) or combined (14), the effect on motor activities outcome measures was observed as improved in seven studies (figure 2). [6]

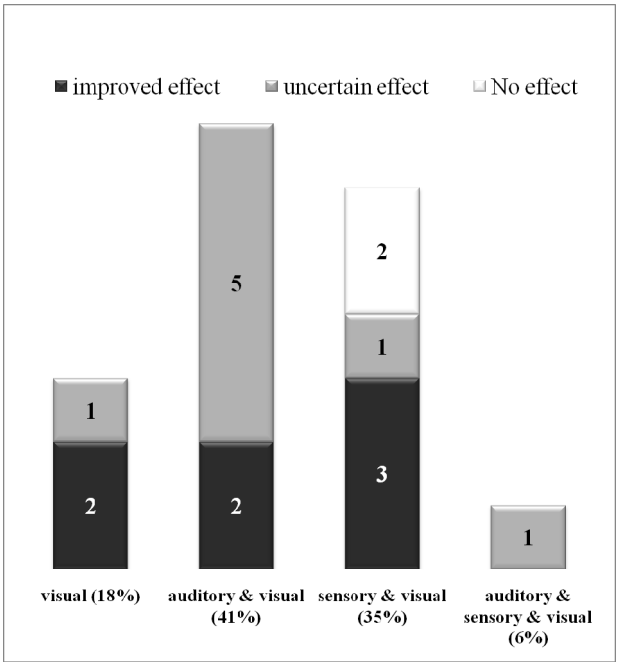

Figure 2. Amount of studies and their observed effect of different feedback modalities in research setting on motor activities.

IV. DISCUSSION

As was expected we observed a difference in feedback use between clinical practice and research setting. Main findings were that combined use of visual and sensory (or manual) feedback is much more used in research setting (35%) than in current clinical practice (2%). Visual feedback is applied to similar extents in research and clinical practice, respectively 18% and 19%. Combined use of auditory and visual feedback is remarkably different, in research this combination is used about 41% while in clinical practice only 14% of the average amount of feedback is a combination of visual and auditory feedback. In current clinical practice mainly verbal feedback is provided, while in research mainly combined use of auditory and visual, or sensory and visual feedback is provided.

In research many innovative technologies such as robotics and screens for virtual gaming environments are used. In clinical practice these technologies are only used scarcely. This application of innovative technologies in research and not (yet) in clinical practice could contribute to the difference in applied use of feedback between research and clinical practice. The application of practical (simple) experiments in the clinic could obtain insight into which modality of feedback other than verbal comments could optimize stroke rehabilitation therapy. An example of research applicable in clinic practice is a recent study of Thielman. They trained stroke survivors to minimally perform trunk movement during reaching exercises by touch (a strap) or by sound (bleebs). They observed that stroke survivors learned fastest and best from the auditory condition, not from the strap around their trunk. This type of research is of fundamental interest to gain a better optimalization of stroke rehabilitation therapy. Research settings and clinical practice should work more closely together to improve applicability of innovative techniques in the clinic and more functional and practical studies in research settings.

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