Developing technology-based speech interventions for patients with Parkinson's disease

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Introduction

Acquired dysarthria is a symptom of Parkinson's disease and poses a substantial risk for social isolation due to unsuccessful communication [1].
New technology promises high potential for empowerment of patients in the health care sector.
Research and development need to address solutions that will be accepted by patients with Parkinson's disease.
The main goal of the project is to develop an automatic speech recognition system applicable to distorted speech and integrated in a speech therapy application that carries the motivational potential contributing to frequent and autonomous usage.
Empowerment and autonomy of patients will be supported.

Challenge in SLT

A limited set of treatment sessions is funded by the health insurer in Germany. Patients have only one appointment per week in SLT.
Studies demonstrated sustainable effects for treatment of dysarthria with at least two to four 60 minutes sessions a week [2].
Face-to-face speech therapy can profit from being supplemented by technology-based intervention by:
(1) enhancing the frequency of training,
(2) individual tailoring,
(3) specific feedback.
In his/her "new" role, the therapist carries responsibility to select, introduce, and monitor the adequate technology to ensure a persistent usage.

ISi-Speech Approach

German engineers for speech signal processing and informatics, media designers, and researchers from the fields of psychology and speech and language pathology were granted in a nationally funded R&D project: 'Individualisierte Spracherkennung in der Rehabilitation für Menschen mit Beeinträchtigung in der Sprechverständlichkeit' ('ISi-Speech') [individual speech recognition in therapy for people with speech disorders]. The interdisciplinary team joined efforts to develop a digital training system for people suffering from Parkinson's disease.

Psychological elements	SLT elements	Technical elements
Motivational design; Systematic user-centered evaluation	Severity of PD; Evidence-based & best clinical practice exercises	Automatic speech; recognition system Technical functions

Figure 1. Work Packages in ‚ISi-Speech'.

Motivational Approach

- Psychological theories for improving : *attractive-ness*, *intuitive usability*, and *convincing effective-ness* [3]
- Embedding Self-Determination Theory (SDT) in technology-based interventions [4]: *autonomy*, *competence* and *relatedness* for personal growth

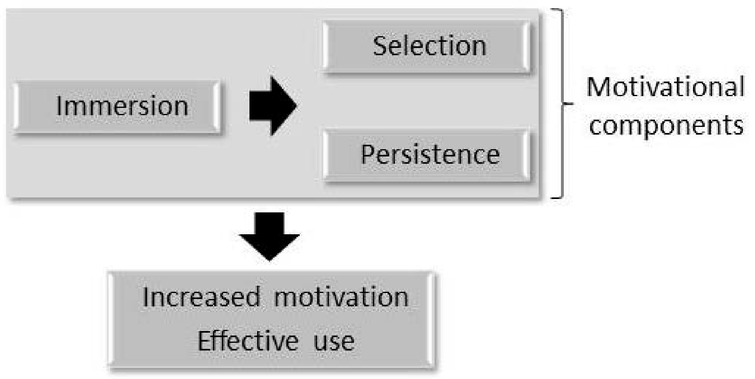

Figure 2. Identification of motivational compo-nents for increased motivation and effective use of technology [5].

Motivational Design

Table 1. Implementing SDT into 'ISi-Speech' [6, p. 97].

Goal	Example of SDT application to 'ISi-Speech'
Autonomy. The patient identifies the value and importance of the technology-based intervention.	The therapist introduces 'ISi-Speech' to his/her patient with Parkinson and advices the usage. The patient is convinced that s/he will be better understood when s/he trained at least twice a day with 'ISi-Speech'.
Competence. The patient experienced personal growth by comparing her/his improvement individually, socially or normative.	*Individual*: "Compared to last week, distinctive articulation of p versus b has become 20% more clearly." *Social*: "Other patients with Parkinson have more difficulties than you in pronouncing p and b clearly." *Normative*: "You mastered the first two steps towards your goal of distinguishing p and b clearly."
Relatedness. Therapist-patient relation-ship and relationship between users of technology supports the patients' need of being respected and understood as well as feeling socially included.	When the patient fails with his/her exercise in 'ISi-Speech', the therapist supports him/her to follow his/her goal. Both pay attention to the results of two other users that are ranked on the ISi-board by the amount of clearly pronounced words with p they logged over a day.

Systematic user-centered evaluation

- User-centered and model-based evalu-ation for sustainable use
- Early and central focus on users in design and development of technology
  - Iterative design
  - Systematic measure of interactions between user and technology
- Considering the seven principles of user participation [7]
- Investigation of a systematic model-based evaluation instrument using items from standardized scales and ad-hoc items

Principles	'ISi-Speech'
Partnership	German Parkinson Association
User organisation based	Members of the German Parkinson Association
Equal payment	Compensation for expenses
Accessibility	Project cloud
Qualified staff	User experienced team
Sound plan	Work package user participation
Early involvement	Involved in discussion project idea

Figure 3. Principles of user participation.

Discussion

Our contribution intends to stimulate the discussion about prerequisites that are necessary for a successful usage of technologies in health care.

Principles such as autonomy, competence, and relatedness can facilitate activity, engagement, social interaction, and scaffolding, all contributing to potential personal growth in patients with Parkinson's disease.

Our R&D project 'ISi-Speech' serves as an example for applying psychological theory into designing technology for speech intervention in patients with Parkinson's disease.

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