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DELL'AQUILA, Elena, MAGGI, G., CONTI, Daniela <<http://orcid.org/0000-0001-5308-7961>> and ROSSI, Silvia

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A Preparatory Study for Measuring Engagement in Pediatric Virtual and Robotics Rehabilitation Settings

Elena Dell'Aquila

CRDC Tecnologie

University of Naples Federico II

Napoli, Italy

Daniela Conti

Sheffield Hallam University

Sheffield, UK

Gianpaolo Maggi

CRDC Tecnologie

Università degli Studi della Campania Luigi Vanvitelli

Caserta, Italy

Silvia Rossi

silvia.rossi@unina.it

DIETI, University of Naples Federico II

Napoli, Italy

ABSTRACT

The rehabilitation intervention in children with motor or cognitive impairments requires to be effectively measured in terms of engagement to understand the effects of the rehabilitation process and to enable more targeted interventions leading to improved experiences for both children and rehabilitation therapists. Indeed, the rehabilitation practice may be enhanced by attending to the client's signals of engagement in therapy. In this paper, we present the results of the validation of the PARE scale (Pediatric Assessment of Rehabilitation Engagement) that was designed to capture the dimensions of affective, cognitive, and behavioral engagement in the interaction of clients-rehabilitation providers. Results showed that the scale can be effectively used for the measurement of the different components of engagement in intervention settings to support therapeutic virtual scenarios or the application of robots to treat motor and cognitive impairments.

KEYWORDS

Engagement evaluation; Socially Assistive Robotics; Rehabilitation

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1 INTRODUCTION

There is a growing interest in investigating the role of engagement in determining service outcomes in pediatric rehabilitation [6] and, more generally, health care [1, 7]. The concept of engagement is considered as a multifaceted state involving affective, cognitive, and behavioral dimensions. More specifically, in the literature, the

construct of engagement has been conceptualized in two inter-related ways: 1) as a process “engaging with”, as it is co-constructed through the interaction and connection between the patient and the therapist [5, 8]; and 2) as a state “engaged in”; thus an internal state experienced by the patient expressed via a number of observable behaviors [1]. Indeed, the development of a mutually trusting relationship (e.g. [2] between client and therapist) appears as a crucial factor in facilitating a state of engagement characterized by involvement, commitment and investment in the therapeutic encounter, which changes throughout therapy [3, 5].

The process of engagement requires an optimal motivational state defined by receptiveness (affective aspect, belief in therapist and therapy), willingness (cognitive aspect, belief in intervention effectiveness), and self-efficacy (behavioral aspect, belief that the therapeutic intervention is feasible and acceptable). Therapists and supportive technologies, as robots and games, have a key role in creating optimal motivational conditions using strategies supporting client's needs for autonomy, connection, and competence.

In this paper, we present the results of a validation study of the PARE scale designed by taking inspiration from the work of King et al. on the PRIME-O [6]. The PRIME-O is a discriminative measure designed to assess specific pediatric rehabilitation sessions on the affective, cognitive and behavioral components of engagement. Similarly, the PARE scale was designed to capture those three inter-related dimensions of engagement involving client-assistive technologies interaction in pediatric settings. This observative scale will be part of a series of measurement tools to assess the engagement of children with different levels of motor and cognitive impairments within the AVATEA project (such as EEG, Automatic Engagement Visual Recognition). A group of children, supported by therapists, will be involved in game-like rehabilitation tasks performed within virtual scenarios or with robotic companion, delivering stimulus of varying levels of difficulty and challenges [4].

2 METHODS

The PARE scale is composed of 8 items on a 5-point Likert scale comprising 3 affective, 2 cognitive, and 3 behavioral engagement items (see Table 1). For each of them, specific Behavioral Indicators have been identified that were taken and adapted from the PRIME-O scale. As for the last, the PARE is a flexible tool able to capture a variety of cognitive and/or motor impairments.

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Table 1: The PARE scale. Item 1-3 : affective subscale; Item 4-5: cognitive subscale; Item 6-8: behavioral subscale.

1) Positive reactions
The patient felt happy and experienced a positive body language during the activities.
2) Activation/arousal
The patient was active during the activities and showed positive energy levels.
3) Interest and enthusiasm
The patient was interested in and enthusiastic about the activities.
4) Attention
The patient attended and focused on the task.
5) Receptiveness and understanding
The patient appeared open or receptive and showed an understanding of what is being said/done during the activities.
6) Posture and movements
The patient assumed a suitable posture of the trunk/limbs/head during the activities.
7) Interaction with therapist/assistive device
The patient showed a positive rapport and a mutual relationship with therapist/assistive device.
8) Participation in the activities
The patient responded adequately to the proposed activities showing an active participation.
0 Not at all - 1 - 2 To a Moderate extent - 3 - 4 To a Great extent.

Affective engagement includes positive and negative reactions to the therapist/assistive device; it is crucial to create connections and to influence the willingness to perform the tasks. Examples of client's affective indicators are: good eye contact, open posture, sustained interest rather than boredom or disinterest, appropriate facial expression, warmth of the interaction, mutual responsiveness, empathy, and trust. *Behavioral* engagement ties on the idea of participation; it regards involvement in the activities, including behaviors such as effort, persistence, concentration, and attention. Examples of client's behavioral indicators are: undertaking activities, following instructions, cooperating during activities, responding to changes in session, sharing something they want to do, improve or change; establishing a mutual relationship with therapist/device. *Cognitive* engagement embraces the idea of investment; it involves thoughtfulness and willingness to exert the effort necessary to understand and master skills targeted in the intervention plans. It refers to children's affective reactions, including interest, enthusiasm, and arousal. This dimension involves children's openness to the task to be performed and the confidence in engaging with the therapist/assistive device. Examples of client's cognitive indicators are: sharing thoughts, expressing understanding verbally and behaviorally; listening to the therapist, paying attention, participating in the activity, willing to try new experiences/activities.

The two objectives of the study were: (1) to provide a measure of reliability of the instrument based on interrater consensus. To this end, the a priori criterion of agreement on the 5-point scale concerned whether the observers provided ratings within 1 point of

Table 2: Average ratings for low/high engagement videos.

Low engagement videos	average=1.375
V7=0.75, V11=0.875, V12=1.5, V15=1.625, V16=1.75, V20=1.75	
High engagement videos	2.946
V10=2.25, V2=2.5, V3=2.625, V4=2.625, V5=2.75, V6=2.75 V8=2.75, V9=2.875, V10=2.875, V13=3, V14=3, V17=3.625 V18=3.75, V19=3.875	

each other; (2) to verify the construct validity of the PARE scale that is intended to be used by professionals in rehabilitation settings.

3 RESULTS

To address the research objectives, two experienced psychologists in pediatric and elderly people rehabilitation selected, from a limited number of freely available videos on Youtube¹, a total of 20 videos of 5 to 10 minutes in length showing, to their judgment, interventions of rehabilitation with higher and lower levels of the different engagement indicators. Among the 20 videos 6 presented sessions with low levels of engagement and 14 with high levels of engagement. Subsequently, five professionals were asked to watch and rate the selected videos according to the PARE scale. Results showed that rating consensus was high: 56.4% of the ratings were identical, 38.8% were within 1 point, for a total consensus of 95.2%. With respect to construct validity, results confirmed that the videos representing low levels of engagement indicators have received significantly lower ratings than videos representing high levels (see Table 2). Indeed, low levels of engagement videos were rated 1.375 on average, while high levels of engagement videos were rated 2.946 on average. A t-test comparison of the mean for the two samples showed a significant statistical difference ($p < .001$). Moreover, the internal reliability on the scale as a whole was really good (Cronbach's $\alpha = 0.940196$).

4 CONCLUSIONS

The PARE scale has demonstrated high rating consensus and significant ratings for videos presenting higher and lower engagement and good internal reliability on the scale as a whole. We are confident that PARE may help therapists to effectively assess engagement and disengagement in pediatric rehabilitation contexts within the AVATEA project, as well as favour the implementations of new tools such as virtual scenarios and robot companions to attain successful therapy intervention and positive outcomes. The application of rehabilitation robots designed to treat motor and cognitive impairment may disclose the development of an innovative perspective based on accurate measurements of engagement in the interaction of client-therapist.

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¹URLs of the selected videos are available on request.

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