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Visual telerehabilitation in the Covid-19 era: tradition meets innovation

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Abstract

Visual telerehabilitation is crucial to rise to the challenges of Covid-19 in order to advocate impaired individuals' adaptation and social inclusion. The present research aims at detecting the predictors of the visual telerehabilitation protocol's best outcome, also exploring variables' interactions. The protocol by Chiossone Institute (Italy, Genoa) was administered in 2020 (March-May). Patients weekly video-called the orthoptists (by tablet or PC) to follow a personalized program on residual vision and diagnosis. The sample included seventy-five visually impaired individuals, across different age ranges (n=46 children and n=29 adults), who had all begun in person rehabilitation before pandemic. To detect the predictors of visual telerehabilitation effectiveness, orthoptists completed a self-report sheet with evaluation of the reaction time, participants socio-demographical data, diagnosis, residual vision, telematic session time-length, compliance level. Descriptive, linear regression, and moderation analyses were implemented. Children's reaction time was predicted by age, sessions' time-length, and compliance. Adults' reaction time was predicted by sessions' time length, without significant moderators. These findings encourage the combination of traditional setting elements and technological innovation.

Keywords: *telerehabilitation, orthoptist, visual disability, children, adults.*

Introduction

The Coronavirus is challenging the healthcare system to provide remote rehabilitation for individuals with disabilities in a global emergency context (Martinez et al., 2020). The worldwide crisis has led to a new synergy between traditional elements of rehabilitation and the innovational components provided by the Internet Communication Technology (ICTs). Across different fields and diagnoses, the need for adapting pre-existing rehabilitation protocols to the telematic environment has become a priority for rehabilitation professionals (Das & Christy, 2021), including orthoptists. All the rehabilitation services for individuals with low vision commonly aim to prevent patients' vision loss and to help them maintaining autonomy and psychosocial wellbeing (Bittner et al., 2020). Visual telerehabilitation protocols have the advantage to enable visually impaired individuals to overcome daily life physical barriers (e.g., transportation), but the problems in the use of the technology that may arise from a visual impairment (Saltes et al., 2018). Accordingly, a systematic review by Bittner et al. (2020) stresses out the importance of exploring patients' ability to access the Internet and their preferences for in-person versus telematic visual rehabilitation, suggesting alternating the two modalities. Notwithstanding this recommendation, the pandemic socio-behavioral restrictions have led orthoptists to pioneering tools entirely developed online (Senjam et al., 2021), since visual impairments are risk factors for social isolation (Cochrane et al., 2008) that may increase with the pandemic. In this sense, visual telerehabilitation protocols have been developed to advocate visually impaired individuals' social inclusion and autonomy. The lack of international guidelines and the difficulties in the use of technology by visually impaired individuals (Saltes et al., 2018) have emphasized the importance to understand the features that make visual telerehabilitation effective. This study aimed at exploring which factors predicted telematic visual rehabilitation protocol's best outcomes (in terms of reaction time) among a constellation of factors including socio-demographical factors, residual vision, disability, rehabilitation time-length (i.e., duration of each session), and compliance level. Low residual vision and pluri-disability were expected to negatively impact on the outcome. Rehabilitation time-length and compliance level were, instead, expected positively predicting reaction time.

Method

2.1 The visual telerehabilitation protocol

The visual telerehabilitation protocol by Chiossone Institute (Italy, Genoa) was implemented between March 2020 and May 2020. The patients received one session per week. During the sessions, patients had to be connected through a video call (e.g., Skype, Google Meet, Zoom, etc.) with a orthoptist using a tablet or a PC, positioning at 30-40 cm from the screen. In line with previous studies on the choice of telerehabilitation apps (Panesi et al., 2020), each participant followed a program based on her/his residual vision and diagnosis (i.e., visual impairment due to acquired brain injury, congenital brain injury, congenital pathologies of the eye).

The visual telerehabilitation protocol included different exercises in the following areas: i. Fixation stability: the patient was required to stare at a static target on the screen (see Fig. 1); ii. Visual pursuit: the patient was required to gaze-follow a target on the screen (Fig. 2); iii. Visual search and exploration: the patient was required to visually search for a target on the screen, that disappeared and re-appeared in another position (Fig. 3); iv. Saccadic eye movements: the patient was asked to stare at a target on the screen and then to stare at another one (Fig. 4); v. Visual attention: A static scene was presented on screen, then a sudden change happened, and the patient had to verbally report the alterations (Fig. 5); vi. Visual-spatial-motor coordination: the patient was asked to describe the spatial orientation of a target (e.g., stimuli that appeared rotated from their normal orientation) (Fig. 6); vii. Eye-hand coordination: the patient had to indicate with the index finger the position of a static or mobile target on the screen (Fig. 7); viii. Aid-training use: the patient was remotely trained in the use of aid devices (e.g., eyeglasses, speech synthesis instruments, visual magnifier) (Fig. 8).

Fig. 1 Fixation stability example.
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Fig. 2 Visual pursuit example.
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Fig. 3 Visual search and exploration example.
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Fig. 4 Saccadic eye movements example.
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Fig. 5 Visual attention example
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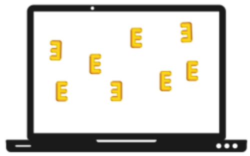

Fig. 6 Visual-spatial-motor coordination example.
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Fig. 7 Eye-hand coordination example.
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Fig. 8 Visual aid-training example.
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2.2 Sample

The study included n=75 visually impaired participants. The sample includes n=46 children (37% Females) and n=29 adults (58% Females). All the participants had already started a traditional rehabilitation program with Chiossone institute's orthoptists before pandemic.

2.3 Measures

Orthoptists completed a self-report sheet by annotating participants' gender, age, diagnosis, residual vision (in tenths), type of disability (i.e., 1=mono-disability, 2=pluri-disability), telematic session time-length in minutes, reaction time (i.e., 0=not sufficient, 1=sufficient, 2=good), compliance level. Compliance was the sum of the help received by caregivers (i.e., 1= not-helped, 2=helped) plus the level of collaboration with the orthoptist (i.e., 1=not collaborative, 2=medium collaborative, 3=highly collaborative).

2.4 Analytic plan

The statistical analyses were conducted separately for children and adults with SPSS (IBM) and Process (Hayes, 2012). In linear regression models, the independent variables were inputted as: gender and age in block 1, residual vision and level of disability in block 2, telematic rehabilitation time-length in block 3, compliance level in block 4. Reaction time was inputted as dependent variable. Moderation models were explored to test if session length and residual vision impacted the relationship between compliance (X) and reaction time (X)

Results

Descriptive analyses showed the samples main characteristics (Table 1.1).

Table 1.1. Descriptive Statistics

Descriptive statistics		
	Children (n=46, 37% females)	Adults (n=29, 58% females)
Mean Age (years)	7.48±3.86 (min=2, max=16)	72.66±11.83 (min=33, max=89)
Mono-disability	25	27
Pluri-disability	21	2
Mean Residual Vision (tenths)	2.46±2.53 (min=0, max=10)	1.36±1.58 (min=0, max=7)
Mean Session Time Lenght (minutes)	36.2±6.51 (min=30, max=45)	38.79±4.36(min=30, max=45)
Level of Rated Compliance	3.8 (Good)	4.34 (Good)
Level of Evaluated Reaction Time	1.32 (Sufficient)	1.74 (Sufficient)

In the children sample (n=46), linear regression model resulted statistically significant $F(6,39)=9.48$, $p<.001$, explaining 53% of variance ($R^2=.53$). The reaction time resulted associated with age $\beta=-.27$, $p < .05$, telematic rehabilitation session time length $\beta=.29$, $p < .05$, $\beta=.34$, and compliance $\beta=.68$ $p < .001$ (Table 2). Moderation model resulted significant at $F(5,40)=11.78$, $p<.001$ (explaining 59% of variance, $R^2=.59$) showing that the level of compliance (X) significantly predicts reaction time (Y) (B=2.23, t=2.88, p<.05, LLCI=.66, ULCI=379. The relationship between X and Y is moderated by telematic rehabilitation session time length (B=-.04, t=-2.12, p<.05, LLCI=-.09, ULCI=-.01) as the interaction between compliance and telematic rehabilitation session time length is significant (p<.05). No moderation effect emerged for residual vision (B=-.31, t=-1.41, p=.15, LLCI=-.75, ULCI=.12) (Fig. 9).

Table 2.1. Linear Regression: factors predicting children's reaction time

Independent Variables	Regression Coefficient (unstandardized)		Standardized Coefficient	t	p value
	B	SD error	Beta		
Constant	-4.30	.77		-5.58	.00
Gender M=0 F=1	.02	.23	.01	.07	.94
Age	-.07	.03	-.27*	-2.13	.03
Residual Vision	.03	.04	.07	.67	.50
Disability	.03	.23	.02	.15	.87
Session time lenght	.04	.02	.29*	2.12	.04
Compliance	.74	.14	.68***	5.29	.00

Note: p<.000***, p<.01**, p<.05*.

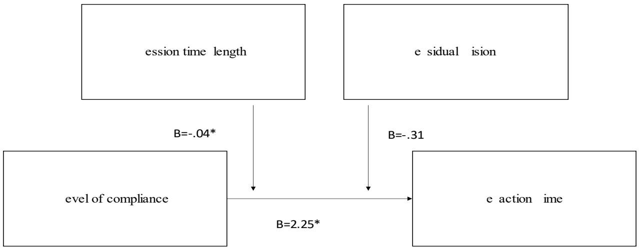

Fig. 9. Moderation model: child's level of compliance predicts child's reaction time with the moderation of session's time length.
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In the adults' sample (n=29) linear regression model resulted statistically significant $F(6.22)=5.21$, $p<.01$, explaining 47% of variance ($R2=.47$). The reaction time only resulted associated with telematic rehabilitation session time length $\beta =.73$, $p<.01$ (Table 3.1). Moderation model resulted significant $F(5.23)=5.23$. $p<.01$ (explaining 53% of variance. $R2=.53$). Moderating interactions did not result significant (Fig. 10).

Table 3.1. Linear Regression: factors predicting children's reaction time

Independent Variables	Regression Coefficient (unstandardized)		Standardized Coefficient	t	Sig.
	B	SD error	Beta		
Constant	-5.53	1.89		-2.92	.00
Gender M=0 F=1	.26	.23	.21	1.14	.26
Age	.01	.01	.23	1.19	.24
Residual Vision	.05	.07	.12	.71	.48
Disability	-.36	.45	-.14	-.81	.42
Session time lenght	.11	.03	.73**	3.29	.00
Compliance	.16	.22	.12	.74	.46

Note: p<.000***, p<.01**, p<.05*.

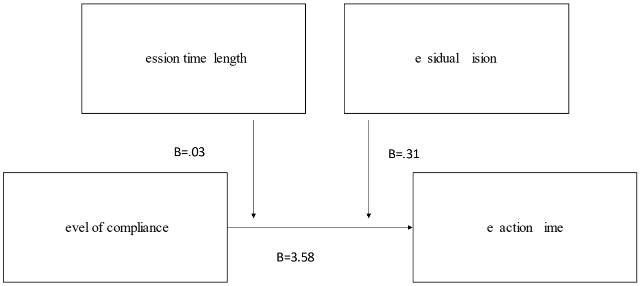

Fig. 10. Moderation model: adult's level of compliance does not predict reaction time. No moderation effects by residual vision and session time length emerge.
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Discussion

he protocol of David Chiossone's institute raised to the challenges of Covid-19 pandemic in the field of rehabilitation (Das & Christy, 2021). The present research investigated the factors predicting good reaction times of patients administered with visual telerehabilitation between March and May 2020. Findings highlight that younger children, with higher compliance, undergoing longer sessions of telerehabilitation are likely to have better reaction time as outcome. Telematic rehabilitation session time-length moderates the association between children's compliance and rection time. This data highlights the primary importance of the orthoptist-child alliance in the telematic setting. he results from the adults' sample, instead, reveal that patients that receive longer sessions are likely to have better reaction time as outcome. In telerehabilitation, the duration of the sessions emerges to be an influential factor both for adults and children, an element that should be kept as similar as possible to the traditional setting. Since no significant variables' interactions emerged among adults, increasing this sample's size will be crucial for further testing. In both samples, neither being mono or pluri-disabled not associate with the outcome confirming that telerehabilitation provides all patients with equal opportunities (Bittner et al., 2020).

Conclusion

The study presents limitations. Given Covid-19 emergency, participants recruitment was based on convenience-sampling and no a-priori power analysis was conducted. Plus, the present study is based on self-report measures by the orthoptists with a risk for social biases. Due to the lack of proper equipment at orthoptists' home, the time was assessed qualitatively. No longitudinal assessment was designed. Future studies should include quantitative data and longitudinal data for a deeper investigation of the phenomenon. Statistical comparisons with a control group (not undergoing rehabilitation) and with a traditional rehabilitation group are suggested.

Visual telerehabilitation session's time length and patient compliance predict better reaction times in the protocol trainings and exercises. These outcomes encourage orthoptists to maintain crucial elements of the traditional setting (e.g., sessions' time length, therapeutic alliance) in telerehabilitation. Conclusively, the experience of David Chiossone Institute raised to the challenges of pandemic crisis, combining tradition and innovation through knowledge and enthusiasm.

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