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CyberTherapy meets COVID-19: The Potential of Positive Technology Against the Burden of Coronavirus

Editors:

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ANNUAL REVIEW OF CYBERTHERAPY AND TELEMEDICINE 2020

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Virtual Reality Meets COVID-19: The Potential of Positive Technology Against the Burden of Coronavirus

Edited by

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ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. The mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of CyberTherapy and Telemedicine through original investigations in the Telemedicine and CyberTherapy areas, novel experimental clinical studies, and critical authoritative reviews. It is directed to healthcare providers and researchers who are interested in the applications of advanced media for improving the delivery and efficacy of mental healthcare and rehabilitative services.

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Our publication pays careful attention to the protection of a patient's anonymity in case reports and elsewhere.

Identifying information such as names, initials and hospital numbers must be avoided. Also, authors should disguise identifying information when discussing patients' characteristics and personal history.

Preface

ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. This mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of Cybertherapy and Telemedicine through original investigations in the telemedicine and cybertherapy areas, novel experimental clinical studies, and critical authoritative reviews.

Healthcare delivery systems have been evolving to rely more heavily on technology. There has been a shift in care diagnosis and treatment which has decreased the importance of traditional methods of care delivery. Technology has not only helped to extend our lifespan, but it has improved the quality of life for all citizens.

We have put a great deal of effort into the definition of the structure of the volume and in the sequence of the contributions, so that those in search of a specific reading path will be rewarded. To this end, we have divided the different chapters into six main sections:

1. Editorial: This introductory text expresses the position of the Editors – Brenda K. Wiederhold Giuseppe Riva - about the focus of this year's issue;
2. Critical Reviews: These chapters summarize and evaluate emerging cybertherapy topics, including technology, enhanced rehabilitation, Interreality, and Intersubjectivity;
3. Evaluation Studies: These chapters are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;
4. Original Research: These chapters research studies addressing new cybertherapy methods or approaches;
5. Clinical Observations: These chapters include case studies or research protocols with long-term potential.
6. Work in Progress: These chapters include papers describing a future research work.
7. Brief Communications: These chapters include brief papers reporting preliminary data on-going research work and/or new developments.

For both health professionals and patients, the selected contents will play an important role in ensuring that the necessary skills and familiarity with the tools are available, as well as a fair understanding of the context of interaction in which they operate.

In conclusion, this volume underlines how cybertherapy has started to make progress in treating a variety of disorders. However, there is more work to be done in a number of areas, including the development of easy-to-use and more affordable hardware and software, the development of objective measurement tools, the need to address potential side effects, and the implementation of more controlled studies to evaluate the strength of cybertherapy in comparison to traditional therapies.

We are grateful to Silvia Serino and Ian T. Miller for their work in collecting and coordinating chapters for this volume.

We sincerely hope that you will find this year's volume to be a fascinating and intellectually stimulating read. We continue to believe that together we can change the face of healthcare.

Brenda K. Wiederhold
Giuseppe Riva

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Section VI. Work In Progress

SECTION I

EDITORIAL

This introductory text expresses the position of the Editors – Brenda K. Wiederhold and Giuseppe Riva - the focus of this year's issue.

Brenda K. Wiederhold and Giuseppe Riva

Virtual Reality meets Artificial Intelligence: The Emergence of Advanced Digital Therapeutics and Digital Biomarkers

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Abstract. In the past 25 years, researchers have discovered that Virtual Reality (VR) is an effective tool for mental health treatment and assessment in anxiety disorders, eating and weight disorders, and pain management with long-term effects that generalize to the real world. Moreover, VR is also an effective assessment tool with practical applications that range from social and cognitive deficits to addiction. Nevertheless, despite progress, evidence-based psychological treatments still need improvement. In this paper we suggest that the integration of VR with another emerging technology – Artificial Intelligence (AI) – will provide clinicians with two new powerful tools for improving evidence-based psychological treatments: advanced digital therapeutics and digital biomarkers. The term "Digital Therapeutics" indicates the use of digital/online health technologies to treat a medical or psychological condition. Following this definition, any VR clinical application can be defined as a form of digital therapeutics. However, the integration between VR al AI allows a critical feature for any digital therapeutic: personalization. On one side, VR allows the collection of "Digital Biomarkers" - physiological, and behavioral data that are collected by means of digital technologies and used as an indicator of biologic processes or biological responses to therapeutic interventions – that are directly connected to the brain functioning and can be altered to correct the specific dysfunctions of the predictive coding mechanisms in the individual's brain. On the other side AI, by applying machine learning techniques to the individual's digital biomarkers, allows the optimization the individual treatment strategy facilitating the transition to a personalized, effective and engaging medicine.

Keywords. Virtual Reality, behavioral health, neuroscience, digital therapeutics, digital biomarkers, embodied medicine

1. Introduction

In the past 25 years, researchers have discovered that Virtual Reality (VR) is an effective tool for mental health treatment and assessment. As suggested by two recent meta-reviews [1, 2], VR is a successful treatment in anxiety disorders, eating and weight disorders, and pain management with long-term effects that generalize to the real world.

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Moreover, VR is also an effective assessment tool with practical applications that range from social and cognitive deficits to addiction. Nevertheless, despite progress, as clearly underlined by Homes and colleagues [3]: “evidence-based psychological treatments need improvement.” (p. 288). In particular, the integration of VR with another emerging technology – Artificial Intelligence (AI) – will provide clinicians with two new powerful tools for improving evidence-based psychological treatments [4, 5]: advanced digital therapeutics and digital biomarkers.

2. Virtual Reality meets Artificial Intelligence

According to Wikipedia, “Digital Therapeutics” are “a health discipline and treatment option that utilizes digital and often online health technologies to treat a medical or psychological condition.” Following this definition, any VR clinical application can be defined as a form of digital therapeutics. However, as underlined by different researchers, a key feature of these tools is “personalization” [6, 7]: the individual treatment strategy is optimized through the use of technology. For example, by applying machine learning techniques to the patient's data.

Machine learning is an emerging AI approach that uses statistical approximation to learn from a data set and make predictions without being programmed with explicit rules [8]. More, differently from expert systems that use rules-based algorithms, machine learning improves and learns with experience via exposure to large and new data sets. Finally, the machine learning approach is data independent: the same tools used for medical imaging interpretation can also be used to assess human personality, allowing for rapid expansion in different fields. The power of machine learning fits well with one of the key characteristics of VR: the total control over everything enacted (implicit and explicit behaviors) and experienced (emotions and cognitive states) by its user. In other words, VR brings different and effective digital biomarkers to AI that facilitate an advanced prediction and personalization of the therapeutic approach.

The term “biomarker” indicates a physiologic, pathologic, or anatomic characteristic objectively measured and used as an indicator of biologic processes - normal or pathologic - or biological responses to therapeutic interventions [9]. Following this definition, “digital biomarkers” are a set of objective, quantifiable, physiological, and behavioral data that are collected and measured by means of digital technologies used to explain, influence and/or predict health-related outcomes [10]. The use of VR allows the direct collection and storage of many digital biomarkers, both related to the behavior – explicit (i.e., movements, speech and language, etc.) and implicit (i.e., facial expressions, eye-movements, saccades, etc.) – in the virtual environment and to the different characteristics of the physiological states associated to it (i.e., heart rate, EEG data, etc.). Additionally, the collection of these digital biomarkers is mostly transparent for the user, since many sensors are directly embedded in the VR tools and the input/output devices.

3. Brain-like Digital Biomarkers

The power of VR is not only related to the quantity of digital biomarkers it allows to collect, but also to their quality. Different major discoveries in the field of neuroscience suggest that our brain produces and updates an embodied simulation of the body in the world: the “body matrix” [11, 12]. This simulation is actively used by different cognitive processes to represent and predict actions, concepts, and emotions [13-15].

VR works in a similar way: through the integration of data from trackers and contents of a simulated 3D world, a VR system builds a model (simulation) of the body and the space around it. If we compare this process with the one used by the brain, the VR system - like the brain - uses the simulation to predict the sensory consequences of the individual’s movements [12]. This prediction is then used to provide, using the VR hardware, the expected sensory input: the same scene the user would see in the real world after the tracked movements. Obviously, to be realistic, the VR model tries to mimic the brain model as much as possible: the more the VR model is similar to the brain model, the more the individual feels present in the VR world [12, 16].

As noted by Riva and colleagues [12], if presence in the body is the outcome of different embodied simulations, and VR is a simulation technology, then assessing the experience of the body and the cognitive processes directly connected to it by designing targeted virtual environments is a possibility.

A series of recent studies support this vision. Serino and colleagues [17] and Realdon and colleagues [18] recently compared the efficacy of a simple immersive non-interactive VR experience - the Picture Interpretation Test (PIT) 360° – with standard conventional paper and pencil tests of executive functions in two different clinical samples: Parkinson’s disease and Multiple Sclerosis patients. In both samples, while standard neuropsychological tests failed to differentiate between clinical and non-clinical groups, the PIT 360° was successful in detecting executive dysfunctions. More, all participants described the PIT 360° as an engaging tool and reported positive reactions to their experience. In another study, Pedroli and colleagues [19] used VR to investigate executive functions in individuals with obsessive–compulsive disorder. Using either two VR scores or three neuropsychological tests was possible to discriminate between patients and controls.

4. Digital Therapeutics 2.0

The direct link between VR and brain functioning also makes VR an “embodied technology” able to update/modify the embodiment experience of its users [2]. Specifically, this feature suggests the use of VR as an advanced digital therapeutic tool able to correct the dysfunctions of the predictive coding mechanisms (embodied medicine [20, 21]).

Different authors [20] recently suggested that an altered functioning of the predictive and simulative mechanisms of the brain might be the causes of different neurological and psychiatric conditions. In this view, it should be possible to counteract these deficits through the modulation and/or integration/replacement of the different components of the Body Matrix [12, 22-24]. Specifically, VR can be used to generate new cross-modal associations between bodily stimuli that have not been experienced as systematically related before [25]. Moreover, the cross-modal association has to produce a *significant prediction error* (high surprise), reducing the level of estimation uncertainty, to update the predictive internal models of the body matrix through the generation of new priors [20]. Using this approach, technology can be used:

1. *to facilitate the integration of external and inner body signals* [26-28] and,
2. *to induce a controlled mismatch between the predicted/dysfunctional content and the actual sensory input* [29].

The emerging fields of interoceptive technologies [26, 30, 31], sonoception – the use of sound and vibration to modify inner body signals [20, 28] – and body illusion techniques [32], support the feasibility of this approach.

In conclusion, even if digital biomarkers and digital therapeutics can be obtained using different technologies, the integration between VR al AI may offer more advanced solutions. On one side, VR allows the collection of digital biomarkers that are directly connected to the brain functioning and can be altered to correct the dysfunctions of the predictive coding mechanisms in our brain. On the other side AI, by applying machine learning techniques to a patient's digital biomarkers, can optimize the individual treatment strategy facilitating the transition to a personalized, effective and engaging medicine.

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SECTION II

CRITICAL REVIEWS

In general, there are two reasons why cybertherapy is used: either because there is no alternative, or because it is in some sense better than traditional medicine.

In this sense telehealth has been used very successfully for optimizing health services delivery to people who are isolated due to social and physical boundaries and limitations.

Nevertheless, the benefits of cybertherapy, due to the variety of its applications and their uneven development, are not self-evident.

However, the emergence of cybertherapy is supporting the cost-effectiveness of certain applications, such as assessment, rehabilitation and therapy in clinical psychology and neuroscience.

Wiederhold & Riva, 2004

A Call for Responsible Innovation in Mobile Mental Health: Content Analysis of the Depression App Marketplace

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Abstract. Mobile mental health presents many ethical challenges in the wild. These ethical issues were explored through a content analysis of the depression app marketplace. App search in Google Play Store (UK) and Apple App Store (UK) found 353 unique apps for depression. Analysis uncovered a range of ethical issues and highlighted the limited presence of ethical values. Our findings suggest a need for designers to adopt a responsible innovation approach to creating mental health technologies that meet these ethical demands.

Keywords. mobile mental health, ethics, responsible innovation, content analysis

1. Introduction

There has been increased discussion of the ethics of mobile mental health [1-5] with authors highlighting issues in areas of privacy and data security; risks and safety; benefits and evidence; and transparency and trust. Content analyses of apps for depression report insufficient evidence of app use and outcomes [1,2,6,7], poor fidelity to evidence-based interventions [1,8], limited disclaimers and integration of real-world care [2,7,9,10], inadequate reporting of expert involvement [8], and insufficient privacy policies [9]. Few authors have framed these discussions within existing ethical frameworks, such as biomedical ethics [5] and the principles of the American Psychological Association [3,4].

Principlism [11] and professional ethical codes [12-14] provide structure for reflection on ethical practice and issues which are highly relevant to mobile mental health. Our research builds on previous content analyses to explore the ethics of mobile mental health, with a focus on apps for depression. Guided by principlism, professional ethics, and the literature on the ethics of mobile mental health, we conducted a content analysis of app store listings of apps for depression to determine: (1) *What ethical issues are evident in the depression app marketplace*? and (2) *How do these issues reflect ethical values in app design, development, and marketing*? This study extends our previous evaluation of depression app store treatment descriptions [1] by providing an ethical review of depression app store listings with the aim of framing findings within existing ethical frameworks and developing guidance for increased ethical practice

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2. Methods

App search and data collection was conducted between October to November 2018. Detailed methods were outlined in our companion paper [1] and will not be repeated in full. Search was performed in the two main UK app stores—Google Play and Apple App Store—using the terms “depression” and “mental health”. Apps for depression were defined as those with app store listings mentioning depression or depressive symptoms. Search returned 353 unique apps for depression (see [1] for sampling flowchart).

Data extraction and coding were done iteratively within the research team using a list of variables compiled prior to review and developed throughout as ethical issues emerged (see [1] for coding and list of eligible apps). This was guided by established ethical principles [11] and professional codes of conduct in disciplines relevant to mobile mental health [12-14]. Descriptive statistics were computed using SPSS version 25.

3. Results

Analysis found several ethical issues summarised herein under related ethical principles.

3.1 Beneficence

Beneficence relates to doing good or benefiting others. App store descriptions widely touted the suitability and benefits of apps for depression. Yet, there was a notable lack of evidence to support these claims, with most apps (89.0%, 314/353) lacking research evidence of app use, efficacy, risks, or outcomes. This is an especial concern given our previous findings questioning the treatment validity and fidelity of many apps. As reported in [1], none of the apps reviewed fully aligned with clinical guidelines, with app descriptions conveying limited use of evidence-based approaches.

3.2 Nonmaleficence

Nonmaleficence relates to doing no harm. In addition to limited evidence of outcomes and potential adverse effects, there were noted issues in areas of safety. Most app descriptions (80.7%, 285/353) did not provide disclaimers of use or limitations, with some even stating inaccurate information (4.3%, 15/352) or unsafe claims (2.3%, 8/352). Moreover, app listings offered limited provisions for vulnerable groups such as children and young people. Most app store age ratings of apps for depression were rated as appropriate for children and young people; 92.8% (233/251) of apps in Google Play were assigned an age rating of PEGI3 (suitable for all ages) while the most assigned age rating in Apple App Store was 4+ (43.5%, 60/138) followed by 12+ (37.0%, 51/138).

3.3 Responsibility

Responsibility refers to one’s duty or obligation to perform in a certain manner. For our review, it included ensuring the competence of the development team; providing evidence of intervention validity and safety; safeguarding and duty of care; and compliance with regulations. Overall, there was inadequate reporting of the involvement of multisector stakeholders and experts in app design and development. As many as 57.8% (204/353) of apps appeared to be developed by private entities without mention of the involvement of healthcare or other stakeholders. There was also a poverty of apps reporting certification by regulatory bodies, with only five (1.4%) stating some form of certification such as a CE mark for a medical device. There was no standardised reporting of certification in app stores, adding to the difficulty in locating this information.

3.4 Integrity

Integrity describes being honest, moral, and accountable. It includes transparency and accuracy of information communicated to the public. A pervasive finding was the lack of thorough and accurate information provided in app listings regarding fundamental aspects of apps, such as treatment information, evidence, risks and safety, developer information, and app costs and sources of funding. While developer contact information was provided for 91.2% (322/353) of apps, a third (31/94) of apps in Apple App Store failed to provide any contact information. Information on sources of funding was also not found for 84.4% (298/353) of apps, with only four apps declaring that they had received no external funding. This not only highlights issues with transparency with respect to app business models, but also raises questions of possible conflicts of interest that can pose potential risks to user rights.

3.5 Autonomy

Autonomy relates to self-determination and the right to make informed decisions without deception. Without accurate and transparent information, potential users are unable to make informed choices regarding the selection and use of apps. This applies to all aspects of apps, with the poverty of information in areas of treatment, evidence, developer information, and business models all negatively impacting users' informed consent. This was further seen with issues of privacy and confidentiality. In total, 74.2% (262/353) of app listings provided a privacy policy, yet only 41 (11.6%) apps made explicit mention of privacy policies in app store descriptions. Google Play listed information on app permissions for all apps (n=259), but this was not provided in Apple App Store. Overall, only three (0.9%) apps explained the reason for permissions in their app store description, allowing users to make informed considerations about permissions prior to download.

3.6 Justice

Justice describes being fair and reasonable. It includes issues related to equality and access to care, which in the case of mobile mental health may be impacted by initial and future costs. Although most apps were advertised as free to download (94.3%, 333/353), 60.3% (213/353) were free with in-app advertising, purchases, or subscriptions. Yet, these costs were often not outlined in app descriptions, limiting users' capacity to make informed decisions about treatment costs and their ability to access continuous care.

4. Discussion

This study demonstrates several ethical issues in app stores and listings of apps for depression. These issues have been presented under the ethical principles of beneficence, nonmaleficence, responsibility, integrity, autonomy, and justice. By using principlism as a guide [11], our review captures not only the ethical shortcomings of depression apps, but their interrelations and complexities. Singular examples of ethical issues, such as a lack of evidence, often reflect multiple ethical concerns, in this case related to questions of benefits and harms, lack of transparency of treatment information, and insufficient information for users to make informed choices. There is therefore value in the application of principlism in helping to frame these ethical issues and their wider impact.

While our review highlighted a range of issues, we can infer ethical priorities in the design of apps for depression based on the reduced incidences of some issues as well as progress made since previously reported findings. This is most apparent in the case of privacy practices, with our study finding a higher frequency of the provision of privacy policies than previously reported [9]. Similarly, while apps continue to fall short in their use of evidence-based interventions, our findings demonstrate an attempt by many to develop evidence-informed apps [1]. App developers appear to prioritise these areas and the associated values of privacy and validity relative to other aspects of app design and development. Despite calls for increased evidence [3,4], apps for depression continue to be significantly under researched. Additional safety concerns persist with the continued underuse of disclaimers [7] and inadequate guidance and provisions for use by vulnerable populations [2]. This raises concerns of the undervaluing of safety and welfare, risk minimisation, and duty of care. The insufficiency of information throughout also highlights undervaluing of transparency, credibility, and informed consent.

Our review demonstrates the complexity of mobile mental health and the difficulty developers may have in navigating ethical issues and value conflicts. Developers may feel the need to prioritise some values over others, e.g., by prioritising app production over evidence-based development or prioritising universal access over safeguarding. To assist in navigating these ethical complexities, we encourage responsible innovation [15] and value sensitive design [16] in mobile mental health. Responsible innovation is *"a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability, and social desirability of the innovation process and its marketable products"* [15 p.39]. We believe by applying the four dimensions of responsible innovation—anticipation, reflexivity, inclusive deliberation, and responsiveness—developers would better anticipate and respond to ethical issues and conflicts (Figure 1).

Anticipation	Reflexivity	Inclusive deliberation	Responsiveness
Consideration of potential risks and impacts on users and wider society Performed at conceptualisation and throughout app lifespan	Reflecting on the purpose, motivation, and potential impacts of app Consideration of knowns and unknowns, values, assumptions, and conflicts	Engaging with stakeholders to deliberate all aspects of app, values, and impact User and stakeholder involvement from conceptualisation and throughout	Adapting and responding to reflections and deliberations throughout *"An iterative, inclusive, and open process of adaptive learning"* [15, p.38] with feedback into the process

Figure 1. Four dimensions of responsible innovation applied to mobile mental health

A strength of this approach is the emphasis on responsiveness which encourages iterative reflection, inclusion, and adaptation throughout the design and innovation process for the app lifespan. As developers will not be able to fully anticipate all outcomes or risks of apps at design stage, it is crucial through continuous reflection and stakeholder engagement to envisage and amend the long-term impact of apps.

Responsible innovation also encourages developers to use ethical or moral conflicts (e.g., access vs safeguarding) to propel innovation to meet both moral obligations [17]. In such a manner, developers may consider how to design and develop apps that assess users' capacity to make informed choices regarding their treatment, rather than limiting access to all potentially vulnerable groups or providing open access without safeguarding measures. We encourage developers to reflect on value conflicts and ethical issues and to work with stakeholders to utilise technology to design new ways of overcoming ethical challenges and improving ethical practice.

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Reviewing mobile apps for memory impairments in depression

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Abstract. Depression is a major affective disorder that influences autobiographical memory processing abilities. Mobile phones hold great potential for delivering effective self-help treatments for addressing such issues. This work explores apps that support users' everyday challenges associated with depression and memory processing and highlights the current supported functionalities. These could be used to inform the development of novel functionalities tailored to address depression-related memory issues and consequently mitigate depressive symptoms.

Keywords. Depression, memory, mHealth, mobile apps, review

1. Introduction

With significant socioeconomic costs, depression is a major affective disorder impacting over 300 million people worldwide [1]. Addressing this raises significant challenges, both for providing clinical interventions and everyday self-care strategies [2]. Scholarly work has explored mental health interventions [3] more broadly. In addition, mobile phones hold much potential to scale up the provision of interventions that target depression, most often through structured psychological interventions [4]. Researchers, however, have called for the importance of also exploring additional interventions such as those building on users' life narratives [5]. The latter are promising because they particularly target memory processing associated with depression [6]. Recent studies have shown depression is associated with a few distinctive autobiographical memory processing dysfunctions [6, 7] such as over-generalized, negatively-biased memory retrieval, and difficulties in encoding and retrieving positive memories. Prior studies have suggested design opportunities for mobile applications to reduce depressive symptoms by helping users improve their self-memory processing abilities [7], especially for assisting purposeful encoding and retrieval of positive memories [6], enhancing the positive affect of retrieved positive memories, and alleviating rumination [6]. These findings call for further work on memory technologies in order to assist memory processing and alleviate specific impairments in depression [6]. This work aims to identify key functionalities of currently available, top-rated mobile apps with the potential to address memory impairments in depression. Future work will focus on evaluating their effectiveness in addressing memory impairments in depression, and on the provision of guidelines for advancing current apps.

2. Method

App reviews have been increasingly used to explore the design space of commercial apps [8, 9]. This review was carried out on two major mobile app marketplaces: Apple

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(iTunes), Android (Google Play) in Spring 2019. For retrieving the apps for depression, we used the keyword “depression”. For retrieving memory apps, we used the following keywords: “diary”, “mood tracker”, “mood memory”, “journal”, and “daily event” as these were most likely to capture apps for recording and retrieval of daily emotional events. We used a script [5] to extract all apps yielded from searching each of the keywords. Initially, we retrieved 482 depression apps and 3119 memory apps. We then filtered these two sets of apps separately, by excluding apps that: 1) have less than 10reviews, 2) are in irrelevant categories, 3) do not mention keywords such as “depression”, “diary” or “mood” in either title or description, 4) are not accessible at the time of selection, and 5) had average user review scores lower than 4.0 (out of 5.0). This resulted in 34 memory apps and 11 depression apps that meet the inclusion criteria. After removing duplicates, 20 apps were finally selected for evaluation (see Appendix), including 7 apps yielded from searching memory-related keywords, 9 apps from depression keywords, and 4 apps from both. The first author extracted descriptive characteristics of the apps from the marketplace (e.g., price), and has used all apps on an iPhone and a Xiaomi phone to extract the functionalities and iteratively revise the codes.

3. Results

3.1. Apps providing therapeutic functionality for treating depression

Mood tracking is the most common therapeutic functionality employed by 75% of the apps (15/20). While one-third of apps provide solely mood tracking (30%, 6/20) functionality, most apps (60%, 9/15) support mood tracking integrated with other functionalities. Of these 9 apps that provide mood tracking as an assistive tool for depression interventions, 27% (4/15) provide mood tracking for assisting CBT as their main intervention for depression. However, such apps mainly allow users to record their mood and thoughts, as well as to log their daily activities that trigger their moods. Another 20% (3/15) apps allow users to track moods during prompted activities, while 2 apps combined mood tracking with drugs or pain tracking (e.g., Pain Diary). In addition, apps that solely provide mood tracking functionality aim to alleviate users’ depression by revealing their mood swings and factors that affect their mood (such as exercise or drugs), as well as by reinforcing daily habits that lead to positive emotions. Thought diaries are another popular therapeutic functionality, provided by 65% of the selected apps (13/20), with 23% of the apps (3/13) solely providing thought diary function for treating depression and assisting users’ memory processing. We found interesting mechanisms for alleviating depression within CBT apps (31%, 4/13), which allow users to record their thoughts for understanding the underlying negative thinking patterns and for challenging them. In addition, another 4 apps combined thought tracking with mood tracking, whereas 2 apps allow users to record their thoughts during mindfulness practice (Mindfulness daily, Pacifica). Positive and healthy activities concerning mindfulness, exercising, sleeping and eating, and those for encoding positive daily events were also popular therapeutic functionalities provided by our selected apps. 35% of the apps (8/20) encourage users to engage in healthy activities such as meditation (50%, 4/8) or other activities (50%, 4/8) such as drinking water. Another 33% (4/12) encourage users to find and record daily positive events, and record gratitude in journals.

3.2. Apps functionalities for assisting memory processing

We found textual templates provided by most of the apps (75%, 15/20) for guiding users’ recording process, and in particular 15 apps supporting mood tracking, 69% (9/13) apps supporting thought tracking, and 93% (13/14) apps tracking the completion of positive activities. Surprisingly, we found that one-fifth of the thought tracking apps (23%, 3/13) do not provide such templates for recording users’ input, albeit 2 of these apps specifically claim to assist emotional writing and to encourage gratitude (Chronicle, Gratitude Journal 365). However, such apps fail to provide specific guidance on how users could tackle depressive recorded thoughts. For activity tracking, only one app does not provide a template, as this app automatically logs users’ achieved activities (i.e., in-app meditation). In addition, most templates are static and generic, which guide users to select their current mood from a set of provided emoticons, then record annotations or notes by either selecting textual tags or entering text. Good practices for improving users' engagement during recoding were found in 2 apps that deliver templates during users' conversation with chatbots (Wysa, Youper).

All of the 15 mood tracking apps provide templates to log users' mood with general cues (i.e., emoticons or texts). Within such apps, 80% (12/15) also allow users to record personal cues through short textual notes (33%, 5/15) or more enriched information (47%, 7/15). For instance, for proving more enriched contextual information of the mood log, 1 app (Happify) allows users to attach a photo to each mood logs, and another 2 apps allow users to track changes of their mood before or after of their mindfulness practice (Mindfulness Daily, Pacifica - Stress & Anxiety). Most of the selected apps (92%, 12/13) allow users to collect enriched, personal thought record, albeit a fourth of them (25%, 3/12) only record a short note, and 1 app (Youper) does not provide access to users' thought record. With two exceptions (Happify that allows attaching photos, Pacifica that allows voice input), the majority of apps collect and present the users' thought record in textual format. The logs for more than half of the apps (71%, 10/14) are pre-defined （e.g., users can only select and log provided template such as emoticons, while cannot enter self-generated content), with no cues to support later specific memory retrieval of users' memories during mindfulness practice. Only 4 apps allow users to encode notes as cues, to support later recall of their positive memories.

4. Discussion

Prior work suggested the importance of depression apps to provide functionalities for encouraging users to actively engage and record positive events [6]. We found that although 70% (14/ 20) apps offer functionality that supports users to engage in positive activities, their activity logs are mostly pre-defined, thus with little cues to support later memory retrieval. We thus call for more enriched content for app-assisted activity logging. For instance, we found 4 apps providing good such examples by allowing users to input textual thought (e.g., MoodKit), or attach photos (e.g., Happify) in their activity logs. In addition, although purposeful planning of positive activities is both beneficial for activity engagement and effective in treating depression [10], most apps fall short of providing a specific goal and plan for the prompted activities. We only found 3 apps that allow users to set goals by providing target activities (e.g., Moodkit, Fabulous). Our finding revealed that apps solely rely on users' own ability to engage with the prompted activities, which suggest potential for future apps to provide further assistance to help users if they disengage because of low motivation or avoidance tendency [6].

Findings suggest opportunities for supporting enhanced positive memory processing with enriched content and multimodal cues. Most of the apps support users tracking at least one aspect, such as moods, thoughts, or daily activities. The tracked data is beneficial, as it can work as memory cues to support users' later recall. However, such recorded content tends to be generic, with little personal input from users, which may fall short of supporting users' memory recall. For instance, 64% of the activity tracking apps and 33% of mood tracking apps only support generic or brief logs, with limited uniqueness and therefore cue efficiency [11]. We thus suggest that apps for assisting memory impairments in depression should collect and present more enriched, if possible multimodal content for enabling later memory recall. As highlighted by memory research [12], it is vital to collect contextual information such as activity, spatio-temporal content, or people involved in a specific event, to support recall. While such content is essential [12], it may be challenging for users to generate sufficient cueing information (e.g., who, where, what) without assistance. Therefore, it is beneficial to provide templates for guiding users through the recording process, for which good practices have started to emerge. Good practices were found in 36% (5/14) apps providing templates for recording richer content from users to complement the default activity logs.

Additionally, depression is often associated with cognitive dysfunctions including difficulties in vividly and experientially retrieving positive memories [7]. Prior studies

[6] suggested that memory technologies for addressing impairments in depression should provide enriched and expressive cues to assist retrieval, while multimodal cues may better support multisensory engagement, and thus specifically beneficial for memory retrieval. Our findings reveal that the selected apps mainly support data in textual format and rarely support cues in other modalities (i.e., only 3 apps support pictorial cues, 1 app supports voice input). We suggest that apps for treating memory impairments in depression could further leverage the affordances of digital devices for multimodal cues (e.g., visual cues or sensorial cues such as odour or taste) [13, 14].

We also emphasize the importance of apps for depression to offer selective retrieval of emotional memories according to users' current mood. Previous findings indicate that viewing material associated with negative memories, when users are in sad moods, can trigger rumination increasing the risk of harm [6]. Our findings revealed that, although 2 out of 20 apps access users' mood while using the app (Happify, Pacifica), no app filters the recorded content which can act as memory cue according to the negative valence and users' current mood. In addition, only 4 out of 20 apps support users to search or selectively view the recorded memory cues through keywords, while no app enables users to filter the recorded memory cues based on their valence.

5. Conclusion and future perspectives

This work explores the potential of mobile apps to support users' memory processing in depression. Our study is the first to explore the shared functionalities of the two types of selected apps: those for depression and for memory processing. Future work will focus on the evaluation of these apps, and recommendations for guiding the design of memory technologies for depression. Our finding suggests that developers of apps for memory impairments in depression need to better support users to actively plan and engage with positive activities, as well as to purposefully encode cues with more enriched content for later retrieval of such positive memories. In addition, the analysis of apps functionalities provides new insights into opportunities for mitigating harm by safeguarding users' during low motivation, and selectively retrieving emotional memories during sad mood.

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Robotic vision and embodiment. A social and educative hypothesis of experience with robots

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Abstract. The proposal is based on considering the robot (social and educational) as a medium; in this way and through it, we could be in relationship with the environment. Particularly, we want to concentrate on the robotic vision and how it could be useful as mediator in emergency contexts, such as current pandemic COVID-19. We hypothesize that the human-robotics relationship can allow the co-built of several visual, social, performative, and meaningful experiences. The paper aims to highlight the theoretical framework and some empirical and heuristic guidelines to use educative robots in this modality, as a methodology to enhance visual, expressive and communicative competences.

Keywords. Social Robots, Educational Robotics, Audio-visual Language, Embodiment, Vision

1. Introduction: a Human-Robot peer-relationship?

The relationship between man and robots, as a technological form, has been depicted many times over the years in a variety of narrative media. The earliest known of these depictions is *R.U.R.* by Czech playwright Karel Capek (1920); robots created in Dr. Rossum's laboratory are a form of primitive hybridization between human genes and technological elements, creating a sort of cyborg *ante litteram*. Since then, robots have been portrayed in many literary works—Isaac Asimov[2] dedicated his collection *The Complete Robot* to these machines, and Philip K. Dick's *Do Androids Dream of Electric Sheep* is one of the most famous of these stories. Cinema has also often used man-robot relationships as an inspiration, highlighting and translating into images some of the natural inclinations of humanity to place (conditional) confidence in its potential substitute simulacra. In general, many of the narrative works mentioned here are responses to the need to focus on robots' ability to see; all of the entities involved in these different productions are able to see, perceive and cognitively process reality, and therefore to propose their own point of view. This hypothesis is based on an interdisciplinary approach, according to philosophy of media and post-phenomenological theories [1-2-3-4-5]; studies on technological vision [6-7]; human-robot interaction (HRI; IEEE); aesthetics and media experience [8-9-10]; cognitive and technological theories [11-12-13]; and obviously, educational and interactive robotics, and studies on robots used to create cultural objects [14-15-23-24]. Nowadays, the question of a relationship between humankind and robotics is expressed mainly in terms

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2 One of the first films inspired by Asimov's works was The Forbidden Planet (Wilcox, 1956), followed by The Invisible Boy (Hoffman, 1957), both of which starred Robby the Robot.

of HRI and from the point of view of engineering approaches, and computer-based studies; however, some inquiries follow the ontological and phenomenological directions. Thus, according to Breazeal [19], we can individuate four typologies of robotic interactions: the robot as a tool, cyborg extension, avatar and sociable partner. In this brief paragraph, we focus on these typologies. Social robots, like Nao and Pepper, can represent a technological avatar of humans because they are an 'organismoid embodiment'; they could be considered a reflection of the human cognition, agency and performance, and are also useful to sustain identity processes of self-adaptation. Obviously, robots can be tools and extensions to man: they are both tools with which it is possible to make something and they could be a cyber-replacement of a part of the body; but they can also be a perceptive extension and an upgrading of human skills, such as increased vision perception, or as an embodiment of robotic touch. Certainly, robots are intermediaries between a human user and the environment because robots and humans can act reciprocally, modelling and motivating one another's reactions using technology; and, from the point of view of the post-phenomenological theories, robots are technologies with which it is possible to interact in several modes. According to Ihde [12] and Rosenberger and Verbeek [21], robots could be technologies with which we can acquire a 'hermeneutic relation', that is, they can interpret reality and provide us their perspective. At the same time, we can have an 'alterity relation' with them, that is, we can have a similar relationship with robots as we have with other humans. This aspect also allows both the reflexive processes hinted on above and to investigate a hypothesis of a relation of intentionality between humans and robots. In this case, a human-robot relation could construct a sort of media 'dispositive' that allows the enrichment of human skills and to feel a sense of being 'in' the robotic body [2].

Based on these guidelines, and previous quantitative surveys on robotics [16], we want to propose the heuristic hypothesis that the use of some robots currently on the market—especially those designed for educational and social use—can also provide their own interpretations of reality through their ability to see, possibly paving the way to a deeper relationship with humans. That is to say that social robots, i.e. Nao and Pepper previously mentioned, have the possibility of returning the image (via tablet or screen) of the person in front of them, thus allowing the chance of self-recognition through the robot-eyes perspective (cameras) in a sort of a mirror game. Moreover, the return is not only a fact of image, but it is something deeply connected with relational and social aspects. The social robots can "read, interpret, and tell" the surrounding reality through the algorithms: for instance, they can analyse the face of a person and try to associate some specific characteristics with a gender (female or male), an age category, or, additionally, to estimate some emotional expressions (i.e., a certain degree of happiness, sadness, anger, or surprise).

All these pieces of information, together with others eventually collected during the interaction, can be stored in the robot memory and used for future meeting, augmenting the feeling of a real social experience [25]. In this way, it should possible to realize educational products in which children and robots could interact and co-build media and educative tools, also choosing the audio-visual language as a synthesis of potential—and complex—semiological generation and integrative system. This study will theoretically explore this prospective, also referring to some applied experiments 'on the field'. Due to the COVID-19 emergency, we have not been able to test this hypothesis the way we would have liked. Besides, to illustrate how our research continues despite the lockdown, we want to present a heuristic use of the social robot Nao as YouTuber as a form of mediation for children during the pandemic quarantine.

2. Method's hypothesis and its application[1]

Since 2015, we have undertaken some heuristic forms of empirical applications of HRI at several primary school classes (among 150 grouped students, 8–11 year olds). Students were asked to realize robot-storytelling, in which robots were protagonists, or actants, in films. Through this, we could stimulate both the creativity and the expressive integration of languages and experiences (narrative, computational, audio-visual).

[1] Renato Grimaldi.

Therefore, students had to apply a kind of procedural logic that refers to the causal relation, typical of the empirical experiments. Students had to devise a narrative product developing the script and programming robots to be the video characters, communicating the message with their movements and the shooting frame choices. In this way, students can concretize their fantasies and, at the same time, they can practise their disciplinary goals: in fact, robot-storytelling objects should relate to school subjects and educational content. Therefore, this would require students to study deeply about a subject and think about how it can be transformed into a visual story. This is an integrative use of technological languages that allows them to work on multiple levels of abstraction; not only do they need to concentrate on programming, but they also have to think about how mini-robots can express something through their movement and, above all, through the chosen shots and the dubbing of the protagonists' voices. We set up a procedure for the realization of these products, enabling students to practice a number of parallel skills that belong to multiple disciplines. Thus, the HRI relationship manifests itself in two ways at the very least: according to Ihde [12] and Rosenberger and Verbeek [21], we think that there is an alterity relation in which the robot represents the avatar of the students and their intentionality; thus, the robot is the concretization of their agency as well.

Additionally, some robots can 'see' and transcode their perceptions into images (such as schemes, diagrams or real video recordings). These elements allow students to use the perspective of robots (such as a subjective frame), which is another references to the post-phenomenological field: if robots are autonomous, they can provide an interpretation of realities. According to Virilio, they use 'sightless vision' [6] which allows them to establish a 'hermeneutic relation' with students. Since children can begin the creative process of a story from robotic visions and images from robotic depth cameras, we think it is possible to hypothesise a peer dialogue between robots and students into a technological and perceptive peer-relationship. At the same time, we think that this relation can also explicate a hypothetical embodiment [4-17] process of the children into robots; students can use robots as a means to enhance their cognitive and perceptive skills. When some robots (as Makeblock's mBot) interact with humans, students can perform with them using gestures or gazes mediated by smartphones or through an immediate perception by a robot's sensors.

2.1. A Robot YouTuber?[2]

During the pandemic lockdown, students have not been able to attend school or live their daily routine. Thus, it was important to provide an alternative to that situation. We used a Nao Robot as the mediator—or, simply, a medium—to help students (5–11 year olds) feel comfortable. Therefore, we think that Nao (and Pepper) can be a social partner, consistent with Breazeal's [19] findings, and, above all, an innovative and technological YouTuber. In this way, Nao has become an avatar and a reflexive body for students who interact with it, while from the post-phenomenological instance there is an 'alterity relation'; humans and robots interact with each other through the mediation of the video. This is the main aim of our experiment. During the lockdown, we noticed that some videos posted on YouTube were drawings and letters sent by students with email to Nao. Our idea started from the need to represent the lockdown emotions of students and, at the same time stay in touch with them, to favour a kind of identification in the robot. To enable this, we assumed a context: through email and Facebook we presented 'Nao's Quarantine', a YouTube channel, in which Nao is the protagonist. In each video, the robot answers questions sent by students and presents a cultural theme, taken from the school curricula or inspired by reality, resulting in Nao becoming a social mediator and a YouTuber. We are working on continuously updating the channel and building a transmedia story on other social media platforms, such as Instagram and TikTok, to realize learning objectives with the robot. In this case, the HRI is not based on a collaborative approach to produce a collective object, such as in the previous case, but to favour an empathetic identification and embodiment of the human in the robot.

[2] Silvia Palmieri.

3. Starting Results[3]

In our research work, we collected over 600 items of the Test of Relational Concepts (TCR) [22] to evaluate the basic spatial and temporal competences of the students involved. Moving from this data, our goal is to analyse the use of educational robotics oriented towards a technological competence and a form of technological thinking. From direct observation (also from teachers involved in the evaluation phase), we noted that students have a better recognition of some modalities of behaviour and a better modality of using communicative technologies; above all, a more functional ability of reasoning seems to emerge. Students are involved in a performative and interactive relationship with robots and, at the same time, they can reflect themselves in the robotic movements, allowing them to modify their cognitive approach to reality and learn new modalities. In the last four years, students had devised storytelling videos with robots and we evaluated some main soft skills, according to the EU competences: communication skills, creativity and analytical skills [18]. Here, we focused on the applicability of the procedural logics; in this way, we could verify the effective usability of the method to enhance cognitive and expressive abilities. From another perspective, we see that this strategy allows students to work together to realize cultural objects, which can be considered a modality of concretization of their creativity, that is, the possibility of concretely perceiving (i.e. see) their thoughts. Currently, we are testing the same activity with the social robot, Nao, because it can autonomously see and interact with humans and can instantaneously record anything. Thus, using Nao in the YouTuber modality (i.e. as an actor-medium) or in the collaborative process of building meaning (i.e. in hermeneutic and alterity relations) can also be interesting forms of video research because we can see the robot's perspective and how it interacts with students, in a dialogical and performative relationship. Due to the COVID-19 emergency, we could not initiate an evaluation path on both activities. Consequently, this article is more of a draft paper that needs further steps of analysis to corroborate or deny our hypothesis on HRI relationships.

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SECTION III

EVALUATION STUDIES

To date, some cybertherapy applications have improved the quality of health care, and later they will probably lead to substantial cost savings.

However, cybertherapy is not simply a technology but a complex technological and relational process.

In this sense, clinicians and health care providers that want to successfully exploit cybertherapy need a significant attention to clinical issues, technology, ergonomics, human factors and organizational changes in the structure of the relevant health service.

Wiederhold & Riva, 2004

Development And Validation Of Digital Smartness Scale: A Tool To Assess Digital Skills In Professional Contexts

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Abstract. New media literacy (NML) involves a series of crucial skills needed for living and working in the mediated and participatory society of the 21st century. Along with the emergence of new media technologies, individuals are now expected to know the socio-cultural and emotional aspects of new media beyond its technical characteristics. This paper seeks to extend the notion of digital skills by developing and measuring an additional set of abilities: the Digital Smartness (DS). DS is a set of technical and interpersonal skills for a professional practice of ICTs, based on professional identity designing and communication activities. Moreover, this article outlines the main results and methodological challenges of an ad hoc scale to measure digital smartness. The development, properties, and uses of the Digital Smartness Scale (DSS) are described. Dimensionality, reliability, and validity data are presented for two studies (pilot test and validity test) involving a total of 2.257 individuals. The psychometric properties of the scale were examined. The four-factor 34-item DSS revealed good content validity, structural validity, construct reliability, construct convergent validity and discriminant validity. Moreover, findings indicated the novelty of this skill set, thanks to low convergent and incremental validity.

Keywords. New Media Literacy, Digital Skills, Using technology in professional context, Personal Branding, Social Recruiting

1. Introduction

The digitalization of the workplace demands employees that are digitally capable and strategies to ensure that employee skills evolve at a similar pace of technological innovation (Rahanu et al., 2015). The literature broadly defined digital literacy as the ability to access, process, understand and create information or media content in the digital environment (Livingstone, 2005). Being digitally literate means communicating effectively in a global world where a great deal of communication is mediated by ICTs (McLoughlin, 2011). To achieve this aim it is necessary to possess both hard and soft digital skills (Rheingold, 2012; Gui & Fasoli, 2017). Here we propose a new perspective to conceptualize and assess digital skills namely Digital Smartness, characterized by: (1) integration of technical-hard and communicational-soft digital skills; (2) practice orientation (Hsieh, 2012), so we shift from a notion approach to a pragmatic vision; (3) professional context focus, so we shift from general digital skills to specific ones. We define digital smartness as a set of technical and interpersonal skills for a professional practice of ICTs, based on professional identity designing and communication activities. To measure the abilities required to use ICTs for professional purpose, we implemented a new *ad hoc* scale: the Digital Smartness Scale (DSS, based on a theoretical framework

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built on previous research of related fields. Here, we describe the development and psychometric properties of the DSS examined in two studies involving a total of 2.257 participants.

2. Method and instrument

2.1 Item development

Analyzing digital skills frameworks (Eshet-Alkalai, 2004; van Deursen, van Dijk, Peters, 2012; Punie, Brečko & Ferrari, 2014), we selected the needed skills for the practice of ICTs in professional contexts, where digital skills have to be considered in his technical and socio-communicational aspects. For this reason, we developed the set of constituent skills of digital smartness drawing from interdisciplinary literature taken by digital literacy, marketing, and management literature and integrating with the points of view of privileged witnesses. The result was a set of four macro-skills: (1) Digital mindset – it refers to the understanding of the potential of social media tools for personal and professional empowerment (Martin & Grudziecki, 2006). This skill encompasses two dimensions: (1) the awareness of the opportunity offered by ICTs for the development of personal and professional potential; (2) the motivation of taking these opportunities to foster a process of change. (2) Digital operations – it indicates technical skills that are a combination of medium-related and content-related skills (Hargittai, 2002), concerning the advanced use of ICTs. (3) Professional self-design – it concerns the ability to be aware of and design professional identity and future career (Savickas, 2005). (4) Digital strategy – the ability to communicate professional self to the right audience in an online environment (Labrecque, Markos & Milne, 2011), exploiting the professional-relations affordances of ICTs. Ten qualitative interviews were conducted with people of different ages, level of education and gender, to review the first draft of the test. The final set included 39 Likert-type items.

A pilot study was conducted to test the reliability and other characteristics of the constructed scale. It was carried out online with a convenience sample of university students from all the regions of Italy online. A total 1.139 subjects concluded the pilot test: 378 males and 761 females (mean age = 23). Finding demonstrated the reliability of the test and helped to improve several problems.

2.2 Validation study

The second study was conducted to regard the internal consistency of the 4 subscales components the *Digital Smartness Scale* (DSS) and was used for factor-analytical research of the structure of *digital smartness*. The construct validity of the DSS was judged via exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Using the function of SPSS software for selecting cases, we randomly split the sample into two halves: (a) development subsample (n = 671) and (b) cross-validation subsample (n = 447). We firstly employed EFA on the former to identify the factorial structure of the items, and then CFA on the latter to cross-validate and refine the emerged measurement model from the EFA. To evaluate the convergent, discriminant, and incremental validity of the scale, it was administered with other Italian validated scales (*Career adapt-abilities scale*, Soresi, Nota & Ferrari, 2012; *Self-Monitoring Scale*, Delle Grazie, 2008; *Generalized Problematic Internet Use Scale 2*, Fioravanti, Primi & Casale, 2013; *Digital skills of internet natives measure*[1], Gui & Argentin, 2011). The time required to answer the entire survey questions was approximately 25 minutes. The full survey study draws on a convenience mixed sample collected over a period of one month using an online survey. The mixed sample allowed exploring different levels of digital smartness in different clusters of population. The final version of DSS was administered to four clusters of population, under 65 years old to avoid the “grey” digital divide (Morris, Goodman & Brading, 2007). The mixed sample criterion at the base of this

[1] To administrate the *digital skills of internet natives measure* we needed to use another platform, for organizational reasons. Subjects could access to this survey through an online link at the end of the first administration. To match the survey results we created an anonymous code, asked at the beginning of both survey sessions.

clustering action was career-based, choosing professionals at different stages of their career: (1) high school students, (2) university students, (3) employees, (4) freelancers[2]. We reached 1.240 people, 2% of them was excluded from the filter question atthe beginning of the survey. In total, we obtained complete responses from 1.015 individuals (response rate 92%), divided equally between sample clusters, as shown in Table 1.

Table 1. Demographic profile sample**.**

		Gender		Age	Education level						
	N	Male (%)	Female (%)	Age (average)	Junior high school (%)	High school (%)	Bachelor's degree (%)	First level master course (%)	Master's degree (%)	Second level master course (%)	PhD (%)
High school students	214	49,1	50,9	18,1	100	0	0	0	0	0	0
University students	280	34,3	65,7	22,7	0	44,3	55	0,7	0	0	0
Employees	249	24,1	75,9	30	0,8	18,1	10,4	3,2	59,8	6,1	1,6
Freelancers	220	30	70	37,1	3,2	22,3	15,4	6,3	40	9,2	3,6
Total sample	963	33,3	66,6	27,3	22,3	22,4	20,5	2,4	27,5	3,5	1,4

3. Results

3.1 Exploratory and confirmatory factor analysis

Through a Princiapal Axis factoring method and a Promax rotation with Kaiser normalization, factor loadings of .40 and forced a four-dimensional solution we obtained four conceptually distinct factors that together accounted for 50,6% of the variance of the 34 items remained. Examining items' meanings and coherency in accordance with the built theoretical framework of Digital Smartness, we labeled factors as digital mindset (mind, 11 items), digital operations (oper, 8 items), professional self-design (self, 7 items), and digital strategy (strat, 8 items) respectively. The factor loadings ranged from 0.50 to 0.85, suggesting that all items were good measures of their respective factors. As indicated by Cronbach's alphas (0.85, 0.87, 0.89, and 0.93) well above the threshold value of 0.70, all factors were internally consistent and well defined by their items. The factors were significantly correlated indicating that those who are good in one skill area are also good in another area, as shown in Table 2.

Table 2. Correlations between factors of the scale.

	Digital mindset	Digital operations	Digital strategy	Professional self design
Digital mindset	1			
Digital operations	.331	1		
Digital strategy	.599	.475	1	
Professional self design	.198	.200	.283	1

Through the CFA we observed that the four-factor 34-item measurement model of DSS fits well with the observed data and exhibits adequate structural validity (RMSEA = 0.05, CFI = 0.98). DSS presents validity and generalizability of the factor structure, demonstrated by a multigroup confirmatory analysis tested measurement invariance in the four subsamples divided by groups, as shown in Table 3.

Table 3. Multigroup CFA by groups.

Model	χ^2	df	$\Delta\chi^2$(df)	p
Unconstrained	3275,0	2060	-	-
Invariant factor loading	3395,6	2162	120,6 (102)	0.10

[2] For an out-of-control effect of the distribution of the survey, some unemployed people (n=52) were involved in the administration.

3.2 Validity

Concerning convergent validity, all 4 factors have significant positive associations with Career adapt-abilities scales, especially with professional-self design (r from .242 to .485) and digital strategy (r from .342 to .402). Self-Monitoring Scale has not significant correlations with DSS. For what concerns discriminant validity none of the associations with Generalized Problematic Internet Use Scale 2 exceed Brown's cut-off. Last, for incremental validity, controlling for scores on the digital skills of internet natives measure, none of the factors have associations with them.

4. Conclusion

Digital smartness is a new set of abilities crucial for working in the digital reputational and networking-based society of the 21st century. Its novelty in the academic field is inferred by three intrinsic characteristics: (1) Digital Smartness is an intersection of hard and soft skills. It includes a *digital mindset*, some technical skills (*digital operations*) and some soft skills (*professional self-design* and *digital strategy*); (2) Digital Smartness is a set of digital skills practice oriented (pragmatic vision), so it is called smartness; (3) Digital Smartness is professional context oriented. We demonstrate that digital smartness can be measured in an accurate way through the use of the DSS: a 34-item composite self-assessment inventory with four subscales: digital mindset (eleven items), digital operations (eight items), professional self-design (seven items) and digital strategy (eight items). The digital smartness model is applicable for both theoretical and empirical research and has resulted in the development of a measure with most subscales having satisfactory reliability. The face validity and simplicity for the scoring of the subscales of the Digital Smartness measure makes them good candidates for the development of concepts and for attracting audience attention in lecturing and training that is related to professional use of ICTs. In particular the Digital Smartness measure is a candidate as Human Resources tools in two crucial activities: (1) to assess candidate digital skills in order to hire future employees with professional digital; (2) to assess the digital smartness skills and traits of employees that could benefit most from training intervention about professional practice of ICTs.

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Enhancing the Potential of Creative Thinking in Children with Educational Robots

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Abstract. This observational study analyzes the effectiveness of the non-humanoid robot Ozobot as interactive-tool for school- children to enhance their potential of creative thinking. Based on the socio-constructivist theoretical background, referring to the zone of proximal development and the socio-cognitive conflict, the study compares three experimental condition (Ozobot Single Work, Ozobot Pair Work, and Control Group) of a problem-solving task with a robot (programming the robot to perform a given route in a preconfigured labyrinth). 171 children (85 females, 86 males), aged between 9 (IV class) and 10 years (V class) of two central-northern Italy primary schools, participated in the study. Children were randomly assigned to one of the three group conditions. Results show that children who performed the task alone with the educational robot (Ozobot Single Work) significantly improved their potential of creative thinking, compared both to those who perform the task in pair with the educational robot (Ozobot Pair Work) and to the control group. No gender differences occur.

Keywords. Creative Thinking, Educational Robot, Children, Problem-Solving.

1. Introduction

Similarly to an expert partner providing a "scaffold" that allows the child to achieve an upper level within the zone of proximal development, an educational robot (properly programmed) can be seen as a technological artefact helping children in exploiting their potential of improvement in many skills [1; 2; 3].

Starting from these premises, this study aims to verify that using a non-humanoid robot Ozobot to do a problem solving task, improves the potential of creative thinking in 9-10 years old children. For this reason, the Widening Connecting Reorganizing Test (WCR) [4] was used, in the pre-test and post-test phase, in order to evaluate the children's potential of creative thinking. All children completed the test in class singularly.

2. The Potential of Creative Thinking: Widening, Connecting, Reorganizing

Conflicts between partners play an important role in the developmental process, specifically during problem solving tasks: as a matter of fact, in these tasks different

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points of view could lead to more creative or advanced solutions, as described in studies of socio-cognitive conflict [5; 6; 7] and divergent thinking [8; 9].

Creativity can be characterized by three great mental operations: widening, connecting, and Reorganizing [4].

Considering these assumptions, the WCR [10; 4] is structured in three consecutive section (9 items) corresponding to the identified skills:

- The ability to succeed in widening one's point of view, and the ability to produce many different ideas.
- The ability to combine different elements and to establish relationships going beyond appearances and similarities or superficial differences.
- The ability to de-contextualize the elements of a situation to grasp the properties useful for restructuring and changing perspective.

In the present study, in which an educational robot is used in a problem-solving task to enhance the potential of creative thinking in 9-10 years old children working alone or in pair, the WCR test was filled in twice by the children (all together in class room, but singularly), for the pre-test and the post-test phases. Creativity scores were calculated from 1 (less creative) to 4 (very creative), based on the answers' frequency of the target population: the less frequent the answer, the more creative it is and vice-versa, obviously considering its coherence and appropriateness with the task.

The following hypotheses were formulated:

H1. The use of the educational robot Ozobot significantly improves children's potential of creative thinking in both experimental conditions (Ozobot_SW → Single Work, and Ozobot_PW → Pair work);

H2. Children who perform the task in the Ozobot_PW condition significantly improve their potential of creative thinking compared to those of the Ozobot_SW condition.

3. Methods

171 children participated in the study, 85 females and 86 males. 79 children attend the IV class and 92 the V class of Primary Schools in northern Italy. Children were randomly assigned to the two experimental conditions and to the control group: Ozobot_SW (n=56; 25 attend IV class and 31 attend V class), Ozobot_PW (n=85; 42 attend IV class and 43 attend V class) and control group (n=30; 12 attend IV class and 18 attend V class).

3.1. Materials and Procedures

Ozobot is a tiny educational robot (just 2.5 cm tall) that is programmed to follow colored lines on a surface. Its movements can be coded by mean of color codes. In this study, children are required to code the moves of Ozobot, by coloring the blank spaces of a maze on paper (fig. 1) with the preset color codes, to define a path and complete the task.

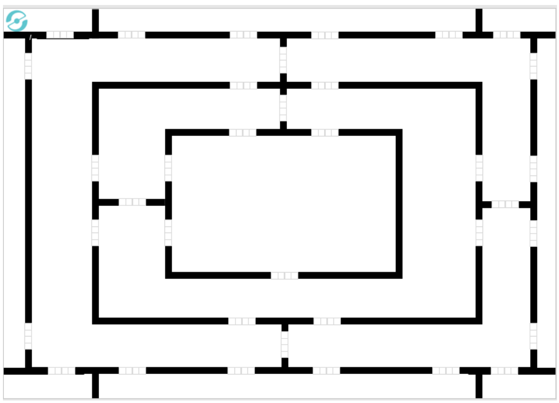

Figure 1: Example of a labyrinth task used in the experimental phase

The interaction between children and Ozobot is twofold: first, children use colors to determine the Ozobot moves, and second, by testing the coded path, children have a feedback about the correctness of the instructions given to the robot. In the Ozobot_SW condition, child completes the task singularly, while in the Ozobot_PW condition, children are required to complete the task in pair. The main difference is that, in the Ozobot_PW condition, having only 1 robot, the two children had to discuss for defining the color codes to use to make Ozobot move. No limited time was given by the researchers to complete the labyrinth.

Before (pre-test) and after (post-test) the experimental conditions, all children were individually evaluated with WCR Test. All the procedure took half a day per each class. Children of the Control group completed both the pre-test and the post-test before carrying out the same activity of the two experimental conditions.

4. Results

No significant differences were found between males and females, therefore the variable "gender" was excluded from the subsequent analyzes.

From the univariate analysis of the different WCR indexes emerges a significant interaction effect pre-post by work condition for the Widening Index ($F_{(2,168)}=5.04$; $p<.05$; Partial $Eta^2=.057$) and for the ACR total score ($F_{(2,168)}=4.13$; $p<.05$; Partial $Eta^2=.047$).

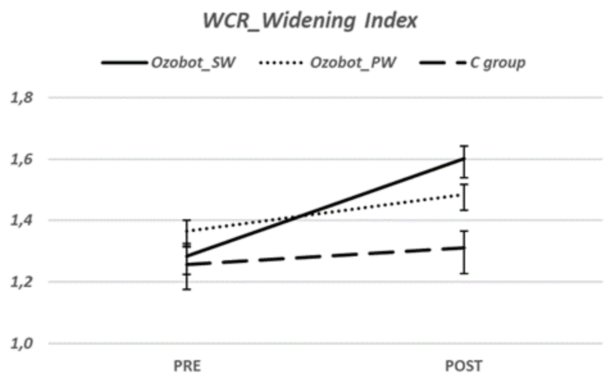

Figure 2: WCR Widening Index interaction between groups and pre-post condition

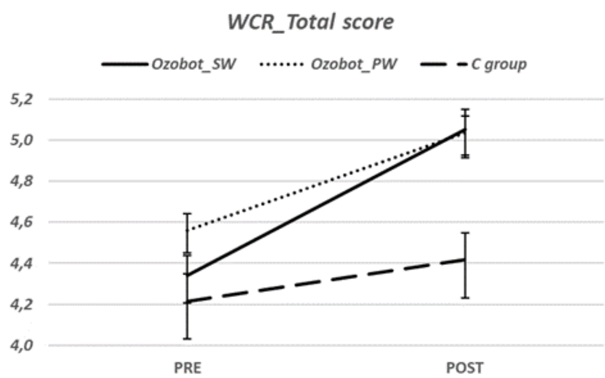

Figure 3: WCR Total score interaction between groups and pre-post condition.

In particular, as shown in fig. 2 and fig. 3, a steeper performance increase can be seen in the Ozobot_SW condition compared to the Ozobot_PW condition and to the Control group, both for the Widening Index (fig. 2) and the total score (fig. 3). No significant interaction effect pre-post by work condition was found for the Connecting Index nor for the Reorganizing Index.

For a descriptive purpose, new variables were calculated as pre-post performance differences in each WCR Indexes (post minus pre). The WCR's difference Indexes has been used as dependent variables in an ANOVA and a post hoc multiple comparison with Bonferroni's correction was used to compare group's scores.

Results show that the performances in Widening Index of the subjects belonging to the Ozobot_SW condition improve significantly more than both the Ozobot_PW condition and the C group (difference =.26, SE=.098, p<.05). There are no differences between Ozobot_PW condition and C group. For the WCR total score Ozobot_SW condition show significant better performance from the C group.

5. Discussion

The main objective of this study was to analyze the effectiveness of the non-humanoid robot Ozobot as interactive tool for schoolchildren to enhance their potential of creative thinking, measured with the WCR test (Widening, Connecting, and Reorganizing). Even though the study have been carried out in ecological contexts (schools) that limited the possibility to have a full control of all the environmental variables influencing the situation (e.g. the attention of the children on the task; the presence of the teacher), significant and very interesting results can be highlighted.Considering the WCR's total score, H1 is confirmed in all experimental conditions, i.e. all groups show a significant improvement between the pre and post-test. Ozobot_SW condition shows the highest improvement, while the lowest characterizes the Control group, and the Ozobot_PW condition is in intermediate position with respect to the other two. However, the Ozobot_SW condition has a significantly higher improvement than the C group, while no differences exist between Ozobot_SW condition and Ozobot_PW condition. Thus, we could explain the result of the Control group as a habituation effect to the proposed activity.

H2 is not confirmed. A possible explanation could be that children working singularly were asked to do all the actions needed alone without the possibility to adjust to someone else's solution: thinking a solution (route), finding the correct codes, coloring the blank spaces of the labyrinth, checking the correctness of the solution adopted. Children that carried out the task in pair, on the contrary, show a sort of normalization effect [11] i.e. many times they distributed their actions so e.g., a child checked for the correct code while the other colored the labyrinth. In this way, they tried to avoid conflict rather than find the best solution to the task. As the socio-cognitive conflict is seen as one of the motor of the creativity, avoiding it by adopting a solution without reflecting and discussing on it did not probably allow those children that worked in pairs to develop in a more creative way their solutions (and their way of thinking in the post-test).

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Cultural comparison models on the assessment of basic psychological needs using a virtual serious game

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Abstract. Virtual serious games (VSG) are games developed for specific purposes, providing more naturalistic environments and objective data than traditional approaches. VSG have been mainly tested in education and training, and less in psychological field. Basic psychological needs are a relevant topic for the individual well-being and depend on the satisfaction of attachment, self-esteem, self-efficacy, and stress avoidance. Furthermore, cultural factors can have an influence on the needs' satisfaction. In this framework, the aim of this study was to compare cultural differences on the 4 needs. 122 subjects (61 Mexican and 61 Spanish) participated to 5 sessions of a VSG. The results showed that marital status, education and age are the main attachment factors for both countries. In Spain, the education level influences the self-esteem perception and in Mexico, income level is the main factor. Regarding self-efficacy perception, in Spain, gender and age represent the main influential factors and work situation and education are relevant in both countries. Regarding stress avoidance, educational level and gender are especially important in Spain, and age, income level and work status are the main factors in Mexico.

Keywords. Psychological needs, attachment, self-esteem, self-efficacy, behavioral approach, behavioral inhibition

1. Introduction

Virtual serious games (VSG) are games developed for specific purposes, in which narratives, challenges, and interactivity represent the main engagement features. VSG provide more naturalistic environments and more objective data than traditional approaches [1]. Objectivity can be rendered using stealth game design approach (SGDA) that allows gathering users' performance during the gameplay [2-4]. Until now, VSG have been mainly tested in education and training, and less in psychological field [2]. Basic psychological needs are a relevant topic for the individual well-being and, according to the consistency model, they depend on the satisfaction of attachment, self-esteem, self-efficacy, and stress avoidance [5]. Consistency is defined as the mental activity congruence between the goals' achievement and the satisfaction of the four basic psychological needs. In this framework, cultural factors and socio-demographic variables can have a relevant influence on the needs' satisfaction and the present study aimed to investigate how cultural differences based on socio-demographic variables impact on the satisfaction of the four basic psychological needs.

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2. Methods

2.1. Participants

122 subjects (62 = women and 60 = men; Mean Age = 36.13; SD = 10.59) participated in this study (Table 1). No significant difference in the distribution of demographic variables between countries have been found, except for education (p-value < 0.005).

Table 1. Demographic description of the participants, separated by country.

Variable	Spain	Mexico	Variable	Spain	Mexico
Age	36±11.2	35.6±10.3	**Occupation**		
Gender			Student	12	14
Female	30	32	Employee worker	24	21
Male	31	29	Freelance	6	7
Education			Housewife/husband	3	9
≤10 years	2	9	Unemployed	15	10
>10,≤12 years	4	6	Retired	1	0
>12, ≤16 years	16	24	**Income Levels**		
>16, ≤18 years	7	10	<15.000€ or <75.000$	26	24
>18 years	32	12	15.001€ - 30.000€ or 75.000$ - 105.000$	20	12
Marital			30.001€ - 60.000€ or 105.001$ - 210.000$	3	7
Single	30	33	>60.001€ or >420.000$	1	3
Married	26	23	NR/DK	11	15
Divorced	3	5			
Widow/widower	2	0			

2.2. Psychological instruments to measure outcomes

Six questionnaires were administered to the participants: 1) Adult attachment questionnaire [6] is a 40 items self-report scale that assess four factors: a) low self-esteem, need for approval, fear for reject; b) hostile conflict resolution, rancor, and possessiveness; c) secure affect or expression of feelings and comfort with relationship ; and d) emotional self-sufficiency and discomfort with intimacy; 2) The Rosenberg Self-Esteem Scale (RSE) [7] is a 10-item measure that assesses general self-esteem; 3) The General Self-Efficacy scale (GSE) [8] is a 10-item questionnaire that assesses the efficacy self-perception; 4) The Internal-External Locus of Control Scale (LOC) [9] Rotter, 1966) consists of 29-items in which high score indicates that people have an external locus of control and a low score indicates an internal locus of control; 5) Behavioural Approach/Inhibition Scale (BIS/BAS) [10] is 24-items questionnaire rated on a 4-point Likert scale. The scale presents four subscales: one for BIS and three for BAS (BAS drive, BAS reward, and BAS Fun Seeking); and 6) Brief Cope [11] consists of 28-items that measure the two primary coping styles of approach and avoidant.

2.3. The Virtual Serious Game

A narrative VSG, settled in a spaceship, has been developed whose aim was to discover a new earth for living. The VSG included six virtual agents, which personality have been created in accordance with the attachment styles, and a child. Each virtual agent had an explicit role, as well as the participant that had to maintain the technical control of the spaceship and take care of the child. The VSG consisted of 10 situations that included three episodes of loss, four episodes of loneliness, four episodes of threat, and two of suspicions to assess attachment. At the end of each situation, the participant self-evaluated how he/she felt, how the crew felt, and according to the feeling of the crew, participant could improve their well-being. Three situations have been involved in the self-efficacy assessment through twelve games each. Finally, twelve episodes on avoiding or approaching pleasant or unpleasant situations have been designed [4, 5].

2.4. Experimental protocol

The study consisted of five sessions of almost one hour each. In the first session, before the VSG experience, participants were administered the questionnaires over mentioned.

Each VR session was experienced used a Head Mounted Display (HTC VIVE/Pro).

2.5. Data analysis

Multivariate outlier detection was performed in the results of the questionnaires considering 4 independent groups of variables (attachment, self-esteem, self-efficacy, stress avoidance). For the groups with more than one subscale, the Mahalanobis distance between subjects was calculated and a Chi-square test was performed to detect the subjects that belonged to the most extreme 1% of the data distribution. 4 outliers were detected in each country and removed from the analysis. Data from 5 Mexican participants was incomplete, so they were also removed. The final analysis was performed on 109 subjects (57 Spanish, 52 Mexican).

Unpaired two samples Mann-Whitney-Wilcoxon tests were performed to test the significant differences between countries for each subscale of the questionnaires, after checking that most of the variables were not normally distributed (Shapiro-Wilk p-value < 0.05). In addition, to test the possible dependency between countries on the categorical variable RQ a $\chi 2$ test was performed. Level of statistical significance was set as alpha $<$ 0.05.

Machine Learning (ML) models were computed for each population separately including demographic variables and the participants' performance in the VSG with a feature selection procedure. Scale scores were classified in high or low levels considering the mean of the participants. Four ML algorithms, including Random Forest, SVM, GLMNet and Conditional Inference Forest, were tested. The best model in terms of accuracy and Cohen's Kappa obtained after this procedure was chosen for each subscale and its features are described in Figure 2. All the data analysis and machine learning were performed using the software R (version 3.6.1).

3. Results

Figure 1 showed the main significant cultural differences on the questionnaires. Figure 2 shows the results of the validation process of the ML models. Most of the models achieved high accuracy and Cohen's Kappa (mostly above 85% and 60%, respectively).

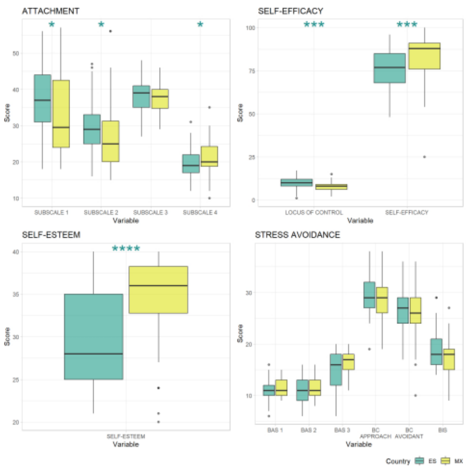

Figure 1. Boxplot showing the distribution of each subscale in each country. The presence of * indicates that the distributions are statistically different in Spain (ES) and Mexico (MX). * for p-value ≤ 0.05, *** for p-value ≤ 0.001 and **** for p-value ≤ 0.0001.

	Variable	Accuracy		Kappa		Age		Gender		Education		Marital		Occupation		Incomes	
		ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX
Attachment	Subscale 1	0.9	0.87	0.76	0.66	X	X	X			X	X	X		X		
	Subscale 2	0.9	0.93	0.74	0.83					X	X		X			X	
	Subscale 3	0.85	0.8	0.63	0.55		X	X		X		X			X		
	Subscale 4	0.88	0.82	0.67	0.68	X								X			
	RQ	0.91	0.92	0.58	0.81								X				
	Total					2	2	2	0	2	2	2	3	1	2	1	0
Stress avoidance	BAS Subscale 1	0.67	0.78	0.16	0.38	X		X		X	X	X	X		X	X	X
	BAS Subscale 2	0.73	0.68	0.45	0.38		X			X	X				X		X
	BAS Subscale 3	0.72	0.68	0.35	0.26	X	X		X	X		X	X				X
	BIS Subscale	0.8	0.8	0.48	0.5		X	X		X			X		X		
	BRIEF COPE Avoidant	0.75	0.62	0.5	0.27	X	X	X			X						X
	BRIEF COPE Approach	0.76	0.7	0.43	0.35		X	X	X		X				X		X
	Total					3	5	4	2	4	4	2	3	0	4	1	5
	Dataset	Accuracy		Kappa		Age		Gender		Education		Marital		Occupation		Incomes	
		ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX	ES	MX
Self-steem	Decisions	0.77	0.83	0.46	0.63		X			X					X		
	Self-reported	0.63	0.8	0	0.56	X	X	X		X		X	X	X			
	Characters' status	0.98	0.95	0.96	0.83		X						X		X		
	All	0.93	0.94	0.68	0.88												X
	Total					1	3	1	0	2	0	1	2	1	2	0	1
Self-efficacy	Attention	0.95	0.95	0.89	0.9	X		X		X			X	X	X		
	Memory	0.83	0.94	0.65	0.87			X		X				X			
	Velocity	0.87	0.87	0.65	0.73			X				X		X			
	Planning	0.92	0.9	0.8	0.68						X	X		X	X		
	Perception	0.72	0.87	0.38	0.69						X		X		X		
	Inhibition	0.82	0.77	0.61	0.38	X		X						X			
	Flexibity	0.78	0.7	0.44	0.34	X		X		X	X			X	X		
	Control	0.58	0.64	0.27	0.09	X	X	X		X	X			X	X	X	
	All	0.95	0.92	0.88	0.77												
	Total					4	1	6	0	4	4	2	2	7	5	1	0

Figure 2. Accuracy, Cohen's Kappa and demographic feature selection dataset available. For each demographic variable, the column ES reports if it was selected for the ML models for the Spanish population, while the MX column reports if it was selected when modelling the Mexican population.

4. Conclusions

The results showed that marital status, education and age are the main attachment factors for both countries. In Spain, the education level influences the self-esteem perception and in Mexico, income level is the main factor. Regarding self-efficacy perception, in Spain, gender and age represent the main influential factors and work situation and education are relevant in both countries. Regarding stress avoidance, educational level and gender are especially important in Spain, and age, income level and work status are the main factors in Mexico. These results seem to suggest that psychological well-being depends on the congruence between the satisfaction of the four basic psychological needs and also on cultural factors' variability. Consequently, cultural variability may imply differences in the diagnostic evaluations and psychological treatments approaches in clinical practice. Although these results are relevant, the present study showed some limitations in terms of reduced sample size and methodically the four basic psychological needs have been measured with self-reported questionnaires and behavioral responses, limiting the external validity of the results. In order to improve the external validity of the results, further studies are needed, introducing also psychophysiological measures, such as galvanic skin responses, that allow also evaluating emotional and motivational internal processes.

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Use of robotic animal companions in dementia care; a qualitative study of the immediate and long-term effects to enhance quality of life and feelings of wellbeing for individuals living with dementia

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Abstract. For the person living with dementia the moments to experience true affection may not occur very frequently. Deterioration of cognitive and physical abilities may eventually force people to live in an unfamiliar environment, like a residential age care facility. The inevitable absence of (deceased) relatives and friends can dramatically undermine the opportunities to touch and be touched resulting in touch deprivation and fewer opportunities for emotional attachment. The affective presence of pets can encourage social touch, bring emotional and social connection, stimulate reminiscence and promote feelings of well-being for the person living with dementia. Due to practical constraints as well as physical decline, elderly often (need to) abandon the wish to take care of an animal. It has been suggested that animal-like robot companions could provide an elegant solution to enhance person-centered care, notably without replacing human contact. In this qualitative study, we endeavor to explore the potential psychosocial health benefits offered by robotic animal companions. We report on insights obtained from two qualitative studies, deploying two different robotic animals in contrasting environments, timespans and circumstances. In the first study, we investigate responses of people with dementia towards a living dog versus a robotic companion in a care home setting. The second study, a longitudinal case study, investigates the psychosocial effects of a single individual with Alzheimer's disease bonding with a robotic pet. Our results suggest that the use of animal like robotic companions can be beneficial, and can significantly enrich the social and emotional life of people living with dementia.

Keywords. Dementia, robotic companion animals, affective presence, longitudinal study, qualitative research, warm technology.

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1. Introduction

In the current paper, we explore the potential psychosocial health benefits offered by robotic animal companions for people living with dementia. Key psychosocial needs expressed by persons with dementia include meaningfulness in life, social connectedness, and coping with feelings of loneliness [1]. In general, daily life in a care facility is predominantly focused on instrumental and functional care needs. As a consequence, a person's psychosocial and tactile needs via, for example, social touch are frequently underserved, despite the fact that caregivers who work in a care home acknowledge that people with advanced dementia show an increased sensitivity to touch as a key component of social awareness and affective presence [2]. This highlight both an opportunity and a challenge to focus on social touch technology when designing for improved quality of life for people living with dementia.

In this paper, we will focus specifically on robotic animal companions. In research to date, such robotic companions have shown promise to enhance quality of life, including the desire to feel needed, to hug, to deal with loneliness, to provide emotional support, social bonding and feelings of security [3]. In our present research, we would like to extend current work by including both a comparative as well as a longitudinal perspective. We report here on two qualitative studies.

2. Methods

We performed two qualitative studies, including both a comparative as well as a longitudinal perspective; deploying two different robotic animals in contrasting environments, timespans and circumstances. Both qualitative studies use behavioral observations and interviews as the primary means of data collection. We use thematic analysis to explore the results and to arrive at larger themes and insights.

2.1. Study 1, comparative engagement with a robotic and a real pet in a care home context

During the first study, situated in a care home, we observed and interviewed people with dementia (n=12), and compared their immediate levels of engagement between (i) a small animatronic dinosaur toy (Pleo), (ii) a real (and friendly) domestic dog, (iii) conversations with a human only. Observations were coded, and interviews were transcribed and analyzed thematically to establish the seniors' level of engagement and register other potentially relevant information.

2.2. Study 2, longitudinal case study of social bonding with a robotic pet

The second study (n=1), was a longitudinal case study over 12 months, situated in a home setting, where a charming lady called Elsie, age 82 with middle stage dementia, was studied as she developed a close personal relationship to a soft fur covered robotic animal companion cat (Hasbro). This cat was introduced to her after her own beloved dog had passed away. Interviews and observations to investigate the psychosocial effects on a single individual were held and recorded at irregular intervals over the course of one year and were accurately transcribed and analyzed using thematic analysis.

2.3. Informed Consent

Informed consent in studies that target vulnerable populations, such as people with dementia, requires extra attention and care. In Study 1, we obtained informed consent from the formal caretakers at the care residence to decide whether their clients would or would not be capable to participate in studies. Information about the study was also provided to the relatives of the residents, where an opt-out possibility was provided.

In Study 2, the person with moderate dementia was asked, at each separate occasion, whether she agreed to be interviewed and recorded on camera. Informed consent was also obtained from the family members involved in informal care.

3. Results

Generally, in Study 1, participants liked the attention they received; however some participants, at the beginning of the interaction, did not feel entirely comfortable and demonstrated some nervous tension. They relaxed and became more at ease once the interactions proceeded. As a warm-up, in the first study, participants were stimulated to tell about animals they used to own. *"She just liked it. The attention. She enjoyed the attention."* Initially, as the Pleo dinosaur was introduced, and started moving around the table, people responded with surprise and enjoyment. *"This is a strange one!" "Beautiful, elephant!" "This is nothing compared to a real dog, however a nice game"*

The Pleo dinosaur would make soft purring and whining noises, and would respond to touch and to sound. It would turn its head in the direction of sounds and voices. Most participant were triggered by these behaviors and some showed emotional involvement and liked to interact with the artificial dinosaur. *"Don't fall off the table, be careful!" "Don't cry, that is not necessary!"* The Pleo would also give rise to interactions amongst the participants, as well as interactions with the interviewer. Conversations and interactions with the real dog and the Pleo dinosaur were both relatively fluent, and triggered more interactions than the interaction with the life person only. In this study, we couldn't find evidence for a clear preference for the dog or the Pleo. As this study is an observation study over a relatively short period of time, and the participant sample was quite low, results should be interpreted with care.

In Study 2, Elsie was enthusiastic to partake in the study, and in sharing information about her life with her robot cat. She greatly enjoyed the conversations and shared a lot of information in an unprompted way, as the robot cat appeared to be front and center of her attention almost continuously. During the first encounter of Elsie with the robot cat, Elsie immediately started talking to the cat, expressed amazement at its responses, and immediately appeared to approach the cat as a socially responsive and feeling creature. Whenever the cat responded, Elsie would laugh in surprise and amazement. She took the cat to her lap, would talk to it, and caress it, in very similar ways to the way she used to care for her dog. After a few months of intense interaction, it appeared that every movement and sound of the robotic cat was highly rewarding still, or perhaps even more so. Elsie strongly feels she has a special, personal relationship to the cat. Even though the behavioral repertoire of the cat is extremely limited (some cat sounds and rudimentary movements), this does not seem to limit the extraordinary feelings the cat is able to engender in Elsie.

Elsie's imagination fills in behaviors that go well beyond the technical possibilities of the robot cat, but seem to reflect the intimate relationship she has built with the cat. For example, she mentions the ability of the robot cat to get into her bed, and cuddle up against her back during the night: *"Yes, at night, he sleeps with me in my bed…"* From time to time, Elsie shows awareness of the artefactual nature of the robot cat. However, this awareness is only rudimentary and fleeting. In the first few instances when the batteries of the cat were running low, Elsie would call her family in distress, saying the cat was *"very ill; there's something really wrong with him, he doesn't move anymore"*. Being aware of the artefactual nature of the cat does not appear to inhibit Elsie in developing and maintaining a very close relationship to the robot cat*: "For me this is a real cat, yes…it doesn't have "Miaow-things" in his little mouth or so, it really comes …from his belly….and he also has….also has two batteries in his belly, doesn't he?"*. In fact, the cat being a robot comes with certain advantages. Elsie reports to find it convenient that the cat does not need any food or needs to be walked, especially in bad weather. The advantage and luxury of a clean and predictable domestic creature is appreciated by Elsie. *"I do really have the feeling….he doesn't eat…he cannot eat, cannot pee, no food, nothing….totally potty trained and clean…"* [Interviewer] *"Do you like that?" "Yes, I very much like that."*

Similar to the results in Study 1 using the Pleo, we noticed that the robotic cat also acts as a social lubricant and creates opportunities for interaction between Elsie and other seniors: *"I take him with me, everywhere I go, where we meet other people. Others are then allowed to touch him too….."*. Even after twelve months of intense interaction with the robot cat, there's no lull in engagement and psychosocial rewards are still strongly experienced.

4. Discussion

It appears that robotic companions generate a form of affective presence which may result in rich and varied responses, ranging from surprise and engagement (Study 1 and 2) to intense feelings of love and attachment (Study 2). Also in Study 2, we noticed that symptoms of sadness and mourning (as a consequence of losing her dog), as well as loneliness, were ameliorated, at least in part, by the presence of the robot cat. Moreover, we also found that even after prolonged and intense use, the engagement with the robot companion was still strong, and continued to yield psychosocial benefits. This bodes well for both the incidental and long-term use of companion animal robots in dementia care.

In both studies, the robots were immediately accepted as feeling, sentient creatures, and treated as such. The 'illusion of non-mediation' [4] of robotic companions appears to be rather high in this context; their artefactual nature is only partly acknowledged, and does not hinder their perception as social creatures. The perception of robots as social actors is common amongst the general population, and is not a sign of mental ill health [4]. Robotic companions provide excellent opportunities for interaction with other people – they are shared objects of interest that can trigger conversations and social interaction between familiar strangers (i.e., triangulation – see [5]). In addition, the robotic companions may stimulate reminiscence of past animals, and storytelling on the part of the seniors with dementia. Even more, in Study 2, the robotic cat unconsciously stimulated Elsie's imagination, reminding her of her dog, who used to cuddle up against her back during the night.

In terms of form factors, the recognizable appearance and tactile qualities of the robot cat's soft fur appeared to be a clear trigger for continuous stroking and caressing, compared to the somewhat uninviting rough skin of the hard-shell Pleo. This resonates with the increased need for positive tactile stimulation and social touch observed amongst people with dementia [2]. From a behavioral design point of view, it appears that less is more. The simple robot cat's repertoire of relatively basic responses and sounds was sufficient to create a strong emotional attachment in Study 2. The more technologically sophisticated Pleo, used in Study 1, with its elaborate and personalized behavioral interactions, advanced learning algorithms, and elaborate motoric actuation, makes the device more vulnerable for malfunctions. Our studies provide evidence for the value of relatively simple companion robots, which can be developed and deployed cost-effectively. Given the fact that animal companions may not always be an option (for reasons of hygiene, adequate animal care, etc.), robot companions may provide a valuable surrogate (e.g., [6]) .

Even though our results are promising, our studies are not without limitations. The comparative study (Study 1) was of short duration, and with a relatively small sample of participants. Study 2, as a longitudinal case study, depended heavily on the experiences of a single individual. Whereas we feel comparative and longitudinal approaches add value to the current state-of-the-art, we are aware that our efforts are explorative in nature. In addition, it is commendable to keep in mind that a preliminary investigation of personal needs for attention, interest in animals, and a history and positive prior experiences with keeping a life pet can be an advantage and a potential predictor of the effectiveness and success of the interaction with robotic animal companions.

Overall, our results suggest that robotic animals, in quite different settings and over longer periods of time, can provide affective presence, create strong emotional attachment, and can play a significant role in the immediate and long term psychosocial health of individuals suffering from middle to late stage dementia. As such, they are an excellent example of positive technology [7], and in particular person-centered *warm technology* designed for people with dementia [8].

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Exploring the Intended Meaning Underlying Reaction Use on Facebook

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Abstract. Facebook reactions are paralinguistic devices that facilitate rapid communication with others. Previous research suggests that *likes* are underpinned by complex motivations and considerations. However, the specific meaning that users intend to transmit with their use of the six *reaction* icons is currently unclear. We used an anonymous online survey to gather data on participants' Facebook activity and naturalistic reaction use. Inductive latent thematic analysis was used to analyse descriptions (N = 618) of the meaning that participants (N = 103) intended to communicate through the reactions used in their six most recent Facebook interactions. The final themes showed that each reaction was most commonly associated with its literal meaning (e.g., funny for *haha*). However, each reaction also had a number of alternative interpretations. The more ambiguous reactions, *like* and *love,* were associated with the greatest complexity in meaning and their use was most clearly distinguished by social closeness and affection. *Like, love, haha,* and *wow* were used as tools to acknowledge sight of a post or comment, while social support was communicated via *like, love,* or *sad.* These findings provide a theoretical framework for decoding reaction use. The results also have implications for everyday Facebook use, in that they help clarify the complex meanings that people can convey through these simple icons.

Keywords. Social networking, Facebook, reactions, communication, qualitative

1. Introduction

The motivations [1, 2] and considerations [3] underlying *liking* behaviour on Facebook are often complex. For example, social media users consider both their enjoyment of content and their relationship with the individual posting, as well as the appropriateness of the post and the impact it may have on their reputation, prior to hitting the *like* button [3]. The meaning of a *like* is also multifaceted, with both content-based (endorsement, agreement, amusement, or interest) and relational-based connotations (care, support, appreciation, or being 'there for' someone) [4].

In February 2016, Facebook extended the original *lik*e button to six *reactions*, which allow more nuanced paralinguistic expression on a post (*like*, *love*, *haha*, *wow*, *sad*, and *angry*). Recent research has started to examine the ways in which users perceive and employ these additional options. Sumner, Hayes, Carr, and Wohn [5] found that, with the exception of *angry, likes* and the other Facebook *reactions* were perceived as being more faithful than ironic. That is, they are more consistent with their designed and literal meaning (faithful) than they are appropriated to communicate an alternative meaning (ironic). Additionally, their findings suggested that the use of *reactions* is deliberate and thoughtful, with the newer *reactions* used less automatically than the classic *like* [5].

Spottswood and Wohn [6] examined how the new reactions facilitate responses to sensitive situations, such as catastrophes and crises. Emotive paralinguistic digital affordances (PDAs), such as *sad* (where the expression of the emoji (icon) captures the

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emotion communicated through the reaction), tended to be used on sensitive posts from more socially distant posters, as a way to maintain weak social ties. The same study [6] found that the six reaction options differed in their rates of use on negative posts, suggesting that users employ the range of reaction options provided for them, and that some may be more useful than others for appropriate expression in certain contexts.

Beyond these findings, and the intended meaning of reactions as defined by their assigned name and emoji, little is known the meanings that users intend to communicate through their selection of the new reactions. Furthermore, it is unclear whether the meaning of a *like* has evolved with the arrival of additional, more diverse, expressive options. Using inductive latent thematic analysis on a naturalistic data-set, this study explored the intended meaning underlying reaction use on Facebook.

2. Method

2.1. Participants

Australian university students (N = 103; 75.7% female; M_{age} = 23.97 years, SD = 8.78) provided basic demographic survey data regarding their Facebook and reaction usage. The majority of participants (91.3%) indicated that English was their first language. The remaining 8.7% additionally spoke either Chinese, Cantonese, Krio, Nepali, Russian, Sinhala, Swahili, or Vietnamese. On average, participants reported spending 2.36 hours (SD = 3.79) on Facebook and reacting to 9.08 posts (SD = 10.11) per day. The self-reported most-used (1) and preferred (2) reactions were *love* (50.5%; 57.3%), *like* (40.0%; 19.4%) and *haha* (6.8%; 15.5%).

2.2. Design and Procedure

Participants provided their consent prior to completing an anonymous online survey. For naturalistic reaction-use data, participants were asked to access their Facebook *Activity Log* and report on their six most recent uses of reactions. They were asked to indicate which of the six reactions was used and to briefly summarise the meaning they intended to convey through that reaction. Across the entire data-set were cases pertaining to all six reactions, *like* (45.3%; n = 280), *love* (29.3%; n = 181), *haha* (13.1%; n = 81), *wow* (4.5%; n = 28), *sad* (4.0%; n = 25), and *angry* (3.7%; n = 23). Qualitative data were analysed as per Braun and Clarke [7]. The entire data-set (618 cases) was coded to ensure a rich description of the data. The first and second author separately examined the data, looking for repeated meanings and patterns from which initial codes were produced. Where multiple codes applied to a single response, this was noted to ensure comprehensive acknowledgement of each idea. The consistency of coding between authors was then examined, and conflicts in terminology and application were reconciled. For example, where the same latent meaning was captured using different terminology, the authors came together to determine the most appropriate descriptor. Next, the codes were analysed, organised, and combined into initial themes. Finally, the themes were reviewed and refined to one final set per reaction (see Table 1).

3. Results

Table 1. Final themes representing the meaning that users ascribe to each of the six Facebook reactions.

Like	Love	Haha	Wow	Sad	Angry
Like	Love	Funny	Surprise	Sad	Angry
Support	Support	Relatable	Acknowledge	Support	Disagree
Acknowledge	Compliment	Acknowledge	Sarcasm	Apology	Dislike
Agree	Acknowledge				
Appreciate	Appreciate				
Social Proximity	Sweet/ Cute				

3.1. Like

As the original paralinguistic option on Facebook, *like* carried a diverse range of meanings. Many of these meanings were consistent with previous research that highlights the meanings, motivations, and intentions that underpin liking behaviour [4], suggesting that *like* is still used similarly, despite the range of additional *reaction* options now provided. A *like* could represent enjoyment and appreciation of the content/message of the post, e.g., *'... I enjoyed the content that was brought to me by the post'*; '*I liked what the post was trying to communicate'. Likes* were also used to convey support for an idea, event, or person, e.g., *'...general support for my friend'*; *'supportive of event they were advertising'*. Users would also use *likes* to reply to or acknowledge a post, e.g., '*I used the like reaction just to acknowledge that I had seen the post I was tagged in'*; *'…to show them I was keeping up with their holiday',* or to demonstrate agreement, e.g., *'I agreed with a political standpoint of a friend and like reacted the post to indicate that I agreed'. Likes* were also used to *'thank the person'*, and demonstrate appreciation, e.g., *'…I was appreciating his accomplishments'.* The use of a *like* was also frequently dictated by a user's social proximity to the person posting e.g., *'I wanted to show I liked the post but did not want to imply closeness with the person by "love" reacting it'*; *'I like the updated profile picture but we are not close enough friends for me to 'love' it'.* This represented the main evolution of the *like*. With the option to now *like* or *love* a post, users were able to choose to respond with the level of intimacy that they deemed appropriate based on their relationship with the individual posting.

3.2. Love

As an ambiguous symbol (a heart) compared to emoji facial expressions such as *sad* or *angry*, *love* was associated with a complex range of meanings beyond its literal use, e.g., *'... to express an emotion stronger than like'*. The same as *like*, *love* could be used to convey support, e.g., *'someone put up a meaningful post so I loved it for support'*; to acknowledge or reply to a post, *'to show that I [had] seen their post and was sending my love'*; or to show appreciation, *'my sister took a beautiful and supportive photo so I love reacted it to show her thanks'*. Uniquely, the *love* reaction was also used to compliment others, e.g., *'this was a very close friend's profile picture that I thought looked very pretty, so this was my way of complimenting her picture'*; and to convey that content was sweet or cute, *'love reacted to a picture of my friend's babies, they were just extremely adorable'*; *'…I thought the dog was super cute'* – both uses demonstrating the affection that appears to be communicated through the use of this paralinguistic option.

3.3 Haha

Haha was used literally to communicate that content was funny, *'the post was funny and I wanted to express that through the laughing reaction'*, but could also be used to convey the relatable nature of content, e.g., *'laughing at a meme that was relatable to myself and the person who tagged me'*; or to acknowledge the sight of a post or to acknowledge that a post was made jokingly, *'Their comment was intended to be a joke and I wanted to show that I knew they were making a joke even though I didn't really find it funny'*. This example further demonstrates how the *haha* reaction could be used even when the user did not find content to be humorous or amusing.

3.4. Wow

Wow represented two kinds of surprise; general/unspecified surprise, e.g., *'surprised with what the person has posted'*; and unpleasant surprise, *'my mum was savage and tagged me in something very shocking'*, *'shocked that it […] was happening'*. Again, this reaction could be used as a tool to acknowledge a post, particularly when users had been tagged. Distinctively, *wow* was also used sarcastically, *'this meme was offensive to me but as a joke so I will sarcastically 'wow' react [to it]*'; *'sarcastic response to a joke posted'*.

3.5. Sad

As well as literally expressing sadness, e.g., *'feeling upset'*; *'I was sad about the content of a post'*, the *sad* reaction conveyed support in the form of empathy or sympathy, e.g., *'empathising with the person who had posted. Showing that I support them'*; *'sympathy to the person who posted'*. A more explicit use of the *sad* reaction was to convey apology, e.g., *'sorry about that'*; *'because I was wrong on something'*.

3.6. Angry

Angry was straightforward in conveying a negative reaction to content. In this way it could communicate literal anger, e.g., *'I was really annoyed about an article a friend shared, I was trying to show that I too was angered by the article'*; disagreement, e.g., *'disagree/not comfortable with what the Facebook member has shared'*; or dislike/disapproval of content, *'disapproving of an incident'.*

4. Conclusion

The aim of the present study was to explore the meaning that Facebook users intend to communicate through their use of the six Facebook reaction icons. Each reaction was associated with its literal meaning, along with a number of alternative interpretations, demonstrating the complexity of these gestures. The more ambiguous and most used/preferred reactions (*like* and *love*) had the greatest diversity in meaning. This complexity in intended meaning is particularly interesting given that, upon receipt, *like* and *love* have been found to be perceived as significantly more faithful than other reactions [5]. This may suggest that the nuance that an individual sending a reaction intends to communicate may not be entirely decoded by the recipient – who interprets the reaction in a simplified and literal manner.

Like, love, haha, and *wow* were often used to acknowledge or reply to a post, communicating that a post/comment had been seen. *Like* and *love* were used similarly. However, *like* was preferred when communicating with more socially distant others, suggesting the perception that a user could decode social closeness from their peers' use of particular reactions. *Like, love,* and *sad* all represented support. Meanwhile, *love* was favoured when communicating affection, e.g., complimenting others or remarking that content was sweet/cute.

4.1 Additional Considerations

Examining participants' six most recent reaction uses may be considered both a strength and potential limitation of this research. The naturalistic data collection did not ask participants to select instances of their use of *each* of the six reactions. Naturally then, those reactions that are generally favoured by users were over-represented in our data. On balance, gathering an accurate picture of recent reaction usage allowed us to examine whether rates of reaction usage mirrored the preferences described by participants – which indeed, they did – with greatest self-reported usage of *love, like,* and *haha*. Mindful of the smaller quantity of data provided for the *sad*, *angry*, and *wow* reactions, future research could ask users to recount instances of all six PDAs to provide data for those which are commonly underused. Future research would do well to also consider other factors which may impact the attributions made, including personality traits, the nature of the content, and the relationship between sender and recipient.

In this paper we extended *like*-specific research to describe the range of meanings associated with the extended set of reactions on Facebook. The present findings are vital to interpreting everyday use of paralinguistic devices on Facebook and begin to decipher the nuance that Facebook users intend to communicate through these simple, one-click gestures.

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Using Virtual Reality to Enrich the Visit at the Botanical Garden

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Abstract. Nowadays, Virtual Reality (VR) is widely used in the tourism industry, improving the tourist experience in several cultural heritage sites. However, little interest has been paid to naturalistic sites. This paper describes the project "This is (not) just a tree" that aims to develop a system offering an educational and engaging experience to allow visitors of a Botanical Garden to live an experience closer to nature. Based on a co-design approach that involved both experts and visitors, an immersive VR (IVR) experience to discover the ecosystem of a tree was developed. A preliminary evaluation of the system with end-users was conducted to investigate aspects of the user experience, showing a high level of aesthetics, reward, involvement, sensory fidelity, immersion, and ease of use. The project outcomes suggest that the application of IVR in naturalistic contexts enriches the visitor experience, preserving the cultural and natural heritage, and making it more accessible.

Keywords. Virtual Reality, Participatory Design, Cultural Heritage, Naturalistic Heritage, Tourism, Botanical Garden

1. Introduction

The exploitation of VR in the tourism industry and cultural heritage is increasing [4]. Two crucial aspects characterize VR: the sense of presence, that is the illusion of "being there" in the virtual environment (VE) [1], interacting and receiving timely feedback from it [2], and the possibility to experience situations that cannot be recreated in real life [3]. In the last 20 years, VR has been employed before, during, and after the visit, changing the modalities to inspire visitors, improving tourists' satisfaction, and offering a memorable experience [5]. VR allows to deliver digital storytelling, capable of conveying accessible and understandable content for both the experts and tourists, thereby enhancing the tourist experience [6].

Most of the researches refer to the use of VR in archaeological sites, museums, and smart cities [4][5][7][8]. Less attention has been paid to sites that offer a naturalistic heritage, such as national parks [9] or Botanical Gardens. In particular, some Botanical Gardens are promoting the use of new technologies to attract visitors, such as multitouch table [10], augmented reality for handheld device [11][12], 360° images [13] and IVR environment with a low interaction level [14]. IVR experiences with high interaction are not thoroughly investigated. In addition, several works have involved users only in the final evaluation phases, neglecting co-creation aspects. The use of IVR in naturalistic and cultural sites such as Botanical Garden deserves to be explored, paying attention to the needs, preferences, and knowledge of end-user.

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The project "This is (not) just a tree" takes place in the Botanical Garden of Padova, which is included in the UNESCO World Heritage List. The goal is to use VR to create an engaging educational experience enhancing the connection between the visitors and flora and fauna populating the Botanical Garden. This article describes the project phases, with particular reference to the development of the system and the preliminary evaluation of the experience, and its contribution to tourism and heritage preservation

2. The virtual journey to discover the tree and its ecosystem

The development of the system is based on a participatory design approach. More specifically, both experts and Botanical Garden visitors were involved in the life cycle process. Methodological details of the participatory design activities and outcomes are reported elsewhere [15].

2.1. System design and development

The sample described in [15] was later extended to include 352 schoolchildren and 134 adults. They were asked to fill the questionnaire described in [15], which was meant to investigate their favorite topics to develop. Results from the final sample are in line with the preliminary ones. The findings show a general preference by both adults and children regarding the exploration of the inner functioning of a tree and the visiting of several botanical environments using IVR. Based on the outcomes of the questionnaire and the comments of experts from various disciplines (HCI, VR developer, zoology and biodiversity, arboriculture), a virtual journey for discovering the tree and its secrets was planned, characterized by stimulating educational content for end-users (i.e., adults and schoolchildren).

The virtual scenarios were built using Blender 2.79 and Unity 2017.3.1f1. Furthermore, data entered in the VE, such as environmental noises, video, and audio insights, have been collected in the field (e.g., the grove's sounds have been recorded in a grove through the binaural stereo microphone Neumann KU 100).

2.2. System architecture and interaction

The virtual system runs on a Head Mounted Display (HMD), the user can freely move and s/he interact with objects using two hand-held controllers.

The multisensory environment consists of 8 different macroscopic and microscopic scenarios that introduce the user into a journey to discover a tree and its ecosystem. In particular, the scenarios are: the grove, the rhizosphere (Figure 1.a), the inside of a trunk, a woodpecker nest, a tree trunk (Figure 1.b), a leaf molecule (Figure 1.c), a plant cell and the frond of a tree. In each scenario the user will be resized accordingly, e.g., from real size to the size of peanut to explore the subsoil. An initial tutorial trains the user on how to explore the VE.

Figure 1. Examples of scenarios: the rhizosphere (a), the trunk of a tree (b), the plant cell (c).

The experience features a customizable guided tour. The user can either follow the pre-defined path, which allows to explore all the scenarios and/or consult a map to freely navigate between the scenarios. The path includes a narrative voice that accompanies the user during the exploration, describing the environment where the user is located. In addition, a green acorn along the route signals the possibility to access scientific insights through explanatory videos, auditory information, and animations. The users can either choose to deepen some knowledge by selecting the acorn or continue the exploration.

3. Preliminary evaluation of the system

To evaluate the system, a preliminary investigation was conducted. Specifically, during 3 showcases, the users tried the system and their experience was assessed.

3.1 Materials, method and procedure

Users voluntarily offered to participate in the VR experience and signed in an informed consent form. In addition, demographic information (e.g., age, education, experience with botany) and previous experience with VR were collected.

The VR experience was played using the HTC Vive Pro HMD. The area dedicated to the experience had a size of 16 m^2. In this space, the user was free to move in the real space, which resulted in consistent movements in the virtual space. To reach further points in the VE, the user had to use HTC Vive controllers.

The experience started with preliminary instructions given by the investigator, followed by a short tutorial. Each participant was asked to explore at least two scenarios, at their choice, thereby ensuring that users navigated in the environment for about 5 minutes and experienced the size change. The investigator monitored the participant from a monitor in case of need.

After the experience, they were asked to fill in a post-experience questionnaire. The questionnaire was devised to investigate the experience of use. It consisted of 20 items in total, exploring six dimensions: aesthetics, reward, involvement, sensory fidelity, immersion, and ease of use. Aesthetics (3 items; adapted from [16]) refers to the aesthetical pleasantness of the experience. Reward (5 items; adapted from [16]) relates to how satisfactory the experience was. Involvement (3 items; adapted from [17]) is defined as a psychological state experienced as a consequence of focusing one's mental energy and attention on a coherent set of stimuli or meaningfully related activities or events. Sensory fidelity (2 items; adapted from [17]) is the extent to which the respondent considers the VE a high-quality representation. Immersion (2 items; adapted from [17]) is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with a VE. Finally, one item was devised *ad hoc* to assess the extent to which respondents thought that using the controllers was effortless. Answers were collected on a 5-point scale (1= at all; 5= completely).

4. Results

The sample included 18 participants with an average age of 45.83 years (SD= 15.59). As for the botanical experience, the majority of participants (61.11%) had no experience, two participants (11.11%) had less than one year of experience, 16.67% of participants had between 3-5 years of experience, one participant (5.55%) had 5-10 years of experience, and one participant (5.55%) had 10-30 years of experience. Moreover, 55.56% of the participants reported that they had never used VR before, while 44.44% reported to have previous experience.

To analyze participants' impressions regarding aspects of engaging and sense of presence of the experience, a series of one sample Wilcoxon tests was run. In particular, we compared the scores that participants assigned to each dimension with the median value of the scale (Mdn= 3). The results show that the IVR experience discovering the tree and its ecosystem is perceived by users as aesthetically pleasing (z= -3.60 $p< 0.001$, Mdn= 4, M= 4.31), rewarding (z= -3.80, $p< 0.001$, Mdn= 5, M= 4.62), involving (z= -2.65, $p< 0.01$, Mdn= 4, M= 3.88), with sensory fidelity (z= -3.52, p= 0.01, Mdn= 4, M= 4.06), immersive (z= -2.48, p= 0.01, Mdn= 4, M= 3.66) and the controllers are easy to use (z= -2.76, p= 0.01, Mdn= 4, M= 3.89).

5. Conclusion

In this article, we presented the project "This is (not) just a tree" aiming to create an enriched experience for visitors to the Botanical Garden of the city of Padova through new technologies. To create an engaging narrative path, a co-designing approach has been adopted. Stakeholders, including academic scholars and the end-users, have been involved since the early stages of designing the experience to understand their needs, expectations, and preferences on different design possibilities.

The main result of the project is an interactive IVR experience about a virtual journey to discover the tree ecosystem, characterized by educational content and entertaining aspects. This experience allows to know some contents while preserving the naturalistic heritage and to explore environments not accessible in the real world (e.g., plant cell). A preliminary evaluation of the system was conducted, showing that the end-users judged the experience positively. In particular, participants considered the experience satisfactory, involving, and aesthetically pleasing. Moreover, participants felt immersed in the environments that they explored, and they reported that the system is easy to use and with high-quality representation.

The outcomes show that interactive IVR experience could be proposed to enrich the traditional visit to a Botanical Garden. In addition, this system can be easily exported even outside the Botanical Garden to promote this destination and to promote the visit [18], or can be used in school contexts for educational purposes [19].

Finally, to make the content more accessible and engaging for different types of audiences, digital storytelling will be adjusted [20] for children. In addition, the devices will be adapted for children under 13 years, because of the likelihood of cybersickness symptoms with the HDM [21], preferring large multi-touch display.

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The Prototype Willingness Model of Adolescents' Risky Photo Disclosure on Social Networking Sites: The Importance of Psychosocial Characteristics

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Abstract. Researchers state that adolescents are likely to engage in risky photo disclosure on social networking sites (SNS). It is proposed that risky adolescents behavior online can be explained by the prototype willingness model and important psychosocial characteristics. Thus, the aim of this study is to find out if an extended prototype willingness model can explain risky adolescents' photo disclosure on SNS. To reach this aim, a cross-sectional study with a random cluster sampling was organized. Five hundred ninety five adolescents (Mage=14.67, SDage=1.41; 57% female and 43% male) have participated in the study. Adolescents were asked to fill in a hardcopy questionnaires. In order to test the theoretical model of adolescents' risky photo disclosure on SNS, the analysis of structural equitation model (SEM) by Mplus was used. The results of the hypothesized model show acceptable model fit: χ^2= 189.340 (54), p<0.001 RMSEA=.07 [.06; .08], CFI=.95, TLI=.92. According to the results, it can be stated that the expanded prototype willingness model can explain adolescents' risky photo disclosure on SNS, where: (1) important psychological characteristics (narcissism, privacy concerns) determine the behavior indirectly through the factors of the prototype willingness model; (2) important social characteristics (age) determine adolescents' tendency to engage in risky photo disclosure on SNS directly. This study shows that the prototype willingness model can be a useful theoretical base in explaining risky adolescents' behavior online and that important psychosocial characteristics must be considered while explaining such kind of behavior.

Keywords. Adolescents, photo self-disclosure, social networking sites, prototype willingness model.

1. Introduction

It is said that nowadays adolescents live in the online world and their social contacts are distributed in the social networking sites (SNS) rather than in the real life settings [1-3]. It is stated that one of the main features of using SNS is self-disclosure [4-7]. The recent research of Paluckaitė & Žardeckaitė-Matulaitienė (2017) shows that adolescents' disclosure online can be both, verbal and non-verbal. Thus, it is important to state that nowadays one of the most popular forms of self-disclosure online is sharing photos with others [8] [9] [1].

Distinguishing photo disclosure on SNS between risky and non-risky behavior is a challenge, as authors, analyzing adolescents' disclosure online, recall such kind of behavior as risky or problematic in general [2] [6-8], due to adolescents' vulnerability and high possibility of experiencing negative consequences while disclosing online [5] [6]. However, risky photo disclosure might also be distinguished to appropriate (e.g., sharing portrait photo) and inappropriate (e.g., sharing semi-nude photos) [10]. Further in this study risky photo self-disclosure will be called as adolescents' tendency to share

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photos with the inappropriate content.
It is complicated to distinguish the trends of adolescents' photo self-disclosure on SNS, because most researchers focus on college or university students while analyzing such kind of behavior. Thus there is a lack of knowledge about the mechanism of adolescents' engagement in risky photo disclosure on SNS, which would be useful for the evidence-based intervention or prevention programs on such kind of behavior. The recent research of Branley and Covey (2018) shows that Prototype Willingness model (PWM), where both, reasoned (intention) and reactive (willingness) pathways are considered, can well explain risky non-verbal self-disclosure on the Internet. Moreover, it is also stated that there are important psychosocial characteristics, related to such kind of behavior. For example, the systematic literature review [12] shows that social anxiety, narcissism and privacy concerns determine adolescents' self-disclosure in online settings, where age and gender must also be considered. According to the results of the afore mentioned study, it is expected that narcissism, social anxiety and privacy concerns will be indirectly related to adolescents' risky photo disclosure on SNS, tested by PWM. Thus, this study aims to test the expanded PWM on adolescents' risky photo self-disclosure.

2. Method

2.1. Procedure

To reach the aim of this research a cross-sectional study with random cluster sampling of Lithuania schools was conducted. Schools' administration were contacted to present the research and arrange the details of the implementation

Because of the national laws, ethical approval was not required. For ethical considerations, written informed parental/guardian consents were collected. Only those students, whose parents/guardians agreed for their participation, could take part in the study. For students, verbal informed consent was obtained. Every student, even if their parents/guardians agreed on their participation, could refuse to participate. The study was conducted during classes at school. The hard-copy questionnaires were prepared for the pupils. After the participation, students were rewarded with candies.

2.2. Participants

Five hundred ninety-five adolescents (Mage=14.67, SDage=1.41) participated in this study. Fifty seven percent of them were female and 43% - male.

2.3. Measures

Risky photo self-disclosure on SNS was measured by 6-item risky photo disclosure scale. Adolescents were asked how often (from 1-never to 5-very often), in the past two months, they have shared different kind of photos on SNS. Cronbach's α of the scale was .82.

PWM variables' measures were based on the studies of Walrave and colleagues (2015) and Van Gool and colleagues (2015). For each variable, participants were asked to rate each statement about every risky photo self-disclosure scale' item in the Likert scale from 1 (never/not at all) to 5 (very often/totally). Cronbach's α for the attitudes scale (measured by 3 semantic differentials scale) was .88; for injunctive peer norms - .87, for descriptive peer norms - .86; for prototype favourability - .87; for prototype similarity - .85; for intention - .81; for willingness - .86. The results of confirmatory factor analysis on all PWM variables showed an acceptable fit: χ^2= 5120.243 (1988), p<.001, RMSEA=.05 [.05; .06], CFI=.92, TLI=.91.

Social anxiety was measured by the 12-item short form of Social Anxiety Scale for Adolescents (SAS-A) [13]. Cronbach's α=.88.

Narcissism was measured by 12-item Narcissistic Personality Questionnaire for Children-Revised (NPQC-R) [14]. Cronbach's α=.84.

Privacy concern was measured by the 5-item Privacy concern while using SNS scale [15]. Cronbach's α=.87.

For this study, all measures mentioned above were grouped into total aggregation parcels, while the measure of the attitudes was grouped into 3 parcels.

Adolescents were also asked about their age and gender.

3. Results

The expanded PWM was analyzed using Mplus 7.4. The model fit was assessed by Root Mean Square Error of Approximation (RMSEA), Bentler's Comparative Fit Index (CFI) and Tucker-Lewis index (TLI). Model fit was measured based on: RMSEA <.05, CFI, TLI >.95 shows a good model fit; RMSEA .05-.08, CFI, TLI >.90 shows an acceptable model fit [16] [17].

The main characteristics (means and standard deviations) of the study's variables are presented in Table 1.

Table 1. Means and standard deviations of the main model's variables

Variable	M	SD
Attitudes	31.08	13.57
Injunctive peer norms	10.19	5.23
Descriptive peer norms	10.34	4.86
Prototype favourability	11.23	5.80
Prototype Similarity	8.39	4.79
Intention	8.19	3.64
Willingness	8.43	3.99
Risky photo self-disclosure	7.46	2.93
Narcissism	30.81	8.85
Social anxiety	28.71	9.03
Privacy concerns	15.16	5.12

The results of the model show an acceptable fit: χ^2= 189.340 (54), p<.001, RMSEA=.07 [.06; .08], CFI=.95, TLI=.92.

As it can be seen in Figure 1, social anxiety isn't related to any of the PWM main factors. However, narcissism is positively related to all variables of PWM. To be more precise, more narcissistic adolescents have more positive attitudes towards risky photo disclosure and evaluate social peer norms and the prototype of disclosing inappropriate photos online more positively. Moreover, privacy concerns are only negatively related to the attitudes.

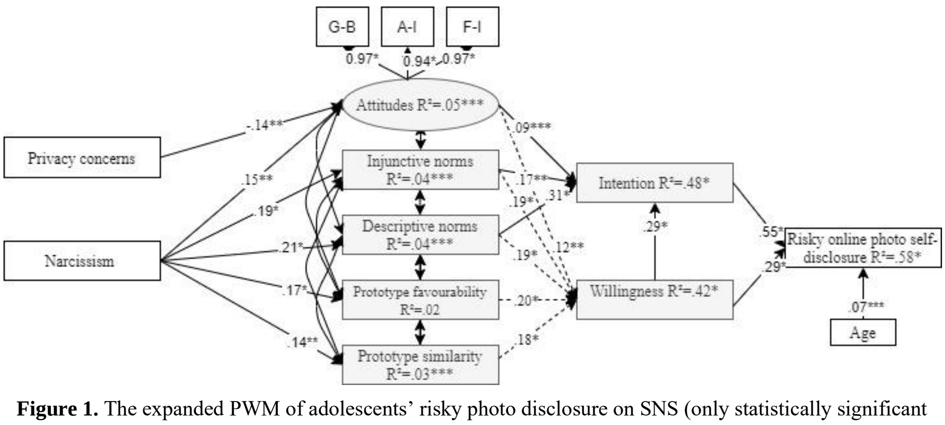

Figure 1. The expanded PWM of adolescents' risky photo disclosure on SNS (only statistically significant results are presented). *p<.001; **p<.01; ***p<.05. Solid arrow shows reasoned pathway; dashed arrow shows reactive way.

The results of the study also show that all reasoned pathway variables explain adolescents' intention to engage in risky photo disclosure and reactive pathway variables explain willingness to engage in such kind of behavior. Importantly, both, intention and willingness explain 58% of adolescents' risky photo disclosure on SNS. Only age has a significant impact on such kind of behavior: older adolescents are more likely to engage in risky photo disclosure on SNS.

4. Discussion and conclusions

The results of the study show that expanded PWM can well explain risky adolescents' photo disclosure on SNS. However, this study also shows that not all considered as important psychosocial characteristics are essential while explaining such kind of behavior.

According to the results, only narcissism and privacy concerns indirectly determine adolescents' risky photo disclosure on SNS. As expected, narcissism is an important factor while explaining adolescents' attitudes, social peer norms and prototype in PWM. Thus, narcissism indirectly predicts adolescents' intention and willingness to engage in risky photo disclosure on SNS. Thus, it is possible to state that narcissism has an impact on both, reasoned and reactive pathways of adolescents' risky photo disclosure on SNS. It is also important to mention that more concerned of their privacy adolescents have more negative attitudes towards risky photo disclosure on SNS. Thus, it means that privacy concern is an important factor while explaining more reasoned pathway of decision making in adolescence, but not the reactive pathway. Results suggest, that social anxiety doesn't indirectly predict adolescents' risky photo disclosure on SNS. However, it may also mean that social anxiety directly determines such kind of behavior. Thus, future research may focus on social anxiety as direct predictor of such kind of adolescents' behavior.

Interestingly, social indicators (age, gender) show a very low importance in this study: only age predicts adolescents' risky photo disclosure on SNS. It means that older adolescents are more likely to engage in risky photo disclosure. Gender isn't an important factor in this model and we may predict that sharing risky photos online is a universal behaviour among gender.

To sum up, both, intention and willingness are important factors which explain adolescents' risky photo disclosure on SNS, where narcissism and privacy concerns indirectly and age directly determines such kind of adolescents' behavior on SNS. Thus, we may state that intervention and prevention programs of adolescents' risky photo self-disclosure could be based on PWM, considering the importance of afore mentioned psychosocial characteristics.

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Examining the Sociodemographic Variables and Social Networking Site Addiction among University Students in Sarajevo

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Abstract. Research into internet addiction has dramatically increased over the last decade. Therefore, studies on Social Networking Site (SNS) addiction are increasing day by day. It is acknowledged that problematic use of SNS may affect academic improvement; however, there are contradictory findings in the literature. To ascertain its effect on academic achievements and to reveal its associations with sociodemographic variables, this study aimed to examine the relationship between academic success, sociodemographic features, and SNSs use patterns among university students. A total of 275 individuals participated in the study. A sociodemographic data form and the Bergen Social Media Addiction Scale (BSMAS) were administered. The results revealed a statistically significant negative relationship between age and BSMAS total score, and grade point average (GPA) and relapse criterion of BSMAS. Findings are discussed in light of previous literature on SNS. Limitations and suggestions for future studies are indicated.

Keywords. Social networking, social networking site addiction, social media addiction, internet addiction, age, academic achievement

1. Introduction

Research on addictions to new technologies has been studied for many years, and it dates back to the 1940s when Preston studied radio and movie addiction on children [1]. Due to the technological advancements over the years, technologies that people depend on have alternated as well. Indisputably, social media addiction is one of them.

Social media addiction is conceptualized as having a strong desire to use social media sites and the emergence of problems in school, interpersonal relationships, and mental health due to the time and effort spent on these sites [2]. Motives behind using social networking sites (SNSs) include the comfort of use [3], maintaining relationships [4], gathering information about others [5], and entertainment [6].

A great deal of research into SNS patterns has focused on academic and sociodemographic variables among university students. For example, researchers have shown that a negative relationship between SNS use and academic achievement exists [7,8]. However, the mean correlation between academic achievement and SNS use is close to zero for studies investigating a particular SNS platform use but relatively higher for studies investigating the use of SNSs in general [9]. Previous studies also suggest a gender difference in terms of SNS use patterns among university students. For instance,

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female university students are more engaged in using SNSs than male students [10], and male students are more likely to be addicted to SNSs [11].

The present study, which is the first empirical study examining SNS use patterns on university students in Sarajevo, Bosnia and Herzegovina, investigates the academic and sociodemographic variables and SNS use patterns among university students.Furthermore, this study targets to contribute to a growing body of cross-cultural literature on SNS use.

2. Method

2.1. Sample and measures

Two hundred seventy-five university students were included in the study. The sociodemographic information form and Social Media Addiction Scale (BSMAS) were used. The sociodemographic information form included questions about age, gender, marital status, years of education, occupation, financial status, cumulative grade average point (CGPA), present tobacco and alcohol use. On the other hand, to assess social media addiction levels in participants, BSMAS was administered. The BSMAS includes six items ranked on a 5-point Likert scale ranging from 1 (very rarely) to 5 (very often). The six items of BSMAS measure: (1) salience; (2) mood modification; (3) tolerance; (4) withdrawal; (5) conflict; and (6) relapse. Higher scores indicate greater social media addiction [12].

2.2. Data analysis

To examine the mean, S.D. and count of the variables in sociodemographic data, the descriptive statistics method was utilized. Pearson's correlational analysis was applied to examine the relationship between sociodemographic variables and SNS addiction patterns. The level of significance (p) was adjusted as 0.05, and all analyses were estimated with the Statistical Package for Social Sciences (SPSS) version 22.0 (IBM Corp., Armonk, NY).

3. Results

Descriptive statistics showed that the mean age, years of education, and CGPA of the participants were 21.80, 14.69, and 2.76, respectively. The number of female participants was higher than male participants (63.0% female, n = 174; 37% male, n = 102). 65.9% (n = 182) of the participants had no relationship. While most of the participants were unemployed (n = 244, 88.4%), their financial status was between 2000-5000 TL (n = 344, 69.4%). The majority of the participants had no present tobacco (n = 194, 70.3%) and alcohol use (n = 253, 91.7%) (Table 1)

Table 1. Descriptive and frequency features of sociodemographic variables

Variables	Mean	S.D.
Age	21.80	2.58
Years of Education	14.69	1.54
CGPA	2.76	.67
	n	**%**
Gender		
Male	102	37.0%
Female	174	63.0%
Marital Status		
Married	16	5.8%
In relationship	78	28.3%
No relationship	182	65.9%
Occupation		
Unemployed	244	88.4%
Working periodically	17	6.2%
Full time job	15	5.4%

Financial Status		
Lower than 2000 TL	18	3.8%
2000-5000 TL	344	69.4%
Higher than 5000 TL	133	26.8%
Present Tobacco Use		
Yes	82	29.7%
No	194	70.3%
Present Alcohol Use		
Yes	23	8.3%
No	253	91.7%

On the other hand, the correlational analyses revealed negative correlations between age and Item 1 (r = -,130, p = ,03); Item 3 (r = -,208, p = ,00); Item 4 (r = -,136, p = ,02); Item 5 (r = -,179, p = ,00); Item 6 of BSMAS (r = -,195, p = ,00); and BSMAS total score (r = -,210, p = ,00). Moreover, years of education (r = -,133, p = ,02); and CGPA (r = -,153, p = ,01) were negatively correlated with Item 6 (Table 2).

Table 2. Correlation coefficients between age, years of education, GPA, BSMAS items, and BSMAS total score

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Total
Age	**-.130***	-.085	**-.208****	**-.136***	**-.179****	**-.195****	**-.210****
Years of education	-.053	.003	-.095	-.050	-.102	**-.133***	-.098
CGPA	-.075	-.086	.014	.026	.003	**-.153***	-.060

Notes: Total: Total score of BSMAS, Item 1: Salience subscore of BSMAS, Item 2: Mood modification subscore of BSMAS, Item 3: Tolerance subscore of BSMAS, Item 4: Withdrawal subscore of BSMAS, Item 5: Conflict subscore of BSMAS, Item 6: Relapse subscore of BSMAS, CGPA: Cumulative grade point average. $p < 0.05^{*}$; $p < 0.01^{**}$

4. Discussion and conclusions

This study investigated the academic and sociodemographic factors and SNS use levels of university students in Sarajevo, Bosnia and Herzegovina. In general, findings suggest that higher problematic SNS use is related to the participants' younger age. This result is consistent with previous studies [13–15]. Given that younger people tend to be more impulsive [16,17] and problematic SNS use is associated with impulsivity [18], this can explain the higher SNS use by younger participants. Moreover, higher CGPA was correlated with lower relapse of SNS use. In other words, the higher the CGPA, the lower the incidence of unsuccessful attempts to manage the SNS use. This finding is in concordance with some studies investigating the link between academic achievement and SNS addiction among university students [19]. Another finding from this study suggested that lower years of education was associated with higher relapse in problematic SNS use. This result may be supported by Blum et al.'s previous research, which indicates that in addictions other than social media addiction, i.e., opiate or alcohol addiction, relapse is higher among individuals with lower education [20]. Since SNS and substance addicted individuals have identical brain anatomy—specifically, reduced grey matter volume in the amygdala, which indicates impulsivity [21]—and internet addiction is analogous to other addictions like alcohol, opiate, or gambling [22], work of Blum et al. can explain the link between higher relapse scores and lower education level.

This study adds to a growing body of cross-cultural literature on SNS addiction by being the first study to examine SNS addiction patterns in Bosnia and Herzegovina. However, it has several limitations to be addressed. The sample of this study consisted of college students. Thus, it should have included various participants from different age groups and different educational backgrounds to acquire more representative findings. Secondly, this study was cross-sectional; longitudinal studies should be conducted to counteract the bias due to the cross-sectional design. Self-report instruments were used to examine the SNS use patterns. Further studies should investigate the causal relationship between academic and sociodemographic factors and SNS addiction patterns. Consequently, SNS is an umbrella term that includes various types. Future studies that focus on a specific SNS (e.g., Instagram, YouTube, Facebook) may yield more clear results to reach a refined understanding of the topic.

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User Experience Evaluation of a Physical versus Virtual Product: An Exploratory Study Using Immersive Virtual Reality

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Abstract. Recently, it has been proposed that virtual reality (VR) could be used as a tool to assess user experience (UX) of a product. However, to our best knowledge, no research has yet compared physical and virtual UX evaluations. To address this issue, we assessed the UX of a product (a "Graziella" bicycle) in a physical and a virtual setting. In the physical condition, participants evaluated the physical product, whereas in the VR condition they evaluated the virtual simulation of the same product using a head-mounted display. The evaluation in the simulated condition was performed using two different social VR platforms: Amazon Sumerian (N=14) or Sansar by Linden Lab (N=21). The Object Presence Questionnaire (OPQ) was administered to evaluate the perceived presence of the product, while the ITC-Sense of Presence Inventory (ITC-SOPI) was used to assess personal presence. In addition, the Positive and Negative Affect Schedule (PANAS) was administered to evaluate participants' emotional response. The analysis of OPQ data revealed that neither object presence, nor personal presence was influenced by presentation condition (i.e., physical or virtual) and no significant difference was also found between the VR platforms. The analysis of ITC-SOPI indicated that levels of subscale Engagement were higher in the virtual than in the physical model, with no differences between the two VR platforms. PANAS results showed that the virtual condition was characterized by significantly higher positive affect than the physical one, again with no difference found between the VR platforms. Results suggest that the evaluation of a product in an immersive setting produces comparable results in terms of perceptual realism and perceived presence with the evaluation of a physical product. Furthermore, the virtual UX assessment task elicited engagement and positive affect, suggesting the potential of VR as a tool to assist designers in the evaluation of a product's UX.

Keywords. User Experience, Virtual Reality, Presence, Product Design, Rapid prototyping.

1. Introduction

A key challenge in the product design process is how to evaluate the user experience (UX) of the designed product. Recently, it has been proposed that immersive virtual reality (VR) could be used as a tool to assess UX. Compared to the evaluation of physical products in conventional laboratory settings, VR-based UX evaluation would provide a more ecological setting, the possibility of understanding the interaction between the product, the user and the context of use, as well as higher flexibility in orienting design decisions [1]. Mengoni et al. [2] carried out a study to compare usability testing in physical and virtual environments. Findings showed that in physical usability testing, the

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impression of a product mainly depends on material characteristics rather than those of hape, whereas in VR tests the impression of a product was mainly stimulated by visual spects (shape, layout, regularity of forms, symmetry). Overall usability value was found igher in the physical condition rather that in the immersive one, due to impossibility of xploring textures and materials in a VR environment. However, to our best knowledge, no research has yet compared physical and virtual UX evaluations, beyond mere usability aspects. To explore this issue, we assessed the UX of a product (a Graziella bicycle) in both a physical and a virtual setting. In the physical condition participants evaluated the physical product, whereas in the VR condition they evaluated the virtual simulation of the same product, using a head-mounted display. The evaluation in the simulated condition was performed using two different social VR platforms: Amazon Sumerian and Sansar by Linden Lab.

2. Methods

2.1. Design and sample

The study was based on a between-subject design with two conditions (VR-based UX evaluation versus physical-based UX evaluation of a product). In the physical condition participants (N=20; 12 m and 8 f, mean age: 39,29, d.s. 17,10) evaluated the physical product, whereas in the VR condition they evaluated the virtual simulation of the same product using a head-mounted display (HTC Vive, by Valve). The product evaluated was “Graziella” bicycle, which was displayed either in a physical or a virtual setting. The physical setting consisted in a meeting room of Studio Volpi design studio, in which was positioned the Graziella bicycle. The virtual setting consisted in the 3D-rendered version of the meeting room and product.

2.2. Materials

The evaluation in the simulated UX scenarios was performed using two different VR platforms: Amazon Sumerian (N=14, 7 m and 14 f, mean age 44.05; d.s.= 21.12) or Sansar by Linden Lab (N=21, 10 m and 11 f, mean age 39.29; d.s.= 17.10), with a total sample of 35 participants. Sumerian is a platform designed by Amazon, which allows to create virtual reality experiences on web. The platform is based on Java and supports several headsets. Sansar is a VR platform produced by Linden Lab, that allows creating immersive and social interactive experiences. This software uses C# is supported by most commercial headsets.

The ITC - Sense of Presence Inventory (ITC-SOPI) [3], was used to assess user’s sense of presence. The scale includes four subscales: sense of physical space, engagement, ecological validity and negative effects.

Participants respond to each item through a 5-steps Likert scale (1= totally disagree; 5= totally agree). The Objects Presence Questionnaire (OPQ) [4], [5] was used to evaluate the perceived quality of the virtual product. The OPQ is a modified version of the Singer & Witmer [6] Presence Questionnaire and measures “the subjective experience that a particular object exists in a user’s environment, even when that object does not” (p. 79). It includes three subscales: The Involvement-Control subscale measures how much participants are absorbed by the experience and responsiveness of the application; the Natural subscale measures the consistency with reality; the Interface Quality subscale measures the ability of participants to focus on a task. Participants respond to each item through a 5-steps Liker scale (1= totally disagree; 5= totally agree). The Positive and Negative Affect Schedule (PANAS) [7] questionnaire was used to evaluate the emotions that participants felt during the test. The questionnaire measures two distinct and independent dimensions: positive and negative affection. It is composed of two subscales: Positive Affect (PA) subscale measures the extent to which the participant feels enthusiastic, active and determined; Negative Affect (NA) subscale is about the extent in which the participant experiences some unpleasant general states such as anger, guilt or fear. Participants respond to each item through a 5-steps Likert scale (1= not at all; 5= very much). In addition to these instruments, ad hoc questions were administered to participants in the VR condition to further explore the perceptual features of the virtual model.

3. Results

After checking for homogeneity of variance across groups, a one-way ANOVA was performed. The analysis of OPQ data revealed that object presence was not influenced by the presentation condition (i.e., physical or virtual) except for the subscale “Quality of Interface”, whose mean ratings were higher in the Real model than in the VR one (Real model: 18,70; VR model-Sansar 15,76; VR model-Sumerian 15,29; F=4,202; p<0.05). As concerns personal presence, the analysis of ITC-SOPI indicated that levels of subscale Engagement were higher in the virtual than in the physical condition, with no differences between the two VR platforms (Real model: 38,50; VR model-Sansar 52,86; VR model-Sumerian 52,24; F=19,203; p<0.01). PANAS results showed that the virtual condition was characterized by significantly higher positive affect than the physical one, again with no difference found between the VR platforms (Real model: 38,50; VR model-Sansar 39,81; VR model-Sumerian 38,10; F=5,162; p<0.09).

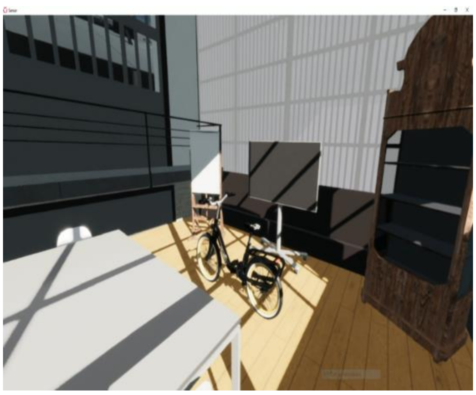

Fig. 1 The virtual bicycle used in the VR experimental condition

4. Discussion

These findings suggest that the evaluation of a product in an immersive setting produces comparable results in terms of perceptual realism and perceived presence with the evaluation of a physical product. Clearly, the present evaluation was mainly limited to the assessment of the overall visual experience of the product and did not include the possibility of interacting with the model. Nevertheless, participants reported their ability to assess the key features of the virtual model. Furthermore, the virtual UX assessment task was associated with higher engagement and positive affect than the physical UX assessment, indicating that participants enjoyed the virtual test. These results support the potential of VR as a tool to assist designers in the evaluation of a product’s UX. A future research goal is to design and test a full-interactive UX virtual simulation environment, including programmable and customizable testing features to “replicate” in a VR setting the capabilities of a physical UX testing environment.

5. Acknowledgments

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Transformative Conversations. Questioning collaboration in digitally mediated interactions

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Abstract. Given the innovative, technological and Computer-Mediated Communication (CMC) environment in which we live, it would be essential to understand which role humans can take on in it, as well as the empowerment provided to human beings by this complex context. This paper constitutes a focus on these possibilities through the investigation of the dynamics of collaboration in Mixed-Reality (MR) environments (PC-HoloLens), paying particular attention to the role of nudges in eliciting (optimal) shared experiences among team members. This study, therefore, intends to investigate the interactive and emotional outcomes related to a mediated communication based on different nudges (three experimental conditions: nudge for empathy, nudge for awareness, and no nudge). We hypothesized that these nudges could also modulate the emergence of optimal shared experiences, such as the one of group flow and of social presence. Through the quantitative analysis of psychometrical measures and the qualitative analysis of the dialogue within one dyad, we detected featured elements and patterns that can be used as starting points to question collaborative processes in digitally mediated interactions.

Keywords. Computer Mediated Interaction (CMC), Mixed Reality (MR), nudge, shared-flow, conversation, HoloLens

1. Introduction

The technological and digital innovation that has been permeating our reality is pushing further boundaries, introducing new, free, always connected, and blurring ways of communicating and staying in touch. The innovative technologies suggest questions on the new ways of communicating in *phygital* environments that need answers from a Social Psychology of Cyberplaces point of view [1]. Cyberplaces are interactional places, in which participants' identities and meanings can be co-constructed during the interactional process where deep connections with the remote, mediated, and digital Other can take place. In the light of these general considerations and by following the above-mentioned theoretical framework, we assumed that cooperation could appear and grow until the reaching of a shared optimal experience, called shared flow [2]. Flow in Computer-Mediated Communication (CMC) is still a debated phenomenon, mostly studied at the individual level. The majority of studies considered flow emerging from single participants interacting with a computer, while the interaction between networked participants is still an open issue. In this paper, based on a preliminary study [3], we aim

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to address this aspect focusing on the analysis of shared flow phenomenology in Mixed Reality (MR) environments.

Specifically, this study explores the role of a nudge in the emergence of optimal shared experiences. Based on the study cited above, we assumed that nudge could be a trigger for the elicitation and support of the status of deep sharing within CMC interlocutors and, therefore, it could acquire a key role in optimal experiences' elicitation.In this regard, the principal aim of the current study is to investigate the outcomes produced by different types of nudge provided within an MR environment during dyadic collaborative interactions. Based on this study, we discuss to what extent and how, within a CMC environment, a specific nudge could bring forth an emergent entity which merges the members into a single unit, and which can eventually culminate in the experience of an optimal collaboration.

2. Conceptual Framework

By 'optimal collaboration' we mean an interaction characterized by high levels of Social Presence and Flow (cognitive aspects of collaboration) and We-ness (social quality of collaboration). These are the concepts that, together with Nudge, compose the framework of our study. We labelled a Nudge ad "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" [4]. In this study, we decided to differentiate between Nudge for empathy (experimental condition 1 = C1) and Nudge for awareness (experimental condition 2 = C2), comparing the action of both with a situation of control (no Nudge: experimental condition 3 = C3).

Social presence is defined as the feeling of "being with other Selves" in a real or virtual space, resulting from the ability to intuitively recognize the intentions of Others in one's surroundings" [2]. Three levels characterize social presence: Pro-social (or imitative) presence, mainly based on the recognition of the motor intentions of the Other (Other versus the Self); Interactive social presence, which allows for the recognition of the intentions of the Other oriented towards the Self (Other toward the Self); Shared social presence (or empathic), which allows the Self to enter into resonance (like a tuning fork) with the intentions of the Other (Other like the Self). Types of Nudge able to elicit the 3rd level social presence is what we looked for in this study.

The term *Flow* refers to "a holistic sensation that people feel when they act with total involvement" [2]. Nine essential elements characterize Flow: the balance between challenges and skills, union between action and consciousness, clear objectives, immediate feedback, focus on the task, sense of control, loss of self-awareness, deconstruction of time, autotelic experience. When the subject experiences this sensation, his emotional, cognitive, and motivational skills work synergistically, responding to requests from both the external world and the inner world.

Finally, *We-ness* is a form of thinking that develops in the relationship with the other and allows one to shift attention from one's awareness to that of the group, creating a "new perspective" within a relationship indicated with the We. The members of the group, in this case, are committed to the group itself to achieve shared goals. The shared representation of the interaction allows synchronizing members' actions. Since conversation is the means naturally developed in the course of evolution to produce synchronization among human beings, we believe that the enunciative dimension has a fundamental role in the process of building We-ness. This process consists of influencing interlocutors' behaviour and regulating the values of their communication through some form of feedback. It is because of this role that we consider the enunciative presence an essential facilitator of collaboration, especially in the MR environments.

3. Methods: Setting, Task, Data Analysis and Hypothesis

The study involved 102 participants (51 dyads) randomly assigned to one out of three different conditions: Nudge for empathy (C1), Nudge for awareness (C2), and no Nudge (C3). Before tackling the task, the subjects assigned to conditions C1 and C2 listened to a 4':32'' audio recording in which a professional actor told the story of Luca, a high school student bullied by his classmates. Before the listening, we asked participants to put themselves in Luca's shoes. At the end of the listening, the dyads of conditions C1 were immediately immersed in the collaborative task phase, because we wanted to focus on the feeling of "enter emotional contact with" that reflect the concept of empathy [8]. Instead, in the C2 condition we want to increase social commitment and personal consistency, so they had to respond in writing to four stimuli related to the way the respondent could have behaved if he had been in Luca's place. For each stimulus, C2's participants had to choose among three types of behaviours featured by increasing degree of empathy. Three independent referees judged the graduation of the behaviours. C3 participants were asked to do the task directly. Participants occupied the two available workstations separated by a movable wall. The participant on the left used HoloLens and the participant on the right used the pc on the desk in front of him/her (fig.1), only viewing the holograms on his/her screen. Couple members tasked to help each other to identify, choose and arrange objects in the digital space to make a shared narrative.

Figure 1. Experimental setting.

3.1. Task. Each pair of participants faced a collaborative task that consisted of inventing a story built from 5 holograms chosen from those available in the digital room. The only constraint to the narrative was the context suggested for the story, which had to be necessarily set on an island. Overall time available: 15 minutes with a 5-minute report at the end. The participant with the PC was assigned the task to write the story on a sheet of paper, sign it and then read the text aloud.

Data Analysis. The data produced has been analyzed using a mixed methodology combining quantitative and qualitative measurement of individuals' mediated experience. The quantitative phase dealt with the measurement of participants' trait empathy (Interpersonal Reactivity Index, IRI) [5] before the task, and with the assessment of social presence (Networked Minds Social Presence Inventory, NMSPI) [6] and flow (Flow State Scale, FSS) [7] after the task. The qualitative phase consisted of the conversational analysis of four critical sub-sequences taken from conversations produced by each of the four dyads. The qualitative phases is still in progress (discourse analysis of 20 dyads and conversational analysis of 20 sub-sequences, one for each of the dyads). As far as the qualitative analysis is concerned, in the section dedicated to the results, we will give an account of the analysis of a sub-sequence taken from one of the four investigated sequences. We chose this sub-sequence because we consider it representative of the most appropriate way to exploit the characteristics of the interaction in MR environments to produce a collaborative process.

3.2. Research questions (RQ). (RQT = RQ of the quantitative analysis; RQL = RQ of the quantitative analysis):

- RQT) Does C1 produce higher levels of empathy, social presence, and flow than C2 and C3?
- RQL) Do empathy, social presence and flow expressed in conversational form contribute to generating collaboration in MRI environments?

4. Results

4.1. Quantitative analysis:

- A one-way ANOVA did not reveal significant differences between C1, C2, and C3 with regards to empathy, as measured by the IRI test.
- The Interactive social presence – which allows for the recognition of the intentions of the Other oriented towards the Self – did not show significant

differences between condition C1 and C2. Only for C3, it showed a tendency to the significance concerning the perceived emotional contagion with a p=0.06.

- As regards to the Flow, three sub-scales (Action Awareness Merging, Concentration on the task and Loss of Self-consciousness) showed significantly higher results in condition C1, compared to the other two (C1>C3>C2). Results of the three sub-scales are as follows: Action Awareness Merging (p=.01); Concentration (p=.05); Loss of Self-consciousness (p=.05)

4.2. Qualitative analysis. The analysis of the conversations highlighted the presence of a high number of signals of enunciative co-presence ("G. are you there?" "Yes, I am there") and role embodiment ("you are seeing what I am seeing". These elements respond to a need for coordination to generate involvement in the task (level of synchronization). What follow next are exchanges such as "P., do I invent it myself, or do we do it together?" "no let's do it together" or expressions such as "Can we use it?", "Here we are!" that signal the tendency to create a shared context and a continuous reference to one's interlocutor (We-ness level). Finally, signs of confirmation, such as "perfect!" "exact", "brilliant!" and indications of the efforts made to assume the same perspective ("Wait until I come closer... do you see it?". "Ok now I see everyone again") show the effort to build and share a common ground (level of intersubjectivity).

5. Discussion

The degree of Interactive social presence in the C3 dyads showed an orientation to the altruism of a 'selfish' nature: participants approach each other not so much driven by empathy, but rather to have information on how one's interlocutor sees them. In this sense, the recorded data do not falsify HQT. Data on flow showed that C1 dyads did not necessarily act more 'empathically' but were more task-oriented in terms of awareness, concentration. With the support then of the qualitative analysis, we may say that in MR environments, by encouraging empathy, we could obtain an improvement of task consideration and collaboration. To conclude, the convergence of empathy, social presence and Flow expressed in conversational form has shown, at least, in the C1, the tendency to generate a productive and relationally satisfying collaboration. The primary limits of this work coincide with its most interesting aspects: the ambition to work on interactive-relational data not entirely possible due to the lack of adequate data production techniques and the intention to work by interweaving quantitative and qualitative analysis, already recognizable from the commentary, but still to be developed.

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Subjective evaluation of autonomous and manual driving in advanced simulation

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Abstract. In the present study, we compare the user experience of driving a fully automated vehicle with that of driving a fully manual vehicle. We used a high-fidelity simulator displaying a highway road with four different obstacles. The user experience and usability of 26 participants was compared in the two conditions. The sense of presence in the simulation was also measured. The results showed differences between the two conditions.

Keywords. Human-computer Interactions, Virtual Reality, Autonomous Driving.

1. Introduction

Autonomous vehicles are considered a promising solution to reduce road safety risks, as human error is reported as one of the main causes of accidents [1]. Following the suggestions of Pettersson and colleagues [2], this study aims to compare the subjective experience of drivers under two conditions, manual driving (Man) and fully autonomous driving (Aut) using a dynamic driving simulator with a high definition Virtual Environment (VE). User experience, Usability and Presence were evaluated.

1.1. Human Factors in Driving Simulator

Driving simulators have been widely used to safely study user behavior during traditional driving activities, starting with the assumption that the drivers' experiences were similar between field and simulator studies [3]. Different subjective metrics have been considered in the literature. A relevant measure is the User Experience (UX), i.e., "user's perceptions and responses that result from the use and/or anticipated use of a system, product or service" [4]. In the field of automotive research, UX questionnaires have been used to assess the interacting experience regarding, for example, in-Vehicle Infotainment Systems (IVIS; [5]) or the driving simulator itself [6]. Moreover, the concept of Presence, defined as the sense of being in a VE [7,8] where virtual objects are experienced as real objects [9], is a crucial variable to be evaluated when considering a VE.

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A third important aspect is the System Usability defined by Shackel [10] as "the capability (i.e., of a system) to be used by humans easily and effectively" and, like UX, its applicable both to IVIS [11] and to simulators [12]. Another aspect to consider is the participants' driving skills. A useful tool for this purpose is the Driving Skill Inventory (DSI; [13]), which investigates the level of safety and skill of drivers with a scale ranging from 0 (far below average) to 4 (far above average). This tool has recently been used to compare these self-assessed skills with actual performance in simulated driving activities**.**

2. Procedure and Methods

Twenty-six participants aged between 22 and 47 (*M*=29.5, SD=6.8, F=10) were involved in a within-participant design experiment, with the driving condition (Man vs. Aut) as the independent variable, randomly assigned to participants and counterbalanced. A highly dynamic DiM simulator (Driver in Motion; Vi-Grade ©, Figure 1) was used in the study. It was composed of a real-size cockpit in front of a curved screen (200° angle) on which three high-definition projectors displayed a three-lane road. Besides, inside the cockpit, there was an active seat, vibrating pedals, three rearview mirrors showing images of the VE (the back of the scene) and speakers reproducing realistic vehicle noises.

Figure 1. Driver in Motion simulator. The first image shows the inside of the cockpit, the second the outside.

The VE included four obstacles, the two hardest and the two easiest based on a pilot study's perceived danger questionnaire results. Before the driving sessions, demographic information was collected, and the DSI was administered to assess participants' driving skills. After each driving session (Man or Aut), the following questionnaires were administered: the System Usability Scale (SUS; [15]) evaluating the perceived usability of the system; an ad-hoc 12-item questionnaire 5-point Likert scale measuring the user experience considering three subscales, i.e., Pleasantness, Engagement, Use & Time Flow; a Presence questionnaire [16], containing three items for the assessment of vibrotactile stimulations in addition to the classic items.

The experiment lasted around 80 minutes.

3. Statistical Analysis

In case of non-normal distributions of the gathered data, series of non-parametric tests were carried out. On normally distributed data, the test performed was a parametric t-test. Spearman correlation tests were carried out on non-normal distribution while Pearson correlation tests on normally distributed data. Whenever needed, the p-values were adjusted for multiple comparisons (i.e., BH correction; [17]).

4. Results

In our analysis, we want to highlight the differences between the two different driving modes on the UX, SUS, and Presence questionnaires. We also verified the possible correlations between the dimensions of these tools and the two dimensions of the DSI. Concerning the latter, the results obtained showed that the 26 participants estimated their skills significantly below the median (Figure 2; *Mdn*=3), both for the Safety dimensions (*V*=0, *p*<0.001) and for the Skill dimension (*V*=0, *p*<0.001).

The UX questionnaire showed that the manual condition was significantly higher in the dimensions of Pleasantness (PL; V=60.5, p=0.02) and Engagement (ENG; *V*=33, *p*=0.02). In general, the questionnaire reported values (Man condition, *Mdn*: PL=3.7, ENG=3.6, Use&TF=3.3; Aut condition, *Mdn*: PL=3.4, ENG=3, Use&TF=3.2) equal to or above the median (*Mdn*=3) for both driving conditions (Figure 3).

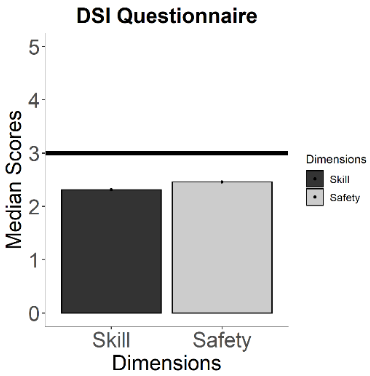

Figure 2 – Driving Skill Inventory questionnaire median scores.

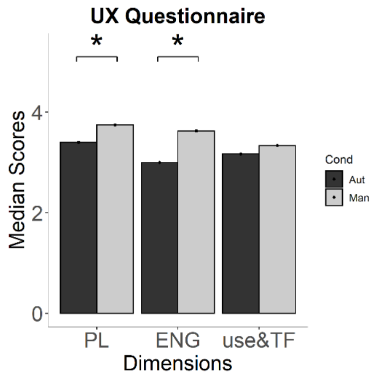

Figure 3 – UX questionnaire median scores.

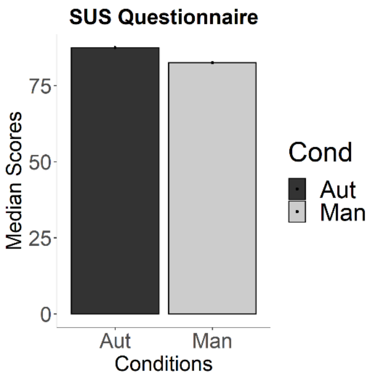

Figure 4 – System Usability Scale median scores.

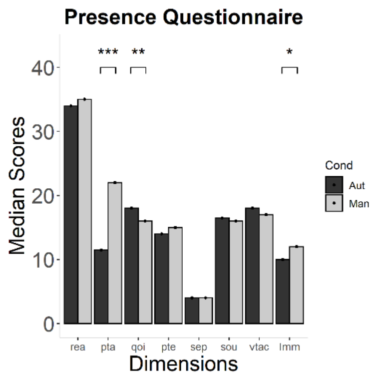

Figure 5 – Presence questionnaires median scores.

Regarding the SUS questionnaire (Figure 4), the two conditions do not differ from each other (*V*=164, *p*=0.9). The scores measured correlate positively with DSI Skill dimension in the Man condition (r=0.43, *p*=0.02) and with Safety in the Aut condition (r=0.38, *p*=0.04).

About the Presence questionnaire (Figure 5), the dimensions of Immersion (IMM, *V*=60, *p*=0.02) and Possibility to act (PTA; *V*=2, *p*<0.001) resulted significantly higher in the Man condition. The Quality of interface (QOI) was greater in the Aut condition (*V*=222, *p*=0.007), where it was also negatively related to the DSI Skill (r=-0.40, *p*=0.03) and positively related to DSI Safety (r=0.44, *p*=0.02). Moreover, the dimension of Self-evaluation Performance (SEP) was positively correlated to the DSI Skill (r=0.42, *p*=0.02).

5. Discussion

The main goal of the experiment was to assess the difference between a fully autonomous (Aut) and a manual (Man) driving simulation. Besides, the simulator itself has been evaluated to understand whether it can be exploited for studies on human factors concerning different driving conditions.

The Presence questionnaire reported high values in most of its subscales, a sign of the employed simulator's quality. Moreover, the participants perceived the Man condition as the most immersive, thanks to the possibility of acting on the simulator, as indicated by the PTA dimension, which resulted higher in the Manual condition. Also, the QOI dimension was higher in autonomous driving because the participants could visually explore the virtual environment as they did not have to drive. The positive correlation between the DSI Skill and the Presence SEP dimensions shows that those who consider themselves good at driving had also evaluated its performance positively. For autonomous driving, the QOI dimension has also been negatively related to the DSI Skill and positively to DSI Safety. It is likely that the more skilled participants, being accustomed to more stimulating high speeds and driving environments, evaluated the proposed monotonous road as less attractive.

The UX questionnaire showed that the manual condition is more pleasant and engaging, an expected result given the possibility of acting on the simulator in this driving task. Moreover, the questionnaire scores highlighted a good general experience of simulated driving, despite the monotony of the track.

The SUS questionnaire showed very high scores in both dimensions (Figure 4; Man *Mdn*=82.5; Aut *Mdn*=87.5), giving further confirmation on the simulator's quality. However, they do not differ from each other. Correlation analyses with the DSI suggest that the subjects who believed themselves to be more competent perceived the simulator as easier-to-use when in-control of the vehicle. Conversely, the more prudent participants felt much more facilitated when the vehicle took charge of the driving and so of the safety issues. This occurrence could offer interesting insights for future studies concerning the drivers' personality and their perception of autonomous driving.

6. Conclusion

The manual condition seemed superior in some dimensions of user experience. In terms of usability, user ratings appeared to be influenced by the participant's driving ability: less-skilled participants found the vehicle easier to drive when autonomous. Presence scores were higher in the manual condition, perhaps connected with the active relationship with the (virtual) street. The autonomous condition only outscored the manual one in the interface's quality, especially for non-skilled participants.

The results obtained highlight how this simulator can effectively reproduce the reality of a driving environment and can be used to conduct, in a safe environment, experiments that include advanced mental workload assessment methodologies, such as sensors for detecting biometric parameters. Such experimentations may shed light on how people perceive fully autonomous driving and subsequently provide the automotive industry with valuable information to increment safety in their autonomous vehicles.

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SECTION IV

ORIGINAL RESEARCH

Health care is one of the areas that could be most dramatically reshaped by these new technologies.

Distributed communication media could become a significant enabler of consumer health initiatives. In fact they provide an increasingly accessible communications channel for a growing segment of the population.

Moreover, in comparison to traditional communication technologies, shared media offer greater interactivity and better tailoring of information to individual needs.

Wiederhold & Riva, 2004

Contact in VR: Testing Avatar Customisation and Common Ingroup Identity Cues on Outgroup Bias Reduction

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Abstract. Though intergroup contact may reduce negative bias in offline interactions, there is mixed evidence for how technology-mediated contact can diminish bias, particularly with the emergence of new technology systems such as virtual reality (VR). Building on avatar communication and technology-mediated contact research, this study explored how customising avatars to resemble the self, together with the salience of common ingroup identity cues affected intergroup perceptions in a VR interaction. Avatar customisation is thought to increase users' connection with the virtual environment and with their own avatars, particularly when avatars mirror their own physical traits. Similarly, the salience of a common identity among members of ingroups and outgroups is thought to influence users positively, by making them feel belonging to a wider category, therefore reducing former outgroup bias. Accordingly, an experimental study involving dyadic VR interactions between members of different ethnic groups was carried out. Results showed that participants who customised self-resembling avatars and interacted with an outgroup member in presence of a common ingroup identity, reported less perceived outgroup bias. Contrary to predictions, outgroup bias was reduced indirectly via identification with the virtual group (superordinate category), but only when the common ingroup identity was not made salient. These results are discussed in terms of how sociotechnical factors in VR can potentially affect technology-mediated intergroup contact.

Keywords. Virtual reality, intergroup contact, avatar customization, presence, social identity, prejudice

1. Introduction

The contact hypothesis assumes that interaction between members of different social groups can overcome prejudice or negative bias towards outgroups and foster harmonious intergroup relations [1]. However, in everyday life, intergroup contact may not be feasible because of linguistic, cultural, geographical, or institutional barriers. This has increased interest in testing for the effects of technology-mediated contact, which has brought promising results [2][3]. With few exceptions, little attention has been devoted to emergent technologies such as virtual reality (VR) and its potential for sensorially-richer contact interventions. Moreover, the mechanisms by which technology-mediated contact reduces prejudice require further research.

This study compares the indirect effects that customizing avatars and priming a common ingroup identity among ingroup/outgroup members have on reducing bias towards the outgroup. Avatar customisation is a consistent feature in many virtual reality systems, that enhances the feeling of being connected to the virtual character, as well as of being "present" or immersed in the virtual environment [4]. On the other hand, the salience of common ingroup identity cues in virtual interactions (e.g., sharing similar uniforms) has been related to higher group identification, better group performance, and positive attitudes toward group members [5]. Particularly, this investigation analyses technical and social psychological mechanisms involved in the bias reduction process by

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examining the role of engagement presence (the extent to which participants engage in the interaction) and identification with the virtual reality group as mediators of the contact effect.

1.1 Avatar Customisation and Engagement Presence

Most VR systems provide users with a choice over their avatars' characteristics, which in turn produce distinct psychological effects on them influencing performance, enjoyment, or engagement [6]. Customisation increases agency or sense of control over the visual presentation of avatars, making the psychological connection between user and avatar stronger, and favouring identification with these virtual characters, particularly when they resemble their own physical selves [7].

Conversely, presence synthesizes how individuals perceive both the physical space and the social aspects of interacting with others [8]. Presence is an elusive notion, sometimes conceptualized as a property of a mediated channel [9], and sometimes as a psychological experience of awareness and/or connectedness with social others in virtual interactions [10]. In particular, this study adopts Schubert, Friedmann, and Regenbrecht's [11] concept of presence as engagement, which implies psychological immersion and involvement in an actual peer-to-peer virtual interaction. Perceiving others and engaging in positive virtual interactions are main predictors of rapport, which involves emotional and behavioural alignment [12]. Moreover, self-presence derived from using avatars has been linked to changes in racial beliefs and prosocial behaviours favouring the outgroup [13]. Assuming the benefits of being present by means of avatar self-customisation in the virtual environment, and engaging with other online users in positive ways, we predict:

Hypothesis 1: Customising an avatar to look like the self, relative to customising avatars to look like someone else, will increase engagement presence which in turn will decrease bias towards the outgroup.

1.2. Identification with a Common Ingroup Identity

Recategorisation refers to the cognitive process of fading ingroup/outgroup boundaries in favour of a wider group category with which subgroup members can identify. By inducing a superordinate group identity, it can be expected that intergroup boundaries get blurred and positive attitudes and behaviours toward former outgroup members will increase [14]. In online interactions, identification with salient groups depends on the degree to which users experience depersonalisation, which refers to seeing others in terms of salient group memberships instead of individual traits.

Depersonalisation and salient group identities facilitate self and partner categorisation as ingroup or outgroup members, as well as adopting explicit and implicit group norms derived from prototypical expectations, such as favouring ingroup instead of outgroup members [15]. Visual cues to a common group identity may increase depersonalization and ingroup recategorisation, for example, by dressing avatars uniformly [16] or by textual/verbal allocation of group memberships [17]. Thus, we formulate:

Hypothesis 2: The salience of common ingroup identity cues will increase identification with the VR group, which in turn will decrease bias towards the outgroup.

1.3. Convergence of Self-Customised Avatars and Common Ingroup Identity

Although both avatar customisation and common ingroup identity cues might bring optimal contact results to VR interactions separately, the interplay of both conditions may alter the sources of engagement presence and identification with the generic VR group. On one hand, perceiving oneself as a group member may also increase engagement in the interaction as this may be seen as supporting ingroup norms [18]. On the other hand, identification with the user's own avatar may be lowered by a salient group identity [19]. As this combination has not yet been tested in a VR environment, we formulate:

Research Question: How does the salience of common ingroup identity cues affect avatar customisation with regard to outgroup bias reduction?

2. Method

Undergraduate participants (N = 135, 82.3% female, M_{age} = 20.47, SD = 2.05) recruited from a public university in the United States held same-sex dyadic interactions in a VR environment. Participants were Asian (52.5%), Hispanic (20.6%), Caucasian (17%), and of other (9.9%) ethnic origin. As the portrayed outgroup for this study was the Latino minority, Hispanic participants were left out of the analysis. The "Latino" participants in this study were, in fact, pre-trained research confederates that ensured consistency in conversations.

Depending upon the experimental condition, participants were instructed to customise their avatars either to make them look like themselves (hair, eyes, skin colour, etc.) or to make them look like someone physically different from themselves. The salience of a common ingroup identity was visually manipulated by means of making users share a similar (versus dissimilar) avatar outfit representing institutional colours. In addition, participants in this condition were asked to read the following text: "You are taking part in a virtual reality group comprising students from (university campus)", in which their hypothetical performance would be compared with scores gathered from other campuses. Following procedures in previous studies [21], participants discussed what are the most common problems faced by first-year university students and they provided solutions to these problems by means of technology (25 minutes average). The VR system was an Oculus Rift head-mounted display with integrated headphones and a three-dimension setting of 110°-degree field of view, whereas vTime (vtime.net) was used as a VR platform.

Participants filled out a Social Distance scale [20] before and after the VR interaction as a measure of negative outgroup bias. In addition, participants filled out a scale of Engagement Presence [11] consisting of the items "I felt mentally immersed in the virtual interaction" and "The virtual interaction was involving" (r = .80). The Identification with the VR Group scale [22] included items such as "I feel identified with my virtual group" and "I see myself as a member of this virtual group" (α = .93).

3. Results and Discussion

Participants completed a Similarity Identification scale [23] as a manipulation check for the avatar customisation manipulation (α = .93). Participants who customised their avatars to resemble themselves physically reported greater identification with their avatars (M = 4.51, SE = 1.13) than those who customised it to resemble a different person (M = 2.62, SE = 1.25), $F(1, 133) = 83.9$, $p < .001$, partial $\eta^2 = .39$. Participants also completed the VR group identification scale to verify the common ingroup identity manipulation. Participants reported more identification when their avatars shared the same institutional colour outfit (M = 6.07, SE = .84) than when they had neutral outfits (M = 5.88, SE = .91), but this difference was only marginally significant, $F(1, 133) = 3.76$, $p = .055$, partial $\eta^2 = .02$. Therefore, VR group identification was dropped from further analyses.

Hypothesis testing was performed using the PROCESS V3.3 Macro for IBM SPSS (model 4). Each test statistically controlled post-interaction bias scores in relation to pre-interaction scores in order to compare the amount of change. Hypothesis 1 predicted an indirect effect of avatar self-customisation on reducing negative bias towards the Latino minority by increasing engagement presence. Avatar self-customisation was significantly associated with engagement presence but in a negative direction (b = -.68, $p < .001$, *95% CI* [-1.15, -.20]), whereas engagement presence was linked positively to social distance (b = .09, p = .04, *95% CI* [.00, .18]). However, no significant indirect effect was observed. Thus, Hypothesis 1 was not confirmed.

This study's research question asked how salient common ingroup identity cues affect avatar customisation with regard to outgroup bias reduction. This test introduced all four conditions resulting from avatar customisation and common ingroup cues following Hayes and Montoya's [24] procedure for multicategorical predictors. The test showed a significant indirect effect of avatar customisation on reduced bias towards the Latino outgroup via engagement presence, but this effect was observed only in the condition in which self-resembling avatars were brought to contact in absence of common ingroup identity cues (b = -.08, SE = .04, 95% CI [-.15, -.06]).

Although participants who customised an avatar to physically resemble themselves felt more identified with their avatars, they experienced less engagement presence in the virtual interaction. One possible explanation is that presence is sometimes linked to perceptions of agency or control over the virtual interaction [10], and allowing users to freely customise their avatars as “someone else” may have increased agency compared to a self-resemblance constraining. Also, participants in this condition probably felt more comfortable speaking freely without any potential accountability. [15]

The recategorisation hypothesis (H2) was not tested in this study as the manipulation of common ingroup identity cues was not successful. This may be explained by participants’ low identification with the university campus. Future studies could use different sources of identification in order to compare which category results more relevant to participants. Conversely, outgroup bias was significantly reduced when: participants customised self-resembling avatars via engagement presence, but in absence of the common ingroup identity. It is possible that disclosing personal experiences to virtual partners, as requested by the experimental task, might have led them to focus on individuating information instead of group identities. In this view, participants could have focused more on personal disclosure rather than on a mutual interaction. Future studies should explore how other social or task-oriented interactions may, in turn, influence bias reduction. Overall, the results obtained in this study provide an initial perspective on how immersive VR might favour intergroup contact interventions.

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Nature's perfection: Clouds' fractals in well-being aesthetics

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Abstract. Physiological and self-report correlates for subjective wellbeing have been widely investigated in aesthetic psychology. Specifically, some of the features of visual stimuli that seem to have a great impact on wellbeing and appreciation are: (i) complexity, (ii) recursion and a certain amount of (iii) randomness. Fractals are examples of visual stimuli that were proven able to promote subjective wellbeing by acting on physiological parameters, determining higher appreciation in self-report measures, and happen to own those three peculiarities. Fractals can be artificially designed- i.e. exact fractals-, resulting in more recursive pattern, or found in nature-i.e. statistical fractals-, introducing higher levels of randomness into the pattern, that seem to elicit greater appreciation, probably due to their lower predictability. Fractals' ability to exhibit the same pattern at every scale is what Mandelbrot first defined as self-similarity or unfolding symmetry, measured with "Fractal Dimension", also known as "D" ($1<D<2$). These studies suggest that visual complex stimuli with a certain amount of randomness have a positive impact on people's wellbeing and gratitude and are preferred to their more recursive counterparts. This study aims to investigate the impact of a specific and highly accessible type of natural statistical fractals, namely clouds, on subjective well-being (using SAM), as gratitude (using the Italian Version of the Gratitude Questionnaire) using ecological images of clouds, with different D values. D values were measured using ImageJ, a Java-based image processing program.

Keywords. Affect, Clouds, Gratitude, Nature, Statistical Fractals, Well-being

1. Introduction

Fractals are examples of visual stimuli that were proven able to promote subjective wellbeing by acting on physiological parameters, determining higher appreciation in self-report measures, and happen to own the three peculiarities. Fractals can be artificially designed- i.e. exact fractals-, resulting in more recursive pattern, or found in nature-i.e. statistical fractals-, introducing higher levels of randomness into the pattern, that seem to elicit greater appreciation, probably due to their lower predictability. Moreover, fractals display another key aspect which concerns the extent to which they exhibit the same pattern at every scale. This property is what Mandelbrot [3] (1975) first defined as self-similarity or unfolding symmetry and can be quantified by means of a "Fractal Dimension", also known as "D" ($1<D<2$). These studies [1] suggest that visual complex stimuli with a moderate amount of randomness, ranging from 1.3 to 1.5 have a positive impact on people's wellbeing. This study aims at investigating the impact of a specific and highly accessible type of natural fractals, i.e., clouds, on subjective well-being. Moreover, this study will focus on statistical, rather than exact fractals.

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Our main hypothesis was that participants would report significantly higher gratitude, positive emotions and affect, pleasantness and appreciation scores when exposed to clouds pictures with average D values (vs. high/low D values)

2. Methods

Gratitude is a well-established construct in positive psychology [4]. It has been defined also as a positive emotion, elicited by the perception that other people or entities positively influenced an occurrence or event [5][6][7]. Several studies have shown its impact on several aspects of wellbeing, such as lower levels of depression and stress [8][9]. The Italian Gratitude Questionnaire [4] was adapted from its original version, that aimed at measuring dispositional gratitude with a six items questionnaire [6]. Gratitude was also assessed in a "state" logic. Specifically, participants were asked to state how grateful they felt in a specific moment, using the following ad-hoc single item "how grateful do you feel right now".

The Self-Assessment Manekin [10] is a non-verbal, pictorial and culture free tool for assessing affect. It enables the measurements of three main dimensions of affect: dominance, arousal and pleasure. This tool is particularly effective when measuring affect in reaction to an event, namely the administration of certain stimuli.

To assess the fractal dimension of the various stimuli, an image elaboration software, namely ImageJ, was used [11]. The software allows to solve different image analysis problems, by installing plugins. The plug-in used to determine fractal dimensions and other characteristics of fractal images is called FracLac.

The sample size was calculated using the software G-power. With an estimated Effect Size F=0.14, α err prob= 0.05 and Power (1-β err prob) = 0.95, the resulting adequate sample size was of 86 participants. The sample size was of 86 participants, 61 females and 25 males. The age ranged between 22 and 73, M= 36,52 SD= 14,37. The participants were recruited exclusively online, mainly through social media platforms and emails.

This is a full within-subject design with six conditions each corresponding to 6 D-values (within conditions: exposure to six images, presented in a randomized order ranging from 1.3 to 1.8 D). An (i) ad hoc measure assessing visual appreciation of natural environments and nature, (ii) the Italian Gratitude Questionnaire (GRAT) [4] measuring dispositional gratitude and (iii) a baseline for the Self-Assessment Manekin (SAM) [10] were administered at the beginning of the survey. The Self-Assessment Manekin (SAM) and a single item assessing "state" gratitude were administered before and after the exposure to each fractal image. All data were collected online, through the survey platform "Qualtrics" (www.qualtrics.com) and analyzed using Jamovi (Version 1.1.9.0)

3. Data Analyses

Normality tests were conducted on each variable. Since almost every variable did not follow a normal distribution, non-parametric tests were conducted in most cases. Specifically, non-parametric alternatives for of the Repeated Measures ANOVA, namely Friedman's Tests, were conducted in order to assess the differences in gratitude and affect across the different levels of fractality. The Durbin-Conover post hoc test was later performed.

4. Results

The average score of state gratitude at T0 was M = 5.60 (SD = 1.19). Both measures ranged from 1 to 7. The higher average scores in state Gratitude (M = 5.61; DS = 1.47) were found in participants exposed to Figure 4 (D=1.6). Affect was assessed using the Self-Assessment Manekin. Average scores at T0 were moderate scores on Valence, Arousal and of Dominance. The measure ranged from 1 to 9. Participants scored higher average values in Valence and Arousal after the exposure to Image 4 (D= 1.6), and higher Dominance when exposed to figure 5 (see Table 1).

The descriptive analyses are in line with the initial hypothesis, concerning that average levels of fractality would result in higher gratitude and greater affect than other images.

Friedman tests were performed to explore significant differences across all conditions of fractality in terms of state-gratitude and the subscales of SAM, namely Dominance, Affect and Valence. In terms of state gratitude, a Friedman test was run and found significant differences across conditions [chi = 26,1; p < .001].

The Durbin Conover Post Hoc test revealed that baseline scores were significantly higher than in figure 2 (t= 2.983; p = 0.003) figure 6 (t= 2.504; p = 0.013). Furthermore, Gratitude in figure 4 was significantly higher than in figures 3 (y = 4.208; p <0.001) and 6 (t=3.729; p <.001). Three repeated measures ANOVAs were conducted with "fractality condition" (6 images) as independent variable and each dimension of Manikin (Dominance, valence, arousal) as dependent variables. A main effect emerged for Dominance (F (2.69), p = 0.014). The Bonferroni Post Hoc showed that Dominance was significantly higher in figure 1 than in figure 3, and significantly higher in figure 5 than in figure 3.

The Friedman test was conducted to test for significant differences among fractality levels in terms of Valence. A significant main effect emerged [chi = 47.3; p < .001]. Post Hoc analyses showed than the baseline score was significantly higher than figure 2 (t= 2.5163; p = 0.012) and figure 3 (t= 3.2352; p = 0.001), but lower than figure 4 (t= 3.0435; p = 0.002). The same test was run to analyze the differences in the scores for the Arousal variable [chi = 5.02; p < .001]. The Durbin Conover Post Hoc showed the only significant difference was the one between the baseline and figure 4, which was significantly higher (t= 1.9586; p = 0.051).

Table 1: Average scores and DS for the Valence Arousal and Dominance at baseline and after each image

	Valence	**Arousal**	**Dominance**
Baseline	Mean: 5.59 SD: 1.95	Mean: 4.53 SD: 2.13	Mean: 5.49 SD: 1.66
Figure 1	Mean: 5.96 SD: 2.14	Mean: 4.46 SD: 2.18	Mean: 5.59 SD: 1.78
Figure 2	Mean: 5.01 SD: 2.04	Mean: 4.83 SD: 2.14	Mean: 5.28 SD: 1.94
Figure 3	Mean: 4.83 SD: 2.17	Mean: 4.83 SD: 2.08	Mean: 5.05 SD: 2.06
Figure 4	Mean: 6.26 SD: 2.22	Mean: 4.97 SD: 2.36	Mean: 5.48 SD: 1.88
Figure 5	Mean: 5.53 SD: 2.30	Mean: 4.77 SD: 2.41	Mean: 5.62 SD: 1.96
Figure 6	Mean: 5.81 SD: 2.30	Mean: 4.77 SD: 2.41	Mean: 5.62 SD: 1.96

5. Discussion

The aim of this work was to investigate the relation between aesthetically pleasing stimuli gratitude and emotions using fractals that are present in nature- namely clouds. First, descriptive analyses were conducted and showed that figures with average levels of fractality (1.6) resulted in the highest level of Gratitude, Valence and Arousal, while greater Dominance was achieved with a higher level of fractality. Then, figures with moderate level of fractality (e.g. figure 4, D=1.6) showed significantly higher scores in Gratitude and Valence, and higher scores in Arousal. Furthermore, this "implicit preference" for Figure 4 was confirmed at an explicit level: when participants were asked to indicate which figure they liked best and the majority of them (almost 30% of the participants) liked figure 4 more than the others.

Bies [1] found that generally preference seem to increase with fractality, in this study we found that, in accordance with Aks and colleagues [12] average levels of fractality seem to elicit a greater response. Hagerhall [2] argued that statistical fractals are generally preferred to exact ones. In this study we examined the relation between gratitude and affect with the exposure to statistical fractals only.

Future studies could do a comparison between statistical and exact fractals using these variables, instead of mere preference. Furthermore, future studies could incorporate other kinds of output measures in their analyses, such as aesthetic preferences, in order to further explore aesthetic correlates of fractal clouds' preference.

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Does Mediated Social Touch Succesfully Approximate Natural Social Touch?

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Abstract. To date, experiments aimed at demonstrating whether effects of naturalistic social touch can be replicated with Mediated Social Touch (MST) provide mixed findings. A possible explanation could be a lack of realism of current haptic displays in combination with not sufficiently taking contextual factors of social touch into account. Using a qualitative approach, our study aims to gain more insight into the influence of contextual effects on experience of an MST, by means of exploring female participants' experiences of receiving an MST from a male stranger versus their romantic partner. Our findings show simultaneously feeling and seeing the touch act performed on a corporeal object can be beneficial for MST experience. However, our findings also demonstrate that it is not self-evident to regard MST as phenomenologically equal to natural social touch, as it often fails to meet expectations people formed based on naturalistic social touch.

Keywords. Mediated social touch, affective haptics, interpersonal communication

1. Introduction

Social touch is essential for human development, social attachment, wellbeing and interpersonal communication [1]. However, there are circumstances where geographical distance impedes skin-to-skin contact. Mediated Social Touch (MST) devices have been suggested for these purposes. MST refers to interpersonal touch over a distance through haptic display technology. The technical development of MST devices has gained interest in the past years, exploring a variety of haptic technologies and functional designs. Research has also begun to test the efficacy of MST by attempting to replicate the effects of unmediated social touch in mediated settings. Results of these studies, however, are mixed and, taken together, not encouraging [2]. One explanation could be the lack of realism offered by current tactile displays. Despite increasingly sophisticated actuators, it remains challenging to replicate an accurate representation of natural touch [3]. One approach to enhance realism of an MST is to combine touch and vision: feeling and simultaneously seeing a similar touch act being performed on a corporeal (i.e., resembling the human body) input medium [4] is argued to render the interface more transparent (i.e., an illusion of non-mediation, see [4]). Another possible explanation is that contextual factors are not taken sufficiently into account when comparing MST against naturalistic touch. Social touch is more than a mere tactile stimulation of the skin. The tactile stimulation is accompanied by other verbal and non-verbal cues, and whom we touch, when, and in what manner is regulated through social and personal norms [5]. Previous research indicates that contextual factors such as gender [6] and visual expression [7] significantly affect the meaning and experience of social touch. Hence, the assumption that MST, as currently designed, offers social touch is debatable. Clearly, we need a more in-depth understanding of how people experience MST, preferably using

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more qualitative methods [8]. Whereas quantitative research allows us to test and validate theoretical assumptions, a qualitative approach would allow for a more in-depth descriptive understanding of people's experiences with MST [9]. It thus is essential that experimental work focussing on uncovering the possible response similarities between MST and unmediated social touch is complemented with more qualitative approaches aimed at investigating people's experience and interpretation of MST across different contexts and technological implementations.

In the present experiment (pre-registered: https://osf.io/w4zqs/) we took such approach complementing quantitative analyses with qualitative data, while manipulating two contextual factors thought to influence MST experience: the sender of the touch (spouse vs. stranger) and the form of the input medium on which the touch recipient can see the MST being performed (corporeal vs. non corporeal). The present paper will focus on the qualitative data, and the quantitative analyses will be reported elsewhere. We addressed the following research questions: (1) How do people experience MST? (2) How does MST experience depend on the toucher and the input medium's form? (3) What are people's attitudes and interests towards MST and the use thereof in daily life?

2. Method

2.1. Participants

Fifty-one female participants and their partners were recruited through the university database. All participants were in a relationship for at least three months and were fluent in English. Age ranged between 18 and 65 years (M = 24; SD = 7.9). One participant withdrew participation. Therefore, the final sample size was 50 participants.

2.2. Design and procedure

We conducted a 2 (MST from romantic partner vs. stranger) x 2 (seeing the touch performed on a corporeal—hand-shaped—vs. non-corporeal object—touchpad) within-subject experiment. The MSTs were provided in four blocks, where each block consists of 4 touches with the same input medium. Within each block, two consecutive touches were from the spouse and two from the stranger (counterbalanced between participants and blocks). Data was gathered through semi-structured interviews. All interviews were recorded and transcribed verbatim. An overview of the procedure of the experiment can be found in figure 1, more details are in the pre-registration.

2.3. Apparatus and stimuli

The tactile stimulus consisted of a stroke applied to the left forearm (3,9 s, speed 3.1 cm/s). The MST was initiated by the experimenter. In order to match visual feedback with the tactile stimulation, the male spouses and stranger were trained to synchronize their stroke with the MST using a visual indicator of the speed and duration. Movement of the hand of the toucher over the input medium, and the middle part of his torso were shown real-time on a computer screen to the participant.

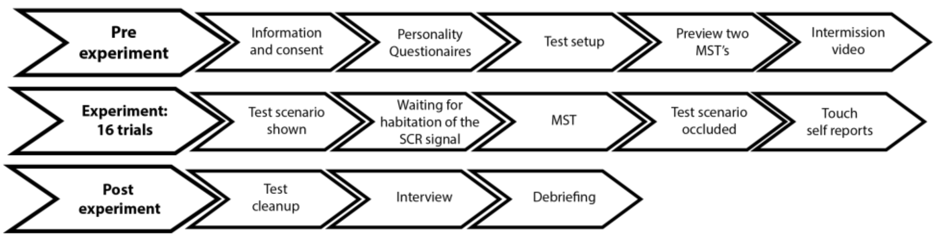

Figure 1. Procedure of the experiment.

3. Results

The data was analysed by means of a thematic analysis [10]. This resulted in three main themes which will be discussed below.

3.1. MSTs were often perceived to differ from natural social touch in various ways.

The analysis revealed large differences in participants' experiences of the MST. Some described it as pleasant *"I found it quite pleasant, it was a very soft and subtle touch (P1)"*, others as neutral "*I also found it quite neutral (P12)*" and some as uncomfortable "*Because like the vibration and uhm and you also hear this sound it's not very comfortable (P24)*". Although some stated it resembled a real touch "*not very different per se from real contact (P6)*", for most it did not. In fact, we identified three ways in which the MST differed from a real touch. The first was that the tactile sensation did not resemble the feel of a natural touch: *"Actually it all feels mechanic. (P15)"*, *"It felt a bit like yeah a brush or something like that, not like skin-to-skin contact (P13)"*, and *"uhm I think because it is just too different, because what I immediately thought was also like it is not warm(P9)"*. The second related, not to the feel of the MST, but to the type of touch (i.e., a stroke on the upper arm) not being regarded as representative for naturalistic touch interactions: *"if we [she and her boyfriend] would sit like this, then this would not be something [such a touch type] that you would typically do exactly like this (P10)"*, and *"not often actually that people touch you like that at all (P2)"*. The third was that, in contrast to natural touch, the MST did not provide a sense of being touched directly by the other person. That is, the MST device did not evoke a perceptual illusion of non-mediation: *"I didn't feel like my friend or the other person really touched me, I was like okay he touches a device and that device then touches me (P26)"*.

3.2. The MST concept was often perceived as being valuable but the right application area and improvements to the quality of the MST device are essential.

Regarding the anticipated value of MST in participants' daily live, opinions varied. Whereas some participants reported no need for MST "*Don't think so, would not know what for (P32)*", others did show interest. We found that for people to be interested in MST they had to recognize a) a clear application context, and/or b) the promise of future improvement in MST technology. The majority of participants reported MST to be useful when distance prevents physical contact, either as a substitute for real touch "*Yeah I think it would be nice to have that physical contact because it's not always possible to visit them face to face (P44)*" or as enrichment of current communication "*Yes maybe if you, just to let someone know that you are thinking them instead of sending a message* (P20)". Specifically, MST was found to be most valuable for long distance relationships "*Someone is gone for half a year… and I would quite like it to occasionally feel something or so from someone (P3)*", and several mentioned family members that are abroad "*I do have family who live far away, and I do think that maybe it could be a nice application (P34)*". For many, interest in MST was hampered by various technological factors, such as the device lacking variability in touch type "*Depends very much on the technique I, I think purely something like this indeed that only provides a line something like this indeed that only provides a line over your arm, I don't know if that would add so much (P12)*", and the kind of sensations provided "*Uh well I think it's it can just be more soft and smooth and without that sound noise, a bit more like human feeling or even animals, if it feels more like a pet yeah (P24)*". Moreover, the addition of other cues such as sound or the facial expression of the touch sender were proposed as beneficial "*Well I think if I had seen my husband completely, meaning with his face and if I had heard him talk and like I'm gonna touch you now, then it was, but now it was too artificial (P18)"*.

3.3. People's experiences of receiving an MST through a corporeal input medium.

The analysis revealed a range of different opinions regarding the two input formats (hand-like vs. button). Several participants indicated no preferences or experiencing no difference between the two input media "*Yeah not a lot of difference for me… it all feels* *the same (P31)"*. Many however were positive towards the corporeal input medium and described an enhanced MST experience *"Yes the hand I found better indeed, or at least I noticed a difference yes (P3)"*. As reasons, participants stated that the corporeal input medium helped them imagining the touch act "*Oh yes I could have a lot more imagined the situation happening when the hand was there compared to the wood; I could imagine but the hand helped a lot (P11)*". For others the experience became more real "*I thought it felt a lot more real with the hand (P35)*", which some participants stated was caused by a stronger identification with the corporeal input medium "*Yes, yes you if there was such a hand lying there, then yes I don't know then I identified more with that hand and then it was more like someone was actually stroking (P17)*". Indeed, some participants had the impression that corporeal input medium (i.e., the hand) was theirs "*Because of that I can yeah it looks quit realistic seems really and because it is also, you see it happening live so it gives the impression that it is your arm there (P22)*". However, our analysis also showed that the use of the corporeal input medium had its limitations. Several participants indicated not perceiving the corporeal input medium being their hand "*Because you cannot really move your hand, you still do not really have the idea that it is your hand (P10)*". This, in turn, resulted in discomfort with some of the participants "*I thought it was strange because it was artificial and I noticed that very much (P9)*". Discomfort was also experienced by several participants when being touched by a stranger through the corporeal input medium "*Uh yes more unpleasant with the arm and the stranger than with the picture yes (P13)*".

4. Discussion

To date research in the field of MST has not convincingly demonstrated the efficacy of MST in replicating the effects of a natural (unmediated) social touch. Our findings, similar to previous observations [3]. revealed most participants did not perceive of the MST as resembling a naturalistic touch. This lack of realism was caused by several factors: the quality of the tactile stimulation, the type of touch used, and the fact participants did not perceive the touch to be originating directly from a human. In line with previous findings [4] our results suggest that, for some participants, seeing the MST being initiated on a corporeal input medium (i.e., one that resembles to body part being touched) can enhance MST experience. However, it appeared to deteriorate the affective experience for others (e.g., increased discomfort). A possible explanation is that only a few experienced a sense of body ownership over the hand-shaped object. There exist large individual indifferences in the extent to which people can transfer body ownership to external objects [11], and our method of combining touch with congruent visual feedback may only work for some. Nevertheless, many participants were positive as to the value of MST in daily life, mainly for situations where real touch is not possible. However, for MST to be useful changes need to be made to the tactile display in terms of sensation and touch type. Taken together, these and other findings, suggest that we as researchers should be careful with framing MST as social touch. Framing these devices differently, for example as affective haptic devices, may allow for a better investigation of their potential as participants may no longer be compelled to evaluate the technology against naturalistic social touch—a comparison with something the technology currently cannot live up to. Response similarities, or lack thereof, between MST and naturalistic social touch seem to result from a complex set of factors, including tactile qualities and the social context of touch. Before exploring whether we can achieve beneficial health effects of MST, we should first obtain a better understanding of what the essential characteristics are that turns tactile stimulation into a social touch.

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Mental Time Travel: The role of Positive Rumination

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Abstract. According to a long tradition of research, people are used to mentally time travel: That is, to recreate memories from the past and envision future scenarios. To date, a growing body of evidence has revealed that people's estimations about past and future emotional states are inaccurate. Nevertheless, the mechanisms underlying these biases are still understudied, and the potential role of response style to positive affect (PA) has not been explored yet. Here, we implemented a two-week Ecological Momentary Assessment (EMA) design to monitor PA in 84 healthy individuals, who were asked to forecast and recall their mood before and at the end of the study. According to the results, participants with high levels of emotion-focused positive rumination showed higher accuracy in forecasting future PA, whereas participants with high self-focused positive rumination overestimated future PA and were highly accurate in retrospectively recalling experienced PA. Altogether, we suggest that more accurate or positively biased estimations of past and future states may in part be the consequence of an individual's predisposition to ruminate on positive experiences and self-qualities.

Keywords. Recall bias, affective forecasting, mental time travel, cognitive bias.

1. Introduction

According to a long tradition of research, people are used to mental time travel, i.e. to recall episodes from the past and forecast future scenarios (1). While positive reminiscence has been proved to be an effective strategy to increase positive emotions (2) and happiness (3), affective forecasting has been suggested as a future-oriented strategy (4) that drives decisions (5) and enhances emotional well-being (6).

Interestingly, people's ability to forecast and recall positive emotional states is often imprecise (7–9). So far, several individual factors have been associated with the presence of these biases, such as personality traits (10,11), emotional intelligence (12), or psychopathology (13,14). Besides, an additional factor contributing to inaccurate emotional estimations might be represented by response styles to positive affect (PA) (15). Whereas dampening is the attempt to reduce the intensity and duration of ongoing positive emotions (16), positive rumination refers to recurrent thoughts about one's positive experiences and personal strengths that allow to maintain and prolong positive emotions (17). Notably, an intense over-focus on positive events, pleasant emotions and self-qualities might influence the mental representation of future and past affective states,

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thus leading habitual positive ruminators to have an optimistic, yet biased, past- and future-oriented disposition.

The aim of the current study was to explore PA forecasting and recall biases and their association with response styles to PA. We hypothesize that habitual positive ruminators will show more accurate or positively biased future and past PA estimations.

2. Methods

2.1. Sample

91 undergraduate students were recruited via online advertisements at Jaume I University (Spain). In order to control for the confounding effect of depression and anxiety on forecasting and recall biases (18), we excluded participants with a score above 14 on the Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder (GAD-7), i.e. participants with moderately/severe clinical conditions. 6 participants were therefore excluded from the study. One further participant was excluded due to missing data. The final sample was composed of 71 females and 13 males (n=84), and mean age was 20.77 years (SD=2.25). This was a secondary analysis of data from a previous study investigating forecasting abilities in relation to resilience and well-being.

2.2. Measures

Anticipatory and retrospective affect estimations: Participants were administrated the Spanish adaptation (19) of the Positive and Negative Affect Schedule (PANAS) (20). Only the PA subscale was considered within the analyses. In the case of forecasted affect, the instructions provided to participants were “Indicate the extent you think you will feel this way over the next two weeks*”,* whereas the instructions for affect retrospective estimation were “Indicate the extent you have felt this way over the past two weeks”. Both forecasted PANAS-PA (α=.907) and recalled PANAS-PA (α=.911) showed good internal consistency.

Response style to positive affect: The Response to Positive Affect (RPA) scale was adopted to assess participants’ habitual use of three strategies in response to positive mood: Emotion-focused positive rumination, i.e. recurrent thoughts about positive mood and pleasant somatic experiences; self-focused positive rumination, i.e. recurrent thoughts about the Self and personal goals; and dampening, i.e. the attempt to decrease the intensity and duration of positive emotions (15). Good internal consistency was observed for the three subscales (emotion-focused positive rumination: α=.764; self-focused positive rumination: α=.827; dampening: α=.839).

Experienced positive affect: Participants were prompted three times per day to rate momentary PA (“To what extent are you experiencing positive emotions?”) on a 0-100 scale.

2.3. Procedures

After checking for the inclusion criteria, participants were invited to sign the informed consent. Repeated daily assessments were collected by means of Qualtrics, a web-based platform to create and automatically send customized surveys by email. In the present study, three semi-randomized daily assessments were sent (between 9:30 - 14:00; 14:00 - 18:30; and 18:30 - 23:00) over two weeks. Participants were given sixty minutes to complete the evaluation. At the end of the study, participants completed the psychological scales. This study was approved by the ethics committee of the Jaume I University.

2.4. Data analysis

Forecasted and recalled PA refers to the PANAS-PA subscales administrated at the beginning and at the end of the study. Experienced PA was the mean of the 42 possible PA-EMA assessments. To have the same range of scores for forecasted (PANAS: 1-to-5 Likert scale) and experienced PA (EMA: 0-100 scale), PANAS-PA scores were transformed to Percent of Maximum Possible (POMP) Scores (21,22), which express raw scores in terms of the maximum possible score and can range between 0 and 100.

To investigate the effect of time on affect estimations, an ANOVA analysis was performed using one within-subject factor (PA estimations) with three levels (forecasted PA, experienced PA and recalled PA). To explore the effect of PA response styles on PA affect estimations, three separate ANCOVAs analyses were conducted using one within-subject factor (PA estimations) and three levels (forecasted PA, experienced PA and recalled PA). In three different models, we explored the impact of PA response style by including each of three possible styles as covariate (positive rumination - self focused, positive rumination – emotion focused, dampening).

3. Results

A repeated measures ANOVA showed that mean PA differed significantly across time (Mauchly's Test of Sphericity: $\chi 2(2) = 3.65$, $p = .161$; $F(2,166) = 22.87$, $p<.001$). Paired comparisons with a Bonferroni correction showed a significant difference between forecasted ($M=49.97$, $SD=18.47$) and experienced PA ($M=55.65$, $SD=18.56$; $p<.05$), between forecasted and recalled PA ($M=42.02$, $SD=16.70$; $p<.001$), and between experienced and recalled PA ($p<.001$). In other words, participants both forecasted and recalled lower levels of PA than what experienced.

ANCOVAs analyses were conducted to explore the presence of a statistically different effect of time on affect scores controlling for PA response style. A significant effect was observed for emotion-focused positive rumination ($F(1,82)=4.77$, $p<.05$) and self-focused positive rumination ($F(1,82)=11.05$, $p<.001$) (**Figure 1**), but not dampening ($F(1,82)=1.87$, $p=.175$). Forecasted PA significantly correlated with emotion-focused positive rumination (forecasted PA: $r=.213$, $p=.05$), whereas both forecasted ($r=.361$, $p<.001$) and recalled PA ($r=.272$, $p<.05$) were positively associated with self-focused positive rumination.

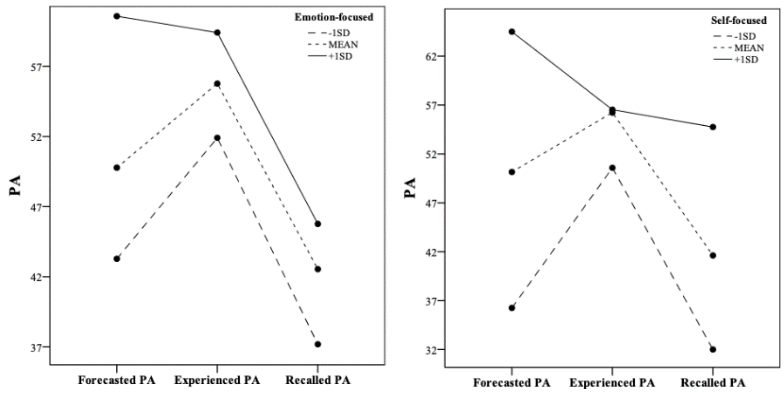

Figure 1. Estimated mean levels of forecasted, experienced and recalled PA controlling for positive rumination.

4. Discussion

In the current study, we explored the ability to estimate future and past positive affective states in a sample of undergraduate students, and we investigated the potential association between PA response style and biased PA estimations.

According to the results, participants were generally inaccurate in estimating PA levels. However, a significant effect of strategy use in response to positive states was observed. More specifically, participants with high levels of emotion-focused rumination showed higher accuracy in forecasting future PA, whereas participants with high levels of self-focused rumination overestimated future PA and were highly accurate in retrospectively recalling PA levels. These results suggest that more accurate or positively biased estimations of positive affective states may in part be the consequence of an individual's predisposition to use positive rumination.

The act of ruminating is the process of continuously and repetitively thinking about the same thoughts (23). While self-focused rumination refers to an individual's emphasis on the Self, personal qualities and life goals, emotion-focused rumination implies a specific focus on positive emotional states (15). Accordingly, intense positive rumination could lead to more optimistic and positively biased expectations about the future, while consolidating the memory for the positive experiences happened in the past. The presence of a more optimistic past- and future-oriented disposition in habitual positive ruminators is coherent with previous findings, revealing lower depressive symptoms and higher self-esteem in individuals showing high rates of positive rumination (15).

The results of the current study have to be considered in light of some limitations. Further research is needed to confirm the present findings, which involved a relatively small sample composed of undergraduate students. Furthermore, experimental studies are needed to disentangle causal rather than correlational conclusions.

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Age Effects on Recollection and Automaticity in a Fully Immersive Virtual Reality Environment

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Abstract. Previous studies that focused on the dual-memory processes in cognitive aging have shown a strong decline of recollection and, to a lesser extent, of automaticity. The current study is the first to investigate the dual memory processes among older and younger healthy adults in a highly immersive virtual reality (VR) environment and to evaluate if automaticity is age invariant. We expected reduced recollection for older adults compared to younger adults and similar performance between the two groups on automaticity. Twelve older adults (M = 66.00) and 26 younger adults (M = 24.15) participated. Our predictions were supported by the results. Two Mann-Whitney U Tests with recollection and automaticity as dependent variables showed that younger adults outperformed the older adults on recollection estimates, but no significant differences between the two groups emerged for automaticity. We demonstrated that, in an immersive environment, older participants had poorer recollection compared to younger adults, probably because controlled memory process are affected by ageing. For automaticity, we found no differences in performance between healthy adults and older adults. Our findings are consistent with most studies and suggest no age effect on automaticity, as automatic processes are age invariant.

Keywords. virtual reality, process dissociation procedure, memory, recollection, automaticity, ecological validity

1. Introduction

Explicit memory or recollection refers to conscious, controlled, and intentional recollection of information, while implicit memory or automaticity, targets unconscious, automatic and unintentional retrieval processes [1]. Healthy aging is associated with impairments in episodic (e.g., autobiographic) memory, but not all forms of episodic memory (e.g., recollection or automaticity) are influenced in the same way [2]. Controlled memory processes, such as recollection, appear to be more sensitive to ageing, as older adults perform worse than younger adults [2, 3]. Most of the studies failed to identify age-related deficits for automaticity, as both healthy and older adults perform similarly [2-4].

An alternative to the classical neuropsychological assessment with a potentially high level of ecological validity is the VR assessment [5]. Most studies focused on episodic and prospective memory and assessed it in healthy and in cognitively impaired participants in various virtual environments [6-9]. Taken together, the episodic memory paradigm is replicated in VR and the negative impact of healthy and pathological ageing on episodic memory is highlighted. VR measures are both ecologic and valid measures of memory [10]

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Because of the poor understanding of why explicit memory is more sensitive to ageing than implicit memory [2], there is a practical need to clarify the dissociation of these processes. The current study is the first to investigate in a highly immersive VR environment the dual memory processes among older and younger healthy adults and to evaluate if automaticity is age invariant. We expected reduced recollection (R) for older adults compared to younger adults and similar performance between the two groups on automaticity (A).

2 Method

2.1. Participants

The sample consisted of 12 older participants aged between 60 and 77 years old (M = 66.00, SD = 5.13) out of which 7 (58.33%) were females and 26 young adults aged between 19 and 34 years old (M = 24.15, SD = 4.54) out of which 19 (73.1%) were females. Participants had normal or corrected vision and hearing and reported themselves free from any neurological and psychiatric conditions. Older participants were recruited from several social clubs from retirees in Cluj-Napoca City, Romania. Their participation was voluntary. The young adults were mostly psychology students who received extra credit for their participation.

2.2. Measures

The process dissociation procedure (PDP) is one of the most used method to compute estimates of recollection (R) and automaticity (A) and has a study phase and a test phase [11]. In the first phase, the participants are instructed to learn new words, while in the second phase they must recollect the studied words using a stem completion task with an inclusion and an exclusion test condition. In the inclusion condition, the participants have to complete the stems with studied words (e.g. fl___ for flower) and to use stems as cues to remember the studied words. If they fail to recall, they should complete the stems with the first word that comes to their mind. In the exclusion condition, the participants complete the stems with new words, and avoid completing the stems with old words. They should try and generate new words, and if they cannot do so, they should complete the stem with the first word that comes to mind (e.g. flock for fl___). The probability to complete the stems with old words in the inclusion test and with old words in the exclusion test provide estimates R and A [12]. Simulator Sickness Questionnaire (SSQ, [13] was used as a measure of cybersickness. A total score above 20 indicates that participants experience cybersickness [14]. Internal consistency was excellent (Cronbach's α = .90).

2.3. Materials: VR environment

The basic virtual environment consisted of a virtual apartment which ran on a CAVE environment (EON Icube) with the following technical specifications: 4 walls constructed of acryl screens, 4 projectors with a resolution of the display at 1400 × 1050 pixels at a refresh rate of 96 Hz with 3000 ANSI Lumens luminosity, stereoscopic 3D active shutter glasses, a NaturalPoint tracking system with 12 tracking cameras, a 360 Microsoft wireless controller for Windows, and a Surround Sound System 500W. The VR apartment [12] consisted of a bedroom, bathroom, and an open space living room with a kitchen with 40 objects that are common to every house (e.g., bed, chair, glasses, bookshelf, vase, and flower).

2.4. Procedure

The University Research Ethics committee approved the research. The procedure contained a study phase and a test phase to obtain estimates of recollection and automaticity [12] and was adapted using Jacoby's PDP [11]. The study phase was performed in the VR apartment, and the test phase on a desktop computer. In the study phase the participants were guided in the VR environment by the experimenter on a predefined route and had to learn as many objects as possible in 5 minutes. The test phase followed the inclusion and exclusion conditions as used in the classical PDP procedure. The participants' responses were recorded on a blank sheet of paper by the experimenter. At the end of the VR exposure (study phase) participants completed the paper-and-pencil version of the SSQ. The testing session lasted for approximately 45 minutes. The primary dependent variables were estimates of recollection and automaticity as measured by the PDP, whereas the secondary dependent variable was simulator sickness.

3. Results

Due to small sample of participants and the skewed distribution, we performed two Mann-Whitney U Tests: one with recollection as the first dependent variable, and the second with automaticity as a dependent variable and found significant differences in recollection estimates of healthy adults (Md = 0.17) and older adults (Md = 0.0), U = 63.00, z = -2.97, p = .003, meaning that that younger participants had a better recollection performance compared to older participants, with a large effect size, r = 0.48. For automaticity, results showed no significant difference between healthy adults (Md = 0.23) and older adults (Md = 0.32), U = 105.500, z = -1.58, p = .11 and a small effect size, r = 0.25. An analysis of simulator sickness showed that three younger participants (11.53%) experienced increased cybersickness symptoms and six (23%) experienced moderate symptoms. One older participant (8%) reported moderate symptoms.

4. Discussion and conclusions

As expected, our results fit with the previous studies and point out that, even in a highly ecological environment, older participants showed recollection difficulties compared to younger adults because controlled memory process are more affected by ageing. Similar to most of the studies on automaticity, there were no differences in performance between healthy adults and older adults and no age effect on automaticity and age-related deficits in recollection [2, 15].

Navigating in VR has a positive effect on memory as increases performance [16, 17] probably because it enhances visual-motor features of episodic memory [18}. The positive effects can be explained by sensorimotor interaction that facilitates automatic encoding as the information processing through action is more automated compared to the verbal one [16-18]. As the participants were guided by the experimenter in the VR, this might have facilitated automatic encoding of the objects from the apartment. Older adults benefit most from a more general material, in terms of global semantic characteristics than from specific material [19]. In a fully immersive CAVE environment and applying a PDP, no superiority learning effect of VR compared to a classical encoding tasks (2D and computerized learning conditions) was found for automatic and controlled influences in a sample of young healthy adults [2]. Cognitively vulnerable populations (e.g., older adults, dementia) might therefore benefit most from VR learning [9].

Due to its positive effects on memory, VR can be used in memory rehabilitation. The main advantage of VR is the possibility to create ecological scenarios to enable the transfer of the experiences in VR to everyday life situations [20]. If recollection or explicit memory is more sensitive to ageing or to various brain conditions (e.g., neurodegenerative disease, brain injury) [21, 22], while implicit memory remains more preserved, interventions in VR may focus on automaticity.

Several limitations should be mentioned. Post hoc achieved power calculations using G*Power [23] revealed that for recollection outcome, our study had a relatively increased statistical power (0.91), but for automaticity it was underpowered to detect an effect (0.40). The smaller sample size reflected in the reduced external validity and its representativeness. Another limitation is the experimental control of the stimulus order and exposure time in the original PDP. To control this, we used a predefined route which was the same for each participant. Similar procedures are used by studies that use virtual apartments to assess episodic memory [6, 16, 24]. It is also suggested that active navigation in VR with increased agency where participants can walk and explore the route can facilitate encoding [25]. In our attempt to control for stimulus exposure and duration, we guided participants in the VR. This can be viewed as a semi-active navigation with low agency. Increasing agency and encouraging active navigation could lead to better memory performance.

In our study, most of the participants were females, which could have produced gender-biased estimates of recollection and automaticity although a meta-analysis, using non-VR tasks identified that males performed better on multiple working memory tasks and worse on memory location tasks [26], yet there is not enough data to support gender differences on cognitive abilities and task performance in VR [27].

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The effect of simulated feedback about psychophysiological synchronization on perceived empathy and connectedness

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Abstract. Social interaction technologies have increasingly become available to psychotherapeutic practice. Despite evidence for their efficacy and other unique benefits, adoption among therapists is still relatively low. A main barrier for therapists is their perception that the ability to empathize and connect with their clients is compromised in technology-mediated interactions. However, the unique affordances of technologies also offer opportunities that could help overcome this barrier and possibly even enhance the empathic interaction. One potential direction is to augment social interaction with feedback derived from psychophysiological measures. A specific interpersonal psychophysiological phenomenon that seems particularly relevant is psychophysiological synchronization, the occurrence of substantial levels of synchrony in human physiology between persons, which has been linked to empathy. The current study investigates the effect of (simulated) feedback about psychophysiological synchronization on perceived empathy and connectedness. Sixty-six participants received simulated feedback, indicating high or low synchronization, while watching an emotionally salient movie simultaneously with a confederate in a separate room. Participants receiving feedback indicating high synchronization reported higher levels of perceived empathy and connectedness compared to the low synchronization feedback group. This study suggests that feedback about physiological synchronization might be used to influence levels of empathy and connectedness in remote interactions, which could potentially be applied to increase empathy between therapists and clients in technology-mediated psychological treatment.

Keywords. technology-mediated interaction, psychophysiological synchronization, empathy, e-mental health

1. Introduction

Over recent decades, technology-mediated psychological treatment has shown a level of efficacy comparable to that of unmediated treatment [1], and has been associated with several unique benefits such as increased convenience, and accessibility of mental health care [2, 3]. However, adoption of technology in clinical practice of mental health care professionals remains relatively low [2]. Among a variety of reasons, one important barrier of practitioners is their concern that mediated interactions do not allow for sufficient empathic understanding [3]. Empathy, or the process by which an individual is able to understand and, to some extent, feel what another individual is feeling, is a crucial ingredient of successful psychotherapy [4]. The expressed concerns on reduced empathic understanding seem to originate in having less access to important social cues, such as eye gaze and posture [5]. The more traditional approach to overcome this is to try to simulate face-to-face interactions as closely as possible, for example by implementing eye gaze correction technologies. Another, complementary approach is to use unique affordances of technology to transform the interaction in a way that could add value above and beyond what is possible in unmediated interactions [6].

A possibility along this line is interpersonal psychophysiology, i.e., using psychophysiological signals as social and affective cues [7]. In the past decade, technologies to measure physiological signals have rapidly advanced. These developments in the field of biosensing have made physiological measurements less costly and much easier to conduct, especially with the increased availability and quality of wearable devices. Thereby, the application of psychophysiology for social interaction purposes has come within reach. At the same time, since these developments are relatively new, it is a largely unexplored area with many questions that still need to be addressed (for a review, see [7]). A specific interpersonal psychophysiological phenomenon that might be particularly relevant to enhance empathic interactions is psychophysiological synchronization, the phenomenon that the physiology of two persons can show substantial synchronicity, e.g., heartbeats that run in synchrony [8]. Psychophysiological synchronization has been studied in relation to empathy, especially in close relationships, and findings generally show that feelings of empathy tend to be higher with higher levels of synchronization [8].

While evidence for the existence of psychophysiological synchronization is accumulating [8], the underlying mechanisms and potential effects are still under-researched. For instance, it has rarely been studied how providing feedback about the level of psychophysiological synchronization affects social interaction. Studies that provided feedback on physiological signals (i.e., heart rate) of an interaction partner found that this could enhance interpersonal intimacy [9] and closeness [10]. If these findings also hold for feedback on psychophysiological synchronization, this could be a valuable addition to solve the lack of non-verbal cues in remote interactions and facilitate empathic understanding in social and therapeutic interactions. Results of a first exploratory study of psychophysiological synchronization feedback during a meditation exercise in Virtual Reality were promising; they found that higher synchrony in respiration rates was related to higher feelings of empathy [11]. To further investigate the potential of psychophysiological synchronization feedback, the current study aims to investigate the effect of (simulated) feedback about the level of psychophysiological synchronization on perceived empathy and social connectedness during a remote interaction.

2. Methods

2.1. Participants

The sample consisted of 66 participants (53% male, age ranging from 18-81 years, M = 28.9) recruited through the J.F. Schouten participant database of the Eindhoven University of Technology. Most of the participants were students (80%). The participants received a monetary compensation of €3 for their participation.

2.2. Materials and measures

In this lab-experiment, participants watched a 3-minute emotionally salient videoclip from the movie ‘The Champ’ from 1979, where a child cries over his father who just died. This videoclip has been shown to elicit high levels of sadness [12-13]. During this video, a colored border around the screen was shown which represented (simulated) feedback on the level of physiological synchronization with the other participant. This representation was chosen based on a short pilot study (N = 6), mainly because it was found easy to interpret and does not require direct focus, in contrast to for example a graph or numerical value. The border varied between three colors: green referred to high synchronization, orange to medium, and red to low. Participants were randomly assigned to one of two conditions: high synchronization (76% of time green border, 24% orange) or low synchronization (76% red, 24% orange).

Perceived empathy was measured with seven statements on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". These items were based on the questionnaire used in [14], adapted to the context of this experiment (α = .75). Social connectedness was measured with the Inclusion of Other in Self (IOS) scale [15], a single-item pictorial measure in which participants have to pick one of seven options of increasingly overlapping circles that best represents their closeness to the other participant. To measure subjective closeness, we included the Subjective Closeness Index (SCI) [16], which consists of two statements on a 7-point Likert scale ranging from "not at all close" to "very close".

2.3. Procedure

The participant was picked up from the waiting area, while a confederate (a 19-year old woman) was already in the lab. After giving informed consent and introduction of the experiment, the participant and the confederate were seated in separate booths. The skin conductance sensors were applied to the participant and he or she was instructed "to wait while the sensors were being applied to the other participant" (the confederate). After an appropriate waiting time and a neutral video (i.e., images of an aquarium), the sadness evoking video with the colored border was shown, followed by a digital survey consisting of the questionnaires and additional questions on demographics and control variables. Last, participants were debriefed and received their compensation. The entire procedure lasted approximately 15 minutes.

3. Results

Independent-samples *t*-tests were performed to test the effect of high vs. low (simulated) synchronization feedback on perceived empathy and social connectedness. Both effects were statistically significant: the high PS feedback group gave a higher score on perceived empathy ($t(62.9) = -4.54$, $p < 0.001$, $d = 1.10$) and social connectedness ($t(43.6) = -4.14$, $p < 0.001$, $d = 1.01$) compared to the low synchronization group. No significant effect of the conditions was found on subjective closeness ($z = -1.35$, $p = 0.18$), although differences were in the expected direction. A regression analysis to check for age- and gender related differences did not yield significant results. Table 1 shows the descriptive statistics of the scores on the measures for both conditions.

Table 1. Descriptive statistics for the scores on the dependent measures for both conditions.

Condition	Perceived empathy		IOS		SCI	
	M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI
Low synchronization	2.57 (0.58)	2.36-2.57	1.67 (0.74)	1.41-1.93	2.15 (1.22)	1.72-2.58
High synchronization	3.17 (0.51)	2.99-3.35	3.00 (1.70)	2.40-3.60	2.61 (1.42)	2.10-3.11

4. Discussion

This is a first study exploring the effect of (simulated) psychophysiological synchronization feedback in social interactions. The results generally support our hypotheses, indicating that receiving feedback of high synchronization with another person increases feelings of perceived empathy and connectedness with that person, compared to feedback of low synchronization. These results are in line with earlier studies indicating that sharing physiological signals can support intimacy and empathy [9, 10]. This is especially relevant in the context of (online) psychological treatment, as one of the main concerns of practitioners is the lower ability to empathize and connect with clients in technology-mediated interactions [2, 3]. The current findings suggest that there might be an opportunity for psychophysiological synchronization feedback to overcome this barrier and even add an extra element to the interaction, in mental health care but also in other contexts, such as online dating, gaming, and remote collaboration.

The results of this study also appear to be in line with previous research that found a relation between psychophysiological synchronization and empathy [8]. Two major differences with these studies though, is that they used genuine physiological signals and did not provide feedback to the interactional partners on their level of synchronization. A logical next step, then, would be to investigate how these findings relate to each other.

Whereas simulating the feedback enabled us to control the differences between conditions, real physiological synchronization will most likely not show a variation that is as clear cut as the differences between high and low synchronization presented in the current experiment. So, it will be of interest to investigate if the measured effects persist if genuine feedback with realistic levels of synchronization is provided, as results of a first exploratory study suggest [11]. Further studies with control conditions and actual measurements will also help to clarify questions regarding whether and how synchronization feedback, actual synchronization, and feelings of empathy are related, and in which direction. Do people feel empathy and then synchronize, do they synchronize and then feel empathy, or is it a continuous bidirectional process? And how does receiving feedback on one's level of synchronization influence this relationship?

Another important factor is the task that is performed by the participants, and in particular the level of interaction during their activity. In the current experiment there was only minimal contact between partners. It is reasonable to assume that tasks that involve higher levels of interaction have more effect on feelings of empathy, but more research is needed to clarify its exact working. Another possibility requiring further investigation, is that the synchronization feedback not necessarily has to be psychophysiological in nature, but that any kind of perceived similarity affects affiliative outcomes. Perceived similarity has been associated with increased liking between persons [18], although evidence for a link with increased empathy is mixed [19].

A limitation of the current study is that it used red, orange, and green colors, colors that we have strong evaluative associations with [20], potentially confounding the interpretation of the feedback. A future study could use colors that do not have strong associations, colors such as yellow and purple. More generally, future studies are necessary to investigate how different kinds of representation influence the found effects.

In short, the current study finds support for earlier work indicating that physiological feedback can be used to facilitate empathic interactions. With the accumulating evidence for the existence of physiological synchronization and its link to empathy, the application of psychophysiological synchronization feedback seems particularly promising for social interaction purposes, and the current study provides first evidence that justifies future investigations.

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Psycho-physiological Effects of a Virtual Reality Relaxation Experience after Acute Stressor Exposure

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Abstract. We examined the effects of a VR experience ("The Secret Garden") designed to promote relaxation following acute stress induction. Participants (N=47, mean age = 26,0 years, S.D. 7,9, 31 females, 16 males) were exposed to a laboratory stressor (i.e., The Trier Social Stress Test Protocol for Inducing Psychological Stress, TSST and randomly assigned to either the experimental condition (VR relaxation environment, N=24) or the control condition (resting, N=23). Stress recovery was assessed via repeated measures at baseline, after TSST and following VR/resting conditions. Psychological measures included the administration of State-Trait Anxiety Inventory (STAI) and the ITC-Sense of Presence Inventory (ITC-SOPI). Heart rate (HR) and heart rate variability (HRV) data were also collected. Repeated-measure ANOVAs revealed that anxiety levels significantly increased from baseline to post-TSST, with main HR indexes following the same pattern. There was no main effect of experimental condition on both anxiety and HR measures, but a significant time per condition interaction effect, with a higher mean reduction of anxiety in the VR group after the acute stress induction than in the control group. No main effects of condition were found on HR/HRV indexes. These findings suggest that TSST increased psychological and physiological stress and that VR relaxation was able to help recovery from stress condition, although this effect was not corroborated by HRV data analysis. These results confirm the potential of VR as a procedure to support recovery from acute stress and warrant further studies.

Keywords. Virtual Reality, Stress, Trier Social Stress Test Protocol, Presence, Heart Rate Variability.

1. Introduction

Psychological stress is a process characterized by the subjective perception that environmental demands exceed a person's adaptive capacity, resulting in psychological and physiological changes, which, if persisting, increase risks for mental and physical health [1]. In recent years, there has been growing interest towards the potential of using virtual reality (VR) environments for reducing stress and anxiety [2]. VR can be effectively used as a tool to simulate potential stressful situations and help a person to learn emotional coping skills. A further potential of VR is as a tool to train relaxation skills, i.e. by using simulated natural environments; this includes also emerging approaches that combines the use of VR and biofeedback techniques, where participants can learn to control bodily processes that are normally involuntary (i.e., heart rate) through the 3D visualization of changes in physiological functions, with the goal of regulating the somatic response to stress and promoting emotional wellbeing [3]. Adding to this literature, in the present contribution we examined the psychological and

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physiological effects of a VR experience designed to promote relaxation following a laboratory stressor (i.e., The Trier Social Stress Test Protocol for Inducing Psychological Stress [4]), as compared to a control resting condition.

2. Methods

2.1 Design and sample

The study consisted of a mixed design. Eligibility criteria were self-assessed by students. The sample (N=47, mean age = 26,0 years, S.D. 7,9, 31 females, 16 males) included current undergraduate or postgraduate students (aged ≥18 years) at the Universitá Cattolica del Sacro Cuore. We excluded students who were currently experiencing any serious mental or physical health problem that would affect their ability to engage with the experiment.

2.2. Procedure

The overall experimental procedure is schematized in Table 1. Participants were first exposed to the Trier Social Stress Test Protocol (TSST, [4]) and then randomly assigned to either the experimental condition (VR relaxation environment, N=24) or the control condition (resting, N=23), with repeated measures. The TSST is a laboratory used to reliably induce stress in human research participants, by requiring them to prepare and deliver a speech, and verbally respond to a challenging arithmetic problem in the presence of a socially evaluative audience. As indicated by the TSST protocol described in [5], we administered pre-stress measures including State-Trait Anxiety Inventory [6] and recorded 5 minutes of pre-stress physiological measurements (heart rate, HR). HR data were collected using the wearable sensor Bitalino, in combination with the software OpenSignal. These measures were repeated immediately after the TSST. In the following phase, participants assigned to the VR relaxation condition were exposed to the virtual environment "The Secret Garden" (Fig. 1), a natural scenario developed by Become S.r.L., designed to induce calm and relapse of tension.

Table 1: Experimental procedure

Phases	Valence	Arousal
1. Instructions	Briefing, instructions, setup	Briefing, instructions, setup
2. Pre-stress	STAI, baseline HR recording	STAI, baseline HR recording
3. Stress ind.	TSST	TSST
4. Post-stress	STAI, HR recording	STAI, HR recording
5. Recovery phase	VR Relaxation "The Secret Garden"	Rest
6. Post-treatment	STAI, ITC-SOPI, HR recording	STAI, HR recording

7. Conclusion	Debriefing	Debriefing

The scenario included also a relaxation narrative and a music soundtrack. Participants assigned to the rest condition (control) were instructed to rest for the same amount of time. After this phase, participants in both conditions were re-administered the STAI questionnaire. In addition, participants in the VR condition were asked to fill the ITC - Sense of Presence Inventory (ITC-SOPI), to assess their sense of presence [7]. The ITC-SOPI includes four subscales: Spatial Presence; Engagement; Ecological Validity and Negative Effects. Participants respond to each item through a 5-steps Likert scale (1= totally disagree; 5= totally agree). Ad hoc questions were administered to participants in the VR condition to explore aspects related to usability and pleasantness of the experience. HR recording were collected for all participants.

Fig. 1 The “Secret Garden” used in the VR relaxation condition

3. Data analysis and results

As expected, repeated-measure ANOVAs revealed that anxiety levels measured by STAI significantly increased from baseline (M=34.8; DS=6.46) to post-TSST (M=43.34; DS=10.83), $F(1)=40.15$; $p<0.05$, indicating that the TSST procedure was effective in enhancing participants’ stress. This result was corroborated by the analysis of HR variability index rMSSD, (i.e., the square root of the mean R-R interval), which decreased from baseline after the TSST, and increased again after the recovery phase $F(1,63)=35,19$; $p<0.05$. A mixed ANOVA indicated that there was no main effect of experimental condition on both anxiety and HR measures, but STAI scores showed a significant time per condition interaction effect $F(1,63)=44.54$; $p<0.05$, with a higher mean reduction of anxiety in the VR group after TSST than in the control group.

As concerns physiological measures, no main effects of condition were found on HR/HRV indexes. However, it should be mentioned that due to artifacts in data recording and missing HR data during the recovery phase of the protocol, data from several participants in both conditions were excluded from the analysis. ITC-SOPI data showed that the Secret Garden Experience elicited moderate to high sense of presence, as showed by scores in the subscales Spatial Presence (M=3,0; S.D. 0,65), Engagement (M=3,4; S.D. 0,71), and Ecological Validity / Naturalness (M=3,1; S.D. 0,89), and by the low average score in the subscale Negative Effects (M=1,5; S.D. 0,72).

4. Discussion

These findings suggest that the TSST increased psychological and physiological stress, supporting the reliability of this laboratory stress induction procedure. The comparison between the VR relaxation and rest showed that both conditions helped participants recovering from the acute stress phase by reducing the level of state anxiety. The relaxation effect of the VR condition “The Secret Garden” was not superior to rest, although the virtual experience was associated to moderate-to-high presence levels. However, the analysis of sensors data was inconclusive due to missing or non-reliable HR data in the recovery phase of the experimental protocol. Furthermore, the sample was not balanced by gender. Despite these limitations, these findings support the potential of VR as a procedure to support recovery from acute stress and warrant further investigation.

Acknowledgments

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No Country for Old Men: Reducing Age Bias through Virtual Reality Embodiment

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Abstract. Ageism is a negative attitude toward aging and elderly people. Many studies have investigated the effects of ageist attitudes and age stereotypes, but little is known about their ability to be modified. By making young adult participants embody arms of older individuals, we attempted to induce the illusion of ownership for the virtual body part and therefore reduce the negative implicit bias towards elderly people. They were assessed for explicit (Fraboni Ageism questionnaire) and implicit (Age-IAT) attitudes toward the elderly. Then, through videos of arms touched in virtual reality and a synchronous real tactile stimulation, we elicited an illusion of body ownership. Participants looked at their "virtual" arm while they were touched by the same wooden stick seen in the video, every second for two minutes. After each condition Age-IAT was re-administered. The results suggest a decrease in negative attitudes toward elderly people in the adult population.

Keywords. Virtual reality, Embodiment, Ageism

1. Introduction

Ageism is a negative attitude toward ageing and older adults. Many studies have investigated the effects of ageist attitudes and age stereotypes on the behavior of others towards older people and the self-related beliefs and behavior of older adults themselves [1]. The explicit form of ageism is defined as a conscious alteration in feelings, behaviors and thoughts dependent on the person's age; alternatively, implicit ageism defines an automatic and unaware process of prejudice [2].

The direction of this process is mostly from the young towards the elderly but, in some cases, it also applies in the opposite direction. Levy [3] demonstrated that elderly implicit self-stereotypes can influence how older people perceive themselves and other older individuals. Most dramatically, adults aged 60 and older showed a pro-young effect of similar magnitude to adults in their twenties, despite changes in explicit age preferences [4].

Virtual reality is not only a powerful tool that can provide new insights into social cognition and stereotype issues, but it is also an instrument able to induce a change and provide simple measurements. In recent years, virtual reality has been used for motor and cognitive rehabilitation, neuropsychological evaluation and embodiment induction. Indeed, there is mounting evidence that virtual reality techniques allow a strong illusion of ownership over a virtual body to be produced [5].This in turn provides a methodology to study social cognition and attitudes toward self and others. Moreover, by integrating social cues, such as voice or body characteristics in a virtual environment, it is possible to change consolidated perceptions and beliefs. Some evidence suggests that virtual alteration of the skin reduces implicit racial bias [6] and alteration of age in an older adult can reduce negative stereotypes towards the elderly [7].

Most of the studies of attitudes and virtual reality are based on perspective-taking techniques: taking a different perspective of another social group can reduce stereotypes

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with respect to the outgroup [8]. Furthermore, body changes can be applied to higher levels of cognitive processing rather than only perceptual and motor response. For instance, Banakou [9] found that people embodied in avatar culturally associated with high cognitive abilities (i.e. Einstein) lead to higher performance. Since ageism is a common daily issue in contemporary society, we firmly believe that this kind of methodology could help in studying the effect of an older body on the stereotypes and attitudes of a young population. Based on this goal, this study can be regarded as a first step towards investigating the role of own-body appearance in implicit attitudes of ageism.

Our aim was to induce body-illusion ownership and thus reduce the negative implicit bias toward older adults in young adults. Our expectation was that the effect would be present exclusively in the older-arm condition and not in the same-age arm condition.

2. Method

2.1. Sample

24 participants (12 males, mean age: 23.75±2.308) took part in the experiment. They were all Italian speakers and had no history of psychiatric or neuropsychological disorders. All participants were students at the University of Milano-Bicocca. The project was approved by the Ethics Committee of the University of Milano-Bicocca and conducted in accordance with the 2013 Declaration of Helsinki.

2.2. Experimental Design

We used a within-group design. Each participant completed 4 conditions obtained by crossing two different arm AGE conditions (young arm and old arm) and two different arm POSITION (anatomical and non-anatomical).

2.3. Stimuli

Videos for virtual reality were recorded with a Samsung Gear 360® in the laboratory of the Psychology Department of Milano-Bicocca. The recorded arms belonged to two different real males. For the young-arm sessions, we tapped a 30-year-old's hand with a wooden stick every second for 120 seconds. The arm was extended in front of the participant perpendicular to the lateral axis.

For the old-arm sessions we used the same procedure by tapping a 60-year-old's hand. The experimenter who tapped the hand in the video and in reality was the same. We used two conditions as controls in which the VR-videos were left 45 degrees calibrated (i.e. the arm had a non-anatomical position) in order to avoid spatial overlapping between proprioceptive and visual inputs.

2.4. Measures

2.5. Embodiment Scale

This is a questionnaire adapted from previous studies conducted to evaluate body illusions [10]. It measures the sense of the embodiment through 15 statements evaluated on a 7-point Likert scale. We calculated Embodiment Score by adding the single score of the Ownership, Agency and Location statements [11]. We obtained a single score for each condition.

2.6. Fraboni Ageism Scale (FSA)

It measures both affective and cognitive components of explicit ageism, based on Butler's definition[12]. The Italian version [13] consists of 19 statements to evaluate on a 4-point Likert scale. It is composed of three subscales: separation and avoidance, stereotypes and antilocution, affective attitudes and discrimination. Items of this dimension are 'reverse-keyed'. Higher scores indicate higher levels of ageism.

2.7. Age- Implicit Association Task

This is a widely used cognitive-behavioral test that measures the strength of automatic implicit associations relying on reaction time in a sorting task. An age-IAT measures the bias by requiring people quickly to categorize faces (young and old) and words (positive or negative) into groups. Implicit bias is calculated from the differences in speed and accuracy between categorizing young faces/positive words and old faces/negative words, *compared to old faces/positive words and young faces/negative words. Higher IAT is* interpreted as a greater age bias, or a preference for young faces compared to old faces.

We administered Age-IAT using Inquisit 4.0. software which allowed us to calculate d-scores [14], standardized mean difference scores of the hypothesis-inconsistent pairings (Young-Bad/Old-Good) and hypothesis-consistent pairing (Young-Good/Old-Bad).

2.8. Procedure

Firstly, the participants completed the questionnaire (FSA) and performed the test (pre-IAT), providing an explicit and an implicit measure of ageism. For each session, they watched a video with tapping (2 min, 1 touch/sec) in virtual reality, and then completed the Embodiment Questionnaire Scale, providing a self-reported measure of embodiment and IAT (5 min). The participants wore an Oculus Gear VR headset and were instructed to look in the real arm direction, extended in front of them perpendicular to the lateral axis.

3. Results

3.1. Embodiment Measure

Analyses were conducted with R Studio. We conducted a Repeated Measure ANOVA with Embodiment score as the dependent variable and AGE (old hand vs. young hand) and POSITION (anatomical vs. non-anatomical) as factors. We found a main effect of POSITION ($F(1,23) = 30.686$, $p<0.001$, $\eta^2 = 0.572$).

As we expected, we found a stronger full body illusion in the experimental conditions compared to the control conditions (**Tab. 1**).

Table 1. Estimated Marginal Means of the Embodiment Questionnaire scores.

CONDITION	MEAN	SE	95% CI LOW	95% CI UP
Anatomical	0.937	0.226	0.481	1.394
Non-anatomical	-0.580	0.226	-1.036	-0.124

3.2. Fraboni Ageism Scale

We conducted a Repeated Measure ANOVA with the subscales of FSA scores (**Tab. 2**) as dependent variable. We found a main difference between subscales ($F(2,46) = 20.5$, $p<0.0001$, $\eta^2 = 0.471$). We applied Post-Hoc comparisons between the subscales with Bonferroni correction. The avoidance subscale shows a lower score compared to stereotypes ($p<0.0001$) and discrimination ($p<0.0001$).

Table 2. Estimated Marginal Means of FSA subscales.

FRABONI SCALE	MEAN	SE	95% CI LOW	95% CI UP
Avoidance	1.60	0.104	1.39	1.81
Stereotypes	2.09	0.104	1.88	2.30
Discrimination	2.12	0.104	1.91	2.33

3.3. Implicit Ageism

Our interest focused on the difference between the post-IAT for each condition and pre-IAT (i.e. ΔIAT= pre IAT– post IAT). Our hypothesis was that the mean ΔIAT would show a greater increase for the participants in the old anatomical condition than in the other conditions, where a greater ΔIAT suggests a positive decrease in negative attitudes toward elderly people in the adult population.

We conducted a Repeated Measure ANOVA with ΔIAT values as the dependent variable and AGE (old hand vs. young hand) and POSITION (anatomical vs. non-anatomical) as factors. We found a main effect of AGE (**Tab. 3**) ($F(1,23) = 9.013$, $p<0.01$, $\eta^2 = 0.282$) but no interaction effect.

Table 3. Estimated Marginal Means of ΔIAT values

CONDITION	MEAN	SE	95% CI LOW	95% CI UP
Young Hand	0.066	0.095	-0.128	0.261
Old Hand	0.299	0.095	0.105	0.493

4. Conclusion

The purpose of this study was to investigate attitudes toward aging and the possibility of temporarily changing attitudes and stereotypes. Only a few other studies have, to our knowledge, found changes in age attitudes in virtual embodiment. Nevertheless, this is the first study that has used visuo-tactile stimulation to investigate changes in social attitudes. Firstly, according to previous studies on ageism, our data on young adults show high stereotypes and discrimination traits in behavior towards the elderly.

Moreover, as we expected, the embodiment scores were consistent with the experimental condition: when the real-arm position was spatially coherent with that of the virtual arm, a higher full body illusion was reached. Interestingly, implicit age bias was modified only after older-age exposure, independently from arm position. The data are consistent with a previous study on social cognition in which exposure to a stereotypic exemplar reduces implicit prejudice [15]

Furthermore, according to the Proteus Effect, a phenomenon in which participants change attitudes and behavior according to their digital avatar [7], changes in attitudes do not require strong full-body ownership and the non-anatomical condition could induce an embodiment which is reduced but still present. However, the results do not enable us to determine the duration of the effect following our manipulation. Future studies could address the issue regarding the specific embodiment effect on attitudes by manipulating the long-term effect.

To summarize, the study has shown that a visuo-tactile stimulation in Virtual reality could be a valid method of inducing an old body-illusion ownership. Future studies will be aimed at investigating this effect in elderly people and whether inducing younger body-illusion ownership could positively increase one’s own self perception of aging.

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Digital contents as a tool to address research reproducibility crisis in psychology: A case study on sexual attraction under conditions of high arousal

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Abstract. In the field of behavioral sciences, a crisis of the replicability of data took place. Among the reasons of the crisis, there is the difficulty of replicating some classical experimental settings and the lack of reproduced studies. Nowadays, digital contents might provide valuable opportunities to re-create specific environmental situations and manipulations in a safe and cost-saving way. The present study is a preliminary attempt to replicate the relationship between arousal manipulation and sexual attraction as it was assessed in the classical study by Dutton and Aron in 1974. Here, 30 male subjects will be randomly assigned to high or low arousal condition (induced with digital contents) and then asked to rate attractiveness of a female brief video. The objective of this preliminary study is to assess whether the same pattern of results from the classical study of Dutton and Aron will be confirmed with a virtual reprise of the experiment. Theoretical and practical implications will be discussed.

Keywords. Arousal; experimental manipulation; digital contents; sexual attraction; replication

1. Introduction

Up to now, in the field of psychology and behavioral science a crisis of reproducibility of studies took place. Such a crisis raised concerns about the reliability of scientific results, and it is due to several reasons, ranging from statistical issues to the fact that priority has been given more to novelty than to replication. Despite that trend, replication offers the fundamental confirmation of patterns that are likely and renders psychological data more reliable [1].

In the present work, authors propose to address the issue of the replication of specific categories of studies in the field of psychology by reproducing experimental manipulations with video remotely sent. Specifically, authors claim that technologies which can reproduce complex stimuli (i.e., 360° videos, virtual or augmented reality), might be used to replicate those studies, which present environments difficult to be reproduced for ethical reasons, costs, and availability of the stimuli. Indeed, having the sensation of being present in front of digital stimuli or inside virtual environment might

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constitute a valuable alternative to try to reproduce the key components of the subjects' experience previously realized in real experimental settings.

The idea of using technologies for the replication of study is not new. Slater and colleagues [2] already gave a seminal example of how VR can be used to re-test the relationship between psychological constructs, in this case as it has been done in the well-known classical study on obedience from Milgram [3].
Here authors propose to address the issue of reproducibility of studies with the aims of replicate classical findings, assess whether and to what extent digital contents can be used as a manipulation device on specific psychological variable, and finally to expand on practical implications of classical studies.
Authors identified studies dealing with these three categories: a) arousal and emotional manipulation, b) research involving specific environments such as natural spaces and their relationship with well-being, c) investigations of vicarious learning (the Bobo doll experiment). For all these classes, understanding how to efficiently manipulate psychological variables with digital contents would mean the possibility of performing training and interventions without having physical objects in a time and cost saving manner. The present pilot study is our first attempt to test if and to what extent an internet-based experiment can offer reliable experimental manipulation to replicate the well-known the relationship between arousal enhancement and sexual attraction, as it has been explored in the classical study by Dutton and Aron [4].

2. Materials and Methods

30 male subjects were enrolled in the study. Inclusion criteria were being a male in an age range between 18 and 65 years, native Italian speaker, with no neurological and psychiatric diseases and no disturbs impairing visual or auditory functions. Participants completed an online consent form; the study was conducted according to the Declaration of Helsinki. Overall, mean age was 33.6 years (s.d. 6.8; range: 18-52). For what regards educational level, 1 subject (3.3%) had primary school degree, 14 (46.7%) had high-school diploma, while 12 (40.0%) had a university degree and 3 (10%) had a Ph.D. or a postgraduate educational degree. Considering occupational status, all the participants were employed, 6 (20.0%) were blue-collar workers, 9 (26.6%) were white collar workers, 2 (6.6%) were health care professionals, while the remaining reported other occupational status (e.g., Ph.D. student, researchers). Finally, 12 (40.0%) of the participants were single, 13 (43.3%) were married or lived with their partner, and 5 (16.7%) were in a relationship.

Subjects received a link with a Qualtrics survey and were randomly assigned to one of these two conditions: a) high arousal-anxiety condition, b) low arousal-relaxation condition. In the first condition, volunteers saw two 360° videos with a shark cage and a slackline acrobat, while in the other group subjects saw two 360° videos displaying a walk in a winter and a spring forest. Before the videos, volunteers were instructed to either find a quiet place and turn on the audio of the device. To enhance the likelihood of participants to watch the entire video, a timer was inserted during the reproduction of the videos. Each video lasted 55 seconds, and the order of presentation was randomized within conditions. To test their efficacy in arousal modulation, the videos were pre-selected with a pilot study on 17 male volunteers enrolled with the same inclusion criteria of the present study. After the 360° videos, subjects were asked to rate perceived attractiveness of a brief video with a female actress on 6 visual analogue scale (VAS). Perceived psychophysiological state was also measured through two Visual Analogue Scales (VAS) (from 1 to 100) administered pre- and post-the videos on perceived stress/activation ("How much do you feel stressed or activated right now?") (which was our manipulation check) and on perceived relaxation ("How much do you feel relaxed right now?").

Data were analyzed with nonparametric statistics. To test if levels of activation were modified by the exposure to videos, we performed a Wilcoxon signed-rank test on both the groups, while the differences between groups in activation post exposure were assessed through a Mann-Whitney U test. Differences in perceived attractiveness scores of the female video were assessed with the same test. The data were analyzed with SPSS version 26.00.

3. Results

After the exposure, stress/activation scores of the high-arousal group (*Mdn*= 60) were higher than those of low-arousal group (*Mdn*= 37). The Mann-Whitney test indicated that the difference was statistically significant U = 58, z=-2.26, *p* = .023, r= -.58.

Median activation scores were compared before and after the exposure to videos in both groups. Overall, subjects in the high-arousal condition reported higher scores of stress/activation after the exposure to videos (*Mdn*= 60), compared to the scores given pre-exposure (*Mdn*=30). A Wilcoxon signed-rank test indicated that the difference was statistically significant, T= 83, z= -2.26, p =.009, r= -.58. While in the low-arousal condition, volunteers reported slightly lower scores of stress/activation after the exposure to videos (*Mdn*= 37), compared to the scores given pre-exposure (*Mdn*=40). A Wilcoxon signed-rank test indicated that the difference was statistically significant, T= 3.5, z= -2.45, p =.014, r=-.63. The same pattern was observed for the VAS on relaxation levels, which showed that level of relaxation increased into the low arousal group and decreased in the high arousal one ($Mdn_{\text{High arousal group}}$= 70, $Mdn_{\text{Low arousal group}}$= 61 before the videos and $Mdn_{\text{High arousal group}}$= 62, $Mdn_{\text{Low arousal group}}$= 70 after the videos).

Overall, considering differences in perceived attractiveness scores of the female video, high-arousal group gave higher scores on almost all the assessed dimensions (Table 1). However, the Mann-Whitney test indicated that none of these differences was statistically significant and all the effect sizes were small.

Table 1. Differences in perceived attractiveness scores in the two groups

Attractiveness items	High-arousal group (*Mdn*)	Low-arousal group (*Mdn*)	Mann-Whitney test
Beauty	66	60	*U*=99, z=-.56, *p*=.57, r=.10
Attractive	65	60	*U*=105.5,z=-.29,*p*=.77,r=.05
Sensuality	62	54	*U*=104,z=-.35, *p* =.72, r= .06
Pleasantness	66	72	*U*=106,z=-.27, *p* =.78, r= .05
Erotic	55	40	*U*=91.5,z=-.87,*p*=.38, r= .16
Funny	70	64	*U*=103,z=-.39,*p* =.69, r= .07

4. Discussion

This pilot study is our first attempt to test the suitability of digital contents in the replication of classical studies on arousal and emotional manipulation with the ultimate scope of providing practical guidelines on the efficacy of digital contents as a manipulation tool to address the issue of reproducibility of results.

In the present work, we aimed at studying the relationship between arousal enhancement and sexual attraction, as it has been explored in the previous classical study [4]. Specifically, we speculated that we could effectively manipulate arousal with digital contents, to test if levels of activations yielded to different perceptions of attractiveness. Our results showed that digital contents employed in the present study (i.e., brief videos remotely sent to volunteers) effectively manipulated the level of arousal. However, we did not find any significant difference in the scores of perceived attractiveness and the computed effect sizes were small. Hence, our analysis did not repeat the classical relationship between arousal heightening and sexual attraction.

At the current state, we cannot rule out the possibility that enlarged sample size would get significant results in perceived attractiveness, nor we can exclude that different technological tool (e.g.: virtual reality), with enhanced sense of presence, could have given a stronger manipulation. Furthermore, in future studies, psychophysiological measures should be paired with self-report questionnaires, to add objective data on the manipulation of arousal and emotional states.

We concluded that brief 360° videos constitute a valuable mean for the manipulation of emotional and arousal states and that they can be used as effective stimuli in online experiments. On the other hand, further studies, with enlarged sample sizes, are required to establish the relationship between arousal and sexual attraction as assessed by Dutton and Aron [4].

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Experimenting immersive videos to reduce test anxiety in university students

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Abstract. Test Anxiety (TA) can be a serious concern for students and it can even compromise the university carrier. Virtual Reality (VR) proved to be effective for treating various anxiety disorders (e.g., social phobia). Spherical Video Based Virtual Reality (SVVR) share some important features of VR (i.e., immersion and multimodality) and are typically less expensive and easier to access. In the present study, we investigated the introduction of immersive videos to contrast TA in undergraduate students. A group of 50 university students who were about to take an exam took part in the study. The level of anxiety was assessed with the STAI-Y1 before and after watching the immersive video. A significant reduction in the level of anxiety emerged. These findings are promising, because they show the effectiveness of immersive videos in contrasting TA, even after a brief exposure.

Keywords. Test Anxiety, Spherical Video Based Virtual Reality, 360° video

1 Introduction

Test Anxiety (TA) is conceived as a form of social evaluation anxiety that is experienced by individuals approaching an assessment situation [1]. TA is widespread among University students and can negatively affect their tests performance and, ultimately, their academic carrier [7,2]. 62% of undergraduate students who withdrew from the studies suffered from TA [5].

Different interventions have been proposed to counteract TA, either following the traditional therapeutic approach or leveraging on computer technology, e.g., VR. However, they typically require assisted training, continuous practice, and specific equipment. Recently, immersive 360° videos have been introduced in the clinical practice for treating anxiety disorders. Such technology holds the potential to weaken the effects of TA. However, research on the effectiveness of 360° videos to contrast TA is still scarce. This study aimed to investigate if the exposure to a 360° video displayed through a head mounted display (HMD) can reduce the anxiety experienced by undergraduate students about to take an examination.

2 Related work

TA consists of a cognitive and an affective component [1,8]. The former amounts to the thoughts related to the testing situation, e.g., exam-related expectations. While the latter is related to physiological reactions, e.g., abdominal cramps, dry mouth. Students experience anxiety before the exam, which is linked to the preparation phase, and on the examination day, reflecting the concerns about the test itself [9]. The effects on performance depend on the level of difficulty of the exam and the overall academic load [6]. Several factors affect TA: home-sickness, non-resident students showed higher TA

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and psychological distress [3]; oral exams increase TA [10]; the familiarity of the test-taker with the subject and one's self-confidence [1], and parental expectations [11].
Different interventions have been proposed to support students dealing with TA [12]. Besides traditional techniques (e.g., *systematic desensitization* [13]), treatments exploiting multimedia technology have been introduced. [8] considered a multiple-phase training, delivered through multimedia stimuli, which significantly reduced anxiety. Recently, [15] found that support request from one's social network was more effective in lowering TA than reviewing course materials. Even automatically-generated supportive messages sent to students shortly before an exam decreased anxiety significantly [16]. Audio-based distraction resulted in mixed outcomes [17].

2.1 Immersive 360° videos for the treatment of anxiety

VR technology can create artificial sensory experiences, it can involve individuals at an emotional and attentional level and allows real-time interaction [18, 19]. Thus, VR is a perfect candidate to support the implementation of cognitive therapy techniques for the treatment of anxiety disorders [20]. Spherical Video Based Virtual Reality (SVVR) or 360° videos share some critical features of VR, being fully immersive and multimodal and enabling endless modification of the virtual environments. These videos do not allow the users to see themselves in the virtual environment neither to interact with it, but they can be produced in a short time and with limited resources [21]. Recently, 360° videos have been experimented for treating anxiety disorders, i.e., public-speaking distress [22]. After a 4-week trial, the level of anxiety dropped. This type of videos was also introduced to treat panic disorders and initial results are promising [23]. An 8-minute exposure to immersive videos significantly reduced the state anxiety in a group of students [24].

3 The study

The experiment aimed at assessing if a 360° video is effective in reducing TA in undergraduate students shortly before an exam. Besides, we aimed to investigate the effect of the video type on the TA. We hypothesized that relaxing videos would reduce TA to a greater extent as compared to activating videos.

The experiment followed a mixed-design. Two between-participant factors: video categories (i.e., *relaxing* vs. *activating*) and stimuli type (i.e., 4 levels; see *Experimental stimuli* section). One within-participants factor: time (i.e., *Pre*- vs. *Post*-test).

3.1. Stimuli and equipment

Two stimuli depicted natural scenes as relaxing: an Australian seaside (A) and a scuba diver exploration (S). Two stimuli with fast-changing urban scenes were selected as activating: a roller-coaster ride (RC) and a fast interchange between urban and forestry environments (UF). Each 4K video (YouTube archive) lasted 2 minutes, it was displayed using Homido 360° VR Player on an Apple iPhone 6S Plus with earphones. This last was inserted into a Tera VR Box.

3.2. Materials and procedure

Four questionnaires were employed. A *background questionnaire* (6 items) collected general information (i.e., gender, age, education, experience with VR). The *STAI-Y1 (state anxiety)* and *STAI-Y2 (trait anxiety)* assessed the participants' anxiety. Both tools comprised 20 items with a 4-point scale (i.e., 1=not at all/almost never; 4=very much so/almost always). The total score is computed by adding up respondents' scores (range 20-80; scores above 50 and 60 indicate respectively a mild or severe anxiety disorder). Finally, an ad hoc *users' affective state questionnaire* was devised. 6 items assessed how much the respondent felt relaxed, activated, calm, agitated, anxious, and quiet (6-point scale; 1=not at all; 6=very much). Two items investigated on a dichotomous scale, if the video was relaxing or activating.
Participants were approached near the exam location. They signed an informed consent form and filled in the background questionnaire, the STAI-Y2, and STAI-Y1. Next, they

wore the HMD and the experimenter started the 360° video, each participant watch only one video. After it ended, students completed again the STAI-Y1, and the affective state questionnaire. The data collection was run on average 90 minutes before the exam and lasted about 15 minutes.

3.3. Participants

The final sample consisted 50 students (F = 9; *M* age = 23.04, *SD* = 2.54). They were attending engineering (42), physics (4), and psychology (4) at the University of Padova. 73% of participants had to take a written exam, while 27% of them had to take an oral exam. 20 participants had previous experience with VR.

5. Data Analysis and results

The analyses were run with RStudio. Non-parametric tests were run (i.e., not normal data distribution). No differences among groups emerged for trait and state anxiety prior to the exposure to the visual stimuli (Tab. 1).

Table 1. The mean ranks and mean scores for the STAI-Y2 and STAI-Y1 filled in before the exposure to the 360° videos

	Group							
	A		S		RC		UF	
	Mean rank	*M*	*Mean rank*	*M*	*Mean rank*	*M*	*Mean rank*	*M*
STAI-Y2	23	41.17	23.5	41.62	27.8	44.15	27.67	44.16
STAI-Y1	23.92	53.33	22.31	50.77	28.19	55.46	27.63	54.58

The state anxiety decreased in all the groups after the 360° video (Wilcoxon tests). The scores reduced from a moderate to a low level of anxiety (Tab. 2). The effect of the exam type was not significant (W = 299.5, p = 0.31; Oral, M = 28.89; Written, M = 24.18).

Table 2. The mean ranks and mean values for the STAI-Y1 recorded before and after the exposure to the 360° video and the values of the Wilcoxon tests. *p<.05; **p<.01

Group	STAI-Y1 Pre-test		STAI-Y1 Post-test		*V*
	Mean rank	*M*	*Mean rank*	*M*	
A	61.88	52.33	27.58	37.33	78**
S	58.5	50.77	36.38	41.54	64*
RC	70	55.46	39.81	42.54	87.5**
UF	66.54	54.58	43.08	44.33	60*

We analyze the frequency with which respondents labeled each video as relaxing (Fisher test). No difference emerged (p = .051). The videos were rated as relaxing, regardless of their content. Interestingly, the two stimuli (i.e., A and S) that were categorized as *relaxing* were perceived to have a calming effect by the total (12/12) or the majority (10/13) of the participants. The frequency with which participants rated the activating stimuli as activating vs. relaxing was analyzed (Chi-squared test). No differences emerged (χ^2 (1) = 3.05, p > .05). The self-reported affective response to the video were compared across the stimulus type (Kruskal-Wallis tests). A significant difference emerged for the *activated* item (χ^2 (3) = 10.99, p < .05). Pairwise comparisons revealed (BH correction [25]) a difference between A and UF (i.e., A, M = 114.38, and UF, M = 204.92).

6. Discussion and Conclusion

An overall reduction in TA after the exposure to 360° video emerged. This effect showed even with no purposeful manipulation of the content of the experimental stimuli, indicating that the mere exposure to an immersive video can lower TA. Remarkably, a significant drop in students' anxiety emerged following a 2-minute experience, which is shorter than [8]. Consistently with the literature, the videos with natural environments had a relaxing effect [18]. Nevertheless, also the stimuli without the typical features of a relaxing environment reduced anxiety, thus expanding previous knowledge. In contrast with previous findings [10], the type of exam, i.e., written or oral, did not affect the level of anxiety. This study supports the effectiveness of immersive videos displayed on relatively inexpensive and portable devices to reduce non-pathological states of anxiety. It also opens to the possibility of exploiting 360° videos to lighten the anxiety related to the everyday challenging situations. The sample was mainly representative of male engineering students thereby findings may not be generalizable to the entire population (i.e., women and ethnic minority showed a higher anxiety [15]). A second limitation is related to the recruitment of university students in the field and assess their anxiety right before a test. Not to interfere with their performance, the trial was intentionally kept short and we did not thoroughly investigated their background (e.g., geographical provenance, parents' attitudes). Future studies may consider also interviewing participants.

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Adaptive Virtual Environments using Machine Learning and Artificial Intelligence

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Abstract. Advances in off-the-shelf sensor technology have aided the collection of psychophysiological data in real-time. Utilizing these low-cost sensors, researchers can monitor a person's cognitive, behavioral, and affective states (in real-time) as they interact within virtual environments. Moreover, this psychophysiological data can be used to develop adaptive virtual environments. In this paper, we explore electroencephalography-based algorithms to optimize flow models. These algorithms use various combinations of brain wave channels to develop indices of task engagement (Beta / (Alpha + Theta)), arousal (BetaF3 + BetaF4) / (AlphaF3 + AlphaF4), and valence (AlphaF4 / BetaF4) - (AlphaF3 / BetaF3). Results support accurate determination of when a person has left a state of flow. Moreover, the reported results can be further modeled using machine learning (e.g., Support Vector Machine, Naïve Bayes, and K-Nearest Neighbor) to develop training classifiers used in our adaptive virtual environments. We purpose a set of rules for the development of an adaptive virtual environment that can adjust environmental stimuli to keep the user in a state of flow.

Keywords. Adaptive, Virtual Environments, EEG, Simulations, Gaming, Learning, Training, Diagnose, Machine Learning, Artificial Intelligence, Real-Time Feedback

1. Introduction

Advances in affective computing technologies have made it possible for researchers to investigate and manipulate neurocognitive and affective states of users as they interact in virtual environments.[1,2] This allows virtual environments move from predetermined presentations of environmental stimuli to more adaptive virtual environments.[3] This is important for areas using virtual environments for psychological assessment, cognitive training, education, and rehabilitation. Each user progresses through a given virtual environment at different rates and with varying neurocognitive and affective responses. Ideally, the virtual environment should adapt to the user's ongoing neurocognitive and affective states in real time. This would allow the user to remain in a state of flow by keeping them adequately engaged. [4, 5]

Advances in virtual environments and psychophysiological models allow cyberpsychologists to develop adaptive virtual environments in which behavioral, biological, and/or psychophysiological information about can be processed in real time to draw reliable inferences about user's current condition for dynamic alterations to the virtual environment. One particular area that has shown a great deal of advancement is the use of off-the-shelf electroencephalographic (EEG) systems. In addition to offering researchers an inexpensive alternative to laboratory-based systems, these wireless EEG systems offer user metrics for the determination of task engagement and arousal. Progress in sensors and algorithms for off-the-shelf EEG systems has made it possible

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for researchers to perform real-time estimation of human cognitive and affective states using EEG. Various EEG processing algorithms have been applied for classification of emotions (positive and negative) stimulated by pictures [6, 7] and assessment of neurocognitive workload [8]. Using neurogaming-based EEG headsets (e.g. Emotiv), researchers have found significant differences in Gamma and Beta bands relative to a range of stimulus modalities.[9, 10] Moreover, using neurogaming-based EEG headsets, researchers have found increased power estimates when the avatars of users die.[9] These findings suggest that neurogaming-based EEG headsets (e.g. Emotiv) can detect frequency bands variances relative to stimulus modalities. Increased Beta rhythm has been found with attentional processing during video game play [11]. Changes in brain EEG wave bands have been detected as different events occurred during game play of Super Monkey Ball 2.[11]

For adaptive virtual environments, it is important to consider flow and immersion when attempting balance levels engagement and arousal.[4, 5] Too much engagement and/or arousal can frustrate the user. Too little engagement and/or arousal can cause the user to become bored and disengage. A user's EEG data can be used to determine the user's experience throughout entire level designs.[12] A user's EEG data (and other physiological signals) has been used for assessing the user's states by using game levels designed to induce boredom, flow, or anxiety.[5] While much of the research has focused on EEG data across entire levels of play, our flow model combines "Task Engagement" and "Arousal-Valence" data from a pre-established model of upper and lower thresholds indicating when the player has left a state of flow.[9, 10]

2. Method/Tools

The Emotive EEG neurogaming headset was used to collect data from 30 healthy college age participants as they played Super Meat Boy [13]. During gameplay, participants controlled a small, dark red, cube-shaped character named Meat Boy to make it jump around the level and avoid saw blades. The end goal of each level is to rescue bandage girl (see Figure 1).

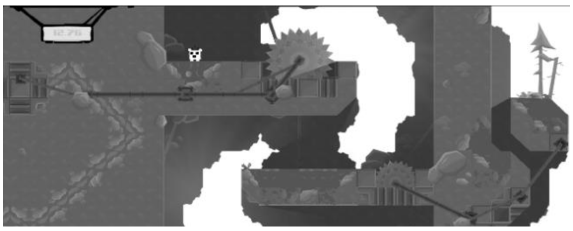
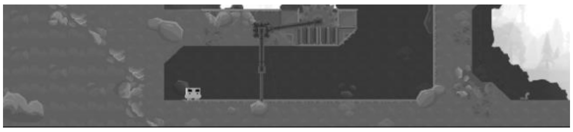


Figure 1. Screen shot of the platform puzzle game Super Meat Boy.



General game play (GGP) was differentiated from specific game events (SGE) in that GGP was sampled during periods that the participant had not experienced any death events (SGEs) for one minute pre- or post-GGP sampling.

The neurogaming EEG setup (i.e., Emotiv EPOC) used 14 electrodes (saline sensors) locating at AF3, AF4, F3, F4, F7, F8, FC5, FC6, P7, P8, T7, T8, O1, O2 and two additional sensors that serve as CMS/DRL reference channels (one for the left and the other for the right hemisphere of the head). These 14 data channels are spatially organized using the International 10–20 system (see Figure 2). The sampling rate was 128Hz. The bandwidth was 0.2-45Hz. The digital notch filters were at 50Hz and 60Hz. OpenViBE and Emotiv TestBench were used to log raw EEG output, which was postporcessed and segmented into epochs (100 ms before stimulus onset, and 750 ms after). Epochs were calculated for GGP and SGE.

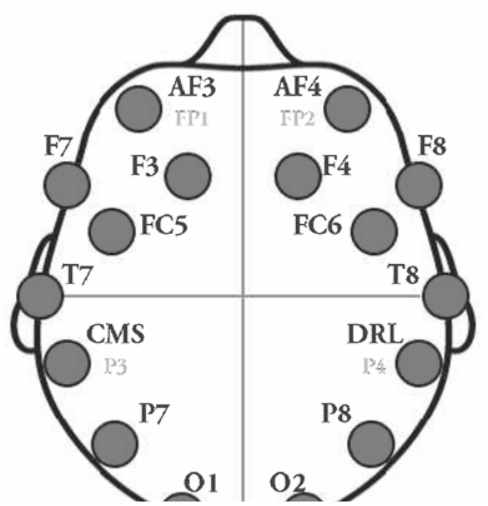


Figure 2. Emotiv Epoc sensor locations relative to the human brain.

Our EEG flow model was based upon the coordination of “Task Engagement” data with “Arousal-Valence” data. We recorded EEG data at a sampling rate of 128 Hz with 14 electrodes using Emotiv EPOC. We compared three indices of engagement found in the literature: 1) Beta/(Alpha + Theta);[14, 15] 2) Frontal Theta/Parietal Alpha;[16] and 3) Frontal Theta.[17] Given that higher levels of engagement during SGEs may reflect increase in autonomic response, we also measured arousal by using (BetaF3 + BetaF4) / (AlphaF3 + AlphaF4) and valence using (AlphaF4 / BetaF4) - (AlphaF3 / BetaF3). Given our desire to establish “Task Engagement” data with “Arousal-Valence” coordinates for a flow model, we divided the data into quartiles. This allowed us to establish upper and lower thresholds of task engagement and arousal for indices of flow. The resulting coordinate was designed for application to expressive transformations to environmental stimuli in real time by tuning different performance parameters in an Engagement-Arousal rule system.

3. Results

A repeated-measures analysis of variance assessment across the indices of engagement, arousal index, and the valence index was used to assess for differences between GGP and SGEs. Using the indices as the within subject factor for GGP and SGEs results revealed a significant main effect ($F(2,28) = 183.22$, $p < 0.001$, partial eta 2 = 0.68). Additional repeated within-subject contrasts revealed difference between GGP and SGEs within each index. Engagement level during SGEs was significantly greater than GGP ($t(1,29) = 2.720$, $p = 0.011$). Arousal was also significantly increased during SGEs in comparison to GGP ($t(1,29) = 3.959$, $p < 0.001$). While no significant differences were found between GGP and SGEs for the valence index, an interesting trend was noted in that valence typically decreased more during SGEs that during GGP. Results revealed that Beta / (Alpha + Theta) was the preferred index for differentiating high intensity game events (participant's character dies) from general game play ($t(1,29) = 2.720$, $p = 0.011$).

4. Discussion

Adaptive virtual environments require detection of changes in the user to properly decide when a change has occurred and how (as well as when) to adapt the virtual environment. Using flow thresholds based on Task Engagement and Arousal-Valence a set of rules were developed to indicate when the participant was in a state of flow: 1) If engagement levels fell below the lower threshold, then the virtual environment needed to become more complex; 2) If engagement level surpassed the upper threshold, then the virtual environment needed to become simpler; 3) If arousal levels fell below the lower threshold, then the virtual environment needed to enhance stimulation; and 4) If arousal levels rose above the upper threshold, then the virtual environment needed to become less arousing. The flow models output along with current engagement, arousal, and valence measurements can be used as input to machine learning algorithms. Upon successful training of the machine learning algorithms in the adaptive environment we can identify what changes has occurred in the user and determine the possible changes to the environment to improve their experience.

5. Conclusion

In summary, we were able to compare various EEG-based exposure indices for interpreting task engagement. These indices can be used to build classification systems for detecting changes in the user's cognitive and affective states. Future work will utilize trained machine learning algorithms for continued development of adaptive virtual environments. These adaptive virtual environments moderate changes in environmental stimuli based on the participant's cognitive and affective states. The adaptive algorithms can make appropriate decisions related to how to best adapt the environment. As an example, if the machine learning algorithm detects that the participant has become bored then the adaptive algorithms can select the appropriate methods to increase the difficulty of the task. Likewise, when the machine learning algorithm detects that the participant has become frustrated, the adaptive algorithms can select the appropriate method to decease the difficulty of the task.

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The Moderating Role of Personality in the Relationship between Temporal Perspectives and Facebook Addiction

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Abstract. In the present paper, we tested the hypothesis that neuroticism moderates the relationship between past-negative or present-fatalistic temporal perspectives and Facebook addiction. A sample of 233 Facebook users (Female: 66%, mean age: 21.4 years) filled self-reports measures of temporal perspective, personality traits, and Facebook Addiction. Results at two moderation models showed that only past-negative significantly predicts Facebook addiction through neuroticism's moderation effect. Individuals with a negative temporal orientation to the past, who are also characterized by a high neuroticism level, were more addicted to Facebook. Peculiar associations between past-negative temporal perspective with neuroticism personality trait in determining Facebook addiction were theoretically discussed. Practical implications of the study are also highlighted.

Keywords. Temporal perspective; personality; Facebook addiction; neuroticism; social media.

1. Introduction

Zimbardo and Boyd [1] defined temporal perspective (TP) as non-conscious processes that help people give order, coherence, and meaning to personal and social experiences. They also distinguished five temporal dimensions referred to present (i.e., Present-Fatalistic and Present-Hedonistic), past (i.e., Past-Negative and Past-Positive), and future (i.e., Future). The direct association between TP and personality traits have been mostly evidenced. Studies based on the Five-Factor Model [2] have evidenced that Past-Negative is positively associated with neuroticism and negatively with extraversion. As well, Past-Positive and Future correlate with agreeableness, conscientiousness, and openness [3] positively. Whereas Present-Hedonistic positively correlated with extraversion. The Future is positively associated with conscientiousness [4]. There is recently increasing evidence that Present-Fatalistic and Past-Negative are the most significant positive predictors for individuals' General Problematic Internet Use, Internet addiction, Facebook intensity use, or addictive Facebook use [5]. Also, Present-Hedonistic is a precursor for Facebook addiction, but results are mixed [6]. As a possible explanation of the relationship between TP and social media addiction, scholars referred to personality traits and specifically to neuroticism [7].

In the current study, we aimed at deeply exploring the reciprocal associations between five dimensions of TP, personality traits, and Facebook addiction (FA), measured by the Facebook Addiction Italian Questionnaire (FAIQ) [8], which is a standardized questionnaire based on a four-factor model offering both a total score of FA and a multidimensional measure of four peculiar dimensions related to users' behaviors. We analyzed the moderating role of neuroticism in the relationship between Past negative or Present Fatalistic and Facebook addiction (total score and subscales scores).

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We expect to find that people more oriented to Past-Negative (Hypothesis 1) or Present Fatalistic (Hypothesis 2) will show higher levels of Facebook addiction (total score and subscales scores) than people less oriented to both dimensions because of neuroticism

2. Method

2.1. Participants

A sample of 248 participants (66% female*;* M_{age}= 21.5*;* SD = 4.4) voluntarily enrolled in the study. Fifteen participants were removed from the data analysis because of missing data in line with methods recommended in the scientific literature [9], leaving the final sample at 233 participants (66% female*;* M_{age}= 21.4*;* SD = 4.2). All the data handling was conducted agreeing with the Ethical Principles for Conducting Research with Human Participant and the Italian Law on Privacy. All participants gave informed written consent.

2.2. Measures and Procedure

Data were collected automatically during the class hours of participants when they filled an electronic version of demographic questions (i.e., gender, age, instruction) and the following three self-report instruments:

- The *Zimbardo Time Perspective Inventor* (ZTPI) [1] is a 56 items questionnaire on a 5-point Likert scale ranging from 1 (very uncharacteristic) to 5 (very characteristic). The score obtained on each subscale is independent of those gathered on the other subscales. A high score on a subscale reveals a temporal orientation of an individual on that temporal frame.

- The *Personality Inventory* (PI) [10] is a 20-item scale questionnaire that measures personality concerning five large dimensions under the FFM [2]. The PI has five subscales, each consisting of four items related to one of the personality factors. Each item is rated on a 5-point scale with anchors 1: Strongly disagree and 5: Strongly agree. The total score was computed by averaging participants' scores in each item of the scale.

- The *Facebook Addiction Italian Questionnaire* (FAIQ) [8] is a 16-item questionnaire on a 5-point Likert scale with anchors 1: Strongly disagree and 5: Strongly agree that offers both a full measure of FA and four subscales scores: Interpersonal Irritability (II; i.e., adverse consequences in daily life), Elapsed Time (ET; i.e., dysfunctional time perception and time management), Social Performance Impairment (SPI; i.e., difficulties into integrating Facebook in life contexts), and Facebook Anxiety (FANX; i.e., feelings of being nervous and anxious when not connected). The total and subscales scores were computed by averaging participants' scores for each item of the scales.

3. Results

First, bivariate correlations between the studied variables were calculated and results showed that all variables correlated in expected directions. Then, a series of moderation models using Hayes's [11] PROCESS macro (Model 1) were conducted to verify our hypotheses. We found that neuroticism showed a moderation effect between Past-Negative and FA and between Past-Negative and II. Past-negative significantly predicts FA, and neuroticism moderates this relationship between Past-Negative and FA, so corroborating H1. Besides, Present-Fatalistic is associated with FA. Individuals with high scores in a fatalistic view of the present are also subjects with high FA levels.

However, neither neuroticism nor the interaction variable proves to contribute significantly to corroborating H2 (see Table 1).

Table 1. The moderating role of neuroticism on the relationship between Past-Negative or Present-Fatalistic and Facebook addiction**.**

	B	SE	t	LLCI	ULCI	
Covariate						
Gender	.28	.05	5.17***	.17	.39	
Age	-.36	.05	-6.44***	-.47	-.25	
Independent variable						
Past-Negative (PN)	.19	.07	2.61**	.05	.33	
Moderator						
Neuroticism (NEU)	.08	.08	.99	-.08	.24	
Interaction						R^2 Change = .001 (F=.09, p=n.s.); R^2=.46
PN*NEU	-.23	.08	-2.69**	-.39	-.06	
Covariate						
Gender	.25	.05	5.26***	.16	.35	
Age	-.29	.05	-5.83***	-.39	-.19	
Independent variable						
Present Fatalistic (PF)	.50	.06	8.40***	.38	.61	
Moderator						
Neuroticism (NEU)	.05	.07	.71	-.09	.19	
Interaction						R^2 Change = .023 (F=7.26, p<.01); R^2=.33
NEUxPF	-.02	.07	-.32	-.16	.12	
Covariate						
Gender	.24	.06	4.34***	.13	.35	
Age	-.31	.06	-5.58***	-.43	-.20	
Independent variable						
Past-Negative	.10	.07	1.44	-.04	.25	
Moderator						
Neuroticism	.08	.08	.89	-.09	.24	
Interaction						R^2 Change = .03 (F=8.69, p<.01); R^2=.25
NEUxPN	-.26	.06	-2.95**	-.43	.08	

Note - N = 233; Dependent Variable: Facebook Addiction total score; LLCI = Lower Limit Confidence Interval; ULCI = Upper Limit Confidence Interval

Simple slope analysis shows that individuals with a high negative temporal orientation to the past, who are also characterized by high or low levels of neuroticism, show similar levels of FA. Conversely, individuals with a low negative temporal orientation to the past show high FA levels only if they have high levels of neuroticism, so corroborating H1. This analysis is also confirmed by the conditional effect of focal predictors shown in Table 2.

Table 2. Conditional effect of neuroticism on the relationship between Past-Negative and Facebook Addiction or Interpersonal Irritability**.**

Neuroticism	Effect	SE	t	LLCI	ULCI
			Facebook Addiction		
Low level	.47	.10	4.66***	.27	.66
Middle level	.31	.07	4.55***	.17	.44
High level	.07	.10	.49	-.12	.26
			Interpersonal Irritability		
Low level	.41	.10	4.09***	.22	.62
Middle level	.24	.07	3.48**	.10	.37
High level	-.03	.10	-.29	-.22	.16

When we performed analyses on FAIQ subscale scores, data show a significant negative relation between interaction term and II. Simple slope analyses evidence that individuals with a high negative temporal orientation to the past, who are also characterized by high or low neuroticism levels, show similar levels of II. On the contrary, individuals with a low past-negative temporal orientation show high II levels only if they have high levels of neuroticism, as confirmed by the conditional effect of focal predictors shown in Table 2.

4. Discussion

Neuroticism is the only compound personality variable that predisposes people to experience more stressful events [12-13]. Thus, it might moderate Facebook addiction levels on individuals who are negatively oriented to the past. Considering that neurotic people also have high levels of self-monitoring [14] and interpersonal surveillance [15], we might explain results as an effect of the neurotic tendency to supervise and control what is happening into the lifetime. Moreover, when we analyze FAIQ subscales scores, we found that only Interpersonal Irritability is deeply affected. Such a behavioral dimension is concerned with Facebook's influence on the quality of users' social relationships [8]. Individuals who adopt a fatalistic view of the present are low impulsive and tend more to depression [16]. In contrast, Facebook addiction is excessive and compulsive behavioral addiction [17].

Thus, neuroticism is an impulsivity trait that might be less effective in moderating the relation between a more passive orientation toward current life events and a behavioral addiction that requests an active and robust impulse control. It must be noted that results about the conditional effect of focal predictors allow us to affirm that low neuroticism levels prevent the risk of developing FA, both considering total or Interpersonal irritability scores. Still, we cannot state the specular result that high neuroticism levels lead people to become more addicted to Facebook. As practical implications, our findings could be useful for psychologists or psychiatrists in the stages of both assessments and clinical intervention on social media addiction. Because of neuroticism's moderating role, clinical or prevention programs might also be aimed at enhancing impulse control, emotion regulation, and stress management.

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Coding with me: exploring the effect of coding intervention on preschoolers' cognitive skills

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Abstract. In the last ten years, the topic of Computational Thinking (CT) has been gaining increasing attention from researchers in the education field. Starting from kindergarten, increasingly programming activities such as coding and educational robotics are proposed to enhance CT and some cognitive skills, such as problem-solving, spatial and reasoning skills. The most commonly used tools are the so-called tangible interfaces, such as floor-robots (e.g. Cubetto, Bee and Blue-Bot and others), through which children can interact with the object and learn playfully. Investigating the effects of CT activities on children's cognitive abilities is important to understand the impact in kindergarten and to comprehend in which developmental periods these activities might be most successful. The aim of the present study is that of evaluating the effect of a coding intervention, based on CT, through the use of the Cubetto robot, on the cognitive skills of 4-years-old children. The coding intervention included three sessions and required the manipulation of physical objects to plan and conduct a Cubetto journey. Results showed that children of the experimental group performed better than those of the control group in programming the Cubetto path after the intervention.

Keywords. Coding, Computational Thinking, educational robotic, cognitive skills

1. Introduction

In the last ten years, the topic of Computational Thinking (CT), such as a thought process that uses analytic and algorithmic approaches to formulate, analyze and solve problems [1; 2; 3], has been gaining increasing attention from researchers in the education field. In particular, several studies implementing coding and educational robotics activities in kindergarten found significant influence between CT and some cognitive skills, such as problem-solving, spatial and reasoning skills and short-term memory [4; 5, 6; 7; 8; 9; 10].

Thus, starting from kindergarten programming activities such as coding and educational robotics can allow children to become code-literate, that is to be able to read, write and think through the computer language and to be able to think in a computational way [11]. The most commonly used tools to sustain CT are the so-called tangible interfaces, such as floor robots (e.g. Cubetto, Bee and Blue-Bot and others), through which children can manipulate the object with which they are interacting and understand the activity they are performing step by step [9; 12]. Specifically, children are required to program

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the correct sequence of actions to achieve a specific goal, thus enhancing sequential skills that are recognized as very important for cognitive development since the early stages of kindergarten [8].

Moreover, in addition to the most current reflection on the use of digital media in education, literature has highlighted how the use of story-telling tasks promotes the development of narrative thinking and other relevant skills such as Theory of Mind and perspective-taking skills [13]. Story-telling tasks, based on a sequential logic similar to the programming language, can be used to support and integrate robotic programming learning in education.

Generally, in the field of computer technology, educational robotics activities are structured according to a playful approach and appropriate to the child's developmental phase [14; 15], thus sustaining independent learning and discovery [16]. Coding activities and educational robotics can be seen as real constructivist programming environments, in which children are encouraged to reflect on their thinking processes through activities in which abstract ideas are concretely and precisely conceived [17; 18; 8].

Moreover, in addition to stimulating the cognitive abilities of the single child, such as problem-solving, spatial skills, reasoning skills and short-term memory, the use of robotics in kindergarten promotes different types of learning, such as new ways of social interaction with peers and opportunities for social and cognitive development [15]. Furthermore, the use of educational robots can stimulate the potential development level that the child can reach through social support from more expert peers, teachers and educators, that play the role of real scaffolders [15].

Exploring the effects of CT activities on children's cognitive skills is important to evaluate the impact of their introduction at infancy school. This paper aims to contribute to this reflection, by exploring how instructional activities that teach the initial elements of CT by guided exposure to coding can boost the development of cognitive skills of 4-years-old children. The coding intervention included three sessions and required the manipulation of physical objects with symbolic meaning to plan and conduct a robot journey, thus stimulating the children visual spatial and story-telling ability.

2. Methods

2.1 Participants

The experimental study involved a sample of 40 children aged 4, attending three different kindergartens in the province of Milan, The children's parents received a detailed description of the study and expressed their written consent for their child participation to the research. All tasks selected were deemed appropriate for age of subjects participating in this experimental study and approved by the Ethics Committee of the Department of Psychology of Università Cattolica del Sacro Cuore of Milan.

2.2 Apparatus and Material

The children were divided into two groups: 1) an experimental group (N=20, 11 females) that followed the coding intervention and whose children were evaluated individually before and after the intervention; 2) a waiting list group (N=20, 10 females) whose children were evaluated at the same time but followed the intervention after the experimental group. The coding intervention lasted four weeks and consisted of three 60-minute laboratory sessions scheduled during the regular kindergarten day. It involved the use of Cubetto, an innovative tangible coding technology that facilitates young children's engagement with basics of coding, founded on the principle of visual programming (i.e. the child can design a route directly with his/her own hands without the use of a computer, yet it incorporates traditional play elements such as patterns, colour recognition and shape sorting). Specifically, children were assisted in defining Cubetto's orientation and the direction needed to reach a specific target throughout subsequent path episodes.

The assessment phase lasted about 20-25 minutes per child both pre (T0) and post (T1) intervention. Each child was invited to actively participate to the assessment sessions and was instructed to carefully listen to the instructions, ask questions when in doubt and perform the test according to his/her own skills. Specifically, the assessment included: an adapted version of Understanding of pictures stories test [19], used to assess the child's ability to reorder images with a predetermined sequence; the Children's Mental Transformation Task [20] used to evaluate the children visual-spatial abilities according to their cognitive development; an ad hoc task that involved the use of Cubetto, to observe what specific methods of achieving a target were used by the child during the task. Children involved in the test were asked to program Cubetto's path over the map using a keyboard in which they could insert coloured cards, where the different colours (green to go forward, red to turn right and yellow to turn left) represented the useful commands to move Cubetto on the map. Drawings were shown on the map that could be used to create educational stories or, as in this case, to construct coding paths to move Cubetto. The task involved the programming, by the children, three Cubetto paths for achieving a precise target on the Cubetto's map, previously indicated by the researcher through the description of a story divided into three parts. Following the preliminary instructions to perform the task, Cubetto was placed on a precise starting point on the map, equal for all, and the following three paths were narrated one by one to enable the child to focus on a single path. Each path started from the previously achieved end point . The final score of the Cubetto task ranged from 0 to 3: 1 point was allocated when the child was able to reach the target of the path. The total score is given by the sum of the three paths' points.

2.3 Results

To test the effect of coding intervention on children understanding of stories and visual-spatial abilities, we ran a 2 (groups) x 2 (pre- vs. post) repeated-measures ANOVA. The primary purpose of two-way repeated measures ANOVA is to understand whether there is an interaction between these two factors on the dependent variable. In this case, results did not show significant interaction effects both related to children ability to reorder images with a predetermined sequence [$F(1, 41) = 1.246$, $p = .27$] and to children visual-spatial ability [$F(1, 41) = .008$, $p = .93$]. Thus, after the coding intervention children did not significantly improve these abilities.

Furthermore, to test the effect of coding intervention on children abilities to program Cubetto to achieve a target on the map, we ran a 2x2 repeated-measures ANOVA with Cubetto task score as dependent variable. In this case, we found both a significant time effect [$F(1, 41) = 30.022$, $p = .001$] in both groups and a significant time x group interaction effect [$F(1, 41) = 9.825$, $p = .003$]. This means that both the experimental and control groups increase their abilities in programming Cubetto to achieve the goal, but children of experimental group performed better than those of control group.

3. Discussion

In this study we analyzed the effects of a coding intervention, through the use of the floor robot Cubetto, on some cognitive skills, such as the sequential ability to reconstruct stories and visual-spatial abilities, in children of 4-years-old. No differences existed between the two groups at T0. The statistical analysis showed both a significant main effect of time (pre vs post) and interaction effect (time x group) on the sequential programming abilities measured by the ad hoc Cubetto task. Thus, the experimental group performed better than the control group in programming the Cubetto path after the intervention. Nevertheless, no significant interaction effects were found related to the children understanding of pictures stories and visuo-spatial skills.

A plausible explanation of the result obtained with the Cubetto task could be linked to the learning effect of a specific task. Various cognitive competences related to that specific type of learning are probably involved but we did not find a generalization effect. Unfortunately, the research focusing on the age considered by this study (4 years-old) is still too limited to draw conclusions on the beneficial effects of coding for these younger learners, whose cognitive skills are still largely immature. Furthermore, other studies

[21] involving 5-6 years children proposed a longer intervention (8 sessions over four weeks) and found significant improvements in two executive functions: planning and response inhibition. Thus, future studies are encouraged in testing the effects of a coding intervention whose duration and articulation is greater in sustaining the interconnections between specific programming skills and children cognitive abilities.

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Assessment of cognitive and functional performance using a Virtual Environment Grocery Store with environmental distractors

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Abstract. Distractions found in everyday life can disrupt activities of daily living in older adults. The conflicting evidence related to aging participants' reports of everyday memory functioning and results from traditional paper-and-pencil memory assessments may reflect the limited ecological validity of traditional assessments. The Virtual Environment Grocery Store (VEGS) offers a virtual environment for neuropsychological assessment of episodic memory with real world distractors. This study compares the impact of distractors on VEGS memory performance between 19 older adults and 25 young adults. Results revealed that the older aged group performed significantly worse than the younger aged group on all measures of episodic memory. Moreover, the older aged group performed significantly worse than the younger aged group on prospective memory and all measures of everyday shopping activities. The findings suggest that the VEGS offers a virtual reality-based neuropsychological assessment that can be useful for differentiating between age groups.

Keywords. Aging, episodic memory, neuropsychological tests, virtual reality

1. Introduction

Distractions found in everyday life can disrupt activities of daily living in older adults [1, 2]. It is important that neuropsychologists understand the increased impact of distractors on older aged cohorts so that they can make predictions about their patients' abilities to perform everyday activities. Assessments are needed that can measure the impact of everyday distractors on recall of information (e.g., episodic memory) and planned activities (e.g., prospective memory) in aging cohorts. Everyday activities often involve the concurrent performance of distinguishable tasks. Episodic and prospective memory capacities are significant features of everyday memory that impact everyday activities. Episodic memory includes storing and recall of particular events or experiences associated with explicit times and places. Prospective memory includes memory for intentions like remembering to go to a coupon machine at a certain time (time-based prospective memory) or remember to listen for one's prescription (event-based prospective memory) while shopping for items learned earlier (episodic memory). Consequently, episodic and prospective memory make up central components involved in the execution of daily activities.

Most episodic memory measures include free recall, cued recall, and recognition

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tasks. While traditional neuropsychological assessments of memory like the California Verbal Learning Test (CVLT) are considered "gold standard" measures, evidence suggests that performance on these measures may not represent everyday memory complaints [3]. Moreover, correlations between participants' subjective memory reports and objective results on paper-and-pencil memory measures suggest limited ecological validity [4]. This may be due to the fact that while subject reports reflect everyday activities that can be filled with various distractions, objective tests (e.g., CVLT) are elivered in sterile laboratory environments with little to no distractions.

The Virtual Environment Grocery Store (VEGS) has been developed to offer a virtual reality-based neuropsychological assessment that taps into several neurocognitive, affective, and social domains. The VEGS Memory Module includes several neuropsychological tests for assessing episodic and prospective memory. While immersed in the VEGS, participants navigate throughout the virtual shopping environment and perform various tasks. Participants navigate to the pharmacy, drop off a prescription with a virtual pharmacist, receives a number, and must remember to listen for that number (ignoring distractions like other numbers; announcements over the public-address system; and virtual humans), while remembering to shop for items that were learned earlier. Participants also must remember to go to the coupon machine after two minutes (time-based prospective memory). In addition to these focused memory tasks, the participants are also scored on additional tasks, including: <u>Navigation</u>: Navigate through VEGS via specified routes through the aisles; <u>List Items</u>: Find and select items from the shopping list; <u>Intrusions</u>: Items that were not on the shopping list are to be ignored; <u>Budget Score</u>: Select items in a manner that maintains a predetermined budget. When the participant hears their number over the public-address system, they are to return to the pharmacist to pick up their prescription (event-based prospective memory). At the completion of the VEGS, the participant performs delayed free (VEGS LDFR) and cued recall (VEGS LDCR) of the VEGS shopping items.

Parsons and McMahan [5] explored the construct validity of the VEGS via comparison of traditional neuropsychological measures of memory and executive functioning with both low distraction and high distractions conditions of the VEGS. Performances on the VEGS memory tasks in the low distraction condition and the traditional neuropsychological assessments of memory were positively correlated, indicating that memory for VEGS content was similar to memory for traditional paper-and-pencil measures. Comparison of performances on the VEGS memory tasks in a high distraction condition also revealed significant correlations with the traditional neuropsychological assessments of memory, indicating that memory for VEGS content was similar to memory for traditional paper-and-pencil measures. The addition of distractors resulted in significant correlations with traditional measures of inhibitory control. In another validation study of the VEGS, Parsons and Barnett [6] found performances on the VEGS memory tasks and the traditional neuropsychological assessments of memory were positively correlated, indicating that memory for VEGS content was similar to memory for traditional paper-and-pencil measures. In the low distractor condition, older adults performed significantly worse than young adults on the VEGS and the CVLT. The executive functioning measure (Stroop task) failed to differentiate the groups. In the current study, we were interested in seeing if the addition of distractors into the VEGS would significantly differentiate between younger and older-aged cohorts on VEGS-based measures of episodic memory; prospective memory; and everyday shopping activities.

2. Methods

To compare the performance of younger and older age cohorts on an episodic memory task with real world distractors, a newly developed virtual reality measure of memory, the VEGS, was administered to 19 older adults and 25 young adults.

2.1. Participants

The University's Institutional Review Board approved the study. Participants included 19 community dwelling older adults (Mean Age = 77.05; Standard Deviation = 7.12;

Mean Education 15.89 years; Standard Deviation = 1.49; Mean Full Scale IQ = 107.58; Standard Deviation = 7.19) and 25 young adults (Mean Age = 21.08; Standard Deviation = 4.81; Mean Education 14.92 years; Standard Deviation = 2.76; Mean Full Scale IQ = 103.52; Standard Deviation = 8.82). Older adults were recruited via flyers at independent living retirement communities in the southwestern United States. Young adults were recruited through a research website and received course credit. No significant differences were found for gender, IQ, or education. Following informed consent, basic demographic information was recorded. A medical health history logged any mental or physical disorders that may have hindered their performance. No participants were excluded for responses given on this form.

2.2. Design and measures

The VEGS was run on the Windows 10 operating system of a high technology computer (HTC) with an Intel Core i7 (16GB RAM) and an NVIDIA GeForce GTX 1060. The HTC Vive head-mounted display was used. The HTC Vive uses an organic light-emitting diode (OLED) display with a resolution of 2160 × 1200 and a refresh rate of 90 Hz. The participant's head position was tracked with embedded inertial measurement units while the external Lighthouse tracking system cleared the common tracking drift with a 60 Hz update rate. The VEGS includes a number of cognitive memory (episodic and prospective memory) tasks. Before the participant was immersed in the VEGS, they took part in a learning task (encoding phase) and a familiarization task. Immediate recall performance was recorded verbatim by a microphone and was logged for each of the immediate recall trials (Trials 1–3). Following the encoding and familiarization phases, the participant was informed that they were going to need to drop off a prescription once the VEGS protocol starts. They were also told that they needed to remember to go to the coupon machine after two minutes of shopping (VEGS Time-Based Prospective Memory). Furthermore, they were instructed that after they dropped off their prescription, they were to shop for items from the list that they learned earlier. After 10 min, the virtual pharmacist announced the participant's prescription number. At that time, the participant needed to return to the virtual pharmacist and clicked on her to end the simulation (VEGS Event-based Prospective Memory score). At the completion of the VEGS, the participant was asked to perform free (VEGS Long Delay Free Recall) and cued delayed recall (Long Delay Cued Recall).

The movement of the VEGS from a low distraction condition with ambient noise and no customers in the virtual environment to a high distraction condition involved populating the virtual store with an additional 20 virtual human avatars that walked around in the environment (see Figure 1). Some virtual human avatars walked throughout the store, while others stood in lines at the checkout counter and at the pharmacy. Other avatars spoke to each other in small groups of two and still others spoke on virtual phones as they ignored the participant. The environment also included a crying baby avatar. In addition to the avatar distractions, there were increased audio distractors: announcements given over the public-access system; human laughter; coughing; dropped merchandise; baby crying; and various ring tones on cellphones.

Figure 1: Low (left) and high (right) distraction conditions of the Virtual Environment Grocery Store.

2.3 Data Analytics

All data were analyzed using SAS version 9.1. Descriptive statistics were calculated for participant demographics and for results of the VEGS-based neuropsychological tests. Missing data were imputed by either mean substitution or last case carried forward. Analyses of variance were completed to assess group differences.

2.4 Results

For all VEGS-based tasks the older aged cohort performed worse than the younger aged cohort. Results were consistent with findings from Parsons and Barnett [6] that the VEGS is able to differentiate between younger and older cohort performances on memory and shopping tasks. The large differences between the two different age cohorts on memory measures with a high level of distractors supports the generalization of findings from Parsons and McMahan's [5] study with younger aged participants. Analysis of variance between younger and older-aged cohorts on VEGS measures of episodic memory (e.g., recall of shopping list items) revealed that the older aged group performed significantly worse than the younger aged group on all measures of episodic memory: VEGS Short Delay Free Recall ($F = 25.28$; $p < .001$); Long Delay Free Recall ($F = 17.46$; $p < .001$); Long Delay Cued Recall ($F = 9.76$; $p = 003$). Analyses of variance between younger and older-aged cohorts on VEGS measures of prospective memory (e.g., remembering to go to the coupon machine at a certain time and to listen for prescription number) revealed that the older aged group performed significantly worse than the younger aged group on prospective memory (time-based: $F = 9.34$; $p = 004$; and event-based: $F = 37.81$; $p < 001$). Analyses of variance between younger and older-aged cohorts on VEGS measures of everyday activities (e.g., shopping, maintaining a budget) revealed that the older aged group performed significantly worse than the younger aged group on all measures of everyday shopping activities: number of times looked shop list ($F = 20.41$; $p < .001$) and Shopping List Items Picked Up ($F = 4.10$; $p < .05$).

3. Discussion

In summary, participants were able to tolerate the virtual environment and participants endorsed comfort with the environment. There were no reports of nausea/discomfort. Moreover, additional distractors in the VEGS condition resulted in the older aged group performing significantly worse than the younger group on all measures of episodic memory, prospective memory, and everyday shopping activities. These findings replicate the VEGS-based performance differences (relative to high versus low distractions) for younger adults to the older adults found in this study. [5] These results extend findings from an older aged study using only the low distraction condition [6] to reveal even greater differences for older adults placed in a high distraction condition of the VEGS. The VEGS has the advantage over traditional measures of providing objective measurement of individual components of memory in simulations of everyday activities that include everyday distractors. While traditional paper-and-pencil assessments are performed in sterile laboratory environments, the VEGS assesses episodic memory and in the presence of real-world distractors. Moreover, the findings suggest that there are significant differences between groups on all measures. This suggests that the VEGS is sensitive to age related differences in memory performance. The results support the potential of virtual environments for enhanced assessment of everyday activities [7, 8].

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SECTION V

CLINICAL OBSERVATIONS

Cybertherapy is a field that is growing rap-idly due to today's technology and information boom.

Virtual reality and advanced technologies have been used successfully to in a variety of healthcare issues, including treatment of anxiety disorders and phobias, treatment of eating and body dysmorphic disorders, neuropsychological assessment and rehabilitation and distraction during painful or unpleasant medical procedures.

The novel applications of these technologies yield many advantages over traditional treatment modalities, and the disadvantages that accompanied the first trials of virtual reality are quickly being addressed and eliminated.

Virtual reality peripherals such as data gloves, physiological monitoring and Internet worlds are swiftly demonstrating their usefulness in cybertherapy applications.

Wiederhold & Wiederhold, 2004

An Immersive Virtual Reality Application for the Rehabilitation of Children with Dyslexia

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Abstract. The standard tools for the rehabilitation of reading skills in children with developmental dyslexia do not usually include body movements. However, literature suggests that movement could represent an aid for those children who have difficulties in facing demanding and uninspiring treatments. Given this, this study presents a novel immersive Virtual Reality (VR)-based treatment that includes a sublexical rehabilitation method for dyslexia. In the training environment, the child is asked to walk around and perform arm movements to select the accurate response to reading-based exercises. It is expected that the use of such application could increase children's engagement and sustained attention, thus leading to improved rehabilitation outcomes.

Keywords. dyslexia, immersive virtual reality, rehabilitation, reading

1. Introduction

Developmental dyslexia (DD) is a specific learning disability affecting children's reading skills and compromising their school achievements. Research showed that it is possible to mitigate the disorder through treatments based on sublexical approach that aimed to automatize the recognition of linguistically relevant cluster of graphemes (e.g., syllables) with increasing difficulty [1]. Improving reading speed means facilitating the rapid recognition of the syllables and groups of letters that make up the sublexical components. Treatments that improve the automatic process of sub-lexical and lexical recognition, e.g., the Sublexical Treatment by Cornoldi and Cazzaniga [2], are the most effective in children with DD. However, they are mainly paper-and-pencil or computerized, namely, they require no, or only simple, body movements (clicking, pressing).

In the embodied cognition perspective, it is emphasized that mental operations and skills are structurally shaped by physical actions [3]. Neuropsychological evidence showed that the cortical mechanisms of language and action are strongly interconnected, and that the language cognitive process is connected to the neighboring space. Consequently, the cognitive ability of language is grounded in our sensorimotor systems, and the representation of words is tied to the bodily experiences that we collect when acquiring them [4]. Infants, during the language acquisition phase, grasp and manipulate objects, and, when they have have a good development of language, they associate sequences of phonemes articulated by the caregivers to such objects. Therefore, each object will have a different sensorimotor

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representation, e.g., a carrot will be represented differently from a tomato, although semantically they are both categorized as vegetables. Also, neuroimaging experiments showed that the motor system is involved in the language process [5].

Innovative theories describe grasping as a precursor of speech. Grasp and manipulate objects could be interpreted as a sort of protolanguage. In infants, this protolanguage is first combined gestural and vocalized communication. Later on, the shift from gestures to vocalizations is believed to emerge with the need of communicating more complex and abstract information [6]. According to these theories, language improvements can be maximized by eliciting appropriate motor responses during the training [6]. Also, being engaged with the whole body during the rehabilitation treatment could constitute an added value for children who find traditional therapy too demanding and/or uninspiring.

An innovative method that can be used to involve the motor component during the training of language skills is Immersive Virtual Reality (IVR), i.e., a technology able to simulate an environment that resembles the real world. A person immersed in such an environment could obtain a specific sense of self-localization within it, can move his/her head and eyes to explore it, can feel that space around, and can interact with virtual objects. What distinguishes IVR from other technologies is the sense of immediacy and control, and the sense of presence that derive from the possibility of experiencing the environment at 360 degrees, by moving the head and the hands. In IVR, objects appear solid and have an egocentric position very similar to objects in the real world. They can be collected, examined from all sides, listened to, touched, raised, and explored in many sensory ways. Virtual objects can also be autonomous and interact in response to a human stimulus [7].

IVR can be explored by means of a "head-mounted display" (HMD), a device allowing to see the virtual world at 360 degrees, simply by moving head and body. Research showed that the use of VR in the context of learning increases the levels of motivation and commitment. This can be attributed to the opportunity for challenge, interactivity, realism, imagination, cooperation, and sense of immersion that VR offers [7]. The effectiveness of IVR could be linked to the same basic mechanism shared by the brain and VR: the "embodied simulations". According to neuroscience, to regulate and control the body in the world effectively, the brain creates a simulation of the body in the world in which it represents and foresees actions, concepts, and emotions. VR works in the same way: it predicts the sensory consequences of the subject's movements, as he/she would be in the real world. Therefore, we can define VR an embodied technology.

This suggests that a new clinical approach, which provides the possibility of altering the experience of the body and facilitating cognitive modeling, may be achieved by virtual environments able to simulate the world and to elicit realistic motor actions.

2. Methods

This study proposes *Alfabeticando*, an IVR application based on the sublexical treatment [3] aimed to improve reading skills in children with DD. It is assumed that, by increasing children’s level of involvement and interest and giving them the chance to use the whole body while wearing a head-mounted display, the rehabilitation outcomes would be maximized thanks to the activation of motor-language shared mechanisms. The goal of our study is to verify whether, assuming the existence of the connection between the mechanisms of language and action, an IVR-based rehabilitation protocol for the enhancement of reading skills in children with DD is more effective than a non-immersive protocol that does not include motor training.

2.1. Participants

Alfabeticando will be tested on a sample of DD children, aged 8-9 years. To measure the specific contribution of IVR, children will be randomized into two groups: The first group will receive *Alfabeticando* training using IVR; the second group will receive the same training using a tablet.

2.2. Instruments

Alfabeticando runs on a HTC VIVE Pro, and has been developed using Unity. It exploits SteamVR Unity Plugin to handle the input from the controllers, and estimate what the player's hand looks like while using them. HTC VIVE Pro has high-resolution displays, 1440x1600 resolution per eye, a refresh rate of 90Hz, and field of view of 110 degrees. It has a new design with a more "balanced" form, lighter weight, and a sizing dial. Moreover, it can be equipped with the VIVE Wireless Adapter, letting the user free to move around wirelessly. The HMD requires a minimum play area of 2 m x 1.5 m (6 ft 6 in x 5 ft) to play. To avoid the collision between the player and the real environment while performing an IVR training session, SteamVR plugin provides a set of facilities: The play area, generated during the calibration of the HMD, is shown inside the Virtual Environment (VE): light blue lines drawn on the floor appear as the player is too close to the limit of the playing area.

Alfabeticando contains three exercises: (1) find the non-words, (2) find the syllable and (3) spelling. Each game trains a different skill, but some features are the same: The floor and the background of the scene which is displayed to the trainee are white to minimize distraction. All texts are written using "Biancoenero", i.e., a special font designed for people with reading difficulties [8]. A positive or negative sound and graphic feedback are given for each user interaction. Moreover, increasing difficulty levels (five for each exercise) have been implemented.

Before starting the game, the trainer sets the exercise type and level, and completes the player's personal information. Such information is also used to save the training session performance, allowing researchers to analyze and compare the data on the child's performance. In (1), the child sees words and non-words scattered on 360° white walls. The goal is to fill the coffer with non-words. The non-words are strings of letters similar to existing words but a letter or a syllable is moved into a different position. There are five different levels of difficulty related either to the cognitive (i.e., number of words and non-words) or to the motor task (i.e., just touching the target (non-)word or dragging it inside the coffer). The increasing difficulty is provided by mixing a set of pre-defined words stored in the application and increasing the number of words shown. The words are divided in: frequently used, not frequently used, and non-words. In the first two levels, the stimuli are taken randomly from the frequently used and non-words lists stored in the application and are displayed on a wall in front of the player. To place the words inside the right coffer no motor task (beside touching them) is required. In the latter three levels, the stimuli are displayed around the users. The mix of stimuli includes also not frequently used words. The player is required to drag the words in the coffer using the controllers.

Figure 1. Screenshots of the 3 games.

In (2), the child sees syllabic groups of different lengths on a wall in front of him/her. The goal is to read the syllables highlighted in green. The number and type of syllables and the placement of the syllables (i.e., on one wall or onto two walls) change according to the difficulty level. The player has five seconds to find and read the syllabic group and a button has to be pushed to begin the exercise. In this case, the evaluation of the responses is done by the rehabilitators because the target users usually have a phonetic deficit which makes the use of the speech recognition system useless.

In (3) the child sees words of increasing length all around him/her. He/she has to choose and touch the words containing the target syllabic group, which is indicated in front of him and highlighted by a green color. In (2) and (3) in the first two levels monosyllabic group of letters are shown. In the following levels, the difficulty is related to the number of syllables and the frequency with which words are usually used. All the users and session data, and the management of the levels of difficulty are saved automatically.

2.3. Procedure

To test the feasibility of the application of *Alfabeticando* and its effects on reading in children with DD, a study with a test-training-retest experimental design will be carried out. The IVR group will receive *Alfabeticando* training using the HMD; the second group will receive the 2D version of the training on a tablet. *Alfabeticando* will be administered to both groups in two sessions a week for three weeks. Each session will comprise two training periods (15 minutes each), with a 10-minute break, for a total of 30 minutes of training. The training sessions will be supervised by psychologists who are experts in the use of immersive VR and *Alfabeticando*.

2.4. Measures

Reading abilities will be assessed before (t0) and after (t1) the intervention using Italian standardized tests. More precisely, different reading subprocesses (i.e., word, non-word) and reading parameters (i.e., reading speed and accuracy) will be considered, so to test the specific effect of *Alfabeticando* on the sub-components of reading abilities. The battery of test will be administered by experts in neuropsychological assessments, who will be blind to the participants' condition.

3. Expected results

We have not collected data so far, as we are waiting for access to the facilities. It is expected that IVR, by providing higher levels of involvement, will determine better outcomes, as measured by the standardized word and non-word reading tests, concerning the 2D tablet version of the training, which does not involve motor action.

4. Conclusions

We suggest that intensive language training integrated with motor actions can be an effective approach for improving reading in children with DD. Besides, intervention studies using this approach can open new perspectives for research into the plasticity of developmental language circuits.

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Assessing User Experience of a virtual reality training in patients with anorexia nervosa: insigths from a pilot study

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Abstract. VR effectiveness has been tested before in Anorexia Nervosa (AN) with full-body illusion. The embodiment of patients with AN into a different virtual body to modify their long-term memory of the body is a crucial factor for the onset and maintenance of this disorder. In this pilot study, we aimed to test the usability and User Experience (UX) of this VR-based protocol. Five Italian women with AN were embodied in a virtual body resembling their perceived body size from an ego- and an allocentric perspective while remembering episodes of their life related to their body. High levels of embodiment were reported while embodied in a virtual body resembling their real perceived body size for ownership ($p<0.0001$), agency ($p<0.01$), and self-location ($p<0.01$). Results from UX in terms of embodiment and personal opinion collected by the think aloud and patient's interviews show that patients with AN can benefit from using VR as a driver for assessing and modulating body image distortions in patients with eating disorders.

Keywords. Virtual reality, anorexia nervosa, user experience

1. Introduction

Virtual reality (VR) have been widely used for modulating the internal body perception in clinical populations [1,2] , and particularly in patients with eating disorders (ED) [3,

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In this regard, a recent study showed that VR can act as a driver for assessing and modulating body image distortion in patients with AN through a full virtual body swapping illusion [5]. Regarding VR experiences, a large number of studies on VR environments have focused on the ability that this kind of environments have to influence peoples' perception [6]. Indeed, elements like these make up the criteria for effectiveness of the system that is if the users can reach their aim with an adequate level of accuracy and completeness within the system[1]. More recently, another criterion of appropriateness when using virtual reality systems emerged: User Experience (UX) [7]. UX is considered to be a multi-dimensional construct [8] that includes "a person's perceptions and responses that result from the use or anticipated use of a product, system or service". In fact, UX occurs as a consequence of the interaction between a user and a product within a physical, social and cultural context, determining the users' experience of a system [9] before, during, and after the interaction, as indicated by the International Standard Organisation[1.] The present pilot study aims to test the user experience of a body-swapping VR-based system in terms of embodiment and user experience scores, and personal opinion regarding the VR experience in patients with AN.

2. Materials and methods

2.1. Participants

Five young women diagnosed with AN participated in this study (age = 17±1,87; BMI= 15,95±0,61). Inclusion criteria envisaged to meet the diagnostic criteria for AN based-on DSM 5, a BMI not under 15 and a normal or correct-to normal visual and hearing. Exclusion criteria included current or prior history of a neurological illness, brain damage or head injuries and psychiatric comorbidity. All participants were informed about the purpose of the research and provided written informed consent. The study was approved by the local ethical committee of the Istituto Auxologico Italiano.

2.2. Measures

In order to evaluate the usability and user experience of this VR-based system, during the VR experimental session the following techniques and tests were used: The think-aloud protocol [10], which consist in semi-directed and undisturbed users' verbalization while using and interacting with the VR set-up, providing useful information for interpreting and determining verbal data to identify system deficiencies; Embodiment assessment [11], during the experimental session after the exposure of each virtual body condition the level of embodiment, (sense of body ownership, self-location, and agency toward the virtual body) was assessed by using three different questions in which patients had to indicate how much they agreed or disagreed with each statement in a 7-point Likert scale, from -3= totally disagree to +3=totally agree. User experience was assessed with the User Experience Questionnaire (UEQ-S) seven-point Liker type from -3 (horribly bad) to +3 (extremely good) for each of the 26 items of the questionnaire [12]. User experience after the VR exposure was assessed in session 1 and session 4. A 4-week follow-up qualitative interview was conducted to verify the final user experience evaluation and the overall experience of the proposed protocol.

2.3 Procedures

In order to participate in the study, each participant carries the informed consent form signed by the parents. The VR-based intervention consisted in four sessions in which participants were embodied in an avatar from an egocentric view (first person perspective) and from an allocentric view (third person perspective). The VR procedure included an HDM, oculus rift connected to a laptop computer and a Kinect Sensor to track motion. Through the motion tracker device, the virtual body was visuomotor synchronized with participants' real body and reproduced the real movements of the participants simultaneously. Once the patients observed the virtual body through the HMD, the experimenter asked them to start the think-aloud phase while slowly moving their arms upwards, in order to experiment with their virtual body, and to visually explore the virtual environment. Finally, patients were asked to co-locate their real body aligned with the virtual one in order to encourage the embodiment. At this point, patients were asked to verbally express what they felt and their sensations. All patients' responses were audio recorded by the experimenters (this part was always conducted from a body first-person perspective). Once the think-aloud was concluded VR experimental session started. Each VR experimental session was composed of four different parts: (1) Embodiment phase, in which the embodiment toward the virtual body was induced by means of synchronous visuo-motor correlations; (2) Virtual body perspective, in which an allocentric or egocentric perspective of the virtual body was provided depending of the session; (3) Modification of the BMI, where the body mass index (BMI) of the virtual body was increased throughout the VR sessions until arrives to a healthy BMI (18.5); and (4) Autobiographical recall, following a classical autobiographical recall procedure [see 13 for further details].

2.4. Data handling

Statistical tests for the repeated measures of the study (embodiment questions) were performed in Stata 13 (StataCorp LP, College Station, TX, USA), using the Friedman test for non-parametrical data. The distribution of the data was tested with the Shapiro-Wilk test. Effect sizes based on mean comparison were also calculated (Cohen's d).

2.5. Results

2.5.1. Embodiment questionnaire scores

Patients reported significantly higher levels of ownership ($Q=30.03$, $p<0.0001$, CI(95) =0.65-1.40, $d=1.02$), location ($Q= 7.63$, $p<0.01$, CI(95)=0.12-0.83, $d=0.47$), and agency ($Q=7.61$, $p<0.01$, CI(95)=0.60-0.77, $d=0.41$) toward the virtual body when they were embodied in a virtual body with their perceived real BMI, than when they were embodied in a virtual body with their desired BMI. However, no differences were found for ownership, location, and agency while observing the virtual body form an egocentric (1PP) or allocentric point of view (3PP). **Figure 1.I.**

2.5.2. User experience questionnaire scores

The results obtained in the UEQ showed that patients perceived the system as more attractive after the VR exposure in session 1 (0,53±0,46) than after session 4 (0 ±0,59). On the other hand, patients perceived the system more familiar and easier to use after session 4 (1,13±0,72) than after session 1 (0,95±0,60). Average scoring for novelty were higher after session 4 (1,69±0,94) than after session 1 (1,56±1,23). **Figure 1.II.**

2.5.3. Think aloud

The thinking aloud technique revealed that no element in the virtual environment gained more attention than the others: two patients first focused on the virtual body and two on the virtual environment. The virtual environment is described by most patients in details, giving attention especially to the interior of the room. The virtual world outside the window is not given much consideration. The description of the virtual body is more critical. The patients used personal nouns and pronouns when describing the virtual body, which indicates a good level of identification with the virtual body ("I saw myself reflected in a mirror").

2.5.4. Patients interview

All five patients appreciated the contextual features of the VR room, which was deemed clear and detailed. However, the virtual body generated contrasting feelings: while the patients could tell that it was meant to be them, the virtual body was usually perceived as unfamiliar and not similar enough to their own body. The body similarity between the virtual body and the real body of the patients emerged as particularly relevant especially in the two youngest interviewees, who expressed frustration in not being able to control the body of the avatar body completely, in its physical aspects. This fixation on the body is on par with the AN pathology. The interviewees said they would continue/re-attend the program as they found it is very innovative and they like the VR aspect of it, and they would suggest others to try it. The VR systems' novelty and innovation is the main driver for continued use.

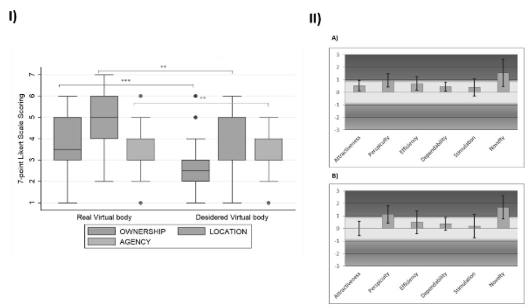

Figure 1. Embodiment and user experience questionnaire scores

3. Discussion and conclusion

The present manuscript shows the preliminary data from the results obtained in a pilot study conducted with five patients with AN to explore user experience in terms of embodiment and user experience scores, and personal opinion regarding the VR body-swapping illusion experience. The results show that the VR-system was able to induce the sense of embodiment toward a virtual body while being embodied in a virtual body with a real perceived BMI (figure 1). Regarding the UX of the system, the results from the UEQ revealed that users found the VR-system familiar and easy to use after the last session (session 4), and novelty compared with conventional rehabilitation training (session 1 and session 4). This result was supported with the high scores obtained in terms of the perspicuity of the system, which indicates the clearness in following the VR protocol throughout the 4-sessions period. Results from UX assessments (embodiment scores, think aloud, and patient's interviews) show that patients with AN can benefit from using VR as an easy to use an innovative technological solution. However, future studies with a higher sample size and a control group have to be done to support the preliminary results of this study.

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Manipulating body size distortions and negative body-related memories in patients with Anorexia Nervosa: A virtual reality-based pilot study

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Abstract. The Allocentric Lock theory (ALT) suggests that anorexia (AN) may be the outcome of a primary disturbance in the way the body is "experienced" and "remembered". A long tradition of research had proved that emotions can influence the encoding, storing and retrieving of memories. The aim of the present study was to explore the effectiveness of a new virtual reality (VR) paradigm combining the autobiographical recall and the body-swapping techniques in order to unlock the allocentric memory of the body in patients with AN. Seven young women diagnosed with AN following DSM-5 criterion, participated in this study. Before and after the experimental sessions, patients underwent pre-post assessment battery in which cognitive, affective and perceptive variables related with their clinical condition were assessed. The VR-based protocol consisted in four sessions in which patients were immersed in an avatar from an egocentric and an allocentric perspective. The body mass index (BMI) of the avatar was increased throughout the VR sessions: starting from patient's BMI until reaching the normal weight. During each session patients were asked to indicate their real and ideal BMI and to recall negative and positive life events. Patients showed lower negative emotions and body shame at fourth session compared to baseline. Furthermore, patients showed an increase in body satisfaction and an improvement in the accuracy of body perception and body shape. This new VR paradigm might be an effective tool for both assessment and treatment of body perception in AN.

Keywords. Anorexia Nervosa, Virtual Reality, Autobiographical Recall, Body Swapping

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1. Introduction

Body image disturbance (BID) affects body-related feeling, thoughts, perceptions and behaviors. BID had been recognized as a clinical feature of critical importance in the development and maintenance of anorexia nervosa (AN) [1,2]. As yet, the mechanisms underlying BID remain unclear. The Allocentric Lock theory (ALT) [3] suggests that AN may be the outcome of a primary disturbance in the way the body is "experienced" and "remembered". Specifically, this theory suggests that individuals with AN have an impairment in the ability to update the memory of the body based upon the allocentric representation with new contests from real-time perception (egocentric representation) [4-6]. According to ALT, impairments in specific aspects of memory function prevent the updating of the self-concept, locking patients with AN in a negative long-term memory of their body (e.g. I'm fat). Increasing evidence has shown that emotions can influence memory by modulating the encoding, storing and retrieving memories, as well as the consolidation of memory traces [7]. Memory retrieval can lead the person to relive specific mental states connected to the event, as emotions, thoughts and desires. In light of this, retrieving significant events, such as body-related events, through an emotional induction able to connect body memory to specific emotions could provide changes in the memory of the body. In the last two decades, researchers have relied on virtual reality (VR) to integrate and extend the assessment tools and treatments for many psychological disorders, including BID [8-10]. In the present study we propose a new VR paradigm combining an emotional induction technique, the autobiographical recall technique, [11] and a VR procedure, body-swapping, [12] to unlock the allocentric memory of the body in patients with AN. The aim of the study is to explore the effectiveness of a new VR paradigm in AN on the perceptual and symptomatologic dimensions. We hypothesized that, after VR intervention, participants would show an increased body satisfaction and body estimation accuracy as well as a decreased body shame and concerns about body image.

2. Materials and Methods

2.1. Participants

Seven young women diagnosed with AN participated in this study (age = 17±1,87; BMI= 15,95±0,61). Patients were recruited from the Eating Disorders Centre, San Luca Hospital in Milan. Inclusion criteria envisaged to meet the diagnostic criteria for AN based-on DSM 5 and a BMI not under 15. Exclusion criteria included current or prior history of a neurological illness, brain damage and psychiatric comorbidity. All participants were informed about the purpose of the research and provided written informed consent. The study was approved by the local ethical committee of the Istituto Auxologico Italiano.

2.2. Measures

In order to evaluate the perceptual dimension, the VR body size estimation task [13] and the embodiment questionnaire [14] were administrated. During the VR body size task, participants were asked to verbally indicate how to modify the size of the virtual body in order to match it with their ideal body size and with their perceived real body size. The BMI of the avatar could be changed from 42.5 to 12.5. Furthermore, an adapted version of 10 item self-reported embodiment questionnaire [14] was used to evaluate the ability of VR to induce a sense of ownership over the avatar, after each virtual condition. The questionnaire assesses three embodiment components, ownership, agency and location through a 7-point Likert response scale. As regards the clinical assessment, the body satisfaction scale (BSS) [15], the body shape questionnaire (BSQ) [16] and the objectified body consciousness scale (OBCS) [17] were administrated pre and post intervention.

2.3. Procedure

Before and after the VR intervention, participants underwent a pre-post assessment battery in which affective and perceptive variables related with their clinical condition were assessed by the experimenter, a clinical psychologist, using questionnaires. The VR intervention included a head-mounted display connected to a laptop computer and a motion tracker device, a Microsoft Kinect sensor, through which participants were immersed in a virtual environment and fully embodied in a virtual body. The protocol consisted in four sessions in which participants were immersed in an avatar from an egocentric and an allocentric perspective. This immersive experience lead to the body swapping illusion induced through visuo-motor synchronization between the real’s participants body and the virtual body. Every session started with an embodiment phase in which participants were asked to align their real body with the virtual avatar and to slowly moved the legs and the arms. Then, participants were asked to observe the synchronization between the movement of the real legs and arms with the virtual body. This phase aimed at induce the embodiment toward the virtual body using synchronous visuo-motor correlations. The body mass index (BMI) of the virtual body was increased throughout the VR sessions: in session one and two the BMI of the avatar corresponds to the participant’s real BMI (underweight), in session three avatar’s BMI increased to 17.5 and in the final session it increased to 18.5 (healthy BMI). Participants were asked to recall unpleasant life events while they were immersed in the low BMI and positive life events while they were immersed in the normal BMI following a classical autobiographical recall procedure. The aim was to help patients associate negative feelings to the underweight BMI and the positive memories to the normal BMI. Finally, during each session, participants were asked to estimate their real and ideal body size with the virtual reality body size estimation task [13]. The experimenter modified the avatars’ BMI through the VR computer interface accordingly.

2.4. Results

As regards the VR body estimation task, a Delta index was calculated between the perceived real body and the real body and between the ideal body and the real body (BMI real). With these outcomes we conducted a Mann-Whitney non parametrical test to compare the perceptual distortions of the real and ideal body size. Moreover, we carried out Wilcoxon Signed Rank test for a pre-post treatment evaluation of the clinical measures. As regards embodiment questionnaire, participants reported significantly higher levels of ownership ($z=4.98$, $p<0.0001$), location ($z=-2.27$, $p=0.023$), and agency ($z=-2.05$, $p=0.041$) over the virtual body when they embodied the avatar with their *perceived* real BMI, than when they embodied the avatar with their *desired* BMI. Regarding the VR size estimation task, participants showed an improvement in the estimation of the desired BMI from session 1 to session 4 (Fig. 1). In the clinical assessment, results showed a reduction in body dissatisfaction from session 1 to session 4 (Fig.2). Furthermore, with a pre-post evaluation, results showed decreased concerns about body image (Fig. 3) and body shame (Fig.4), although not significant.

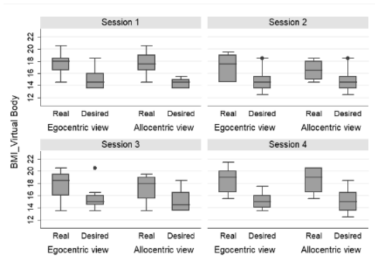

Figure 1. VR body size estimation.

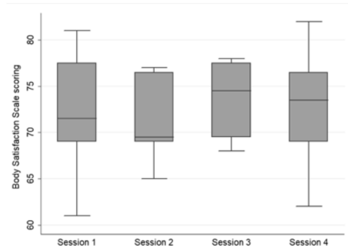

Figure 2. Body satisfaction scale.

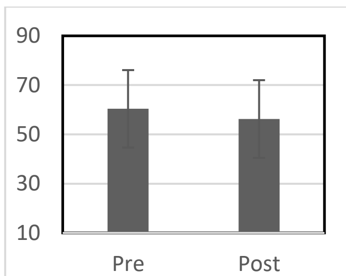

Figure 3. Body shape questionnaire.

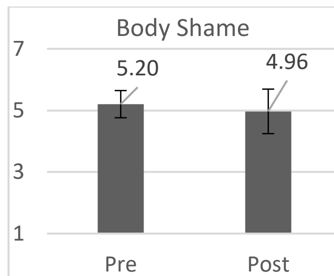

Figure 4. Objectified Body consciousness Scale.

3. Discussion and conclusions

We conducted a pilot study to evaluate a new VR paradigm combining the autobiographical recall technique [11] and the body-swapping intervention [12] to modify the negative memory of the body in subjects with AN. The results showed that after the VR intervention participants reported a trend of decreasing level of general body dissatisfaction [18], concerns about body image and body shame. Furthermore, results from BSS indicated that the autobiographical recall technique together with VR body swapping could modulate patients' body satisfaction after VR exposure. The VR exposure combined with the positive and negative autobiographical recall reduced the satisfaction after the negative recall in session two, that increase after session 4. According to ALT, these findings suggest that the manipulation of the emotional state could change the allocentric memory of the body. Furthermore, regarding the perceptual assessment, results showed that participants reported higher level of embodiment when they were immersed in the avatar with the perceived real body size, rather than the desired body size. This result was in line with a previous study [19] indicating VR paradigm as an effective tool to assess and modify body distortion in AN. Finally, regarding the virtual body size estimation, our results showed that after the VR intervention, participants desired a body that was closer to a normal BMI than the pathological size. This can be a promising and interesting finding, which could stem from the combination of the emotional and perceptual intervention.

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Virtual Reality for Relaxation in the Treatment of Generalized Anxiety Disorder : a Comparative Trial.

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Abstract. Modern therapeutic strategies involving virtual reality (VR) have now become available in mental health for professionals and patients alike. Concerning the treatment of generalized anxiety disorder (GAD), a frequent and debilitating condition, VR had been considered as a possible remedy. Therefore, the efficacy of VR combined with relaxation for patients with GAD was assessed in the context of this analysis comparing VR versus standard mental imagery during relaxation. Specific virtual environments were built for this trial with an inexpensive game level editor. Twenty-seven participants with GAD were included in this intermediate study. Psychometric scales and physiological instruments were used to assess the effects of the treatment. Statistically significant improvement on anxiety, worry and mental quality of life scores was noted for the participants in both groups. Comparison between treatment methods indicated no significant differences, although dropout rate was noticeably higher in the standard group. In the VR group, presence level was satisfactory and cybersickness was low. These results will enable further research in virtual reality relaxation therapy for GAD.

Keywords. Virtual reality, relaxation therapy, generalized anxiety disorder, presence, game level editors, virtual environments.

1. Introduction

Generalized Anxiety Disorder (GAD) is a frequent and disabling condition which affects approximately 2 % of the general population [1]. It is described as excessive anxiety and worry (apprehensive expectation) about a number of events or activities (such as work or school performance) and occurring more-days-than-not, for at least six months [2]. Recommended treatment involves relaxation methods or Cognitive-Behavioral Therapy (CBT) [3]. Both are similar to in terms of efficacy [4]. Based in conjunction with technological improvements such as Virtual Reality (VR), VR protocols for stress management therapy in GAD have been devised [5] and a study compared experimental VR relaxation for GAD with or without biofeedback [6]. Consequently, in order to evaluate the effect of VR relaxation for GAD, this trial furthers previous works by comparing VR relaxation versus standard relaxation involving mental imagery. Moreover, in this test, VR

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relaxation included 6 different calming virtual environments (VE). In addition to anxiety and worry, the impact of VR relaxation on depression and quality of life was also measured. Lastly, this trial aims to ensure that relaxing VE constructed for the experiment yielded presence with limited cybersickness.

2. Methodology

The present trial was registered on ClinicalTrials.gov (Identifier: NCT02571790).

2.1. Sample

Twenty-seven participants (13 women, 14 men) diagnosed with GAD were recruited for the clinical trial through local media and onsite consultations. Nineteen completed the protocol. They all meet the inclusion criteria : being between 18 and 70 years old and with a primary diagnosis of GAD as detected by the Anxiety Disorders Interview Schedule for DSM-5 (ADIS-5) [7]. Exclusion criteria included pregnancy, concurrent psychotherapy, any diagnosed psychotic disorders, medication changes in the month previous to inclusion, photosensitive epilepsy and vestibular disorders. The mean age of the sample was 48.40 years (SD 11.91), ranging from 18 to 67 years. The mean duration of GAD was 7.51 years (SD 7.90) and the mean age of onset was 40.88 years (SD 13.38). Additionally, 19 participants exhibited at least one other axis I disorder.

2.2. Assessments

Pre and post-treatment measures were assessed using self-rated anxiety, worry, depression and quality of life questionnaires with the following self-report scales:

State Trait Anxiety Inventory (STAI Y-A and Y-B) [8]. Form A specifically assesses state-anxiety at the time of the test, and form B assesses trait-anxiety in general.

*Beck's Depression Inventory version II (*BDI-II) [9]. This scale allows for a quick self-evaluation of depression symptoms.

Penn State Worry Questionnaire (PSWQ) [10]. This questionnaire assesses the level of worry of patients suffering from GAD.

SF-12 quality of life questionnaire [11]. Quality of life was assessed with this 12-item scale assessing physical function, physical pain, general health, vitality, social functioning and well-being.

Aside from pre/post measures, the *Subjective Units of Discomfort* (SUD) [12] was recorded at three regular intervals throughout the session. It is a 10 or 100 points scale test which measures the perceived level of anxiety at a given time.

Presence level and cybersickness were registered after each session in the VRT group using the *Presence Questionnaire PQ v3.0* [13] and the *Simulation Sickness Questionnaire (SSQ)* [14]. The PQ consists of 32 items rated on a 7-point scale, assessing the participant's perception of presence. The SSQ is a 16-item instrument on a 4-point scale assesses the severity of motion sickness related symptoms exhibited in a VE.

Heart Rate (HR) was monitored and carried out throughout each session using a Polar RS800CX™ device, which has proved its efficacy in clinical research [15].

2.3. Procedure

Following the intake assessment and the diagnostic interview, participants were assigned to two therapeutic groups by using a stratified random sampling method: VR relaxation therapy (VRT) and standard mental imagery relaxation therapy (MI).

Therapy was conducted over six 30-minute sessions, scheduled at a weekly rate. During the three first sessions and under the therapist's supervision, all participants were taught relaxation techniques including respiratory exercises (session 1), Schultz's autogenic training (session 2) [16] and Jacobson's progressive muscular relaxation (session 3) [17]. From session 4 to 6, the participants were free to choose the practiced relaxation method.

2.4. Apparatus and Virtual Environments

The VR system included a Sensics® zSight Head Mounted Display or HMD (1280x2024 stereoscopic OLED screen with 60° field of view), coupled a head tracker.

Figure 1 & 2. Screenshots of 2 out of 6 VEs created for the present study: a tropical beach (left) and a campfire (Right). All VEs are constructed as open worlds where the participant was free to walk about**.**

The latter enabled the subject to visually explore the environment in first-person view with the corresponding head movements performed in real time. A wireless remote control with a directional pad was also used, allowing various actions, from walking to swimming, to interacting with different 3D objects (such as opening doors).
The software exploited to create and run the VEs is the commercially available game engine / level editor (GLE) CryEngine's Sandbox (Crytek GmbH). In order to offer as well as test diverse calming situations, the first author exploited the aforementioned GLE to build 6 specific VEs. At the beginning of each session, VRT participants can select the VE used among these 6 relaxing virtual situations (a tropical beach, a campfire in a forest, polar ice fields, a living room, a journey across the solar system, a peak in a sea of clouds). Relaxing stereo sound effects specifically designed for each virtual environment (flowing water, chirping, etc.) can be heard and the participants also had the option to choose from 6 types of relaxation music during the VR session. Additionally, they had the possibility to select the time of day from four different ambiences (sunrise, noon, sunset, nighttime).

3. Results

Scores of questionnaire measures, ANOVA and effect size are reported in table 1. Statistical analysis with ANOVA indicated significant improvement on anxiety, worry, mood and mental quality of life in both groups. Although there was a notable mean HR difference, it did not reach significance at this stage. Presence level was satisfactory (PQ = 112.73, SD = 22.87) and cybersickness was low (SSQ = 7.93, SD = 5.77). Comparison between treatment methods found no significant differences. Dropout rate was noticeably higher in the standard group (6 in the standard group versus 2 in the VR group).

4. Conclusion

This ongoing research shows evidence that relaxing and open world VEs created with a game engine / level editor elicited sufficient presence and yielded clinical effects.

Table 1. Means, standard deviations of the dependent variables, results of two-way ANOVA Between Pre-and Post-test period (Time) and ANOVA for time x group comparison (Interaction).

Test	Gp	Pre-test Mean (SD) n=19	Post-test Mean (SD)	ANOVA Time F(1,17)	Eta² Time	ANOVA Inter. F(1,17)	Eta² Inter.
STAI-YA	VR	46.10 (12.26)	35.90 (12.87)	13.06**	0.43	0.36ns	0.02
	IM	49.22 (8.06)	37.89 (11.28)				
STAI-YB	VR	56.90 (11.26)	51.00 (9.61)	3.34ns	0.16	0.18ns	0.01
	IM	56.78 (6.55)	54.22 (9.03)				
PSWQ	VR	60.90 (8.70)	52.20 (8.61)	9.711**	0.36	1.406ns	0.08
	IM	63.78 (9.05)	57.67 (10.6)				
BDI-II	VR	11.10 (7.16)	8.30 (5.33)	14.33***	0.46	0.30ns	0.02
	IM	11.00 (6.36)	5.67 (4.06)				
SF-12 Mental	VR	33.42 (5.80)	36.64 (5.70)	13.22**	0.44	0.04ns	0.00
	IM	30.69 (8.43)	40.53 (9.56)				
SF-12 Phys.	VR	46.44 (9.14)	45.50 (8.05)	0.18ns	0.00	0.07ns	0.00
	IM	46.04 (7.27)	47.45 (4.54)				
SUD S1S6	VR	30.75 (12.73)	16.60 (11.50)	17.00***	0.5	0.11	0.00
	IM	32.22 (18.54)	16.20 (11.70)				
HR S1S6	VR	78.40 (23.24)	71.40 (16.51)	3.44ns	0.17	0.36	0.00
	IM	76.11 (19.63)	70.55 (17.08)				

ANOVA: analysis of variance; VR: virtual reality; MI: mental imaging; STAI-YA and -YB: State Trait Anxiety Inventory; PSWQ: Penn State Worry Questionnaire; BDI-II: Beck Depression Inventory version 2. SF-12 mental and physical quality of life questionnaire. SUD & HR S1 S6: mean Subjective Unit of Discomfort and Heart Rate per min during the 1st session and 6th session. ***p<.001; **p<0.025; *p<0.05; ns: non-significant.

Outcomes revealed a significant reduction in anxiety, worry and depression as well as an increase of the mental factor of quality of life. Group comparison did not lead to any significant interactions between all variables, indicating that relaxation in VR is as efficient as mental imagery for the treatment of GAD. Regarding calculation trends towards group differences in some anxiety related physiological variables, this continuing clinical trial will verify if those tendencies are maintained and achieve significance. Concerning the dropout rate, it is possible that the participants in the VRT group were more motivated. In this group, it should be noted that participants mainly selected the virtual tropical beach and campfire at night for their relaxation sessions in VR as well as musical ambience over sound effects only. In the VEs, participants also tend to choose sunset or evening as preferable time of day. Finally, further studies are required to test possible adjuvants to VRT such as olfactory stimuli, high field of view and wireless HMD and the use of specific music scores as potential tools to enhance VRT for GAD and for the betterment of mental health in this intriguing XXIst century.

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Predicting Post-Traumatic Stress Disorder Treatment Response Using Heart Rate Variability Response to Virtual Reality Environment and Modified Stroop Task: An Exploratory Study

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Abstract. This study examined heart rate variability (HRV), and a Modified Stroop Task (MST) as objective predictors of PTSD treatment response in 45 combat veteran patients. The following self-report baseline variables were predictors of 6-month Clinician Administered PTSD Scale (CAPS) score: baseline CAPS and combat experiences. Controlling for baseline CAPS and combat experiences, the following baseline HRV recovery variables were significant predictors of 6-month CAPS: SDNN after combat scene minus SDNN during combat scene and LF after civilian scene minus LF during civilian scene. HRV at rest and MST index scores did not predict treatment response. The direction of this relationship indicates that greater baseline HRV recovery predicted lower 6-month PTSD symptom severity.

Keywords. Stress Disorders, Post-Traumatic; Combat Disorders; Heart Rate Variability; Attentional Bias; Prediction

1. Introduction

Being able to accurately predict treatment response can inform treatment response expectations, treatment decisions, and use of mental health treatment resources. A recent systematic review of biomarkers predicting PTSD psychotherapy outcomes included 9 veteran studies [1]. The biomarkers included neuroimaging (3 studies), serum glucocorticoids (2 studies), genetic factors (2 studies), and heart rate/electrodermal activity (2 studies). A subsequent study reported that eye blink startle predicted PTSD treatment response in veteran samples [2]. The following self-report variables have also been reported to predict veteran PTSD treatment response: lower levels of combat exposure [3], lower levels of depression severity [4], lower anger levels [5], and lower alcohol use [5]. However, in one of the largest randomized controlled medication trials in veterans with PTSD there were no consistent self-report predictors of treatment response [6]. In this study, we chose heart rate variability (HRV) and a modified Stroop task (MST) to predict PTSD treatment response because they could be collected in a typical clinic setting. We hypothesized that greater autonomic and cognitive processing flexibility as measured by HRV and MST would predict PTSD treatment response.

2. Methods

2.1. Design.

Observational and longitudinal data were collected from PTSD treatment-seeking Iraq and Afghanistan veterans. The study protocol was approved by the Central Arkansas Veterans Healthcare System Internal Review Board.

2.2. Subject eligibility.

Participants met the following inclusion criteria: currently receiving treatment for PTSD (medication and/or counseling); age 18 to 60; deployed to Iraq or Afghanistan; and willing to provide contact information for at least one person. Exclusion criteria were: being unable to don the virtual reality (VR) headset; current diagnosis of schizophrenia; daily use of benzodiazepines except as needed for sleep; daily use of alpha-adrenergic antagonists or beta-blockers; plans to leave the area within 6 months; diagnosis of color-blindness; and previous treatment with a VR-assisted intervention.

2.3. Recruitment and screening.

Veterans were recruited from VA outpatient mental health clinics by self-referral and clinician-referral. Of the 101 veterans who completed the baseline assessment, 68 (67.3%) completed the 6-month assessment and 45 had usable HRV data. Unusable HRV data was due to equipment malfunction and/or excessive participant movement.

2.4. Procedure.

Physiological and attention bias data were collected prior to self-report measures in this order: baseline HRV with no stimuli; MST; and HRV collected before, during, and after two 3-minute VR simulations (combat and civilian scenes). The order of the combat and civilian scenes was randomized.

2.5. Virtual reality (VR) environments.

Combat and civilian VR environments were developed by Virtual Reality Medical Centers. The combat scene placed participants in a military patrol walking through a small Iraqi market and the civilian scene placed participants walking alone on the sidewalk of a US city. Participants experienced 3 minutes in the first VR environment, 5 minutes rest, 3 minutes in the second VR environment, and 5 minutes rest.

2.6. Heart rate variability (HRV).

Greater HRV is associated with greater parasympathetic activity which acts as a brake to offset sympathetic activity [7]. HRV data collection was described in more detail elsewhere [8]. HRV variables included: standard deviation of normal R-R intervals (SDNN), low frequency (LF, 0.04-0.15 Hz) and high frequency (HF, 0.15-0.4 Hz) power (ms^2). IBI data were cleaned and HRV calculations made using Kubios HRV analysis software version

2.0 (http://kubios.uef.fi/KubiosHRV/). Participants requiring correction of greater than 10% of IBIs were excluded.

2.7. HRV recovery.

HRV recovery was calculated by subtracting HRV (SDNN, HF, and LF) during the VR scene from HRV immediately following the VR scene. We predicted a positive relationship between HRV recovery and treatment response.

2.8. Modified Stroop Task (MST).

The MST requires individuals to color-name trauma-relevant and trauma-irrelevant words. MST used in this study was described in more detail elsewhere [9]. Two separate threat indices were calculated: combat word interference (mean combat word response time minus mean neutral word response time) and general threat word interference (mean social threat word response time minus mean neutral word response time). Positive values reflected greater attentional bias to threat words.

2.9. Self-report measures.

Combat exposure was measured using the 16-item Combat Experiences Survey [10]. PTSD symptom severity was measured using the 17-item Clinician Administered PTSD Scale (CAPS) based on DSM-IV [11]. Post-Deployment Health Assessment TBI items identified participants who experienced a deployment related TBI [12]. Depression severity was measured using the Patient Health Questionnaire nine-item depression module (PHQ-9) [13]. Anger/aggression was measured using the 29-item Buss Perry aggression scale [14]. Comorbid alcohol dependence was measured using the DSM-IV version of the Mini-International Neuropsychiatric Interview (MINI) [15]. Post-deployment social support was measured using the Post-deployment Social Support from the National Center for PTSD [16].

2.10. Statistical analyses.

Using a correlation matrix and generalized linear models, the strongest covariates were baseline CAPS score and combat experiences score. Predictors of interest (HRV and MST) were added individually to this equation. HF and LF variables were natural log transformed. Secondary analyses added remaining covariates of interest to the main model: baseline CAPS, combat experiences, and significant HRV or MST measures.

3. Results

Veteran participants were young, mostly male with some college education. Most participants were taking psychotropic medications (36/45, 80%) and of these 33 (92%) were taking antidepressant medications. Most participants had baseline PCL scores $\geq$ 50 (37/45, 82.2%) and PHQ-9 scores $\geq$ 10 (34/45, 75.6%). Significant correlations ($p<0.05$) between baseline variables and 6-month CAPS included: baseline CAPS, PHQ-9, combat experiences, SDNN combat recovery and LF civilian recovery. Trend level significance ($p=0.10$) with 6-months CAPS was found for baseline Buss-Perry aggression, deployment related TBI, post-deployment support, HF civilian recovery ($p=0.13$), and LF combat recovery ($p=0.16$).

Baseline CAPS and combat experiences explained 35% variance in 6-month CAPS. HRV and attentional bias variables were added and the following HRV variables were significant: SDNN combat recovery and LF civilian recovery and explained an additional 10% and 8% of the variance, respectively. Other HRV and MST predictors of interest were not significant. The significance of HRV results was unchanged when the PHQ-9, deployment-related TBI, Buss Perry score, age, race, or gender were added to the HRV recovery equations.

4. Discussion

The only significant multivariate longitudinal predictors of 6-month CAPS were baseline CAPS and HRV recovery measures. These HRV recovery measures explained an additional 8-10% of the variance. Stress resilience is a complex construct that is generally defined as the ability to bounce back from stress [17]. The negative sign for the HRV recovery variable coefficient estimates indicates that greater HRV recovery (or resilience) was associated with lower 6-month PTSD symptom severity after controlling for baseline CAPS and combat experiences. This result is consistent with self-report resilience predicting PTSD treatment response [18]. Limitations of this study include its exploratory design and use of multiple statistical tests. Replication of these exploratory results is needed. The sample included OEF/OIF veterans only limiting generalizability. PTSD treatment was not controlled, and treatment adherence was not monitored. There was a large amount of unusable HRV data.

Based on these results, future studies should consider HRV recovery data on larger samples prior to starting treatment and monitoring treatment adherence closely. Second, consolidation of HRV data collection into a shorter timeframe may reduce the amount unusable HRV data. Third, HRV recovery was significant for both combat and civilian scenes suggesting that specific simulated stressor content may not a critical element.

5. Conclusions

HRV recovery measures following a standardized stressor were significant predictors of PTSD treatment response and could be used as objective measures of treatment response.

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An Investigation Into The Impact of Virtual Reality Character Presentation on Participants' Depression Stigma

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Abstract. There is a large body of research investigating who stigmatises mental illnesses, why they do so, and the factors that mediate these thoughts and behaviours. Depression stigma in particular has been widely studied using written vignettes to depict a character with depression. While vignettes provide easily manipulatable experimental tools for measuring people's reactions to a diagnosed character, they lack the capacity to depict a character's expressions and actions. This has led to concerns about their ecological validity. This study attempted to increase the ecological validity of traditional vignette studies by presenting a virtual character and then measuring the participant's stigma towards depression. Participants were presented with either a depression or control vignette and then both groups interacted with a virtual human with experimentally manipulated eye contact behaviours. Initial exploration of the data suggests that previously reported effects of diagnosis when using written vignettes may not generalise to more dynamic and interactive virtual social situations, and thus may not hold up in real life situations. The use of virtual reality uniquely allowed for testing such complex questions..

Keywords. Virtual Reality, Virtual Human, Research Methods, Social Interaction, Depression Stigma

1. Introduction

The power of labels is long established [1]. Diagnostic labels are known to elicit emotions such as anger, sympathy and fear towards persons with mental disorders including depression [2,3]. Many of these studies report negative thoughts, feeling and intended actions towards people diagnosed with depression [4,5]. These reactions towards diagnosed individuals seem to be present in a wide variety of populations including the general public and psychology students [6]. It is important to understand the aspects of mental illness that illicit such reactions, considering that fear of stigma can discourage help seeking and hinder recovery [5,7]. As such, it is important to study the possible reasons why people stigmatise individuals with a depression diagnosis. In relation to the label itself, it is purposed that diagnostic labels may amplify a person's perceptions of the differences between themselves and a diagnosed individual, promoting the idea that individuals who share a diagnosis are a collective entity

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[8]. This can lead to a society where labels and perceived negative difference are socially salient, resulting in increased stigmatization.

Written vignettes are frequently used to assess depression stigma [9]. Their manipulability allows for measuring the extent to which a particular stereotype or label is stigmatised by participants. As such, they have high internal validity, consistency, and control. However, Link et al [9] point out that vignettes do not provide insight into a character's actions (e.g. expressions, gestures, eye contact) that may be involved in a real-world interaction, leading to reduced ecological validity. Dolphin and Hennessy have sought to improve the validity of vignette methods by using audio-visual vignettes [10]. However, the use of fixed recordings of actors did not allow for interactivity between the participant and the vignette character. Many assessment tools used in the clinical and social neurosciences suffer similar criticisms to vignettes [11]. Psychologists are increasingly utilising virtual environments and virtual human vignettes for assessing bias [12], personality [13] and simulating clinical symptoms [14]. Virtual environments allow for the impact of character actions to be explored in stigma studies, which may curtail some of the shortcomings illustrated by Link et al [9]. For example, ecological validity can be raised by including bodily movements and social cues. In this study, we use eye contact behaviour to explore this. Eye contact was chosen as previous findings indicate that it may exert influence on attributions of humanness [15] and that averted eye gaze from virtual avatars can elicit emotional responses in participants [16].

In an effort to build on the work of Dolphin and Hennessey [10] the present study aimed to pilot the use of a virtual human as a dynamic, ecologically valid method to explore the impact of diagnosis and character action on participants' stigma. Specifically, we aimed to assess whether previously reported effects of diagnosis when using vignettes generalise to virtual social situations with more dynamic and interactive qualities than traditional written vignettes. Effects of mental health diagnosis (depressed versus control vignette character) and virtual character action (eye movement behaviour) is explored.

2. Methods

2.1. Research Design

This lab-based experiment used a 2×2 independent groups design. Written vignette (depression labelling vs. control) and virtual character action (interactive eye-contact vs. no interactive eye-contact) were the between subjects grouping variables. The two dependent variables were participants' subjective personal and perceived stigma.

2.2. Participants

Sixty-two participants completed the experiment. Of these, seven were excluded from the analysis as they reported through the Level of Contact Report (LRC; 17) that they themselves had a diagnosed mental health condition. One participant was excluded for indicating during debriefing that they had not followed the instructions correctly. Thus, the final sample included 54 participants (26 females, 28 males; age: M = 22.06, SD = 5.61). Twenty-five participants had an educational background likely to include mental health content (e.g., psychology (social sciences and nursing) and twenty-nine fell into an 'other' field of study (e.g. natural sciences). The sample mean score for the Level of Contact Report was 8.76/12.

2.3. Measures

The relevant subscales of the Depression Stigma Scale (DSS) [18] were used to measure participants' personal stigma and perceived stigma towards depression. The personal stigma subscale measures the participant's own stigma. The perceived stigma subscale measures the extent to which the participants perceive depression to be stigmatised by the general public

[19]. The LCR (17) was used to measure participants previous contact with mental illness given that interaction with people with a diagnosed mental health problem can reduce stigma. The scale runs from 1 (no previous contact) to 12 (I have a diagnosed mental illness).

2.4. Materials and Procedure

Participants were immersed in a virtual environment café (VEC) which was run on an ASUS computer using the Oculus program and Oculus Rift headset. The environment was presented using the "Coffee Without Words" simulation, in which the participant interacts with a virtual stranger in a real-world setting. The café included various virtual bystanders and ambient sounds of chatter that would be typical of this setting in the real world. With the exception of eye contact behaviours, the virtual human's gender (Male) and behaviour (head and body movements) were kept consistent across conditions. Participants were exposed to a traditional written vignette that either described a character diagnosed with major depressive disorder (adapted from Griffiths et al, [20]) or a control character with symptoms of temporary low mood triggered by poor exam results. Following this, participants experienced a virtual environment café (VEC) where they interacted with the character. The character's actions and behaviours were fixed across conditions with the exception of eye contact. This was manipulated whereby the virtual character actively trying to avoid eye contact with half the participants and the other participants saw the virtual character actively attempting to make eye contact with them. Following the virtual reality (VR) experience, participants filled in open-ended questions about the virtual human interaction (for a separate research hypothesis that is not reported here). Finally participants filled in the DSS [18] and LCR [17] and were debriefed.

3. Results

Table 1: Mean scores for personal and perceived stigma

Groups	*N*	Mean Perceived Stigma (SD)	Mean Personal Stigma (SD)
Control + EC	13	17.69 (4.01)	7.69 (3.54)
Control + NEC	14	19.14 (4.17)	8.57 (4.72)
Exp + EC	14	16.78 (5.37)	6.28 (3.91)
Exp + NEC	13	18.6 (4.72)	7.84 (3.34)
Control: Control Vignette, Exp: Experimental Vignette, EC: Eye contact NEC: No Eye Contact			

Groups did not differ significantly in gender, age, previous contact with mental illness, education level or college major indicating that groups were comparable on key demographics and could be compared for difference in personal and perceived stigma. Both the perceived (α = .627) and personal (α = .639) subscales of the DSS had good internal reliability and both were normally distributed. Factorial Analysis of Variance (ANOVA) was used to measure differences in stigma towards the VR character presented as depressed or the control VR character. The dependent variables were perceived stigma and personal stigma. The independent variables in both cases were vignette (depression versus control) and character action (eye contact offered versus no eye contact offered) with previous contact with mental illness included as a covariate for both analyses. No significant effect of vignette type or character interaction on participant's personal stigma ($F(2,54) = 0.121$, $p = 0.73$; $\eta_p^2 = .002$) nor perceived stigma ($F(2,54) = 0.85$, $p = 0.77$; $\eta_p^2 = .002$) was observed.

4. Discussion

This study used a novel approach by incorporating virtual reality into the widely used vignette methodology. The aim was to explore the effect of a diagnosis of major depressive disorder on stigma towards a virtual character following an interactive virtual social interaction. The study also sought to explore whether character action contributed to participants' reported stigma. Results revealed no significant effect of diagnosis or virtual character action on stigma. Initial exploration of the data suggests that previously reported effects of diagnosis when using vignettes may not generalise to more dynamic and interactive virtual social situations. The use of virtual reality uniquely allowed for testing such complex questions. However, it must be noted that in the present study written vignettes were combined with virtual characters and so future research is required to make comparisons between the media. As exposure to information-based learning about mental health can reduce stigma, these results must be interpreted with caution as the sample consisted of college students with a large cohort of psychology and social science majors [21]. Additionally, the sample reported a high level of previous exposure to mental illness, which is shown to reduce stigma and prejudice [22]. However, level of contact and field of study were balanced across groups in this study. Future research can explore this question by recruiting diversified samples. It is also possible that the results may be driven by the character design; the human likeness of the character may not have been high enough to trigger a strong response, due to an uncanny valley effect [23,24]. The present methodology offers a way to bypass the ethical concerns that prevent stigma research exploring reactions to real people with a clinical diagnosis by utilizing an interactive virtual character [25]. However, the present study is limited in the way it used measures of general stigma towards depression rather than measures that assess specific attitudes towards the character in the study. It is however noted that the potential for social expectancy to exacerbate stigmatising attitudes should be considered in a character centered design [26,27]. Consideration of the uncanny valley also increases in importance when focusing on a character centric research design [23]. Future work should investigate the underlying cognitive and affective mechanisms that contribute to the manifestation of stigma, such as social cognitive processes.

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Breast Cancer Survivors' Attitudes Towards Internet-Based Psychotherapy

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Abstract. Breast cancer (BC) is the most common cancer among women and treatment has notable consequences on quality of life and recovery. Internet-based psychotherapy represents a useful resource to monitor and support BC survivors, yet no study to date examined attitudes towards internet-based psychotherapy in this specific group. We expect that participants' attitudes will be influenced by their general opinion about digital technology in therapy and self-curiosity. 48 women who had BC were invited to read the descriptions of four internet-based psychotherapy (i.e., *Webchat*, *Videoconference*, *Virtual Reality, and Avatar therapy*) and then responded to questions regarding their perceptions (e.g., useful, reassuring). Moreover, they filled in self-report questionnaires on internet-based therapy attitudes and self-curiosity. BC survivors were more positive towards technologies offering rich interaction with the therapist (*Virtual Reality* and *Videoconference*). General attitudes towards eHealth was associated with self-curiosity. Future research may further explore contingent and personal factors influencing acceptance of technological resources for psychotherapy in BC.

Keywords. Internet-based psychotherapy, breast cancer survivors, healthcare, attitudes, psychotherapy, psychological intervention

1. Introduction

Breast cancer (BC) is the most common cancer among women in the world and the second leading cause of death. Despite the advance in cancer treatment, BC patients can experience notable psychological consequences that impact their quality of life and recovery after care [1-3]. This is associated with the illness experience that changes individual lifestyle and activities, and reconfigures future plans. Survivors may also experience depression, anxiety, fatigue, and pain, as well as distortions in intimacy, such as loss of pleasure, sexual desire, and womanhood [4]. In this scenario, psychological support and psychotherapy may help to promote cognitive reframing and improve well-being. In traditional face-to-face psychotherapy, cancer survivors establish a therapeutic relationship with professionals and work on their psychological impairments, negative emotions, and questions of what they wish to learn from the therapeutic sessions [5-6]. The rise of the internet progressively changed the ways mental health treatment could be provided [7]. Alongside the traditional psychological support procedures, internet-based psychotherapy may be regarded as an alternative way of delivery modality, which allows mental health professionals to reach patients limited by geographical distance (e.g., living in rural areas), and possibly provides

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digital resources for monitoring such as health apps. The internet as a tool for treatment has been presented as a chance to inform the dissemination of psychological interventions. Evidence exists for the effectiveness of different internet-based interventions on various mental health disorders [8-9].

Psychotherapy via the internet includes for example videoconferencing psychotherapy [10]. Patients gain access to psychotherapists, overcoming barriers (e.g., geographical distance, limited access to treatment). Another kind of internet-based psychotherapy features web chat. Compared with other forms of communication such as e-mail or message boards, webchats are more interactive because the typed sentence is displayed immediately on the screen [11]. A third interesting tool is virtual reality, namely "*human–computer interface that allows the user to interact with and become immersed in a computer-generated environment*" [12]. It can be used to promote relaxation in patients and to treat psychological diseases by exposure therapy [13-14]. Finally, a resource for psychotherapy is represented by avatars. People could create a digital representation of themselves (avatar) that interacts with the professionals and/or others in a virtual environment. Avatars are customized by users and generally such customization represents aspects of their personality, self, and physical appearance that could be analyzed in the context of psychological assessment [15-18].

Although internet-based psychotherapy is becoming widespread worldwide, attitudes towards it in BC survivors are still not well known. Attitudes toward eTreatments have been mainly assessed among professionals and patients [19,20] but, to our knowledge, no studies investigated attitudes in BC survivors. Apolinário-Hagen et al. [21] developed a tool to explore public attitudes toward internet-based psychotherapy, the E-Therapy Attitude Measure (ETAM). Items assessed subjective beliefs and benefits of e-therapy and its comparability with traditional face-to-face psychotherapy. Items were grouped in two dimensions, namely *perceived usefulness (PU)*, and *advantage relative to face-to-face therapy (RA)*. As in Apolinário-Hagen and colleagues [21], we considered mean scores <1.5 (a median score of 0 or 1) as negative, values between 1.5 and 2.49 (median score of 2) as neutral, and scores ≥2.5 (median scores of 3 or 4) as positive attitudes toward internet interventions. Attitudes could be also influenced by individual traits, such as the attitude and interest in exploring one's own inner world (i.e., *Self-curiosity*), which may affects motivation to engage in psychological treatment. *Self-curiosity* is a psychological construct conceptually similar to introspection, reflection, and mentalization that allows humans to explore their psychological functioning, perceptions, and feelings. *Self-curiosity* is assessed by the Self-Curiosity Attitude-Interest scale (SCAI) [22-25], a 7-items scale with two dimensions: *Attitude towards Self-Curiosity* and *Interest in Increasing Knowledge of Self*.

2. Methods

The aim of the present study was to explore BC survivors' attitudes towards internet-based psychotherapy, with a focus on specific types of internet delivery. 48 women with a history of BC and with an age range between 36 and 68 years old (M_{age}= 50.23, SD_{age} = 7.06) participated in this study. The majority of them were highly educated (master degree or post-degree: n = 29, 60.42%) and lived with their partner (n = 30, 62.50%).

In order to explore attitudes toward internet-based psychotherapy, women were invited to read the descriptions of four scenarios of internet-based delivery of psychotherapy (i.e., *Webchat*, *Videoconference*, *Virtual Reality*, and *Avatar therapy*) and then respond to questions regarding their perceptions about the internet tools. Specifically, the following scenarios were presented to participants: *Psychotherapy via an internet chat (Webchat)*: Communication between psychotherapist and patient is carried out via chat; *Videoconferencing for patient-therapist communication (Videoconferencing)*: The communication between psychotherapist and patient is mediated by a webcam; *Shared Virtual Reality for relaxation (Virtual Reality):* The patient follows a structured and virtual reality-based internet treatment program to promote relaxation and positive emotional states; *Shared avatar creation (Avatar)*: The patient creates a personal avatar (customizable in appearance) and communicates directly with other users (patients and psychotherapists) and receives feedback in real time. The avatar is analyzed by the therapist. The avatar can be used to communicate meaning about their emotions and thoughts and to express facets of the self [26].

After reading each description of internet-based psychotherapy, participants rated on a 7-point Likert scale of agreement how much they felt any resource (*Useful*, *Effective*, *Reassuring*, *Reliable*, *Innovative*). Additionally, self-report scales were used in order to investigate participants' attitudes towards e-therapy and *Self-curiosity*.

3. Results

Descriptive analyses highlighted that the 48 women included in this study have positive attitudes toward guided internet interventions (ETAM: M = 3.19, SD = .59; PU: M = 3.72, SD = .56; RA: M = 2.87, SD = .70).

In order to investigate differences among participants' attitudes towards different kinds of internet-based psychotherapy (within-subject variable), we computed repeated-measures analysis of variance (ANOVA). Results showed that *Videoconferencing* and *Virtual Reality* were perceived significantly more *useful*, *effective*, *reassuring*, and *reliable* than *web chat* and *Avatar*. *Videoconferencing, Virtual Reality,* and *Avatar* were perceived significantly more *innovative* than *web chat* (Table 1).

Repeated-Measures Analysis of Covariance (ANCOVA) was computed in order to investigate whether the attitude towards e-therapy and *Self-curiosity* influenced participants' perceptions. Results revealed that *Videoconferencing* and *Virtual Reality* were perceived as more *useful* than others, also when controlling for e-therapy attitude. No results emerged for *Self-curiosity*, but correlation analyses revealed that it was significantly related to e-therapy-PU (.288*).

Table 1. Descriptive statistics and repeated-measure ANOVA of the participants' attitudes towards different kind of internet-based psychotherapy

	Webchat (*M,SD*)	**Videoconferencing (*M,SD*)**	**Virtual Reality (*M,SD*)**	**Avatar (*M,SD*)**	**F (*df*)**	***p***	$\eta2$
Useful	4.08 (1.76)	5.40 (1.40)	5.17 (1.33)	4.23 (1.75)	F(3) =13.21	<.001	.219
Effective	4.02 (1.55)	5.25 (1.44)	5.00 (1.26)	4.06 (1.47)	F(3) =13.91	<.001	.228
Reassuring	4.04 (1.57)	5.17 (1.49)	5.15 (1.32)	3.98 (1.56)	F(3) =13.94	<.001	.229
Reliable	4.27 (1.55)	5.15 (1.38)	4.83 (1.26)	3.98 (1.31)	F(3) =9.99	<.001	.175
Innovative	4.52 (1.86)	5.56 (1.43)	5.94 (1.00)	5.79 (1.25)	F(2.44)=15.49	<.001	.248

4. Discussion and Conclusions

Women with a history of BC were invited to read four scenarios of internet-based delivery of psychotherapy and then rated their perceptions about four internet tools. Results show that BC survivors tend to have a positive attitude towards guided internet interventions. Concerning the delivery modes, BC survivors tend to perceive *Videoconferencing* and *Virtual Reality* as the most *useful*, *effective*, *reassuring*, and *reliable* modalities. Such tools for internet-based psychotherapy include a direct video and audio interaction with the psychotherapist. In *Videoconferencing,* the communication between therapist and patient is mediated by a webcam but it is more "natural" and similar to face-to-face interaction in terms of non-verbal cues and taking turns in conversation. Similarly, in *Virtual Reality* the patient talks to the therapist who is connected to the virtual simulation and guides him/her through the experience to promote relaxation or positive emotional states. It is possible that women who had cancer appreciate those communication technologies that still assign a central role to the therapist and patients throughout the psychotherapeutic process. Additionally, the use of *Virtual Reality* allows the creation of situations closer to equivalent real ones, thanks to the high resolution [27]. This may provide patients with immersive environments in a similar way to real-life situations that can elicit a vivid "sense of presence" [28].

General attitudes towards eHealth partially influenced the results, and was associated with the curiosity to explore one's own inner world (*Self-curiosity*). Future research could further analyze patients' individual characteristics and their effects on technology acceptance in health and mental healthcare as well as the efficacy of these technologies in internet-based psychotherapy.

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Application of Virtual Reality in an ED Primary Prevention Context : An Exploratory Study

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Abstract. By combining aspects of the fourth generation of eating disorders (EDs) prevention programs with the advantages of the use of virtual reality (VR) in the field of education, two VR-based EDs prevention programs were created. To explores the physical self-perception time series level and variability, participants completed a weekly follow-up notebook. This study demonstrates that the use of VR in the prevention of EDs could positively influence the variability and possibly the evolution of physical self-perceptions among adolescents.

Keywords. Virtual reality, prevention, adolescent, physical self-perception

1. Introduction

Body image disturbances are a major risk factor of Eating Disorders (EDs). Co-occurrence of obesity and EDs constitutes two sides of the same coin in terms of health—physical and mental—among adolescents. Inappropriate attitudes and eating behaviours (IAEB; such as fasting, excessive physical exercise, and body dissatisfaction) represent up to 50% of the general population compared to clinical EDs representing 3% of the population [1]. Indeed, adolescents are particularly vulnerable to EDs because peer comments about weight or body shape can easily affect their self-esteem.
Physical Self-Perceptions (PSP) are defined as the perception and appreciation of oneself over time. As a multidimensional, hierarchical model, PSP integrates global self-esteem and body image, with global self-esteem at the apex; physical self-worth at the next level; and physical strength, sports competence, physical condition, perceived physical appearance, and body image at the foundation. PSP components are interrelated and can influence one another. Moreover, studies suggest that PSP vary according to the persons' situation and their emotional state [2]. Indeed, a positive or negative change in one of the PSP components almost instantaneously affects the proximal domain or subdomains of the entire PSP structure.

EDs prevention program has been shown recently to decrease IAEB and to boost PSP, by decreasing body dissatisfaction in adolescents, drive for thinness in girls, and desire for muscularity in boys [3]. These promising, but preliminary, results have allowed researchers to demonstrate the need for a fourth generation EDs primary prevention programs targeting positive PSP [4]. The fourth-generation primary prevention program for EDs applied in the school context should (i) take place in the person's ecological environment (ii) have a blind

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aim (i.e., not revealing the program objectives to the participants), (iii) address exclusively protective factors, (iv) integrate physical and mental health (e.g., obesity and EDs) and (v) target a specific population [4]. A decade of evidence on promising pedagogy using virtual reality-induced self-perception and self-sensation clearly makes room for new technologies, such as Virtual Reality (VR). In school context, VR is known to increase students' motivation to learn and accomplish tasks and improve learning [5]. Studies have shown that VR-based interventions are effective when used for EDs treatment [6]. Authors have shown that VR-based intervention can increase PSP, emotional engagement, feeling of presence and treatment adherence, reduce body dissatisfaction and eating habits and may allow users to enjoy physical activity and healthy eating [6–8]. By generalizing these results, it is reasonable to suppose that an EDs primary prevention programs including VR would have positive impacts on participants' motivation and PSP. No EDs primary prevention programs in Canada is VR-based. Thus, this idiographic study aims to explore the instantaneous evolution of PSP in students participating in two different school-based programs by [SO.1] exploring the idiographic level of PSP and [SO.2] the idiographic variability of PSP in students engaged in two VR-based EDs prevention programs.

2 Methods

2.1. Participants and procedures

This exploratory study was designed as a school-based controlled trial with an idiographic design and was approved by the Research Ethics Review Boards at the Université du Québec à Trois-Rivières [CER-17-231-07.26]. Two classes from a public high school (Chavigny) in Trois-Rivières, Québec (Canada), in first and second grade (i.e., aged 11 to 14 years old), agreed to participate and were randomly assigned to either to the EDs-only or SILENCE prevention program. Following parental and student consent, 37 adolescent students (i.e., 28 in EDs-only prevention programs and 9 in SILENCE program) completed a weekly follow-up notebook on 14 consecutive weeks.

2.2. Intervention

Thanks to financial support of RBC Royal Bank, the GR2TCA-Loricorps developed the **SILENCE program** and **EDs-only prevention program** grounded in the evidence-based principles of the fourth EDs prevention programs generation [4], with 18 lessons over 14 consecutive weeks. Both programs utilized a "full-blind" strategy in which users were unaware of the program's objectives. The **EDs-only program** focused on mental health and consisted of class lessons on preventive factors for EDs (i.e., peer, family and cultural influence, self-esteem, body image, etc.). The **SILENCE program** integrated mental and physical health (i.e., the EDs-only program enhanced with an interdisciplinary physical activity program for the obesity prevention). In both programs, students were in an educational situation where teachers (Annie J., Annie L., Josée and Mylène) highlight PSP protective factors using the graphic novel *Korkifaipo* and its virtual environment as transdisciplinary pedagogical support [9]. At three moments, students were immersed in the virtual environments using both the egocentric perspective (i.e., in the skin of the *Korkifaipo* characters) and the allocentric perspective (i.e., in front of each *Korkifaipo* character). First, participants were embodying the body of a virtual character representing an anorexia nervosa character in an egocentric perspective and were asked to explore the 3D environment. Then participants were asked to close their eyes and the experimenter change to the allocentric immersion. The same procedure was then followed as participants were embodying the body of a virtual character suggering from bulimia nervosa.

2.3. Measures

Instantaneous evolution of participants' PSP are assessed using a weekly follow-up notebook once a week for 14 consecutive weeks with an adaptation of the Body Image Questionnaire (QIC-EVA [10]) and an adaptation of the Physical Self-Inventory—short version (PSI-VSF [11]). The adapted QIC-EVA uses an analog visual scale of perceived and desired bodies to monitor body dissatisfaction. The response scale consists of a spectrum of body shapes and sizes. A freewriting area entitled "Personal and social events related to my answer" collects qualitative data. The PSI-VSF measures the intra-individual evolution of global self-esteem and PSP (see Table 1). For these questionnaires, participants respond to the items by drawing a vertical line, corresponding to the intensity of the chosen answer, on a 100 mm horizontal line called the "visual analog scale."

2.4. Statistical analyses

Descriptive analysis of a PSP time series (i.e., an extended set of successive observations, ordered and equally spaced in time) containing all 14 consecutive observations is applied. [**SO.1]** A paired *t*-test was used with the means of time series (PSP level) over the first week and those over the last week. [**SO.2]** All of the data from the 14 observations of the time series was treated with three paired *t*-tests to observe the variability between the two groups. The first *t*-test is performed using the mean of (i) the standard deviation, (ii) the ranges (the maximum minus the minimum of observation) and (iii) the mean daily changes (the difference between two consecutive observations of time series, such as $M[(x\text{t}-1)-x\text{t}]$ where xt is observation at time t) from week 1 of the time series to 4 (i.e., before VR exposure) and week 5 of the time series to 8 (i.e., during VR exposure). The second *t*-test was performed using the mean of (i) the standard deviation, (ii) the range, and (iii) the mean daily changes from weeks 1 to 4 (i.e., before VR exposure) and weeks 9 to 14 (i.e., after VR exposure). The third was performed using the mean of (i) the standard deviation, (ii) the range, and (iii) the mean daily changes for weeks 5 to 8 (i.e., during VR exposure) and weeks 9 to 14 (i.e., after VR exposure).

3. Results

No significant difference in the level of the time series was found. Results demonstrate (i) higher variability after VR exposure compared to before VR exposure and (ii) higher instability after VR exposure compared to during VR exposure over the time series of the overall mean of the ranges for several specific components of PSP with a moderate to large effect (η^2 between 0.12 to 0.20) (Table 1).

Table 1. Difference in the level of the two experimental group in the overall mean of the range

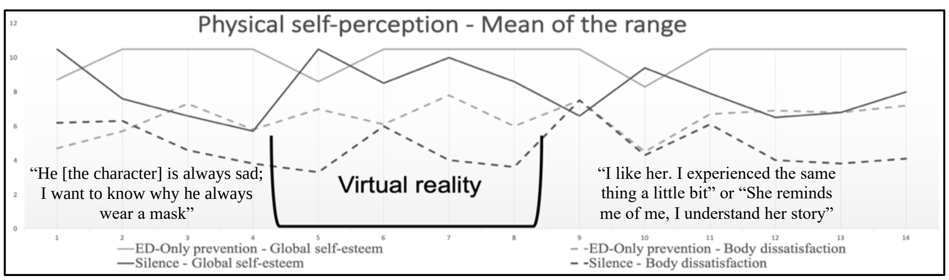
	After VR vs before VR in SILENCE group			After VR vs during VR in ED-only in SILENCE group		
PSI-VSF	M(SD)	*t(36)*	*P value*	M(SD)	*t(36)*	*P value*
GSE	-1.33(3.70)	-2.19	**0.006**	-1.16(3.22)	-2.20	**0.034**
PSW	-1.60(3.37)	-2.90	**0.035**	-1.47(3.36)	-2.67	**0.011**
PC	-1.77(3.55)	-3.04	**0.004**	-1.01(3.25)	-1.90	0.066
PPA	-1.10(3.06)	-2.18	**0.036**	-0.95(3.30)	-1.75	0.089
PS	-1.14(2.97)	-2.34	**0.025**	-0.67(2.62)	-1.56	0.129
SC	-1.25(3.31)	-2.29	**0.028**	-1.29(3.45)	-2.27	**0.029**
PB	-1.36(3.30)	-2.50	**0.017**	-1.27(3.35)	-2.31	**0.027**
DB	-0.55(1.48)	-2.28	**0.029**	-0.53(1.69)	-1.91	0.604

Note. GSE = global self-esteem; PSW = physical self-worth; PC = physical condition; PPA = perceived physical appearance; PS = physical strength; SC = sport competence; PB = perceived body; DB = desired body; M = mean; S.D. = standard deviation.

4. Discussion

This study evaluates the instantaneous evolution of PSP in participants of two EDs blinded school-based programs based on PSP using VR. This innovative study combines the advantages of VR in education and in EDs prevention and demonstrates that the EDs-only and SILENCE programs impact the variability of PSP (Figure 1). Variability of the PSP time series increases significantly after each VR exposure compared to before or during VR exposure. It could be explained by participants increased feeling of personal involvement, which could allow participants to experience the program more intensely. This interpretation is in line with the sociometer theory that the specific components of PSP vary according to context [12]. This study **highlights the use of VR to reinforce the effects of school-based EDs prevention programs**. While the results show no significant change in the level of PSP, the dimensions of PSP tend to improve during time. These results are consistent with studies which demonstrate non-significant improvement in several dimensions of PSP (e.g., self-esteem or body dissatisfaction) [13]. Filling in the gaps in studies that do not test for PSP variability, this study provided weekly results that allowed us to analyze temporal variability highlighting VR's positive effect on PSP over time. Qualitative data demonstrates that by being immersed in *Korkifaipo*, participants understand character's feelings: "he is always sad; I want to know why he always wears a mask." Students also associate their feelings with character through VR: "I experienced the same thing a little bit" or "She reminds me of me, I understand her story" (Figure 1). In addition, teachers agreed that VR has increased the students' motivation. The ecological momentary assessment could have led to difficulties in questionnaire completion if the place and time were not adequate [14]. To overcome this limitation, a mobile application allows to fill out questionnaires at a convenient time [15]. The blind characteristic included interventions as class lessons that could have contributed to the high non-response rate, especially for the ED-Only group.

Figure 1. Variability of PSP time series of the overall mean of the GSE and the BD from the two groups.



5. Conclusion

This exploratory study suggests that the use of VR in the prevention of EDs and obesity could impact positively the evolution of PSP. Further studies should be carried out on exploring the variability of VR-based EDs and obesity prevention programs.

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Blended transdiagnostic group CBT for emotional disorders: opinion of the online modules and group sessions

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Abstract. Internet-delivered Cognitive Behavioral Therapy (iCBT) for emotional disorders (anxiety and depressive disorders) has been proven to be effective. However, not all patients benefit from these treatments equally. Blended treatments (i.e. combination of Internet and face-to-face psychotherapy) may help to reduce this gap. The literature on blended treatments has focused primarily on individual psychotherapy and no studies on blended group psychotherapy for emotional disorders have been conducted to date. In addition, it is necessary to assess the acceptability of blended group psychotherapy to enhance the effectiveness of these interventions. This study aimed to describe a blended transdiagnostic group CBT protocol for emotional disorders and to present preliminary data about the opinion of the treatment of both online modules and group sessions. Overall, all participants reported high scores in all items measuring treatment opinion. To our knowledge, this is the first study to evaluate blended transdiagnostic group CBT in patients with emotional disorders. This study seeks to deepen the understanding of how this intervention works and facilitate ongoing adaptation of blended transdiagnostic group CBT for emotional disorders.

Keywords. blended CBT, group psychotherapy, transdiagnostic, emotional disorders, anxiety, depression

1. Introduction

Emotional disorder are prevalent disorders [1, 2]. The literature shows that Internet-delivered cognitive-behavioral therapy (iCBT) is effective for emotional disorders and can help to enhance the dissemination and implementation of evidence-based treatments [3-6]. Nevertheless, these treatments might not be beneficial for all patients. Blended treatments are a combination of Internet and face-to-face psychotherapy with the potential to reduce this gap [7, 8]. The existing studies on blended treatments have focused principally on individual psychotherapy and no studies on blended group psychotherapy for emotional disorders have been conducted to date. To our knowledge, there are not published studies that combine

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blended and group delivery formats to provide transdiagnostic treatments for emotional disorders. The objective of this study is to describe a blended transdiagnostic group CBT protocol for emotional disorders and to present preliminary data about the acceptability (in terms of opinion of the treatment) of both online modules and group sessions.

2. Method

2.1. Participants

The sample consists of 5 adults (80% women) (mean age: 36.20, SD: 13.88). Regarding marital status, 3 are single and 2 married or with a partner. With regard to the study level, 1 has no studies, 2 have basic studies, and 1 has higher education. Principal diagnoses were generalized anxiety disorder (n=3), major depressive disorder (n=1), and panic disorder (n=1).

2.2. Instruments

- Mini International Neuropsychiatry Interview (MINI): it is a 308 widely used structured diagnostic psychiatric interview to determine DSM-5 and ICD 10 diagnoses [9, 10].
- Opinion of the module questionnaire: it contains a question asking about the opinion of each module on a 10-point Likert scale (0=Not at all; 10= Extremely). This questionnaire is applied after each online module.
- Opinion of the group session questionnaire: it contains 7 items asking about the following aspects on a 10-point Likert scale (0=Not at all; 10= Extremely): 1) usefulness of the session for one's specific problem, 2) usefulness of the session for other psychological problems, 3) logic of the content, 4) difficultness of the session, 5) pleasantness of the session, 6) clarity of the content, and 7) global opinion of the session. This questionnaire is applied after each group session.

2.3. Treatment protocol

Blended transdiagnostic group CBT comprised six 2-hour group sessions alternated with the use an online platform during a period of 21 weeks. The treatment is a transdiagnostic CBT Internet-delivered protocol adapted from the Unified Protocol [11, 12] and treatment strategies derived from Dialectical Behavioral Therapy [13]. The intervention has four core components: present-focused awareness, cognitive flexibility, identification and modification of behavioral and cognitive patterns of emotional avoidance, and interoceptive and situational exposure. These components are delivered in 12 modules. More details about the online treatment platform and the contents of the modules have been published elsewhere [14].

3. Results

Results for the opinion of the modules questionnaires ranged from 6.00 (SD=1.41) to 8.80 (SD=1.64). The scores on the opinion of the group session questionnaire range from 6.80 (SD=1.30) to 9.60 (SD=0.55) (item 1: *usefulness of the session for one's specific problem*); from 7.80 (SD=1.64) to 9.20 (SD=0.84) (item 2: *usefulness of the session for other psychological problems*); from 9.00 (SD=1.00) to 9.40 (SD=0.88) (item 3: *logic of the content*); from 0.20 (SD=0.45) to 2.00 (SD=3.39) (item 4: *difficultness of the session*); from 8.00 (SD=1.87) to 9.00 (SD=1.00) (item 5: *pleasantness of the session*); from 8.40 (SD=0.55) to 9.40 (SD=0.55) (item 6: *clarity of the content*); from 9.20 (SD=0.84) to 9.60 (SD=0.55) (item 7: *global opinion of the session*).

4. Conclusion

The results suggest that this blended transdiagnostic group CBT protocol was well-accepted by participants with regard to both online modules and group sessions. This study seeks to deepen the understanding of how this intervention works and facilitate ongoing adaptation of blended transdiagnostic group CBT for emotional disorders. To our knowledge, this is the first study to evaluate blended transdiagnostic group CBT in patients with emotional disorders. However, more research in large-scale studies is needed to study the acceptability of blended group CBT.

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The intersubjectivity grid as "magnifying screen" for microanalyses of interactions in telepsychotherapy

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Abstract. Conducting psychotherapy with videoconference technologies has become a solution to deliver mental health services when it is difficult or impossible to meet in face to face. During videoconferencing psychotherapy (VCP), the interactions between the client and the therapists are influenced by telepresence and acceptance of the technological setting. In previous work, our group described acceptance of the technological setting in VCP as a multidimensional process that involves verbal, non-verbal, para-verbal and proxemic cues from both interactants. The goal of the present study is to illustrate the intersubjective dynamic processes occurring in psychodynamic-oriented VCP via traditional communication channels. The long-term goal is to describe how intersubjective processes enhance the level of acceptance of the technological setting in VCP. We used a formal interactional approach to analyze intersubjectivity and acceptance during an excerpt from a video recording of a VCP session. We analyzed the following layers of interactions to evaluate intersubjectivity and acceptance: interactional modalities, cooperation modalities, intersubjective modalities. Our results show a dynamic process of accordance between different layers of interactions, related to intersubjectivity process. Despite the perceptual deprivation, caused by the screen in a videoconference telepsychotherapy framework, the screen can allow a dynamic and multimodal communication. Much like a magnifying glass, our micro-analysis revealed a dialogic communication occurring on the video screen where several natural communicative registers converged into a dynamic unified system, increasing the expressiveness of the psychotherapeutic dialogue.

Keywords. videoconference telepsychotherapy, acceptance, intersubjectivity, interactions, telepresence

1. Introduction

For centuries, interactions between a client and a professional during psychotherapy has been occurring in face to face settings. However, since the last decades, the emergence of

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communication technologies and digital relationships have led researchers to refine our understanding on how we perceive another person over videoconference technologies.

Studies about videoconferencing psychotherapy (VCP) have shown that telepresence is associated with the development of a strong therapeutic alliance [1] and acceptance of the technological setting [2].

There are many studies in the VCP literature on the therapeutic alliance, but there are very few examining how acceptance of the technological setting in VCP becomes implicit and natural, and how it leads to telepresence. In our latest study [3], we developed a grid to examine the multi-dimensional interaction processes involved in VCP, including acceptance of the technological setting, based on verbal, non-verbal, para-verbal and proxemic cues for both interactants. This grid has been used to examine layers and outcomes of interactions and intersubjective levels of communication [2, 3] in VCP sessions conducted in Canada and France with psychotherapists delivering psychodynamic and cognitive-behavior therapies.

Our previous results revealed that different kind of breaks in acceptance of the technology could be observed during VCP sessions; some can be rapidly repaired by the client or the therapist, but others could lead to termination of the session. The grid we developed can be refined to construct a formal model of interactions characterized by acceptance of the telepsychotherapy setting that includes intersubjectivity in VCP.

In the current study, our goal is to illustrate a formal approach to evaluate intersubjective processes and acceptance of the technological setting in VCP using traditional communications channels used in face to face psychotherapy, and how it is applied in psychodynamic psychotherapy. Better understanding of these phenomena will contribute to improve the practice of VCP, and in E-health in general [4]. This is especially important in the context of current public health recommendations regarding physical distancing during COVID-19. We assume that intersubjective processes will enhance the degree of acceptance of the technological setting in VCP.

2. Methods

As part of a larger research project, the case was randomly selected among the list of participants who received psychodynamic psychotherapy over videoconference. The main selection criteria was not suffering of a psychotic disorder. During the first intake session, the therapist formally assessed the presence of psychotic disorder by asking about the presence / absence of positive and negative symptoms characterizing these disorders. The project was conducted in accordance to ethical principles in research (consent form, etc.). All therapy sessions were delivered in VCP and video recorded. The verbatim transcript was coded by one researcher and reviewed by the others. We selected one sub-sequence of a VCP session and we used a qualitative formal interactional approach to analyze intersubjectivity and acceptance of the technology.

The systematic observation and analysis method used an improved version of the grid [2, 3[1]] to target intersubjectivity. The multi-dimensional and multi-channel grid analyzed the following layers of interactions:

- interactional modalities: succession of signals: 1/verbal – 2/ non-verbal (eye-contact, "body language", posture);
- cooperation modalities: symmetry, synchrony or desynchrony of signals, regulation of the cooperation level through moments of synchrony and desynchrony;
- intersubjective modalities: correspondence between interactional and cooperation modalities.

[1] Contact the corresponding author for a copy.

3. Results: Example of the analysis of an original case

This sub-sequence of a VCP session conducted in French (Figure 1) illustrates an interaction between a female psychotherapist (referred to as P), and F, a 32-yrd old male single with no children. F studied in computer graphics and was looking for a job. His main complain was strong social anxiety and difficulties getting out of his apartment. He also complained about sever fear (terror) of water, in particular of the sea[2].

Signification of the codes: ↑ upward tone ; ↓ downward tone ; → accentuation of the syllable ; = no time between two speaking slots ; > < said on a higher tone ; < > said on a lower tone ; (.) very short break (0,1 second or less) ; (.figure) break time (.2): 0,2 second break ; [words spoken over each other ; *whispering* ; (()) all that happens during the statement.

P29: what you were staging were > scary things <(↑) =

F30: = not at all =

P31: = When you say > supernatural < it can be supernatural without necessarily being scary =

F32: = Completely yeah

P33: So what persists <on the other hand> in what you describe as > phobic behaviors <(.) is the <fear> (.) we will say (→) that is not necessarily present on the other hand in your artistic productions (↓)

F34: yeah (↓)

P35: Or maybe yes (↑) ((F looks up and makes a hand gesture as a sign of doubt)) Is this element of> fear < of something that is <fearful < is present in> all < your artistic productions also (↑) or not necessarily (↑)

F36: No (↓) ((he steps back and looks down)) No no uh (→) no (↓) > there is perhaps an element that played on fear < but it was a motion detector (↓)

P37: hum hum =

F38: = which thus triggered (.2) a radio turned on very <very strong> (.) near the spectator (→) effectively it created a surprise effect (.) =

P39: = yes =

F40: but hey it's not really (.) it was not scary (.) it played more on uh the effect of [<surprise> (↓)

P41: [hum hum

F42: No (→) things that (→) no no uh (→) no I could do> drawings < drawing that could be violent> things like that> ((L nods)) but it was not for student purposes or else (↑) it was just for me (↓) (.2)

L43: hum hum

F44: but (→) I wonder a little (→) about> that <because (→) I know that the directors of horror films like Roméro or > these people <(.)

L45: yes

F46: somewhere are (→) are also are > adulated <also because they rub on (.) their unconscious (↓) they rub on with (→) (.3) things that d d do some <terror> ((L acquiesces)) things that are very> scary <and it's true that →) well (→) I never had the> courage <really (.) to attack myself to such themes (↓)

L47: hum hum

F 48: Even if for example (→) I am going to have dreams that are going to be super violent (.3) ((shakes hand)) hum (.)

L49: Yes (↑) there have been dreams since we talked last time (↑)

F50: So (.) uh (→) ((touches his chin while getting excited)) Yeah there was, huh (↑)> me <the problem is that I sleep a little a lot

P51: hum hum

F52: I wake up late and (↑) I dream a lot (↓)

P53: Yes (↑)

F54: So the first dream I remember is (→)> this morning <=

P55: = yes =

F56: uh (→) I had a> nightmare <uh (→) where> my mother <was> present <, <yeah still the sea> and so it was (→) simply (.) We were stuck uh (→)

P57: hum hum ((nodding))

F58: Well we were in a > car <(↓) and there was (→) in fact a <band> of (.) thugs who (→) were taking over the car (↓) ((L nods)) so> yes < so suddenly we were> blocked <and therefore suddenly it was quite an adventure to precisely try to manage the mood of these guys uh (→) really completely> crazy <(.) ((L continues to nood)) and it ended> super bad <because (→) after several adventures, little (→) fights and so on (.) =

P59: = hum hum =

F60: thus believing that (→) the advent- this terrible adventure was coming to an end (↑) I realize that my mother has disappeared (↓) ((L nods)) and (→) there in fact in my dream I tell me "Oh F* she's actually being (→) raped" ((L nods again)) uh (→) because suddenly there were thugs who weren't there on the scene (↑)**

P61: hum hum hum hum

F62: uh (→) on the> scene < and thus I though it was over and in fact> no <my mother disappeared, and I think she is being raped (↓)

P63: hum hum

F64: and (→) at that time, the dream ended (↓) (.2) so here is a dream uh (he laughs, L smiles) with uh fabulous sweetness (→) =

P65: (smiles) = You woke up at the end of this dream (↑)

F66: Indeed (↓)

P67: And what state were you in when you woke up (↑)

F68: Oh well (→) it was not pleasant to (→) and then very quickly I got uh I brought myself to reasons (→) it was> scary <(P nodded) I was not> comfortable at all <

Figure 1. Verbatim of the excerpt of a VCP session and the corresponding coding

We can see in Figure 2 the several layers of interactions observed in the previous subsequence (Figure 1) when applying the analytic grid.

[2] In French, the words "mother" and "sea" are homonyms.

1- Interactional modalities:		**2- Cooperation modalities:**	**3- Intersubjective modalities:**
Verbal elements (themes, modalities of exchange)	*Non-verbal elements (eye-contact, "body language", posture)*		
Fear theme (F22 to L43): the psychologist asks questions about the cause of the fear, F says no to the suppositions.	F denies it also with, para-verbal cues: specific hand gesture, look and posture	We could observe a symmetry, a synchronisation and a regulation of signals between interactants, even if F doesn't agree with P	Good fit between interactional and cooperation modalities.
Transition (F44 to F48): the transition to the dream theme goes through a dialog where F compares himself to film directors who confront their fears and their unconscious. Even if he didn't watch these movies, he said he had violent nightmares. P restarts the dialogue asking him about his oniric activity.	F is making the transition through several silences and unhooking of the look, while he might be associating from the theme of the fear to the dream story.	As F was expressing his fear of the unconscious and therefore of the therapeutic relationship, P wasn't mistaken and relaunched on the dream activity of her patient.	Good fit between interactional and cooperation modalities.
Dream theme (F48 to L79): F says that he made a nightmare the morning before the session. He was in a car with his mother and a band of thugs. At some point, he realised that his mother was raped by some of the thugs. He said he woke up at this moment. After telling the dream, F makes an ironic statement	P nods in agreement while F tells the story of his dream and supports his speech ("hum hum") F voice tune is low during the story of the dream, which can cause issues with the microphone in videoconference. When F finishes telling his dream, he smiles and P smiles back	During the interactions, when an initiating act (i.e. a question) required a reflexive resort, we notice a slight body withdrawal in the patient's posture, while unhooking the look. Voice tonality also appears as a dynamic phenomena that goes with the dramaturgy of the sequence of events adressed in the narration. Smiles exchanges show as a sign of inter-comprehension and mutuality.	Good fit between interactional and cooperation modalities.

Figure 2. Layers of interactions observed when applying the analytic grid

4. Discussion

We can see in layer 1 of the micro-analysis of this sub-sequence that the criteria of a 'minimal dialog' are passed in the interactional modalities. A 'minimal dialog' is one in which both speakers could express their own point of view and be understood by the other. However, a minimal dialog is a necessary but not sufficient condition for intersubjectivity. The cooperation modalities in layer 2 revealed a synchronisation and regulation of signals. This confirmed intersubjective modalities of the interactions quoted in layer 3, for every part of verbatim. The VCP excerpt is very rich in semiotics in all domains: postural, gestural, para-verbal and linguistics. This is similar to face to face dialogical interactive communication. In this dialogue, the implementation of all the modalities of interactions appear synchronous and complementary. All these phenomena can be observed separately, the analysis of their parallelism shows a dialogic and dynamic communication, as figured by the two arrows in Figure 2.

This analysis illustrates that, in VCP, communication mediated by a video screen allows to establish dialogic communication, which justifies our methodological approach. Hence, perceptual deprivation caused by the format imposed on VCP does not necessarily prevent intersubjectivity. Even through only the upper portion of the client and the therapist body was visible to the camera, that direct eye contact was not possible, of that they were not in the same physical space, VCP does allow a dynamic and multimodal communication in psychodynamic psychotherapy.

Acceptance of the setting by both interactants seems supported by the intersubjective quality of interactions during video excerpt. Elements like silences, low voice tone or unhooking of the eye-contacts are not discordant and do not prevent continuous intersubjective processes.

Using videoconference and technological settings could actually be an activator of a dialogic communication dynamics that can lead to intersubjectivity. For researchers and clinicians, the video screen could represent a magnifying glass, where several natural communicative registers converge into a dynamic unified system, increasing the expressiveness of the psychotherapeutic dialogue. The current methodological illustration is an original contribution to the study of acceptance in VCP and intersubjectivity processes. Applying it to psychodynamic psychotherapy is also an interesting innovation. Acceptance appears as a dynamic phenomena that evolves as interactions unfold. For future studies, the methodology could be improved by using complementary measures, such as subjective perception of the interaction, telepresence, and facial expressions. The qualitative formal interactional approach allows to highlight unique dynamics in each VCP session. Using such a grid can be useful for the construction of training guidelines and document how psychotherapists deal with breaks of acceptance of the technological setting in VCP.

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Targeting the fear of gaining weight and body-related concerns in Anorexia Nervosa. Preliminary findings from a Virtual Reality randomized clinical trial.

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Abstract. Based on the preliminary findings of a randomized clinical trial with patients with Anorexia Nervosa (AN), this study aims to provide initial evidence of the usefulness of a Virtual Reality body exposure therapy. Method: 17 AN patients (9 in the experimental group, 8 in the control group) participated in the study. Fear of gaining weight (FGW), body anxiety, drive for thinness, body image disturbances (BID), Body Mass Index (BMI) and body-related attention were assessed before and after the intervention. Additionally, the experimental group underwent five sessions of VR body exposure therapy within the standard course of CBT, while control patients received the usual CBT. Results: After the intervention, there were clear reductions in ED symptoms in both groups. The reduction was especially marked in the experimental group. Finally, notable changes were recorded in dysfunctional body-related attention and BMI in the experimental group, but not in controls. Conclusion: To the best of our knowledge, this is the first study to focus on treating FGW, body-related concerns and body-related attention in AN using a VR-embodiment based paradigm. To pursue the analysis further, and to assess the effectiveness of this new VR software, larger controlled clinical trials should now be conducted.

Keywords. Virtual reality, anorexia nervosa, fear of gaining weight, body exposure therapy, body-related attentional bias

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1. Introduction

Previous studies have highlighted the need to address both fear of gaining weight [FGW; 1-2] and body image disturbance [BID; 3] in the treatment of anorexia nervosa (AN). Exposure-based interventions have been proposed as an appropriate method for the treatment of these disturbances [4]. However, exposure-based therapies such as imagery exposure have important limitations, such as the difficulty of achieving or maintaining visualization. The use of virtual reality (VR)-based exposure techniques may overcome these limitations and enable the use of novel methods such as embodiment techniques [5] for targeting body-related concerns and FGW.

The current study describes a technique involving VR body exposure to ED symptoms in AN patients to help them to recover healthy weight. It provides initial evidence of the usefulness of this VR-software based on the preliminary findings of a randomized clinical trial. Specifically, the experimental group was exposed to five additional sessions of VR body exposure therapy as part of standard cognitive behavioral therapy (CBT), while patients in the control group received the usual CBT. Reductions in FGW, body anxiety, BID, and body-related attentional bias, as well as increased BMI levels, were hypothesized in both groups, and were expected to be more significant in the experimental group.

2. Method

2.1. Participants

Eighteen adolescent patients (9 in the experimental group, 8 in the control group) participated in the study, with a primary diagnosis of anorexia nervosa (DSM-5) between 14 and 18 years old. Participants were recruited at the Eating Disorders Unit of the Hospital Sant Joan de Déu in Barcelona.

2.2. Instruments

Patients were exposed to immersive virtual scenario using a VR head mounted display (HTC-VIVE). In addition to the two controllers that HTC-VIVE usually provides, three additional body trackers were used to achieve full body motion tracking. Furthermore, VR HMD FOVE Eye Tracking was used to assess the body-related attentional bias. Virtual avatars were created by Unity 3D and Blender 2.78. The virtual environment was a simple room without any furnishings, with a large mirror placed 1.5 meters in front of the patient. A young female avatar wearing a basic white t-shirt with blue jeans and black trainers was created. Before starting the treatment (pre-evaluation) and at the end of the treatment (post-evaluation), the following measures were assessed:

- Evaluation of change in body weight: BMI.
- Eating Disorders Inventory-3 (EDI-3; Garner, 2004) drive for thinness (EDI-DT) and body dissatisfaction (EDI-BD) scales.
- Physical Appearance State Anxiety Scale (PASTAS; Reed, Thompson, Brannick and Sacco, 1991).
- Body Appreciation Scale (BAS; Avalos, Tylka and Wood-Barcalow, 2005).
- Figural Drawing Scale for Body Image Assessment (BIAS-BD*;* Gardner, Jappe, & Gardner, 2009), Body dissatisfaction (BIAS-O) and Body distortion (BIAS-X)

Evaluation of attentional bias towards the body:

- Complete time of fixation (evaluated in milliseconds) of the gaze towards weight-related and non-weight-related body parts.

- Number of fixations of the gaze towards weight-related and non-weight-related body parts.

2.3. Procedure

Prior to treatment, written informed consent were obtained from both patients and their parents. The VR exposure intervention consisted of five sessions that were administered by two general health psychologist with clinical experience in the treatment of adolescents. In the **pre-assessment session**, which lasted approximately one hour, the virtual avatar was generated by taking a frontal and lateral photo of the patient and creating an avatar whose silhouette matched the pictures by adjusting the different parts of its silhouette to the photographs. In the meantime, the other therapist administered the pre-assessment questionnaires and answered the patient's questions.
Next, the FBI was induced using two different procedures, a visuo-motor and visuo-tactile stimulation, both procedures lasted three minutes. Once the FBI was induced, the three VAS examining intensity of the FBI, body-related anxiety and the FGW were assessed.

According to the **treatment sessions**, each of the five-exposure session, lasted approximately 1 hour and took place once a week. The body exposure treatment was initiated with a virtual body with the same BMI as the patient. During the following sessions, the BMI of the avatar was progressively increased until the target weight (healthy BMI) was reached. During exposure to each avatar, the participant was asked to focus on different parts of the virtual body, by asking what they think and feel about them. In addition, the patient was asked about the level of anxiety experienced every 120 seconds throughout the exposure session (VAS-A). Once the anxiety levels had decreased by 40% with respect to the initial measure, the session was terminated.

Each of the following treatment sessions began with the next BMI increase. In cases where the initial whole-body anxiety had not fallen by 40% or if the exposure to various parts of the body had not been completed, exposure to the same avatar as the previous session was repeated.

2.4. Statistical analyses

The analysis software Ogama (Open Gaze Mouse Analyzer) was used to transform the eye-tracking raw data into suitable quantitative data. An additional data transformation was conducted by subtracting the difference between weight-related and non-weight-related AOIs. Therefore, a positive outcome would mean that the participant had been looking more at the W-related body parts than at the NW-related body parts, while a negative outcome would mean the opposite. Mixed between (group)–within (pre-post assessment times) analyses of variance (ANOVA) were conducted for all measures. The outcome of the intervention, including the AOIs data, was analyzed by the statistical software IBM SPSS Statistics v.23.

3. Results

Mixed between (Groups)-within (Time) analyses of variance showed statistically significant interactions between group and time in complete fixation time (F (1.13) = 8991, *p*= .010, η^2 = .409), number of fixations (F (1.13) = 5.459, *p*= .036, η^2 = .296) and BMI (F (1.16) = 5.418, p= .033, η^2 = .253).
Post-hoc analyses revealed significant group differences (p<.05) in post-assessment in BMI and complete fixation time. The experimental group reported significantly lower body-related attentional bias toward weight-related body parts (see figures 1 and 2), and higher BMI levels compared to the control group. There were also significant main effects of time (p<.05) in FGW, drive for thinness, body dissatisfaction, body distortion and body anxiety.

Overall, in the post-assessment, both groups showed clear reductions in ED symptoms (see table 1). This reduction was more evident in the experimental group.

Table 1. Mean and Standard Deviation of the pre- and post-treatment results as assessed by the following measures.

Measures	Pre-treatment session		Post-treatment session	
	Experimental	Control	Experimental	Control
EDI-DT	21.13 (5.35)	21.11 (3.94)	16.67 (5.61)	17.25 (6.97)
EDI-BD	25.78 (3.85)	28.38 (4.66)	21.22 (6.30)	25.63 (7.42)
PASTAS	18.56 (6.52)	21.25 (3.28)	13.67 (5.61)	19.66 (6.19)
BIAS-Body distortion	48.33 (20.92)	41.88 (11.32)	30.56 (18.91)	36.88 (10.33)
BIAS- Body dissatisfaction	45.56 (21.85)	37.50 (16.90)	27.38 (19.54)	34.78 (11.78)
BAS	27.56 (7.94)	27.63 (5.06)	31.67 (9.42)	30.25 (9.72)
VAS-FBI	42.00 (31.63)	45.63 (32.89)	66.11 (26.78)	47.50 (21.21)
VAS-A	43.33 (33.17)	42.50 (30.12)	37.22 (25.87)	45.63 (31.10)
VAS-FGW	81.11 (22.04)	82.50 (27.12)	58.33 (21.79)	78.75 (24.75)

Note: Body Mass Index (BMI), Eating Disorder Inventory (EDI-3) drive for thinness (DT) and body dissatisfaction (BD) scales, Physical Appearance State and Trait Anxiety Scale (PASTAS), Body Image Assessment Test (BIAS), Body Appreciation Scale (BAS), Visual analog scales (VAS) of full-body illusion (FBI), body anxiety (A) and Fear of Gaining Weight (FGW).

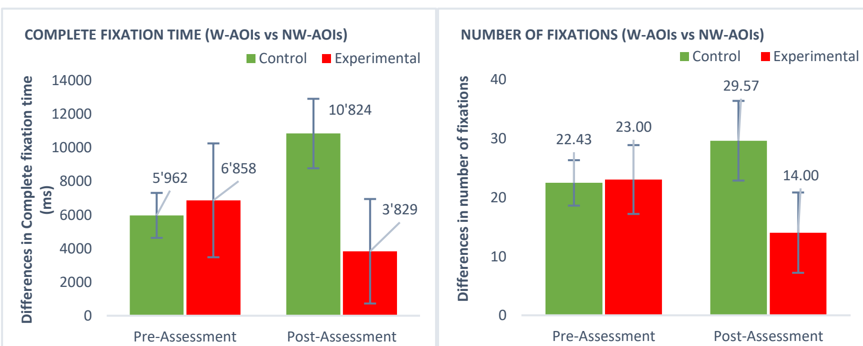

Figure 1 and 2. Group differences (experimental vs control group) in mean complete fixation time, in milliseconds (*ms*), and number of fixations at weight vs non-weight-related Areas of Interest (AOIs), for each assessment time condition. Error bars represent standard error (SE), based on 2SE. Note: VB= Virtual body.

4. Conclusion

This study describes an innovative VR-based exposure procedure which obtained promising results for enhancing CBT in ED.
Specifically, our results showed that patients at the experimental group reached a faster weight restoration and showed a significantly reduction of body-related AB compared to patients at the control group, at the post-assessment and follow-up. While promising non-significant tendencies were also found at other body-related measures, such as FGW, body distortion, body anxiety, body dissatisfaction, drive for thinnes, and body appreciation. These results are important since a weight restoration is considered as one one robust predictor of remission from AN and it is necessary for recovery [6].
Regarding body-related AB, a key aspect to understand these results might rely on the procedure conducted at the experimental group, in which, patients had to focus on different parts of the virtual body (from the head to the shoes) and were asked to orally express what they think and feel about those body areas. Thus, since patients had to look at those parts

during certain amount of time, and every session, it could be expected that they would have also reduced their AB toward weight-related body areas, spreading their attention more equally among all parts of the body. Indeed, similar procedures have been conducted in previous studies with women with high BD, in which a temporary AB toward (un)attractive body areas were induced to reduce BD levels among healthy women [7-8]. To pursue the analysis further, and to assess the effectiveness of this new VR software, a randomized clinical trial with a larger sample should now be conducted.

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Artificial Intelligence in mental health: professionals' attitudes towards AI as a psychotherapist

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Abstract. Nowadays, Artificial Intelligence (AI) is used in the healthcare field, especially to identify diagnosis and treatment. Yet, mental health professionals (e.g., counselors, psychiatrics, and psychotherapists) are skeptical towards AI for practice. Some mental health professionals harbor negative attitudes towards AI because it lacks feelings, emotions, and active listening, or they are not confident in their own ability to use technology. Moreover, attitudes towards technology may be influenced by professionals' methodological approach, which may be more or less open to automatization or informatization of activities. In a preliminary study, 100 mental health professionals were presented with a description of a futuristic AI that could play the role of a psychotherapist and treat mental health patients, then they filled out a questionnaire on perceived usefulness, performance and other attitudes relevant to technology acceptance research. We hypothesize that methodological approach to psychotherapy (cognitive behavioral vs. psychodynamic vs. systemic-relational) would be associated with attitudes towards AI in mental health. Results showed that professionals with a cognitive behavioral approach were more positive than the others regarding AI. In particular, cognitive psychotherapists evidenced higher belief of utility and desirability towards AI. In addition, they were more comfortable with AI than others. AI tools should be developed cautiously, taking into account professionals' attitudes and viewpoints.

Keywords. artificial intelligence, psychotherapy, perceived usefulness, mental health, psychotherapy approach

1. Introduction

Artificial Intelligence (AI) is defined as autonomous intelligent technologies designed to perform activities by specialized intelligent functions capable of reasoning and learning [1]. Today, AI is widely employed in clinical medicine and the healthcare field in general, not just to support medical decisions but also to generate new knowledge and promote patient engagement [2], [3] and it is promising for the mental health field as well [4]. New technologies offer innovative opportunities for psychological diagnosis and treatments generally [5]. The main contribution of AI to medical practice is diagnostic decision support [6, 7]. Furthermore, AI is used in medicine to model organizational practices and behavior, in order to improve the effectiveness of medical systems. Finally, eHealth and Digital

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Therapeutics, namely technologies that directly interact with patients to support health management, are expected to feature more and more AI-based solutions [8, 9, 10]. The use of AI to directly interact with patients is not new. ELIZA was, for instance, a chatterbot developed by Weizenbaum in 1966, a pioneering conversation program that emulated (and someway mocked) psychotherapy [11]. Nowadays, AI-supported psychotherapeutic devices are based on therapeutic apps (e.g. chatbots) which explore patients' symptoms to address depression or anxiety over short message services [12] and assess psychological states [13, 14].

To sum up, AI could be an interesting tool for mental health interventions, by facilitating tailored therapy and promoting users' skills of autonomy and individual competencies [15]. On this basis, can we imagine that AI will play an active role in mental health treatment in the future?

Mental health professionals' attitude towards AI is ambivalent: some of them think that AI can be integrated with information collected via human-to-human interaction [16]. Resistance could be also related to mental health professionals having concerns for delicate ethical issues [17] or employment-related insecurities connected to the risk of being replaced by AI [16]. Finally, the effect of the introduction of AI within the patient-doctor relationship (even in the mental health field) is still to be understood, especially from the point of view of the patient [10].

As a consequence, psychotherapists' beliefs on AI create a clear gap between the current development and the possibility to adopt these tools in clinical settings [4]. For this reason, it is important to identify individual characteristics of professionals that could help or hinder the adoption of AI-based technologies in psychotherapy. One relevant individual characteristic could be methodological approach to psychotherapy, which could vary notably and influences mental health professionals' convictions and practice.

2. Methods

The sample was composed by 100 certified mental health professionals (90 females, mean age = 35.04, DS=6.68). Participants were distributed across three among the most widespread methodological approaches to psychotherapy practice, namely:

- cognitive behavioral (n=29): a directive psychotherapy approach that supports patients in achieving personal challenges by promoting healthy cognitive representations and behaviors. It is always structured and limited in time, involving homeworks to transfer the cognitive and behavioral strategies learned from the therapeutic setting to real life contexts [18, 19];
- psychodynamic (n=29): focused primarily on changes in unconscious states and mental structures, it works on patients' deep personality structures to obtain symptom remission [20];
- systemic-relational (n=42): considering individuals as part of a system (such as family and society), operates on the main individuals' relationships. Often employs couple or group psychotherapy and one of the most used tools is the dialogue technique [21].

Research participants were asked to read a brief description about a futuristic Artificial Intelligence (AI) that could play the role of a psychotherapist. The description of the AI was as follows: "AI is able to use many data of patients and it is possible that, in the future, it would work in the place of a human psychotherapist identifying the best interventions and monitoring patients daily. For example: AI monitors patients collecting and elaborating individual data related to their lifestyle and everyday symptoms; moreover, AI answers to patients' questions and builds a psychotherapy intervention".

Then, participants were asked to respond to questions on their attitudes towards this type of AI usage and related individuals' beliefs and emotions. First, based on the literature on attitudes towards technology acceptance and adoption [22, 23], the participants were asked to rate the described AI in terms of utility (the belief that using the technology will improve treatment effectiveness and related results and satisfy the metal health needs), easiness of use (the belief that employing the technology will be free of effort), individuals sensations (being comfortable and safe in using of AI), and individuals' positive expectations (the belief that psychotherapy will show positive outcomes) results on a 1-7 Likert scale. Secondarily, AI was assessed in reference of being innovative, desirable, and realistic/possible to implement on a 1-7 Likert scale.

3. Results

ANOVA analysis evidenced differences between psychotherapy approaches in reference to AI utility and desirability and being comfortable with AI. Overall, results showed a tendency to significance in terms of AI Utility. In particular, cognitive psychotherapists showed the highest positive attitude towards AI in mental health contexts and post hoc analysis confirm differences between groups. In particular, cognitive behavioral believe more in the AI utility than other approaches. In addition, cognitive psychotherapists report being more comfortable with AI than psychodynamic and systemic-relational professionals. Finally, desirability towards AI is higher in cognitive psychotherapists as well (see Table 1)

Table 1: Differences attitudes by psychotherapy approaches towards AI

	Cognitive behavioral (M, DS)	**Psycho-dynamic (M, DS)**	**Systemic-relational (M, DS)**	**F**	**p**	**eta squared**
AI Utility	3.62, 1.63	2.62, 1.67	2.86, 1.45	2.97	.05	.05
AI improve results	3.28, 1.75	2.41, 1.5	2.52, 1.38	2.83	.06	.05
AI easiness of use	2.97, 1.7	2.52, 1.4	2.76, 1.59	.59	.55	.01
Being comfortable in using AI	2.76, 1.57	1.83, 1.33	1.83, 1.12	5.01	.008*	.09
Being safety in using AI	2.59, 1.37	2.07, 1.58	1.98, 1.19	1.83	.16	.03
AI answers to needs	2.31, 1.6	1.83, 1.39	1.67, .90	2.22	.11	.04
Good expectations	2.83, 1.67	2.10, 1.63	2.26, 1.39	1.79	.17	.03
Innovation	4.27, 1.62	4.55, 1.86	4.6, 1.75	.07	.92	.002
Desirability	3.14, 1.9	2.31, 1.56	2.17, 1.22	3.66	.02*	.07
Realistic	3.24, 1.35	2.66, 1.39	2.95, 1.45	1.18	.31	.02

4. Conclusion

This study reveals the influence of psychotherapy approaches on attitudes towards AI. In particular, findings showed more positive attitudes towards AI by cognitive behavioral psychotherapists compared with other approaches. For example, AI could be perceived appropriate for dealing with cognitive reframing and appraisal in a cognitive-behavioral psychotherapy, because this approach makes more frequent use of variables and tools that could be automatized and mathematically computed (e.g., assessment, psychological tests, structured exercises). On the contrary, psychodynamic and systemic professionals may feel that a machine would not be able to interpret the true meaning of unconscious states or systemic relationships. In any case, mean values tended to be low across all sample, indicating that mental health professionals are not very positive towards AI performing treatment. In conclusion, future developments of AI tools in mental health should explore psychotherapists' doubts, as well as focus on new ways to represent complex psychological variables as computational objects. We assume that age and other socio-demographic variables may be additional relevant factors with an influence on attitudes towards AI in mental health practice, as well as the implementation of user centered design of AI that take into account professionals' needs and representations. Future research interested in attitudes towards AI adoption in mental health should take into consideration the characteristics of specific fields and approaches.

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Tackling trauma with technology: Treating chronic combat-related PTSD in Canadian Armed Forces personnel and Veterans with 3MDR

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Abstract. Introduction: Military members (MMs) and Veterans (Vs) are at risk of developing combat-related, treatment resistant posttraumatic stress disorder (TR-PTSD). The effectiveness and acceptance of Multi-modular Motion-assisted Memory Desensitization and Reconsolidation therapy (3MDR) is being studied with 40 Canadian MMVs with TR-PTSD. Objectives: To measure PTSD symptoms of Canadian Armed Forces (CAF) MMs and Vs with TR-PTSD, and the technology acceptance and usability of the 3MDR intervention with the CAREN technology in this population. Methods: Through a mixed-method randomized waitlist-control cross-over study, quantitative and qualitative data will be collected pre/post-intervention and at 1, 3, 6 and 12 months follow up. Blood and saliva will be obtained to measure biomarkers related to PTSD. Data was analyzed using repeated measures linear regression, and qualitative thematic analysis. Results: Eleven participants have completed the 3MDR intervention. Preliminary results demonstrate a clinically significant reduction in PTSD symptoms, with 27% of participants no longer met the DSM5 diagnostic criteria for PTSD post-intervention. Statistically significant pre-post decreases in mean score on multiple measures of PTSD symptoms, emotional regulation, and moral injury were observed. The expectations of the MMs, Vs, therapists (n-5), and operators (n=2) regarding technology acceptance and usability were met. Participants indicated significant functional, health and wellbeing improvements in relation to the psychosocial domain after completing the intervention. Conclusion: Preliminary results are promising and are trending toward 3MDR being an effective intervention for TR-PTSD and moral injury in Canadian MMs and Vs.

Keywords: 3MDR, PTSD, Military, Veteran, trauma, virtual reality

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1. Introduction

Military members (MMs) are at elevated risk of post-traumatic stress disorder (PTSD) and moral injury (MI). PTSD is the most common condition associated with military service. Characterized by exposure to a traumatic event(s), PTSD symptoms include negative cognitive intrusions, avoidance, hypervigilance, and alterations in mood, arousal, and reactivity [1]. Among Canadian MMs and veterans (Vs), PTSD rates have been reported at 11% [2] and approximately 16% [3] respectively. In addition to PTSD, MMs and Vs are at risk of developing MI upon exposure to potentially morally injurious experiences (PMIEs) that directly or indirectly violate deeply held moral values or beliefs [4]. MI is considered to be a trauma syndrome that can result in psychological, emotional, spiritual and interpersonal distress [4]. The realities of modern warfare put MMs at risk of both PTSD and MI, particularly in situations where ethical and moral dilemmas are frequent. While gold standard treatment for PTSD, including Cognitive Behavioral Therapy (CBT), Cognitive Processing Therapy (CPT), Prolonged Exposure (PE) and Eye-Movement Desensitization and Reprocessing (EMDR) [5] can reduce PTSD symptoms, some MMs and Vs may experience treatment-resistant PTSD (TR-PTSD) [6]. General recommendations for TR-PTSD have been suggested, but specific evidence-based TR-PTSD and MI therapies are lacking.

1.1 (Multi-modular Motion-assisted Memory Desensitization and Reconsolidation (3MDR)

Multi-modular Motion-assisted Memory Desensitization and Reconsolidation (3MDR) therapy is an emerging intervention for combat-related TR-PTSD and MI. 3MDR is delivered in an immersive Computer Assisted Rehabilitation ENvironment (CAREN) which is a room-sized, 3-dimensional, VR-system with a centrally-located treadmill that is surrounded by 240-degree floor-to-ceiling screens with motion-capture technology. During each of six 90-minute 3MDR sessions, a participant continually walks on the treadmill with a clinician standing alongside. 3MDR involves a repetitive cycle including: (A) a brief pre-platform warm-up phase during which the participant walks while listening to self-selected music reminiscent of their military deployment(s); (B) a platform phase which involves a series of seven 4-5-minute cycles of active therapy. Each cycle focuses on 1 of 7 images where the participant describes the traumatic scenario as well as associated physical sensations, emotion words, and thoughts. A ball displaying a series of numbers (which the participants reads out loud) then briefly appears, moving back and forth horizontally across the screen in the foreground of both the image and the emotion words. The cycle then repeats for the remaining 6 images. Following a cool-down, (C) a post-platform phase provides an opportunity for review of the session and discussion of new insights and a self-care plan. The theory and progression of 3MDR administration has been detailed in other publications [7]. Assessing the effectiveness, acceptability and usability of 3MDR among MMs and Vs is important in determining the potential future clinical utilization in these populations.

1.2 Objectives

This paper will present preliminary results from a study that aims to investigate:

- The impact of 3MDR on PTSD symptoms among MMs and Vs with TR-PTSD;
- Technology acceptance and usability of the 3MDR technology among MMs, Vs, 3MDR therapists and CAREN operators.

2. Methods

This mixed-methods randomized control-waitlist trial employs a cross-over design. An experimental group (N=20) of MMs and Vs with TR-PTSD receives 6 sessions of 3MDR; a waitlist control group (N=20) receives usual treatment, and then 6 3MDR sessions. Participants are followed at 1,3 and 6 months after completion of 3MDR. Quantitative data, consisting of clinical outcome measures, is statistically-analyzed. Qualitative data of participants' experiences are collected and thematically-analyzed. An in-depth protocol paper outlining the methods in detail has recently been released [8].

2.1 PTSD and MI

Symptoms of PTSD are measured using the Clinician-Administered PTSD Scale (CAPS5) [9], PTSD Checklist (PCL-5) [10], and Difficulties in Emotion Regulation Scale (DERS-18) [11]. The CAPS5 was administered by trained clinician-researchers while the PCL-5 and DERS-18 were administered weekly pre-intervention and at 3- and 6-months post-intervention. MI is assessed using the Moral Injury Symptom Scale Military - Short Form (MISS-M) [12].

2.2. Technology Acceptance and Usability

The unified theory of acceptance and use of technology (UTAUT) model addresses the perceived expectations of technological acceptance and usability of new technology in 5 domains: 1) Performance Expectancy (PE), 2) Effort Expectancy (EE), 3) social influence (SI), 4) facilitating conditions (FC) and 5) Behavioral Intentions (BI) which have a direct impact upon use behavior [13]. The UTAUT Model guided the creation of an outcome measure specific to the participant's perception of technology acceptance and usability of 3MDR with the CAREN. UTAUT surveys were also administered to 3MDR clinicians (n=5) and operators (n=2).

3. Results

See Table 1 for demographic information regarding the MM and V participants (n=11).

Table 1. Descriptive statistics of MMs and Vs participants (n=11) of the 3MDR study.

Gender	n (%)	Marital Status	n (%)	Age (Years)	n (%)	Currently Employed	n (%)
Male	10 (90.9)	Common-law	2 (18.2)	18 to 29	0 (0)	Yes	6 (54.5)
Female	1 (9.1)	Divorced	1 (9.1)	30 to 39	1 (9.1)	No	5 (45.5)
		Married	5 (45.5)	40 to 49	9 (81.9)		
		Separated	1 (9.1)	50 to 59	2 (18.2)		
		Single	2 (18.2)	60+	0 (0.0)		

(1)

Table 2. Pre/post test results of the Wilcoxon sign-ranks test demonstrating effect of 3MDR on PTSD symptoms (CAPS5, PCL-5), emotional regulation (DERS-18) and MI (MISS-M).

	Pre-Intervention		Post-intervention			
Outcome Measure	Mean	SD	Mean	SD	Z-Score	P value
CAPS5 Symptom Severity	46.8	3.7	14.4	3.2	-2.67	0.01

CAPS5 Symptom Number	32.4	14	10.7	5	-2.32	0.02
PCL-5	49.7	12.7	43.7	17.3	-1.94	0.05
MISS-M	58.1	12.9	52.27	14.2	-2.1	0.04
DERS-18	54.1	9.6	50.6	12.9	-2.197	0.05

(2)

3.1 PTSD and MI

Results (n=11) demonstrated statistically significant reductions in PTSD symptom severity (Z=-2.67, P=.01) and number of symptoms (Z=-2.32, P=.02) experienced by the participants post-3MDR intervention (Table 2). The DERS-18 showed an improvement in emotional regulation (Z= -2.20, P=.03; Table 2). MI symptoms showed statistically-significant improvements pre/post 3MDR ((Z=-2.10, P=.04; Table 2). Notably, 27% of participants no longer met the criteria for a diagnosis of PTSD up to the 3-month follow up.

3.2. Technology Acceptance and Usability

MMs' (n=4), Vs' (n=6), therapists' (n=5) and operators' (n=5) intention to use 3MDR was determined using a partial least square (PLS) path model. PE and EE were the most prevalent indicators of an intention to use 3MDR in MMs and Vs while PE and FC were the most prevalent for therapists and operators. SI was the least prevalent indicator for all participants. The resulting non-significant differences in pre/post scores indicated perceived technology acceptance and usability expectations were met for the MMs, Vs, therapists, and operators (P=.624).

4. Discussion

Preliminary results of this 3MDR wait-list control trial are promising for MMs and Vs with TR-PTSD and MI. Amidst a paucity of evidence-based interventions for TR-PTSD, our results show not only a reduction in symptoms, but 27% of participants no longer meet the diagnostic threshold for PTSD. It is possible that combat-related trauma necessitates the simultaneous engagement of multiple biological, cognitive and affective systems to have a positive effect. 3MDR's unique immersive and multi-modal approach may give it an advantage over other treatment modalities with MMs and Vs with TR-PTSD. It is possible that addressing both PTSD and MI in 3MDR has contributed to favorable treatment outcomes. Emotional dysregulation associated with traumatic experiences coupled with an inability to reconcile moral and ethical components within personal belief schemas may be an underlying mechanism driving some of the pathology of both MI and PTSD. The multi-modal nature, novelty and acceptance of the technological components of 3MDR and the CAREN by participants, clinicians and operators may also be a contributing factor and illustrates 3MDR's potential as a first-line PTSD and MI intervention.

5. Conclusion

Preliminary results are promising and highlight the potential for 3MDR to be an effective and feasible intervention for MMs and Vs with TR-PTSD and MI. If proven to be effective and worthy of widespread use, research into the portability, utilization and accessibility of the technology for MMs, Vs and other trauma-affected populations would be warranted.

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SECTION VI

WORK IN PROGRESS

It is important to emphasize the importance of developing technological strategies (such as artificial intelligence or augmented reality) that can provide either new enhanced experiences or technological systems also nurtured by artificial intelligence techniques developed by humans.

These new mixed ICT tools might evolve into experts in "helping others," with the objective of making our net-shared experience increasingly more competitive, creative, and capable in the task of helping others. Of course, this has significant ethical implications, which will also need to be explored at greater depth.

Botella, Riva, Gaggioli, Wiederhold,Alcaniz, and Banos, 2012

Drafting the Psychological Sublime Brain: A Pilot EEG Study

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Abstract. Only recently, neuroscience has devoted attention to one of the most fascinating phenomena that has captured human imagination for centuries, that is, the psychological sublime or awe. Defined as an emotion arising from vast overwhelming stimuli, it has been investigated consistently, i.e., outlining its facial, experiential, behavioral, and cognitive correlates, while far little is known about the underlying neurophysiological mechanisms. The aim of this study is to elucidate the neurophysiological correlates of the laboratory experience of the psychological sublime in a pilot sample of 5 young healthy Italian participants. Five young Italian adults were exposed to four immersive virtual reality environments (VREs), three validated for the elicitation of instances of the psychological sublime and one as control condition, in a counterbalanced order. Stimuli were delivered through an Oculus rift DK2 and simultaneous electroencephalographic (EEG) recordings were performed. Functional connectivity (FC) analyses were performed in the main frequency bands to extract local and global characteristics of the neuronal network. During the sublime experience, we expected differential FC patterns among the three-sublime inducing VREs and compared to the control condition. Compared to the control condition, high mountains showed a significant increase of FC network strength in theta band, while Earth view showed a decrease of FC network strength in beta band. At the link-level, also Tall Trees featured an increased FC in inter-hemispheric connections in theta and alpha bands. This is the first study elucidating the neurophysiological correlates of a dynamic sublime experience and drafting brain activity during different instances of the psychological sublime. Our preliminary results demonstrate the importance of exploring the brain interactions at multiple spatial scales and frequency bands, opening new avenues in our understanding of the neuronal response to awe.

Keywords. Psychological Sublime, EEG, emotion, Functional Connectivity, Virtual Realit

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1. Introduction

The concept of the sublime has brough about intense interest in scholars and researchers from various fields (e.g., art history, philosophy, architecture, psychology) [1, 2] for many centuries. The sublime results both as a cross-cultural concept, which has been discussed in Greco-Roman, Indian, Chinese, and Japanese cultures [2], as well as a long-standing concept, which is well rooted into the philosophical discourse [3, 4], but has established in the psychological and neuroscientific domain only recently [4, 5]. According to this last current view of the psychological sublime, this should be conceived as an emotion displaying specific physiological, neural behavioral patterns as well as specific consequences for people life in general. Psychological works on the sublime have demonstrated the great potential of this emotion for human flourishing and progress [6-9]. However, there are only preliminary, though promising, findings elucidating the peculiar neural mechanisms of this emotion [10]. Extant evidence suggests that sublime experiences engage brain regions that differ from those involved in the experience beauty. Specific regions within the default mode network (DMN) - activated during rest as well as self-referential processing and attenuated during goal-oriented activities [11, 12] - resulted involved in a static sublime emotional experience elicited by means of pictures [10]. Recent fMRI studies proposed that awe contributes to decrease self-reflective thoughts through the underlying brain mechanisms [13]. Here, we explored the neurophysiological correlates of the ongoing experience of the sublime, using electroencephalography (EEG) while exposing participants to different instances of the sublime in Virtual Reality (VR) [14]. We assumed differential patterns of activation across different instances of the psychological sublime, and vs. the control condition.

2 Methods

Five participants (2 females, mean age sample = 26.8 years; S.D. age sample = 1.66 years) were enrolled from the Italian general population. All participants had no balance or vestibular disorders; one was expert in VR, another had previous experiences with simulate technologies and three declared no previous experiences with VR. The participants were exposed to four immersive virtual reality environments (VREs), three validated for the elicitation of different instances of the sublime [14] (i.e., High Mountains, a Waterfall, and the Earth) and one taken as a control neutral condition (i.e., a clearing), in a counterbalanced order, delivered through an Oculus rift DK2. During the sublime experiences, electroencephalographic (EEG) recordings were performed using a Geodesic EEG system equipped with a 64-channel sensor net (Electrical Geodesic Inc., Philips, the Netherlands). Self-reported measures (arousal, valence, awe, and presence) were administered to monitor sublime changes before and after each exposure (see [14]), A debriefing was included. The participants were fully informed about the study and provided their written consent. The processing pipeline included, for each VRE, the analyses of (i) self-reported measures and (ii) functional connectivity (FC) between all pairs of EEG sensors. FC was computed in the main EEG frequency bands theta [θ (4–8 Hz)], alpha [α (8–13 Hz)], beta [β (13–30 Hz)], using the magnitude squared coherence, which is a frequency-based measure of correspondence between two signals. The resulting FC matrices were then compared across conditions both locally, in each network connection, and globally, in the entire network. Specifically, we computed paired sample t-tests to detect significant link-level or network-level changes in the three VREs vs. the neutral VRE. Significance thresholds were set to p=0.001 and p=0.05.

3. Results

The distribution (average and S.D.) of awe, arousal, valence, and sense of presence for each VRE is shown in Fig 1. Mountains resulted as the most awe-inducing environment. In the network-level FC analyses, despite the small sample, we found (i) a significant increase of whole-brain FC strength in the theta band during the Mountains experience ($t = 2.96$, $p < .05$), (ii) a significant decrease of whole-brain FC strength in the beta band in the Earth view condition ($t = 3.02$, $p < .05$), vs. the neutral condition. Such global trends reflected significant link-level FC changes, which emerged especially in the low frequency range. The link-level FC analyses showed that all sublime instances enhanced the theta and alpha FC, at locations that largely varied across VREs. Of note, the Tall Trees emphasized the inter-hemispheric FC in the theta and alpha bands much more than Mountains and Earth view compared to the neutral condition.

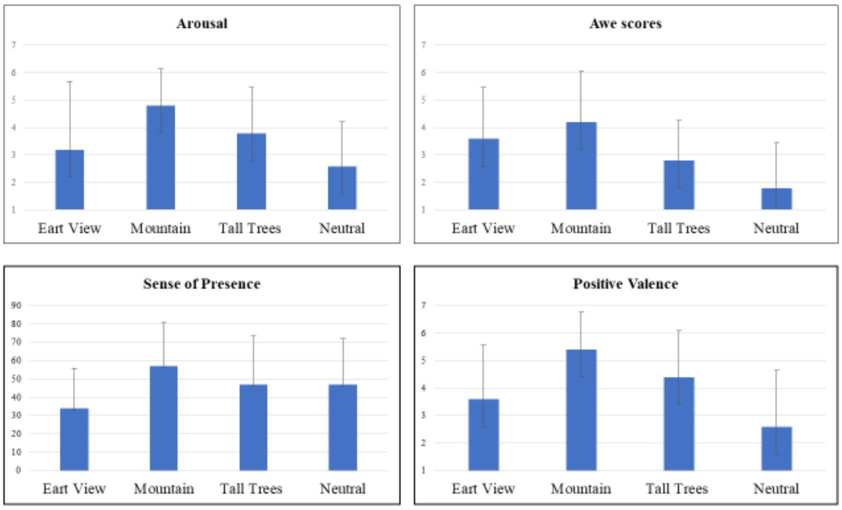

Fig. 1. Means and SD of arousal, awe, valence, sense of presence in each VRE

4. Conclusions

If previous studies focused on static neural images of the sublime, in this pilot, innovative EEG study we aimed to measure the brain network signatures of the ongoing experience of the sublime elicited by different validated prototypical elicitors of the psychological sublime. By investigating FC at multiple frequency bands and spatial scales, we have unveiled complex patterns of interactions among brain regions even in our small sample. Several connections showed significant FC increases in the theta and alpha bands , which were the most affected by the exposure to the three target VREs. The most "paradoxical" scenario (i.e., Earth view) led to a significant decrease of whole-brain FC compared to the control condition in the beta band. Communication within this frequency range is usually associated to an alert state [15] and resulted as reduced in this environment, as it happens in meditative states. Earth view might activate a brain network usually involved in meditative practices, thus suggesting a different attention directed towards the self. A potential reduced focus on the self was more manifest in alpha waves, which showed significant FC increases from the neutral condition to all sublime conditions, especially the Tall Trees, at the link level. This pattern may also suggest the involvement of novel stimuli processing, as well as a potentially reduced focus on the self [16, 17]. Mountains featured a significant increase of theta FC global network strength (vs. neutral condition), thus suggesting an implicit processing of positive emotional stimuli [18-20]. These results were in line with the nature of psychological sublime, also defined as a self-transcendent experience [7-9, 21]. The increased whole-brain network FC strength in theta and alpha bands in all target conditions, can be easily explained with the epistemic essence of the psychological sublime [22, 23], which can lead also to an increase in our creative thinking potential [24]. These results, albeit preliminary, can suggest not only that a deeper analysis of the psychological sublime is needed, but especially that it may be no longer useful referring just to a single "psychological sublime". Instead, it would be better considering different instances of the sublime. This can be a key aspect in real-life implementation of sublime-eliciting stimuli exposure for healthy people and patients.

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A Virtual Reality tool for the Assessment of the Executive Functions

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Abstract. Background: The limitations of traditional neuropsychological tests and several difficulties in administering tests in real-life scenarios have led to the increasing use of technological tools and virtual reality (VR) for the assessment of executive functions (EF) in real-life. VR enables the development of scenarios that, reproducing daily life situations, allows an ecologically valid evaluation of EF, guaranteeing rigorous control over key variables. Several studies have adopted a multimodal approach to integrate the EF assessment through the identification of new indices and non-verbal response using different devices such as eye trackers (ET) and electroencephalograms (EEG). Objective: The main aim of this study is to propose a protocol for assessing the EFs by using an innovative technology-based task, a new app that integrates EEG and an eye-tracker. Methods: Participants are subjected to a 15/20 minute evaluation with a new technological instrument involving innovative tasks for the assessment of EFs. Each subject explores a domestic virtual scenario aiming to get out of it as fast as possible, overcoming seven different steps of increasing complexity. Through the LooxidVR device, it is possible to receive information from the eye-tracker (e.g. saccadic movements, fixations) and EEG (electrical activity of prefrontal cortex) in addition to verbal responses. Expected results: This protocol allows evaluating several EFs (e.g., planning, problem-solving) through an innovative technology-based task. Moreover, this innovative tool facilitates the acquisition of non-verbal information regarding the executive functioning of the subjects. Conclusions: This innovative app, that integrates EEG and an eye-tracker, will provide clinicians with more information about executive functioning in a short time.

Keywords: Virtual Reality, Assessment, Executive Function, Eye Tracker, Electroencephalograms

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1. Introduction

The assessment of executive functions (EFs) represents a challenge due not only to the complexity of the construct [1] but also to methodological difficulties related to their assessment [2–5]. Chan and colleagues described EFs as “an umbrella term comprising a wide range of cognitive processes and behavioural competencies which include verbal reasoning, problem-solving, planning, sequencing, the ability to sustain attention, resistance to interference, utilisation of feedback, multitasking, cognitive flexibility, and the ability to deal with the novelty" [6–8]. EFs are traditionally assessed with paper-and-pencil neuropsychological tests based on the theory, such as the Modified Wisconsin Card Sorting Test [9] or the Trail Making Test [10], which guarantee the standardized scores. However, several studies have shown that these tests are unable to reliably predict the "complexity" of executive functioning in real life settings [4,6,11,12]. Since EFs play a key role in everyday life [13] and independent functioning, it is necessary that clinical tests of EF have ecological validity [14]. An attempt to overcome this issue is the development of tests able to evaluate the different components of executive functioning in real life scenarios [3,15], such as the Multiple Errands Test, which involves performing simple tasks in a real supermarket [12]. The assessment of EF in real-life settings showed the advantage of giving a more accurate estimate of the patient's deficits than within laboratory conditions [16]. Nevertheless, such assessments also have limitations, such as long times, high economic costs, difficulty of organisation, poor controllability of experimental condition or applicability with patients with motor deficits [17]. Given these difficulties, there has been an increasing use of technological tools and virtual reality (VR) for the evaluation of FE in real-life settings. VR enables the development of scenarios that reproduce situations of daily life, allowing an ecologically valid evaluation of FE [18–21], ensuring rigorous control over key variables [18]. For example, the virtual version of the Multiple Errands Test (VMET) has been developed and successfully tested in various clinical populations, such as Parkinson's disease and Obsessive-Compulsive Disorder [22–24].

Over the years, several authors tried to further explore executive functioning through the identification of new indices and non-verbal response using different devices such as eye trackers (ET) and electroencephalograms (EEG). ET allows for tracking and recording in real-time the eye movements of subjects (e.g., saccadic and antisaccadic movements, fixations). The combination of ET and VR advantages (e.g., natural stimuli, natural movement, controlled environment and controlled data collection) makes it possible to answer many research questions in a radically innovative way. The gaze of the subject can be calculated within the 3D virtual environment and where the subject is looking during the session can be observed. Moreover, ET allows defining regions of interest in 3D space and fixation time of each region [25]. Coherently, several studies, which have adopted such multimodal approach, have showed differences between patients with compromised EF and healthy control subjects [26]. On the other hand, EEG is used to record, monitor and analyze the electrical activity and any anomalies affecting the prefrontal cortex and related associated cortico-subcortical circuits, involved in EF [27]. To date, very few studies have successfully integrated these two devices [28], and current studies have mainly focused on children [29].

2. Objective

The main aim of this work is to propose a protocol for assessing EF through an innovative technology-based task, a new app that integrates EEG and ET.

3. Methods

This protocol was designed to quickly obtain various information on executive functioning, of both healthy control subjects and neurological patients with executive dysfunction (e.g., Parkinson Disease and Mild Cognitive Impairment). This protocol provides for a complete assessment of EFs through a new VR tool that makes use of an innovative task and technological device "LooxidVR". "LooxidVR" is comfortable Mobile-powered VR headset combined with ET and EEG sensors. It records physiological signals, collecting the participants' eye (pupil size and position) and brain (6-channel, 24-bit EEG signals) data simultaneously while immersed in a virtual environment. Moreover, this technological device allows for engagement in virtual environments delivered via smartphones. These environments reproduce domestic settings, in which the participants must perform several tasks. Before starting the evaluation, the participants undergo a phase of "familiarisation" with the technological instrument. By wearing the headset, subjects are completely immersed in a neutral virtual environment that they can freely explore. This phase is designed to prevent the results from being contaminated by external causes (e.g., dizziness). Subsequently, participants are involved in a 15/20 minute evaluation with the "new technological instrument". In this phase, the subjects are immersed in different virtual experimental environments in which they must perform an innovative task for the assessment of executive functioning. The examiner encourages participants to explore the virtual environment freely. In light of the importance of evaluating EFs in real-life (ecological validity), the chosen virtual environments are common domestic environments such as the kitchen, bedroom, living room and landing.The main goal of the executive task is leave the domestic setting in the shortest possible time. To do this, the participant must plan a strategy and overcome seven different sub-tasks of increasing complexity. At each stage, the subjects must perform and successfully pass a sub-task that evaluates a particular EF. In each level, the subject is asked to answer to a sub-task, choosing between three or more "chances", according to the task's request. Several alternatives are shown to the subject, but only one of these is useful to him to continue his journey. In line with the choice of virtual environments, the sub-tasks represent situations that reproduce scenes of everyday-life that ask the subject to make different decisions accordingly. The global task is designed with the aim to tap different components of executive functioning through the seven sub-tasks (e.g. planning, decision-making, attention, problem-solving, working memory). For example, the first step aims to assess the ability of problem-solving and decision-making. The participant must explore the environment until he sees a landing with a closed door. The job is to open the door by choosing one of the three options that are provided, that is key, bottle, and screwdriver. The examiner accompanies and guides the participants along the entire path: provides the instructions of the sub-tasks, collects all verbal answers of the subjects and manages the transition from one level to another of greater complexity. If the subject chooses a wrong alternative (i.e., does not pass the level), the investigator will have to immediately stop the test. Since this instrument evaluates the actual status of executive functioning of the participants, the examiner will not be able to provide any suggestions to the subjects during the evaluation. The use of LooxidVR allows for further exploration of executive functioning; in fact, in addition to verbal responses, the examiners can obtain novel significant information from the ET (i.e., saccadic and antisaccadic movements, fixations) and EEG (electrical activity of prefrontal cortex).

4. Expected results

This innovative technology-based task allows for the quick assessment of EF through verbal response (choosing between three or more "chances"), reaction time and non-verbal data by ET and EEG.

5. Conclusion

This innovative app that integrates EEG and ET will allow clinicians to obtain integrated data about executive functioning in a short time and assess several executive abilities, such as planning, decision making, problem-solving, attention and working memory simultaneously. Moreover, it ensures executive functioning can be assessed while participants perform every-day tasks in a virtual environment that reproduces real-life context (ecological validity). Finally, this app allows testing complex cognitive functions of daily life in an enjoyable way.

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Deep-dream 360° Virtual Reality videos for stimulating creativity: A pilot study

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Abstract. Altered states – as induced by altering substances or mindful experiences - are connected with higher levels of creativity. Deep-dream 360° virtual reality videos are being used successfully to simulate altered states in participants. The present study aims to pilot-test whether two deep-dream 360° videos with different layers of distortion can be used to stimulate creativity in subjects and evaluate their emotional response. Twenty-eight participants took part in the experiment. Albeit non-statistically significant, results show that both deep-dream 360° videos generate higher levels of creativity and higher emotional arousal than the non-modified control video.

Keywords. Deep dreaming, hallucination, creativity, virtual reality, emotions

1. Introduction

Altered states of consciousness imply a condition in which the person experiences an alteration of normal mental patterns, which includes temporal and visual distortions, ego-dissolution, and in general a hallucination-like experience [1, 2]. Such states are usually induced by psychedelic drugs, pathological conditions or meditative activities [3]. These states – obtained in different ways – seem to encourage creativity [5], and they may be configured as transformative experiences [5]. Recently, this kind of altered state experiences has been simulated through the use of 360° panoramic videos modified with deep convolutional neural networks (DCNNs) [6] and it has been proved that DCNN-stimulated altered states resulted in modifications of subjective experiences. However, there is no clear evidence that DCNN-modified videos and the consequently altered state contribute to higher levels of creativity.

Consequentially this study wants to pilot-test if two 360° DCNN-modified videos can induce higher levels of creativity after the baseline, compared to a non-modified 360° video. Additionally, emotional valence and arousal of the videos are tested.

2. Methods

The study employs a mixed design, comparing 2 experimental conditions (DCNNs videos) to a control group (non-modified video), with pre-post measurements for creativity, emotional arousal and valence, and after experience between-group measures of perception of distortion, and induced emotions. After completing the baseline measures, the participants viewed the videos using a head-mounted display, sitting on a swivel chair to prevent balance issues but promote a 360° exploration of the virtual environment. After the experience, they completed the rest of the measures.

2.1. Virtual Environments

The environments were created using clips from 360° panoramic videos from a validated database [5] and DCNNs [6]. Different DCNN parameters were used to create two environments, one middle layered (see fig. 1 b) and one high layered (see fig. 1 c). The control video was not modified (see fig. 1 a). The middle layered (1b) Deep Dream video uses standard Googlenet Caffemodel parameters (layers = 'inception_4b/output'). The high layered (1c) Deep Dream video was generated by selecting a higher DCNN layer, which responds selectively to higher-level categorical features (layers = 'inception_3b/output', octaves = 3, octave scale = 1.8, iterations = 32, jitter = 32, step size = 1.5 -b loop). The final edited clips amounted to 6 min. and therefore were mirrored and edited together for a total length of 12 min.

a b c

Figure 1. Still images from the VR environments: (a) original (control); (b) middle layer modification (low intensity stimulus); (c) high layer modification (high intensity stimulus)

2.2. Participants

Twenty-eight participants (F=20, 71.4%) took part in the study and were randomly allocated to the three conditions. Mean age of the sample was 22.82 years old (s.d.=1.645).

2.3. Measurements

The participants completed the following pre-experience measures:

- Torrance Test of Creative Thinking (subtest 4; improvement of a product) to assess the participants' levels of creativity. The test presents the participants with a situation: they have to write down all the modification they came up with to make an elephant toy more fun for children. Participants' solutions are coded according to the test manual and four scores are calculated: fluency (number of interpretable and relevant ideas), flexibility (number of categories of relevant responses), originality (statistical rarity of the responses), elaboration (amount of detail in the responses) [7].

- Self-assessment Manikins (SAM) quick, nonverbal method of quantifying subjective feeling states on the valence and arousal dimensions.

In addition to another round of SAM, post-experience measures were:

- Torrance Test of Creative Thinking (subtest 5; unusual uses). Comparable to the above-mentioned subtest 4 and scored in the same way, subtest 5 asks the participants to list interesting and unusual uses of a cardboard box [7].

3. Results

Mixed ANOVAs for three dimensions of creativity show a main effect of the pre-post measures: fluency $F(1,25)=5.306$, $p=.030$; flexibility $F(1,25)=8.805$, $p=.007$; originality $F(1,25)=39.196$, $p=.001$; elaboration does not seem to yield significant results for main effect of time ($F(1,25)=.134$, $p=718$). There is no effect of condition [fluency $F(1,25)=.784$, p.=.468; flexibility $F(1,25)=1.289$; originality $F(2,25)=1.803$, $p=.186$), p.=.293, elaboration ($F(2,25)=1.143$, $p=.335$] or interaction between conditions and time [fluency*condition $F(2,25)=1.216$, p.=.313; flexibility*condition $F(2,25).178$, $p=.838$; originality*condition $F(2,25)=1.447$, $p=.254$; elaboration*condition $F(2,25)=.039$, $p=.962$] for all TTCT dimensions. Table 1 shows mean scores and standard deviations for the TTCT dimensions and it is interesting to note that the highest layer modification achieved the highest scores in the post-experience measurements.

Table 4. Mean scores and standard deviations for the TTCT dimensions in the three conditions.

	TTCT Fluency		TTCT Flexibility		TCCT Originality		TTCT Elaboration	
	m(s.d.)$_{t0}$	m(s.d.)$_{t1}$	m(s.d.)$_{t0}$	m(s.d.)$_{t1}$	m(s.d.)$_{t0}$	m(s.d.)$_{t1}$	m(s.d.)$_{t0}$	m(s.d.)$_{t1}$
Control Video	12.40 (5.73)	17.10 (7.76)	7.00 (1.94)	10.50 (4.22)	4.50 (3.50)	12.10 (7.17)	6.70 (4.08)	6.70 (4.73)
Middle layer modification	12.11 (7.89)	12.22 (6.32)	6.11 (3.10)	8.22 (4.46)	4.89 (5.44))	9.56 (6.40)	7.22 (4.94)	8.21 (8.46)
High layer modification	13.33 (5.67)	18.22 (9.79)	6.56 (2.01)	9.56 (3.43)	7.00 (5.5)	16.52 (8.02)	9.78 (4.55)	10.22 (5.78)

Non-parametric Kruskal-Wallis tests for both deltas of arousal [$H(2)=3.245$, $p=.197$] and valence [$H(2)=4.269$, $p=.118$] perceptions are non-significant but mean scores show a trend toward increased emotional activation, with the high layer modification video having the greater delta between pre and post measurements (see table 2).

Table 5. Means and standard deviations for the deltas of the manikins measurements

	SAM_Arousal - Δm (s.d.)	SAM_Valence - Δm (s.d.)
Control Video	.25 (.88)	.33 (1.07)
Middle layer modification	.77 (1.39)	-.44 (1.01)
High layer modification	1.44 (1.33)	-.11 (1.16)

4. Conclusions

Hallucinatory states, such as those induced by psychedelic substances, can produce mood and cognitive positive long term effects. These effects have been studied in clinical populations and several double-blind, placebo-controlled RCT demonstrated positive effects of hallucinatory states in conditions such as depression [8] and mood disorders, alcohol and substance abuse [9]. However, these studies rely on the administration of psychoactive substances, which requires regulations and could potentially harm the participants. In recent years, technological development brought massive innovations in the field of virtual reality and artificial intelligence [10-13]. These technological advancements, however, have not yet been systematically explorer nor the possibility of combining artificial intelligence and virtual reality has been studied, especially in healthy participants. Nonetheless, these innovations can provide powerful instruments not only to address clinical conditions but also to enhance the function of healthy individuals, fostering for example creativity, creative thinking and flow states. Moreover, such applications could also be useful in specific subpopulations, like adolescents to foster creative thought and cognitive restructuring but also in clinical or subclinical populations as well such as people with internalizing problems, enhancing the ability of the individual to rescript dysfunctional cognitive constructs [14]. In the present pilot study, we tested the possibility to enhance creativity in healthy participants, providing simulative hallucinatory experiences mediates by technology via 360 videos altered through a hallucinatory deep neural network (DCNN). Results indicate that the 360° exposition was able to enhance participants creativity suggesting a potential effect of the 360° technology as a mean to foster creativity, however, no significative interaction effect was found when the 360° technology was paired with the hallucinatory distortion produced by the DCNN. Several explanations can make sense of these results. Albeit the interactions were not significant, this can be due to the small sample size of the groups and further investigation with larger sample size is needed in the future. However, the lack of significative interactions could also be explained by recent conceptual frameworks regarding hallucinatory experiences. Specifically, Mediano, Rosas [15] suggest that hallucinatory experiences relies on the ability of these experience to enhance brain entropy (as neural signal diversity). In this context, hallucinatory experiences could be effective not only because they can modify and alter the perception of the outside world, but more likely because they enhance the entropy of the brain from within. The authors investigated how brain entropy is modulated by visual inputs and found an inverse relationship according to which brain entropy during hallucinatory experiences is larger when participants' eyes are closed and that the hallucinatory experiences are disrupted when participants are viewing a video. Speculatively, these results suggest that multisensory conflicts between outside (e.g., visual, and auditory) and inside (e.g., interoceptive) inputs could disrupt the effectiveness of the hallucinatory experience in enhancing the brain entropy. In this context, merging virtual reality [12, 16-18] and DCNN technology with interoceptive technology [19-21] could provide a multidimensional system able to generate immersive hallucinatory experiences. This preliminary study has several limitations that, nonetheless, will be addressed in future studies providing stronger and more reliable evidence regarding the effect of DCNN hallucinations. Specifically, future studies could incorporate physiological measures such as heart rate variability (HRV) in a pre-post design, thus providing higher sensitivity outcomes, further exploring the hypothesis that this kind of technological solution might also modify the user's physiological response.

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The BIAS-VR. Assessing body image disturbance using a virtual reality software. Preliminary results.

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Abstract. Aim: The current study presents initial data on the psychometric properties of a new Virtual Reality (VR)-based body image assessment software (BIAS-VR). Body image distortion and body image dissatisfaction were assessed in two different conditions: perceived and ideal body size were evaluated a) when participants were embodied in a virtual body, and b) when participants saw the virtual body in front of them. Method: 26 female college students participated in the study. Before starting the VR-assessment tasks, body image distortion and body image dissatisfaction were measured using a paper-based silhouette test. Body dissatisfaction, drive for thinness and body anxiety were also assessed using questionnaires, and actual body mass index (BMI) was measured. Then, participants were randomly exposed to both assessment conditions in a counterbalanced order. Participants' body dissatisfaction (the discrepancy between perceived and ideal BMI) and body distortion (the discrepancy between perceived and actual BMI) were calculated in each condition. Results: Paired-sample t-test showed no significant differences (p>.05) between conditions when assessing either body distortion or body dissatisfaction. Pearson correlations showed significant, moderate and large positive and negative correlations (p<.05) between the BIAS-VR and the other body image-related questionnaires. Conclusion: BIAS-VR shows good convergent validity and may be an adequate tool for the assessment of body image disturbance. However, further research into the influence of BMI and the role of embodiment techniques is required.

Keywords. Body image distortion, body image dissatisfaction, virtual reality, embodiment, assessment.

1. Introduction

Body image disturbance (BID) has been strongly associated with several negative psychosocial consequences, such as depression, anxiety and social impairment, and is considered a risk factor for developing an eating disorder (ED) [1]. BID involves dysfunctional cognitions, attitudes, and emotions related to the way in which individuals experience their own body shape or weight [2]. Among the tools most widely used to assess BID are figural rating scales, in which individuals must select their perceived and ideal body size from among a series of silhouettes ranging from very slim to very large [3]. Even though paper-based instruments show robust psychometric properties [4], recent studies have used new procedures in which body image representations are assessed using more realistic computerized human-based 3D scales [5,6,7] and embodiment techniques [8]. Thus, virtual reality (VR) not only allows the creation of a

3D body with the same proportions and physical particularities as the participants, but makes them feel that this virtual body is their own by using embodiment-based procedures [8,9].

The aim of this study is to provide initial data on the psychometric properties of the VR-based Body Image Assessment Software (BIAS-VR), a new version of a previously developed 2D software [5]. The BIAS-VR allows participants to modify the width of a 3D virtual body in order to generate a figure that represents their perceived body image (a virtual body with the BMI they believe that they have) and a figure that represents their ideal body image (a virtual body with the BMI they would like to have). Once these tasks are completed, the software estimates participants' body image dissatisfaction (the discrepancy between perceived and ideal BMI) and body image distortion (the discrepancy between perceived and actual BMI). In this study, the BIAS-VR was administered in two different conditions: a) participants were embodied in the virtual body using visuomotor synchronization and were then asked to generate their perceived and ideal body image (the embodied condition); b) participants saw the virtual body in front of them and, from this perspective, were asked to generate their perceived and ideal body image (the non-embodied condition). Furthermore, the relationships between body image distortion and body image dissatisfaction according to the BIAS-VR, in both embodied and non-embodied conditions, and other body image-related measures were also assessed.

2. Method

Twenty-six female college students from the University of Barcelona (M_{age} = 21.96, *SD* = 1.89; M_{BMI} = 22.85, *SD* = 4.90) participated in the study. After providing signed informed consent, participants were measured in order to calculate their actual BMI, and then completed a battery of tests. Body image distortion and body image dissatisfaction were assessed using a paper-based silhouette test (*Body Image Assessment Test*; BIAS-BD) [4], and body dissatisfaction, drive for thinness and body anxiety were assessed by means of questionnaires: *Eating Disorder Inventory* (EDI-3) *drive for thinness* (DT) and *body dissatisfaction* (BD) scales, *Physical Appearance State and Trait Anxiety Scale* (PASTAS), and *Body Shape Questionnaire* (BSQ). Then, participants were administered the BIAS-VR in the two conditions (embodied and non-embodied) in random order. Starting from a female or male 3D virtual body with a BMI of 22.5 kg/m^2, participants could increase or reduce the body size (BMI) of the virtual body they owned (the embodied condition) or saw in front of themselves (the non-embodied condition) in order to represent their perceived and ideal body size (Figure 1).

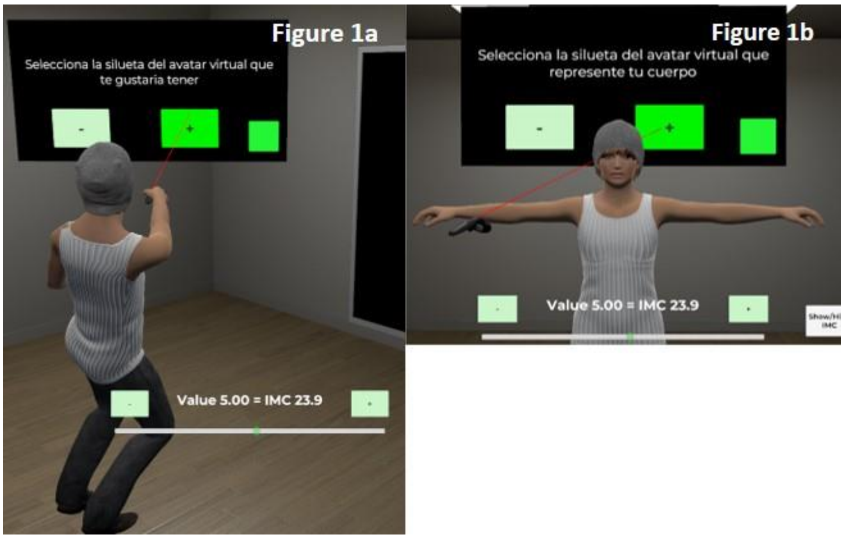

Figure 1. Body image assessment tasks in the embodied (a) and non-embodied (b) conditions.

3. Results

Paired-sample t-test showed no significant differences (*p*>.05) between the two conditions (embodied and non-embodied) in either body image dissatisfaction or body image distortion measures as assessed by the BIAS-VR. Overall, and independently of the condition, students tended to overestimate their body size (i.e., perceived BMI was higher than actual BMI) and desired to have a slimmer body (i.e., perceived BMI was higher than ideal BMI). Pearson correlations were also conducted to assess the relationship between body image distortion and body image dissatisfaction measures of the BIAS-VR (in both embodied and non-embodied conditions), and other body image-related questionnaires (Table 1). The results showed that:

Table 1. Pearson correlations for the main variables of the study.

Measures	Body distortion (BIAS-VR) embodied condition	Body dissatisfaction (BIAS-VR) embodied condition	Body distortion (BIAS-VR) non-embodied condition	Body dissatisfaction (BIAS-VR) non-embodied condition
Body distortion (BIAS-BD)	-.392*	.544**	-.361	.529**
Body dissatisfaction (BIAS- BD)	-.009	.357	-.126	.525**
EDI-BD	-.510**	.722**	-.628**	.633**
EDI-DT	-.499**	.537**	-.461*	.483*
PASTAS	-.599**	.689**	-.625**	.620**
BSQ	-.506**	.757**	-.613**	.635**
BMI	-.821**	.695**	-.856**	.627**

***Note*:** Body Image Assessment Test (BIAS-BD), Eating Disorder Inventory (EDI-3) drive for thinness (DT) and body dissatisfaction (BD) scales, Physical Appearance State and Trait Anxiety Scale (PASTAS), Body Shape Questionnaire (BSQ), Body mass index (BMI).
** = statistically significant at p <.05 level*
*** = statistically significant at p values <.01*

- There were statistically significant relationships (*p*<.05) between body image distortion/dissatisfaction assessed with the BIAS-VR, in both conditions, and body image distortion assessed with the paper-based BIAS-BD (silhouette test). However, there was only a statistically significant relationship (*p*<.05) between body dissatisfaction assessed with the BIAS-VR in the non-embodied condition and body image dissatisfaction assessed with the BIAS-BD.
- There were statistically significant relationships (*p*<.05) between body dissatisfaction/distortion, assessed in both conditions, and other paper-based questionnaires, such as body dissatisfaction (EDI-BD), drive for thinness (EDI-DT), body anxiety (PASTAS) and body image concerns (BSQ).
- Surprisingly, there was a significant but negative relationship (*p*<.05) between body distortion of BIAS-VR and the other body image-related measures. Taking a closer look at our data, it was observed that individuals (*n*=7) with overweight and obesity underestimated their perceived virtual body size compared to individuals with healthy BMIs. This underestimation was observed in the BIAS-VR but not in the paper-based questionnaires.
- Consistent with these results, a negative significant correlation between BMI and body image distortion assessed with the BIAS-VR was also found.

4. Conclusion

This study provides preliminary data on the psychometric properties of the BIAS-VR, a new VR-based software for the assessment of body image disturbances. When assessing body image dissatisfaction, BIAS-VR showed good convergent validity with other standardized paper-based questionnaires that also assess body image dissatisfaction and other body-related concerns, regardless of whether the assessment task was enhanced with embodiment techniques (from the first-person perspective) or whether it was conducted with a virtual body located in front of the participant (from an external perspective). Unexpectedly, when assessing body image distortion, the BIAS-VR showed significant but negative correlations with other standardized paper-based questionnaires that also assess body image distortion and other body-related concerns, in both the embodied and the non-embodied conditions. These results may be explained by contraction bias [7], a perceptual error produced when a standard reference (i.e., a virtual body with a BMI of 22.5 m/kg^2) is used in size estimation tasks. Thus, size estimation is at its most accurate when the BMI of the participant is closest to the standard reference and becomes increasingly inaccurate as the difference increases.

The use of the first-person (embodied) versus the third-person perspective did not affect the results of the BIAS-VR's body size estimation tasks, which supports previous findings reported by Corno et al. [8]. Both studies were conducted with non-clinical samples. Future research should assess whether these results are replicated in ED patients.

The results found show that BIAS-VR may be an adequate tool for the assessment of BID. However, further research into the influence of BMI and the role of embodiment techniques is required.

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Virtual Reality-Cue Exposure Therapy for the treatment of Alcohol Use Disorder: Preliminary results

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Abstract. The present study is part of a larger multi-site clinical trial aiming to test the efficacy of Virtual Reality-Cue Exposure Therapy (VR-CET) in patients diagnosed with alcohol use disorder (AUD) considered resistant to treatment as usual (TAU). In this study, we focused on exploring alcohol craving, anxiety, and attentional bias as indicators of the efficacy of VR-CET as an additional treatment to TAU. Twenty-eight adult patients from the Addictive Behavior Unit from Hospital Clinic of Barcelona participated in the study. Patients were randomly assigned to the VR-CET group (12 patients) or the TAU group (16 patients). Both groups completed the same pre- and post-treatment sessions, in which significant information about substance misuse patterns was collected and several questionnaires were administered (AUDIT, STAI, MACS and Alcohol Stroop Test). The VR-CET group was subsequently administered a six-session protocol of VR exposure (one hour per session) and the TAU group continued with their current treatment. T-tests were performed to assess differences between pre- and post-treatment groups. Although group differences did not reach significance, the decrease in the measures was more evident in the experimental group. CET based on VR is proposed here as a potentially useful complement to habitual treatments for AUD patients.

Keywords. Alcohol use disorder, anxiety, craving, virtual reality, cue-exposure therapy.

1. Introduction

Several studies have targeted alcohol craving, related anxiety and attentional bias as important mechanisms in the development, maintenance, and relapse of alcohol use disorder (AUD) [1]. Cue-exposure therapy (CET) is a commonly used psychological technique aiming to reduce craving through repeated and systematic exposure to alcohol-related cues without subsequent consumption [2]. Nevertheless, there is no consistent evidence regarding the efficacy of CET [3], mainly because treatments often present limited alcohol-related cues in a controlled, safe setting, which hinders later

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generalization to real-life situations. It has been proposed that Virtual Reality (VR) technology adds effectiveness to CET by providing an immersive environment, with multiple sensory inputs, that can induce greater craving and thus enhance ecological validity [4]. The present study is part of a larger multi-site clinical trial aiming to test the efficacy of Virtual Reality-Cue Exposure Therapy (VR-CET) in patients diagnosed with AUD considered resistant to treatment-as-usual (TAU). Preliminary outcomes on alcohol craving, anxiety and attentional bias are presented as indicators of the efficacy of VR-CET as an additional treatment to TAU.

2. Method

2.1. Participants

Twenty-eight adult patients (12 in the VR-CET experimental group; 16 in the control TAU group) from the Addictive Behavior Unit of the Hospital Clinic of Barcelona participated in the study. Patients age ranged from 36 to 67 years (M_{age} = 53.82, SD = 7.93). Inclusion criteria were moderate to severe AUD according to the *Diagnostic and Statistical Manual of Mental Disorders, (5th ed.; DSM–5; American Psychiatric Association [APA], 2013)* [5] criteria, with a minimum of three-day abstinence prior to the first session and classification as resistant to TAU (i.e., presenting at least one relapse within six months of detoxification, and having been on at least one ambulatory treatment in the last five years, or having started more than three ambulatory treatments in the last five years). Patients with severe cognitive impairment, severe co-morbid psychopathology, opioid addiction, epilepsy, or pregnancy were excluded from the study.

2.2. Instruments

Alcohol consumption, drinking behaviours and problematic alcohol-drinking patterns were examined with the Alcohol Use Disorder Identification Test (AUDIT) [6].
Alcohol Craving was assessed with the Multidimensional Alcohol Craving Scale (MACS) [7].
Anxiety (both trait and state) was explored with the State-Trait Anxiety Inventory (STAI) [8].
Attentional bias (interference) for alcohol-related words was explored with the Alcohol Stroop Test [9].
VR equipment included the Oculus Rift S head-mounted display (HMD), two sensors, a touch controller for each hand and a computer compatible with the VR equipment. *"ALCO-VR" software* was the platform used to deliver the VR-CET approach, and included a menu of 22 different alcoholic beverages and four environments (restaurant, house, bar, and pub).

2.3. Procedure

Before providing signed informed consent, patients were randomly assigned to the VR-CET group (12 patients) or the TAU group (16 patients). Both groups completed the same pre-treatment sessions, in which significant information about abstinence, comorbidity, other substance consumption and medication was collected, and several questionnaires were administered [AUDIT, STAI (the trait and state part), MACS, and Alcohol Stroop Test]. The mean (SD) score of the AUDIT of the sample was 17.21 (10.66). As a baseline treatment, both groups received TAU at the Addictive Behaviors Unit from Hospital Clinic of Barcelona. In addition to TAU, the experimental group received six VR-CET, which involved repeated CET to alcohol-related cues and contexts using the "ALCO-VR" software. Each session lasted for one hour. In all sessions, olfactory inputs were included and corresponded to the alcoholic beverages the user was exposed to. After each VR-CET session, participants received a short debriefing with the aim of reducing anxiety and craving levels and thus minimizing any later alcohol consumption. The post-treatment session was identical to the pre-treatment session

[MACS, STAI (the state part) and Alcohol Stroop Test], except that AUDIT and anamnesis were omitted.

2.4. Statistical analysis

Possible pre-test differences between the experimental and control groups were assessed by means of Student's T-tests. T-tests were also performed to assess differences between pre- and post-treatment groups. Statistical power was also calculated with the aim of establishing whether the study was under-powered or the sample size was sufficient to detect an existing effect. All analyses were performed using IBM SPPS version 25.0 (Armonk, NY: IBM Corp).

3. Results

Table 1 shows means and standard deviations of the pre-and post-treatment results as assessed through four variables: STAI-Trait, STAI-State, MACS and Stroop Test.
The T-tests performed revealed no statistically significant differences between groups (experimental vs control) at pre-treatment for any of the variables measured: STAI-Trait ($t = 1.388$; $p = 0.176$), STAI-State ($t = 1.162$; $p = 0.255$), MACS ($t = 0.076$; $p = 0.9396$) and Stroop Test ($t = 0.166$; $p = 0.8693$).

Concerning differences between pre-treatment and post-treatment, T-tests indicated no statistically significant differences for both the experimental or control group across the different variables measured. Although group differences did not reach significance, the decrease in the measures was more evident in the experimental group.

The statistical power obtained was 0.623, revealing that the sample of the current study ($n = 28$) might not capture the effect even if it exists in the population, therefore expounding that the sample selected might not be representative of the population.

Table 1. Mean and Standard Deviation of the pre- and post-treatment results as assessed by the following measures.

Measures	**Pre-treatment session**		**Post-treatment session**	
	Experimental	Control	Experimental	Control
STAI-Trait	23.83 (11.40)	30.42 (13.13)		
STAI-State	12.72 (9.14)	17.71 (12.56)	7.45 (8.73)	15.07 (7.49)
MACS	25.58 (11.30)	25.92 (11.88)	19.08 (9.24)	19.71 (7.61)
Stroop Test	18.84 (10.36)	19.67 (14.76)	15.89 (12.72)	18.00 (14.62)

Note: *Multidimensional Alcohol Craving Scale (MACS), the State-Trait Anxiety Inventory (STAI) and the Alcohol Stroop Test.*

4. Conclusion

This study presents an innovative VR-based software that may be suitable for improving the existing treatment methods for alcohol addiction. The post-treatment changes recorded here are interpreted as a result of a process of desensitization regarding alcohol cues and are considered an interesting indication of the clinical potential of VR technology in AUD treatments. Some limitations that may influence our data are gender imbalance, presence of co-morbid diagnosis, differences in medication or in reported days of abstinence, as well as the small sample size. Nevertheless, the study is an ongoing project, and more data is required to state the efficacy of VR-CET as a potentially useful complement instrument to habitual treatments for AUD patients.

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Using Social Media to Assess State and Trait Emotional intersections during the Longest-lasting Lunar Eclipse of the Twenty-first Century: A Pilot Study

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Abstract. A lunar eclipse is an extraordinary natural event and a potential elicitor of complex emotional experiences. Preliminary scientific evidence investigated the impacts of the moon on human behavior, but without deepen its effects on emotions, which are essential to understand our cognitive evaluations and actions. Here, we tested whether specific dispositional emotions and emotional regulation strategies can be predictive of specific discrete state emotions including awe, anxiety, general positive and negative affect lived by participants during the Total Lunar eclipse (TLE) occurred in July 2018. 401 participants compiled validated questionnaires measuring state and dispositional emotions and affect: Awe-experience Scale (Awe-S), the Dispositional Positive Emotions Scale (DPES), the Emotion Regulation Questionnaire (ERQ), the Positive and Negative Affect Scale (PANAS) and the State-Traits Anxiety Inventory (STAI). DPES factors compassion, love, pride and awe, and ERQ factor reappraisal predicted state positive affect, state anxiety and awe. Negative affect was predicted only by the DPES factor compassion. Specifically, a higher predisposition to live pride and love predicted respectively lower state awe and anxiety, while higher levels of dispositional compassion and awe led to higher state awe and anxiety. Dispositional awe with a reappraisal strategy led to experience more intense state positive emotions, while dispositional compassion alone led to more state negative emotions during TLE. Therefore, it was the combination of dispositional emotions and regulation strategies that significantly impacted on contingent emotions lived during the lunar eclipse.

Keywords. state emotions, lunar eclipse

1. Introduction

A lunar eclipse is a natural phenomenon consisting in the obscuration of the moon by earth's shadow. The "moon cycle's effect" is a field of studies aimed to investigate the impact of this rare phenomenon on human cognition and behavior [1]. Preliminary scientific and anecdotic evidence showed associations between a specific moon phase and several human behaviours, such as theft, robbery and assault [e.g., 2], or homicides, which are significantly more frequent during the full moon phase rather than other periods [3; 4]. If just few studies focused the behavioural impact of moon exposure on people, no researches have investigated the impact of a total lunar eclipse on people behaviour. Given the rarity of total lunar eclipse (TLE) and the scant evidence in literature, in this study, we focused on antecedents of people' behaviours, that is, on

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peculiar emotions and affects stemming from a TLE, and the emotion regulation strategies we use to interpret the stimuli we encounter, which can orient individuals' actions in a stable way. In fact, discrete emotions can be either stable and durable or contingent phenomena, depending on their frequency of occurrence, duration, and relation with the context. The durability of trait emotions has a concrete impact on the contingent affects experienced during our every-day life [5; 6]. This happens also for affects such as anxiety [5;7]. Trait anxiety could lead to refusal and flight reactions, differently to what could happen to people with a calmer dispositional affectivity, influencing also the cognitive and behavioral levels [7]. Further, also the way in which discrete emotions are usually managed plays an important role in explaining our behavior: this is the reason why also emotion regulations strategies must be considered together with dispositional emotions [8]. Anxiety can be regulated by reframing the situation in order to change its meaning and emotional impact, or moderating outward signs of the affect by decreasing concurrent emotion-expressive behavior [9]. Here, we focused on two key emotion regulation strategies: (i) cognitive reappraisal, which involves the reinterpretation of the situation in order to up or down-regulate emotions [9]; (ii) suppression, which entails the suppression of the negative emotions experienced. At the same time, discrete emotions are differentiable accordingly to [10; 11]: (i) their stability vs contingency; (ii) their valence, which allows to distinguish between positive and negative emotions; (iii) their specific psychophysiological correlates. Considering recent evidence [12; 13; 14; 15; 16; 17; 18], both state and trait emotions can be differentiable according to their appraisal themes and action tendencies as well as to their evolutionary functions, thus, leading to a different way to appraise everyday situations. We drew from this evidence to outline differential paths linking trait emotions to state emotions lived by participants during the TLE occurred in July 2018, in order to scientifically test whether the "moon effect" could impact on individuals' contingent emotional states, and how dispositional emotions could influence the way people experience this complex event.

2. Methods

2.1. Participants

Our sample was composed by 401 Italian participants (263 females – mean age = 20 years; SD = 6.34; 138 males – mean age = 19.89; S.D. = 7,00). They were adults, mostly educated, with an average of 13.30 years of schooling. They lived mostly with their families (84.5%, n = 339), and almost half of them were Christian Catholic (41.1%, n = 165). Participants were recruited through announcements on principal social network platforms, such as email, Facebook, Twitter and Instagram. They received a link provided by a description of the main objective of the research, containing all the questionnaires they were required to compile. The survey was conducted entirely online using Qualtrics (www.qualtrics.com), a secure online survey distribution and data collection program.

2.2. Trait Measures

To measure trait emotions and regulation strategies, we administered the Italian version of the *Dispositional Positive Emotions Scale* (DPES) [10] assessing the disposition to live seven positive emotions. We also administered the *Emotion Regulation Questionnaire* [8], measuring respondents' tendency to regulate their emotions and assessing two emotion regulation's (ER) strategies: Cognitive Reappraisal and Expressive Suppression.

2.3. State Measures

In order to measure state awe lived during the TLE, we administered the *Awe Experience Scale* [19], measuring the intensity of state awe lived by participants during a peculiar event (in our case, the TLE). To assess state anxiety, the *State-Trait Anxiety Inventory* [20] was compiled in order to evaluate contingent and dispositional anxiety, focusing only on the state one. Finally, the *Positive and Negative Affect Schedule* [21] was administered to assess the two main dimensions of the state affective experience: the positive and the negative one.

2.4. Procedure

The research was conducted online using Qualtrics, a secure data distribution platform. To ensure that participants completed the survey during or after the lunar eclipse, the questionnaire was launched during the TLE. Participants received from researchers a link containing all the questionnaires described above they were required to fulfil. The experimental protocol was approved by the Ethical Committee of the Università Cattolica del Sacro Cuore prior to data collection and all methods were carried out in accordance with the Helsinki Declaration.

3. Data Analyses

Values of skewness and kurtosis of each variable featured a normal distribution. We carried out 10 multiple linear regressions to test the impact of trait positive emotions (happiness, love, pride, amusement, compassion, and awe), affect and ER strategies (suppression and cognitive reappraisal) on each state emotional experience (positive and negative affect and state anxiety) related to the TLE. Only significant results are reported.

4. Results

Several multiple linear regressions were calculated to predict each discrete emotion, positive and negative affect, and anxiety, based on a combination of trait emotions and emotion regulation strategies. A significant regression equation was found [F (8,390) = 12,388, $p < .001$, $R^2 = .203$)] for awe lived by participants during the lunar eclipse, even though not all single predictors were statistically significant. Dispositional compassion (β=.112, t=2,136, p=.033), pride (β=-.129, t=-2,176, p=.030) and awe (β=.339, t=6,640.81, p<.001) significantly predicted state awe, while only reappraisal strategy (β=.174, t=3,366, p=.001) was predictive of state awe. A significant impact of dispositional emotions and ER strategies on state positive affect was found [F (8,390) = 9,943, $p < .001$, $R^2 = .163$)]. In this case, only two variables were significant predictors, that are dispositional awe (β=.254, t=4,856, p<.001) and reappraisal ER strategy (β=.118, t=2,227, p=.027). A significant effect was found also between trait emotions, ER strategies and participant's state negative affect [F (8,390) =2,599, $p = .009$, R^2= .051)], but results indicated that in this case the model was not very power. In fact, only dispositional compassion (β=.118, t=2,227, p=.027) significantly predicted participants' state negative affect. Finally, we found a significant effect of dispositional emotions, ER strategies on state anxiety experienced by participants [F (8,389) =4,727, $p<.001$, R^2=.089]. Here, no ER strategy could significantly predict participants' state anxiety, while dispositional compassion (β=.216, t=2,781, p<.001), love (β= -.135, t= -2,157, p=.032) and awe (β=.152, t=2,227, p=.006) were significant predictors in the model. Again, it should be noted that the more participants were basically compassionate and disposed to live awe, the more they experienced state anxiety in response to the TLE; conversely, the more they were prone to live love in their lives, the less they experienced anxiety in response to TLE.

5. Discussion and Conclusions

This study investigated how different dispositional positive emotions and ER strategies could lead to different state emotions and evaluations of the same extraordinary event. Results showed that dispositional emotions of compassion, love, pride and awe, and reappraisal ER strategy, predicted positively state positive affect, anxiety, and awe, while negative state affect was predicted only by participants' dispositional compassion. Each dispositional emotion had a specific role in leading people to live differently the TLE. Specifically, being prone to live pride and love had a detrimental effect toward experiencing contingent awe and anxiety during the TLE. Conversely, in the same situation, people who were more inclined to live awe in their daily life, experienced higher state positive affect, state awe but also state anxiety during LTE: this is consistent with what reported by literature on awe [15], and with its nature linked both to wonder and fear [15]. Thus, different dispositions to live pride and love, or awe, could elicit one emotion or its contrary, as state anxiety and positive emotions and affects. The only ER strategy that had an impact on state emotions was reappraisal. In front of a unique and unfamiliar stimulus such as the TLE, the reappraisal strategy might have facilitating people to live the TLE positively, experiencing state awe and positive affect. This is also in line with literature on positive affect and reappraisal strategies, which demonstrate the strong link between reappraisal strategy and positive emotions [24]. Neither a specific single trait emotion nor an ER strategy alone could define the emotional contingent response of individuals exposed to this complex experience, but rather dispositions to live positive emotions and specific ER strategies were closely intertwined in defining the emotional influence of the lunar eclipse. This study showed that the disposition to live specific positive emotions could enhance or diminish the intensity of some state emotional responses, elicited as a result different cognitive evaluations and behavioral reactions. Therefore, in studying and understanding human cognition and behavior related to unusual, unfamiliar and extraordinary experiences, such as lunar eclipse, it is fundamental to start from emotions, which means examine and deepen people dispositional and temperamental emotional profiles.

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Let's dive into it! Exploring mentalizing abilities in adolescence in an immersive 360° environment.

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Abstract. Adolescence is a crucial developmental phase encompassing sometimes rapid changes in the psychological processes concerning the quality of interpersonal relationships, i.e., social cognition (SC). Mentalization is a form of SC that describes the ability to understand behaviors in terms of underlying mental states such as thoughts, emotions, and motivations (theory of mind, ToM). However, mentalization assessment showed mixed findings and highlighted the need for valid ecological measures to capture the complexity of adolescents' subjective experience of "making sense" of interpersonal relationships. Assessment with 360° videos enables an engaging and immersive environment fostering a first-person and realistic experience. This contribution's main objective is to suggest the development of a new tool for assessing mentalizing abilities (MA) in adolescence through an immersive technology-based approach. Subjects participate in 25/30 minutes evaluations using a new technological app to assess MA via a head-tracked Head Mounted Display (HMD). Each subject is inside a virtual apartment and observes the interaction between some characters. The subject must try to evaluate their thoughts, emotions, and motivations. The HMD device will assess the participants' ability to make inferential thoughts about others' states of mind and a validated device will record Heart Rate Variability as a measure of emotion regulation. This protocol allows thoroughly evaluating MA in an ecological and valid environment via an innovative technology-based approach, providing useful insights on the individuals' specific abilities/deficiencies. This innovative and engaging tool will provide reliable information for clinical use and research about adolescents, often adverse to psychological assessment.

Key words: Assessment, Adolescence, Mentalization, Social Cognition, 360° videos

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1. Introduction

Adolescence is characterized as a crucial developmental phase, encompassing sometimes rapid changes in the psychological processes concerning the quality of interpersonal relationships [1,2]. Indeed, the ability of adolescents to fully engage in meaningful relationship with friends is a protective factor from maladaptive outcomes such as emotional and behavioral problems. Moreover, it allows the formation of stable internal representations of significant others as well as facilitate identity development and integration [3]. Therefore, in this crucial developmental phase, social cognition (SC), the ability to understand social interactions, plays a fundamental role [4]. SC allows us to navigate the complexity of human experience, recognizing and interpreting social information. SC is associated with the broader concept of mentalization, or "theory of mind" (ToM), that allows the individual to understand others' behaviors as influenced by underlying mental states. Mentalization (also referred to as "reflective functioning") allows the individual to consider others as having autonomous mental states and is crucial in capturing the complexity of the intertwining self-interpersonal dimensions [5,6,7,8].
Numerous research showed that dysfunctions in mentalizing abilities are related to Borderline Personality Disorder (BPD) core features and other psychological disturbances such as anxiety, depression, and nonsuicidal self-injury [9,10,11,12].
However, research on mentalization assessment showed unsatisfactory findings fostering a reflection on the appropriate measures to assess it. Indeed, in some studies, the use of tasks (mostly self-report measures) that do not capture the complexity of the interpersonal dynamics has made it difficult to define appropriate mentalizing thresholds to distinguish clinical and non-clinical populations and BPD patients showing higher levels of mentalization [13,14]. A recent contribution by Quek and colleagues, trying to tackle these difficulties, underlined the need for "the importance of examining mentalizing abilities with varying levels of complexity, interpersonal contexts, and levels of arousal" [15]. All in all results highlighted the need for valid ecological measures to capture the complexity of adolescents' subjective experience of "making sense" of interpersonal relationships. Acknowledging some of those limitations, Dziobek and colleagues had developed the Movie Assessment for Social Cognition (MASC), a video-based test for assessing mentalizing abilities [16]. The MASC is a computerized test that asks the subjects to evaluate a relational situation that is very close to everyday life demands. Indeed, the subjects visualize a 15-minute film whose protagonists are four characters (Sandra, Michael, Cliff, and Betty) who meet for a dinner party. The video is interrupted 45 times to ask participants to answer questions that are related to the mental states of the various characters (accounting for intentions, thoughts, and feelings) (e.g., "What is Sandra thinking?", "What is Cliff feeling?"). The themes of each segment have to do with aspects related to both friendship and romantic relationships. Each of the characters experiences different mental and emotional states during the evening (i.e., affection, anger, jealousy, fear, disgust). Moreover, the characters have different levels of intimacy and knowledge (friends to strangers) to represent different attribution types of mental states depending on the level of "closeness." The MASC allows to score, together with a total score of mentalization, other qualitative levels of reflective functioning abilities useful in distinguishing clinical and not clinical populations (e.g., hyper-mentalization, low mentalization, and no mentalization) [17,18].

However, just as the MASC has effectively compensated for the lack of tools that would allow subjects to self-identify with the "reality" of the environment correctly, we nowadays have the opportunity to make the subject experience a much more immersive and engaging one [19,20]. Indeed, assessment with 360° videos enables an engaging and immersive environment fostering a first-person and realistic experience. 360° videos are spherical videos that record the physical environment and are usually displayed through a head-tracked Head Mounted Display (HMD). During the 360° experience, the user can completely "dive into" the environment (i.e., in a room, looking up/down or on the sides to observe the ceiling, the floor, or the interiors).
360° videos offer a uniquely immersive experience that makes an ecological and realistic assessment possible [21,22]. A fully immersive environment is even more critical when

exploring abilities that pertain to a universe of implicit meanings that are challenging to fully capture in their complexity, such as mentalization.
This contribution's main objective is to suggest the development of a new tool for assessing mentalizing abilities in adolescence through an immersive technology-based approach.

2. Methods

For the pilot study, participants will be adolescents ranging from 14 to 18 years old, recruited in secondary schools. Before starting the evaluation, participants carry out a phase of "familiarization" with the HMD and wear the validated device to record HRV. By wearing the headset, subjects are entirely immersed in a neutral environment that they can freely explore. The examiner asks to look for a blank notepad on a table and then signals that it is where to look for written questions during the assessment. This initial phase is designed to prevent the following results from being contaminated by external causes (i.e., dizziness). Afterward, subjects participate in 25/30 minutes' evaluations using the new technological app to assess mentalizing abilities. In this phase, each subject is immersed inside a virtual apartment and observes some characters' interactions. A voice-over introduces the setting of the story. Characters' interactions follow and further develop the MASC plot, involving four friends that meet for a dinner party.Subjects verbally reply to specific questions evaluating the characters' thoughts, emotions, and motivations as the story plot unfolds. Questions are asked by a voice-over and also appear on the blank notepad for extra reference. The examiner tape-records all verbal responses as well as HRV data.

3. Expected results

An initial pilot study will assess overall user experience and possible difficulties such as video-length fatigue. The new technological app will assess the participants' ability to make inferential thoughts about others' states of mind, thus assessing mentalization levels. Moreover, it will highlight specific abilities/deficiencies in making assumptions on others' behaviors, emotions, and motivations. A validated device for HRV will further explore adolescents' emotion regulation abilities, providing convergent data to interpret the new app's results.

4. Conclusion

This innovative and engaging tool will provide reliable information for clinical use and research about adolescents, often adverse to psychological assessment.

This original tool allows to:

1) Assess mentalizing abilities (reflective functioning) in adolescence in a reliable way.
2) Differentiate the ability "to make sense" of interpersonal dynamics collecting data on thoughts, emotions and motivations.
3) Obtain specific information about different areas of mentalization to tailor clinical intervention.
4) Test complex and developmentally crucial functions of daily life in an pleasurable way.

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The Potential of Transformative Interactive Video Storytelling For Improving Caregivers' Mental Wellbeing: A Research Protocol

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Abstract. The existing interventions for caregivers address concrete issues arising from the caregiving role, neglecting the deeper meaning-making needs of informal caregivers. The TVD technique proposed in this study aims to provide directions for helping caregivers self-manage stress and maintain wellbeing within the caregiving context by facilitating a meaning-making experience. The mixed-method design study takes place in three phases. The informal caregivers Perceived Stress (PSS scale), emotions (Noldus FaceReader), Coping skills (COPE), Emotion Regulation (ERQ), Role Burden (BSFC-s), and Meaning in Life (MLQ), will be assessed.

Keywords. Transformative, storytelling, experience, caregiver, stress

1 Introduction

Informal caregiving is defined as unpaid care provided for the spouse, parent, relative, and even close neighbor. This type of care adds up to 60% of total long-term care in Europe [14]. The role-related outcomes of long-term care include caregiver depression, anxiety, deterioration of physical health, gradual lack of self-care behaviors, and even an increase in mortality rates through the development of chronic conditions [1, 16].

The meta-review of the systematic reviews and meta-analyses of mental health interventions for informal caregivers of dementia patients grouped the available interventions into psychoeducation, psychotherapeutic interventions, mindfulness-based interventions, occupational therapy, and multicomponent interventions [4].

The available interventions for informal caregivers address adverse health outcomes (e.g., reduce depression, address self-care, etc.) and assist caregivers to maintain the role [4]. However, we note an important gap in the design of the existing interventions related to the lack of consideration of deeper meaning-making needs within the role [7], and the problem-focused rather than person-focused design.

Following the theory of narrative identity by McAdams [15], the sense of meaning provided through the stories which are created out of episodic particulars of autobiographical memory, ultimately shape a narrative identity of a person. In line with that, the ability to structure one's experience in a positive story, even out of stressful events such as caregiving, is crucial for evolving narrative identity.

Therefore, we are adding to the existing interventions by providing directions for the new technique that will allow structuring the caregiving story cohesively, provide a meaning-making experience, and in turn improve wellbeing. The cohesive structure of

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the caregiving experience entitles the restructure of the personal caregiving story in an organized manner, visually distinguishing between the beginning, the role acceptance, the ongoing caregiving life, the role transformation, and the current circumstances [8].

Considering the Transformative Experience Design (TED) framework [10], technologies such as Virtual Reality, enable the creation of narrative content and allow the reflection on one's life story, resulting in the long-term transformation of the inner self-world. We argue that using the technology of video storytelling will address two important gaps noted in the existing interventions for informal caregivers.

First, we pose meaning-making experience as an inner experience requiring external guidance, for eliciting the self-structure. Second, we shift from problem-focused to person-centered design, by approaching the caregiving situation considering the familial connection of the caregiver (e.g., spouse, child, etc.), and the gender difference in the narrative of both caregiver and the care recipient.

The storytelling approach [11] is used here as a basis for the development of therapeutic stories in video format for informal caregivers. We define this technique as the Transformative Video Design (TVD) based on the TED framework [10] and include the user interaction with video throughout the storytelling. One of the main objectives of the technique is to structure one's life story cohesively and facilitate role-related skill training, and emotion regulation building through perspective-shift [5] and video interaction. The project's main research questions are: (1) Could structuring the caregiving experience, with TVD, into a cohesive narrative presented in a third-person perspective help informal caregivers experience lower self-perceived role burden and decrease in perceived stress levels; (2) Can TVD help caregivers improve their perception of meaning in life.

It is hypothesized that the caregivers participating in the clinical pilot testing will show lower levels of stress, after experiencing TVD, compared to the results obtained in the pre-measures. Moreover, it is further hypothesized that caregivers will obtain productive coping strategies and constructive emotion regulation strategies.

2. Methodology

The mixed-method design study will be conducted consisting of qualitative data collection in the phase-one, and quantitative data collection in the phase-two, and three of the study.

2.1. Eligibility Criteria

This study will include (1) informal caregivers (unpaid primary caregivers) above the age of twenty-five, of (2) an older significant other (retirement age – 65 years old and above), who (3) provide long-term care (over six months period), and (4) taking into consideration any chronic disease of a care recipient, excluding care recipient living with cancer.

2.2. Recruitment of participants

Participants will be recruited through the caregiving association. The convenient voluntary sampling will be used for this study.

2.3. Research procedure

We propose directions for the development of TVD storytelling in three phases including (1) content development, focused on the initial creation of the unified stories by gathering the caregiver's life stories with a structured interview. These stories will be analyzed using a narrative approach and dominant themes will be extracted for the creation of the six unified stories. The parameters for drafting six unified stories (Figure 1) are based on the relationship with the care recipient, and the gender of the caregiver and care recipient.

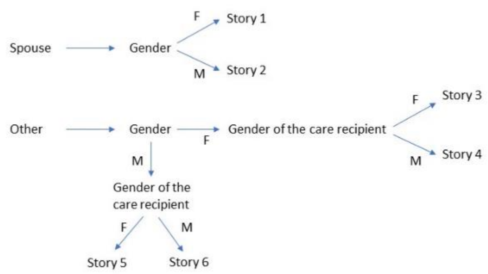

Figure 1. Parameters for story creation

The interaction points of the storylines will be drafted in an "if-then" type of scenarios within a branching narrative. We will select the photographs, using online databases, representative of paragraphs in the stories, and create the drawings corresponding to the photographs as a final step of the content development. (2) The assessment phase, in a form of a mock trial, will measure the concrete outcomes of the stories between groups ("Spousal" and "Other") and within groups in three levels of linear stories –with photographs, drawings, or text only. This phase assesses the narrative engagement, emotional responses to the stories, and provides data for selection between the live-action or animation (photography versus drawing data) video format for the final phase. The final phase, (3) production and testing, includes video production – pre-production, production, and post-production – and testing. In the pre-production phase, the script will be written, and the actors/characters will be cast/created. We will create the final storyboard and begin the production in collaboration with a production company. The final post-production step will include video editing and the recordings of the voice-overs – adaptation for the English-speaking caregivers.

Finally, the second part of the third phase – the clinical pilot testing – will assess the final product delivered via a web platform (e.g., Genial, Charmboard, etc.), with a small subclinical sample, measuring pre-post role-related stress, pre-post subjective caregiver burden and pre-post meaning in life. The coping self-efficacy and emotion regulation strategies will be included in the post-assessment. The six-months and twelve-months follow-up, measuring PSS and MLQ is considered.

2.4. Instruments

Phase One – "Caregiver Life Story" interview, designed for this occasion, will be used, containing eleven questions that explore the life before the role, changes that took place, daily activities, emotional/psychological challenges, and critical points of the role. *Phase Two* – Mock trial will be performed with the facial emotion recognition software – Noldus FaceReader [9] that includes the assessment of six basic expressions and calculates action units, valence, arousal, gaze direction, head orientation, age, and gender. Narrative Engagement Measure – NEM [2] will be used to assess the story engagement, distinguishing four dimensions – narrative focus, attentional focus, emotional engagement, and narrative presence. Perceived Stress Scale – PSS [6] will measure the pre-post perception of stress. PSS is a 10-item scale, with a 5-point Likert scale (0 – "Never", to 4 – "Very Often"). *Phase Three* – Meaning in Life – MLQ [17] will be used in the third phase for the pre-post measure, with the pre-post PSS. MLQ measure is a 10-item measure of two dimensions of meaning (1) Presence of Meaning, and (2) Search for Meaning, on a 7-point Likert scale (1 – "Absolutely True" to 7 – "Absolutely Not True"). Emotion Regulation Questionnaire (ERQ) is a 10-item scale measuring two types of tendencies to regulate emotions, (1) Cognitive Reappraisal, and (2) Expressive Suppression [13]. ERQ is using the 7-point Liker scale ranging from 1- "Strongly Disagree" to 7- "Strongly Agree". ERQ will be used as a pre-post measure in the third phase. The Burden Scale for Family Caregivers (BSFC-s) short form [12] will assess the subjective burden. BSFC-s is a 10-item scale with the 4-point Likert scale (0 – "Disagree" to 3 – "Strongly Agree"). The pre-post coping skills will be assessed with COPE Inventory [3], a 60-item scale, with 15 sub-scales, ranging on a 4-point Likert scale (1 – "I usually don't do this at all", to 4 – "I usually do this a lot"). The special attention will be put on the pre-post scores on the COPE subscales of Positive Reinterpretation and Growth, Focus-on and Venting of Emotions, Acceptance, and Planning, which we argue are some of the coping skills caregivers should have within the role.

2.5. Statistical Analysis

The data will be analyzed in IBM SPSS V25.0. The mock-trial and clinical pilot testing data will be analyzed using one-way ANOVA, and correlational analysis will be used for the data from clinical pilot testing. The post PSS scores will be correlated with the post ERQ from the third phase. The obtained MLQ scores will be correlated with the post-BSFC-s, expecting that the increase in "Presence of Meaning" will result in a decrease in self-perceived burden.

2.6. Expected Outcomes

Informal caregivers' part-taking in TVD storytelling are anticipated to acquire education about the productive structure of the life story for an evolving narrative. More concretely, the knowledge about the proper use of skills, and practical application for the personal story. We expect the TVD will lead to an improvement in coping skills (e.g., increase in positive reinterpretation and growth, increase in the ability to vent out the emotions, acceptance, and planning) and emotion regulation with a stronger emphasis on emotional reappraisal. We argue that with the TVD, the caregivers will gain insight into the caregiving role through a third-person perspective that will act as a trigger for self-structure within the personal narrative by facilitating emotional distance through the exercise of a perspective shift. The TVD technique can be used as a stimulus for initiating the self-structure of personal narrative, expecting the increase in the self-perceived "Presence of Meaning" within the MLQ scale. Therefore, upon experiencing the video storytelling in the full duration of thirty minutes in one session in total, caregivers will receive the exercise booklet, summarizing the TVD with instruction for further use of the technique in the personal story.

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