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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