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Schizotypy, Alexithymia and Affect as predictors of Facial Emotion Recognition Capability using static and dynamic images

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The main purpose of the present study is to investigate the capacity of schizotypy and alexithymia traits, in combination with affectivity to predict facial emotion recognition capability in a sample of nonclinical adults. Consecutive healthy participants (N= 98) were investigated using the Toronto Alexithymia Scale-20 (TAS-20), the Oxford-Liverpool Inventory of Feelings and Experiences-Reduced Version (O-LIFE-R), and the Positive and NA Schedule (PANAS). A set of validated photographs (static images) and virtual faces (dynamic images) for presenting the basic emotions was used to assess emotion recognition. Pearson correlations were applied to investigate the relationship between the study variables; the amount of variance in emotion recognition capability predicted by OLIFE-R, TAS-20 and PANAS was calculated by using the linear regression model. Results showed that alexithymia was strongly associated with schizotypy and NA; furthermore, alexithymia and NA made a significant contribution to the prediction of emotion recognition capability. The predictive model was fitted for two types of presentations (photographs and virtual reality). The inclusion of virtual faces emerges as a response to the need to consider computer characters as new assessment and treatment material for research and therapy in psychology.

Keywords: *Emotion recognition, schizotypy, alexitimia, affectivity, virtual reality.*

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Esquizotípia, Alexitímia y Afecto como factores de predicción de la Capacidad de Reconocimiento Emocional usando imágenes estáticas y dinámicas

El objetivo principal del presente estudio es investigar la capacidad de predicción de los rasgos de esquizotípia y alexitímia, en combinación con la afectividad, de la habilidad de reconocimiento de emociones en una muestra de adultos sanos. Noventa y ocho pacientes sanos (N =98) fueron evaluados mediante la Escala de Alexitímia Toronto-20 (TAS-20), el Inventario de Sentimientos y Experiencias Oxford-Liverpool-Versión Reducida (O-LIFE-R), y la Escala de Afecto Positivo y Negativo (PANAS). Para la evaluación de la capacidad de reconocimiento de emociones a nivel facial, se utilizó un set validado de fotografías (imágenes estáticas) y caras en realidad virtual (imágenes dinámicas). Para el análisis correlacional de las variables de estudio se aplicó la prueba de correlación de Pearson; para el análisis de predicción de la capacidad de reconocimiento emocional se utilizó un modelo de regresión lineal en el que se incluyeron las variables derivadas de las escalas OLIFE-R, TAS-20 y PANAS. Los resultados mostraron la existencia de una relación significativa entre alexitímia, esquizotípia y afecto negativo; el modelo de regresión reveló una aportación significativa de la alexitímia y el afecto negativo en la predicción de los errores cometidos en la tarea de reconocimiento facial. El modelo predictivo propuesto fue válido para ambos tipos de presentación de las emociones (fotografías y caras virtuales). La inclusión de las caras virtuales surge como respuesta a la necesidad de considerar los personajes computarizados como nuevo material de evaluación y tratamiento para la investigación y psicoterapia en psicología.

Palabras clave: *reconocimiento de emociones, esquizotípia, alexitímia, afectividad, realidad virtual.*

Introduction

Facial emotion recognition is a core feature of social cognition and interpersonal communication. In the past decades, several studies have highlighted the role that recognition of facial expressions plays in various psychiatric conditions (Csukly, Czobor, Simon, & Takács, 2008). Individuals' characteristics, despite the presence of a mental disorder, have also been considered important features that might have a direct influence on facial emotion capability. One such trait is alexithymia, defined by Sifneos (1973) as a pattern of symptoms consisting of deficits in the ability to identify and describe emotions, coupled with a tendency towards externally oriented and concrete thinking. Taylor (2000) stated that the salient features of alexithymia include difficulty in recognizing and verbalizing one's feelings, difficulty in distinguishing feelings from bodily sensations of emotional arousal, and a paucity of imaginal capacities and an externally oriented cognitive style. Alexithymia is common in patients suffering from a variety of disorders, such as depression, panic disorder, obesity, anorexia nervosa or post-traumatic stress disorder (Seghers, McCleery, & Docherty, 2011). However, some authors who have studied alexithymia in nonclinical samples consider alexithymia to be more of a personality dimension rather than a discrete categorical variable (Salminen, Saarijarvi, & Aarela, 1995). Lane *et al.* (1996) showed that the ability to recognize emotions decreases as alexithymia scores increase and that this decreased ability is both verbal and nonverbal. More recently, Prkachin, Casey, and Prakchin (2009) have shown that alexithymic participants were differentially insensitive to negative emotions (fear, anger and sadness, specifically). Montebarocci, Surcinelli, Rossi, and Baldaro (2010) recently found that subjects with high self-reported alexithymia showed a reduced ability to identify posed facial expression of emotions. Similarly, Campbell and McKeen (2011) claim that individuals with high levels of alexithymia might have difficulty recognizing and interpreting the affective associations linked with face processing. However, the specific role of alexithymia, in combination with other individual characteristics in facial emotion recognition has not been widely known.

Schizotypal personality has also been related to impaired facial emotion recognition. In a detailed review, Raine (2006) described schizotypal personality disorder as a constellation of cognitive-perceptual and interpersonal disturbances, together with disorganized behaviour and speech. Furthermore, schizotypal personality can be considered an attenuated form of schizophrenia, although it might be viewed as the natural outgrowth of normally distributed individual differences in the general population. Studies on the facial emotion recognition ability of non-clinical individuals with several schizotypy traits have produced mixed results. Poreh, Whitman, Weber, and Ross (1994) found that subjects with schizotypy performed worse than the control group when identifying facial emotions, while Williams, Henry, and Green (2007) showed that schizotypy was strongly associated with reduced facial affect discrimination and facial affect recognition. Additionally, Shean, Bell, and Cameron (2007) stated that unusual perceptual experiences, present in individuals with schizotypy traits, were highly correlated with deficits in the ability to identify emotions on an affect recognition task. However, other researchers (Jahshan & Sergi, 2007; Toomey, Seidman, Lyons, Faraone, & Tsuang, 1999) found no differences between individuals at risk for schizophrenia or with schizotypy traits and normal individuals regarding accuracy in recognizing facial emotions.

A recent study in a non-clinical sample by Seghers *et al.* (2011) looked at these two concepts (alexithymia and schizotypy) in combination. The authors concluded that alexithymic emotional deficits are, in some cases, a direct expression of schizotypy, an idea previously proposed by Van't Wout, Aleman, Bermond, and Kahn (2007). Taken together, these findings highlight the need for further research concerning the individual mechanisms involved in the identification of facial emotions. Knowledge of these mechanisms would be an important step towards understanding emotional disturbances in people with mental disorders.

Finally, positive and negative affect appeared as the first two dimensions in multidimensional scaling of facial expressions or mood terms (Russell, 1980, 1983; Watson, Clark, & Tellegen, 1984; Zevon & Tellegen, 1982). According to Watson, Clark, and Tellegen (1988), positive affect (PA) reflects the extent to which a person feels enthusiastic, active, and alert. High PA resembles a state of high energy, full concentration, and pleasurable engagement, whereas low PA is characterized by sadness and lethargy. In contrast, negative affect (NA) is a general dimension of subjective distress and displeasing engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness, with low NA being a state of calmness. Previous studies have found that measures of alexithymia are positively correlated with measures of negative affectivity (Parker, Prkachin, & Prkachin, 2005). When it comes to specific emotions, low PA shows a correlation with lower identification thresholds for happy faces whereas NA predicts the threshold for disgust and can be related to the accurate recognition of sadness (Coupland *et al.*, 2004; Suzuki, Hoshino, Shigemasu, & Kawamura, 2007). These findings make it plausible that affectivity may play a key role in the accuracy of facial emotion recognition, despite its relationship with alexithymia.

The present study uses two approaches to assess facial emotion recognition: Static images (photographs) and dynamic images (virtual reality faces). The rationale of using these two approaches was that even though experimental stimuli are commonly presented to subjects in the form of photographs or static images, such stimuli might not reflect the liveliness and true form of dynamic human facial expression (Harwood, Hall, & Shinkfield, 1999). Virtual Reality (VR) may offer a way of overcoming this limitation, as it generates realistic and active faces as well as characters (Dyck *et al.*, 2008; Rus-Calafell, Gutiérrez-Maldonado, Carratú, & Cabas, 2011).

The main objective of the study was to examine the contribution of specific individual traits (personality, alexithymia and affect) to the facial emotion recognition capability using a new set of validated dynamic virtual reality faces (Rus-Calafell *et al.*, 2011) and a standardized set of natural faces (photographs; Kohler *et al.*, 2003). Furthermore, the specific relationship between those individual traits was also explored. The main hypotheses of the present study were as follows:

1. Alexithymia, presence of schizotypy traits and NA would predict poor performance in facial emotion recognition.
2. There would be a positive correlation between alexithymia and schizotypy as well as a positive correlation between alexithymia and NA.

Method

Participants

Ninety-eight healthy volunteers were recruited from different faculties of the University of Barcelona and the Adult Education Centre Rius i Taulet (Barcelona). Participants were recruited through university lecturers and the director of the adult education centre. The only inclusion criterion was for the participants to be between the age of 18 and 65. The mean age of the sample was 32.58 years (*SD* = 9.23, range: 21-63), and 65.7% of participants were female (see Table 1 for all demographic data). The exclusion criteria were having a diagnosis of mental disorder or a personal history of physical illness or organic disease. All the participants signed a prior consent form.

Measures

Three different self-report questionnaires were administered prior to performing the task in order to assess schizotypal personality traits, affect and alexithymia variables:

– The *Oxford-Liverpool Inventory of Feelings and Experiences-Reduced Version* (O-LIFE-R; Spanish adaptation by Gutiérrez-Maldonado *et al.*, 1999): This is a reduced version of the original O-LIFE (Mason, Claridge, & Jackson 1995). The questionnaire consists of 40 dichotomous items (true/false) and is divided into four subscales: Unusual Experiences, Cognitive Disorganization, Introvertive Anhedonia and Impulsive Nonconformity. The briefness of the questionnaire does diminish neither its psychometric properties nor its validity (Alvárez-López, Gutiérrez-Maldonado, & Andrés-Pueyo, 2000). This short version has shown high internal consistency (α=.71 for the total scale) and good concurrent validity (Gutiérrez-Maldonado *et al.*, 1997).

– The *Toronto Alexithymia Scale-20* (TAS-20; Spanish adaptation by Moral de la Rubia & Retamales, 2000): This is a self-report questionnaire consisting of 20 statements, with answers ranging from 0=*strongly disagree* to 5=*strongly agree*. It comprises three subscales: (1) difficulty identifying feelings and distinguishing them from bodily sensations; (2) difficulty describing feelings; and (3) externally oriented thinking. The scales' validity and reliability have been demonstrated by Taylor (2000).

– The *Positive and NA Schedule* (PANAS; Bagby, Parker, & Taylor, 1994); Spanish adaption by Sandín *et al.*, 1999): This is a 20-item self-report questionnaire, which measures the individual's positive and negative affect. Each item is rated on a 5-point scale ranging from 1=*very slightly* or *not at all* to 5=*extremely*, and indicates the extent to which the respondent has felt this way in general. Two factors are derived from the scale: Positive affect and negative affect. Its validity and reliability have been demonstrated in different samples (Sandín *et al.*, 1999).

Facial Stimuli

The target stimuli comprised faces representing the five basic emotions: Happiness, sadness, fear, disgust and anger (Ekman, 1992), plus a neutral emotion (no emotion).

Natural Faces

A total of 44 photographs were selected from the Penn Emotion Recognition Test-96 Faces version (PERT96; Kohler *et al.*, 2003). This is a computer-based test consisting of 96 colour photographs of facial expressions of emotions, which include both high- and middle-intensity faces showing happiness, sadness, fear, disgust, anger and neutral emotion. This set of photographs has been standardized and used reliably as a neurobehavioural probe in emotion recognition studies (Gur *et al.*, 2002a, 2002b).

Virtual Faces

For the dynamic faces, 44 previously validated avatars (Rus-Calafell *et al.*, 2011) were used to display the abovementioned basic emotions. These faces were created using the facial surface changes proposed by Ekman in his Facial Action Coding System (Ekman & Friesen, 1978), and were matched to the intensity parameters of the PERT96 photographs (half of the virtual faces was designed with magnitude settings of approximately 0.5 [low intensity], and the other half was designed with magnitude settings close to 1.0 [high intensity]). The faces were first morphed according to the action units (AUs) in the FACS, using 3Ds Max® (Autodesk, Inc., USA). The 3D faces had continuous movement (a transition simulating the muscular movement) from the neutral face (the structure of the bones with all the FACS in 0) to the final expression. Further modelling and animations were also applied using 3D Max. To make the images more realistic, textures were included with the help of Photoshop 6.0®. Finally, 3DVIA Virtools® was used to correctly display each emotion during the final presentation (see figure 1).

Hardware

A laptop with a 15.6-inch monitor and stereoscopic view was used for the task presentation (Acer Aspire 5738dg, 2.2GHz Core 2 Duo, 4GB of RAM, and ATI Radeon HD 4570 graphics). This hardware was selected due to its portability and because it is much more ergonomic for users than other VR hardware, such as a Head Mounted Display. Participants were required to use 3D glasses.

Procedure

The entire procedure was carried out in a single session and was conducted by a psychologist, with a master's degree. Before commencing with the task, demographic data was collected; inclusion and exclusion criteria were reviewed; the study and treatment information were provided to the participants, and they signed a prior consent form. After interviewing participants and checking the inclusion and exclusion criteria they were given the self-report questionnaires to complete (TAS-20, OLIFE-R, and PANAS). Each participant was then seated in front of the 3D-laptop. The task itself was divided into two blocks separated by a 20 s rest interval. The order of the blocks was counterbalanced and each image was presented randomly. Each face was presented for a maximum of 7 s and participants had to choose the corresponding emotion from a list that appeared on the left-hand side of the screen. The instructions were explained orally and also appeared in written form on the screen (see figure 1). The emotion categories were also read out loud to the participants before starting the task. Each participant was instructed to respond as naturally and spontaneously as possible. The number of errors (committed errors in the facial emotion recognition task considering the missing responses or incorrect identifications) was recorded in a data matrix created by the same programme.

Figure 1. Creation of a virtual reality (VR) face and an example of the recognition task (photograph displayed).

Statistical Analysis

Statistical analyses were performed using SPSS 15.0 for Windows (SPSS Inc., Chicago, USA). Correlations between the study variables were analysed using Pearson's correlations. Multiple regression was then performed to assess the contribution of alexithymia, schizotypy and positive/NA to the dependent variables (number of errors made with photographs and VR).

Results

Demographic characteristics of participants

There were no missing data in the current investigation. All 98 participants completed the assessment and the task. The demographic details of the participants are summarised in table 1.

TABLE 1. DEMOGRAPHIC DATA.

		All participants ***N = 98***
Gender	Male	32 (32.65%)
	Female	66 (67.35%)
Mean age (*SD*)		32.58 (9.23)
Ethnicity	Caucasian	95 (96.9%)
	Black Caribbean	1 (1.03%)
	Black African	1 (1.03%)
	Asian	1 (1.03%)
Education Level	Primary	10 (10.2%)
	Secondary	19 (19.4%)
	Higher	69 (70.4%)
Marital Status	Single	86 (87.75%)
	Married	10 (10.20%)
	Divorced	2 (2.05%)

Emotion recognition and schizotypy, alexithymia and affect

Positive significant correlations were found between alexithymia and committed errors in both presentation conditions (photographs and virtual reality). Furthermore, there was a positive correlation between alexithymia and schizotypy traits, as well as alexithymia and NA. Alexithymia was also negatively associated with PA. Finally, there also was a positive correlation between schizotypy and NA. These results are presented in table 2.

TABLE 2. PEARSON'S CORRELATIONS BETWEEN VARIABLES.

	Total Errors_Ph	*Total Errors_VR*	*O-LIFE-R*	*TAS-20*	*PA*	*NA*
Total Errors_Ph	1					
Total Errors_VR	.662**	1				
O-LIFE-R	.042	.061	1			
TAS-20	.320**	.433**	.330**	1		
PA	0	0	-.142	-.447**	1	
NA	-.161	-.102	.564**	.208*	.11	1

Note. Total Errors_Ph: Total errors in photographs; Total Errors_VR: Total errors in virtual reality: O-LIFE-R: Total score on the Oxford-Liverpool Inventory of Feelings and Experiences—Reduced Version; TAS-20: Total score on the Toronto Alexithymia Scale-20; PA: PA score on the Positive and NA Schedule; NA: NA score on the Positive and NA Schedule.
*p<.05. **p<.01.

Multiple regression, using the enter method, yielded a significant model for the constants of total errors with photographs $F(4, 63) = 4.319$, $p < .01$, adjusted $R^2 = .165$; and total errors with virtual reality $F(4, 63) = 5.241$, $p < .01$, adjusted $R^2 = .202$. The standardized beta coefficients showed a significant contribution of alexithymia and NA to the two models presented below. In the regression model of errors made in photographs, the contribution of alexithymia was significant $\beta = .474$, $t = 3.585$, $p < .01$. The contribution of NA was also significant, although in a negative direction $\beta = -.361$, $t = -2.570$, $p < .05$. In the regression model of errors made in VR, both alexithymia and NA made a significant contribution, respectively $\beta = .549$, $t = 4.248$, $p < .01$, and $\beta = -.267$, $t = -1.947$, $p < .05$; as before, the contribution of NA was negative. It should be emphasized that the assumption of multicollinearity was not violated in this analysis, and therefore the contribution of each variable is independent of that of the other, even though they are related. These results are presented in table 3.

TABLE 3. REGRESSION ANALYSIS PREDICTING TOTAL ERRORS IN PHOTOGRAPHS AND TOTAL ERRORS IN VIRTUAL REALITY.

Dependent Variable	*Predictors*	*F (Sig.)*	*Adjusted R^2*	*Beta*	*t*	*Sig.*
Total Errors_Ph	Model	4.318 ($p < .01$)	.165			
	O-LIFE-R			.127	0.899	.372
	TAS-20			.474	3.585	.001**
	PA			.23	2.035	.670
	NA			-.361	-2.57	.013*
Total Errors_VR	Model	5.241 ($p < .01$)	.202			
	O-LIFE-R			.056	0.601	.690
	TAS-20			.549	4.248	.000**
	PA			.177	1.398	.167
	NA			-.267	-1.947	.046*

Note. O-LIFE-R: Total score on the Oxford-Liverpool Inventory of Feelings and Experiences—Reduced Version; TAS-20: Total score on the Toronto Alexithymia Scale-20; PA: PA score on the Positive and NA Schedule; NA: NA score on the Positive and NA.
**p<.05. **p<.01.*

Discussion

The main purpose of the present study was to examine the contribution of schizotypy, alexithymia and affect to the accuracy of facial emotion recognition. Furthermore, the interrelationships between these variables (schizotypy, alexithymia and affect) were explored. A regression model using these variables as predictors of accuracy in facial emotion recognition was proposed and results revealed interesting findings about the contribution of the variables.

Alexithymia made a significant contribution to the prediction of emotion recognition capability, meaning that as the degree of alexithymia increases, so does the number of errors made in the two conditions (photographs and virtual reality). These findings are consistent with previous research, showing that alexithymia modulates accuracy in emotion recognition (Lane *et al.*, 1996; Montebarocci *et al.*, 2010; Prkachin *et al.*, 2009). Although the present results are based on a non-clinical sample it has been shown that a deficit in affect regulation (based on deficits in verbal emotional expression and emotion processing (Van't Wout *et al.*, 2007) impair the correct recognition of posed and evoked emotion facial expressions. Therefore, the proposal by some researchers to consider alexithymia as a personality dimension affecting both non-clinical and clinical populations seems justifiable. The present regression model indicates that both alexithymia and NA could predict an individual's ability to recognize facial emotions. The negative sign of this contribution suggests that participants with high NA do not commit more errors than participants who reported less NA. Similar results were reported by Suzuki *et al.* (2007) who showed that NA can be seen as a significant predictor of sadness identification. One explanation for these findings could be that four of the six emotions presented are classified as negative emotions, and the presence of NA could help participants to recognize negative emotions more easily. In this regard, the present results may also be related to simulation theory (Adolphs, 2002), which proposes that people recognize the emotional state of other people by attempting to generate and experience the analogous emotional state in themselves. Therefore, this pattern of results could be interpreted as a reflection of the "mood congruency" phenomenon (Csukly *et al.*, 2008). Further regression analysis revealed that schizotypy was not a good predictor of accuracy in emotion recognition. Even though previous studies have found that individuals with schizotypy have impaired recognition ability for facial emotions (Brown & Cohen, 2010; Poreh *et al.*, 1994; Williams *et al.*, 2007) this is not confirmed by the present results. One explanation could be that participants did not show high schizotypy scores on the O-LIFE-R, and thus may not be representative of individuals with personality disorder or psychosis-proneness. It has also been noted that individuals in the present sample are adults, and some authors consider adolescence as the stage of interest for studying schizotypy due to its temporal proximity to the onset of schizophrenia, as well as to crucial neurodevelopment (Walker & Bollini, 2002).

Regarding the associations between schizotypy, alexithymia and affect the results indicated that alexithymia was strongly associated with schizotypy and NA. Previous research has shown that schizotypal personality characteristics are associated not only with the inability to correctly perceive affective cues of others (Shean *et al.*, 2007), but also with a poor capability to regulate and identify one's own emotions (Seghers *et al.*, 2011). This explains the observed association between alexithymia and schizotypy. According to the present results, other authors have also found a positive correlation between alexithymia and NA as well as a negative correlation between alexithymia and PA (Parker *et al.*, 2005; De Gucht, Fischler, & Heiser, 2004). These meaningful relationships may explain why subjects with difficulties describing feelings do also experience NA (or psychological distress) and low PA, even though this experience does not necessary hamper their capability to empathize with others. Although a correlation between NA and the facial emotion recognition capability was not found, NA emerged as a predictor of the individual's capability to recognize emotions. This pattern of results may reflect the fact that NA has an indirect effect on the recognition capability due to its meditational or moderational role in processing affective information in alexithymic subjects (Parker *et al.*, 2005).

The clinical implications of these findings rely on the fact that many psychological disorders, such as mood disorders (depression and anxiety), psychotic disorders or personality disorders, present impaired facial affect recognition. Clinicians should consider the assessment of affectivity and alexithymia, as well as other individual's personality characteristics, before assuming that the impairment is a consequence of the disorder *per se* (DeGucht, Fischler, & Heiser, 2004) and consider these characteristics when delivering psychotherapy.

The inclusion of virtual faces emerges as a response to the need to consider computer characters as new assessment and treatment material for research and therapy in psychology. Previous research using these virtual faces (Rus-Calafell *et al.*, 2011) revealed that there are no significant differences in the overall rate of correct recognition for the two presentation conditions (VR and photographs). These faces were created to be included in a VR-integrated program developed by the research group of this investigation to train social skills in people with schizophrenia in one-to-one sessions. The preliminary application of this program has produced encouraging results. Nowadays, human intelligence and human-computer interaction are incorporating animated agents to create face-to-face conversations and social interactions. The advanced technology used to create dynamic virtual faces also permits the introduction of cues (sounds, laughter, affect prosody) to identify emotions, which are an advantage for applications in emotional and social training and may improve the generalisation of the acquired skills to the participant's real life. As mentioned by Russell (1994), observers perceiving a facial movement automatically infer the situation, internal feelings and action, which means that virtual agents acting in social environments could increase the affective interaction between the user and the technology.

In sum, the regression model proposed here has highlighted the importance of alexithymia traits and the individual's NA for predicting the accuracy of emotion recognition. It should be emphasized that this predictive model was fitted for the two types of presentations (photographs and virtual reality).

Several limitations of the present study need to be acknowledged. Firstly, approximately half of the sample consisted of psychology students, who may not represent a general healthy population. Secondly, the lack of diagnosis of mental disorder or a personal history of physical illness or organic disease was based on a self-reported question, not a clinical assessment conducted by a psychologist. Thirdly, even though it is well known that culture is an important variable when studying emotion (Russell, 1994), it was not included in the analysis of the present data. Finally, only six expressions of emotions were used in the study, which some authors consider a small number of basic emotions with prototypical expressions produced by neuromotor programs (Scherer & Ellgrin, 2007).

For further research in this field, research regarding the directionality of the relationships and the specific role NA and PA play in high alexithymic individuals is needed to clarify the moderators' effects of alexithymia and affectivity. It is also necessary to look into the specific contribution of personality traits and affectivity to the accurate recognition of each of the five basic emotions, happiness, sadness, fear, disgust and anger. In addition, controlled experiments to investigate the user's ability to interpret faces of pre-prepared avatars expressing specific emotions are needed in order to demonstrate the reliability and efficiency of virtual reality for emotion recognition research and psychotherapy purposes.

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