Claes L, Jiménez-Murcia S, Santamaría JJ, Moussa MB, Sánchez I, Forcano L, Magnenat-Thalmann N, Konstantas D, Lucas M, Nielsen J, Bults RGA, Granero R, Lam T, Kalapanidas E, Treasure J, Fernández-Aranda F. (2012). The facial and subjective emotional reaction in response to a video game designed to train emotional Regulation (Playmancer). ***European Eating Disorders Review, 20,*** **484-489. doi: 10.1002/erv.2212.**

Abstract

Several aspects of social and emotional functioning are abnormal in people with eating disorders. The aim of the present study was to measure facial emotional expression in patients with eating disorders and healthy controls whilst playing a therapeutic video game (Playmancer) designed to train individuals in emotional regulation. Participants were 23 ED patients (11 AN, 12 BN) and 11 HCs. ED patients self reported more anger at baseline but expressed less facial expression of anger during the Playmancer game. The discrepancy between self-report and non-verbal expression may lead to problems in social communication.

Keywords: anorexia nervosa; bulimia nervosa; emotional expression; emotional regulation

Introduction

People with eating disorders have abnormalities in several aspects of social and emotional processing (Harrison, Sullivan, Tchanturia, & Treasure, 2010a). A systematic review and meta-analysis found that women with AN were less able to correctly recognise complex emotions in others compared to healthy women (large pooled effect size) (Oldershaw, Hambrook, Stahl, Tchanturia, Treasure, & Schmidt, 2011). There was also evidence that the effect persists despite recovery from AN (Harrison, Sullivan, Tchanturia, & Treasure, 2010b). There appears to be diagnostic specificity in that women with BN are not impaired in emotion recognition to the same degree as women with AN (Harrison et al., 2010b).

In contrast to the large amount of work examining emotional recognition much less work has been undertaken relating to emotional expression. Food cues have been found to elicit more negative reactions in people with AN compared to controls (Soussignan, Jiang, Rigaud, Royet, & Schaal, 2010). However, the fa- cial expression of emotion in response to sad or happy film clips is reduced (e.g., Davies, Schmidt, Stahl, & Tchanturia, 2011).Thus there is some evidence that both the recognition and expression of emotions in behavioral experiments with a variety of forms of emotional cues is impaired in people with ED.

In contrast, the subjective experience of negative emotions is increased in ED (Krug et al., 2008; Oldershaw et al., 2011), several studies (e.g., Cserjési, Vermeulen, Lenard, & Luminet, 2011; Fassino, Daga, Piero, Leombruni, & Rovera, 2001; Fox & Harrison, 2008; Harrison et al., 2010a; Joos et al., 2012;Waller, Babbs,Milligan, Meyer, Ohanian, & Leung, 2003) have shown higher state/trait anger and increased anger suppression in ED patients compared to HCs. People with AN expressed more anger towards others with less of a solution-focused response to scenarios depicting socially frustrating situations (Cardi, Matteo, Corfield, & Treasure, 2012; Harrison, Genders, Davies, Treasure, & Tchanturia, 2011).

We have designed a therapeutic video game (Playmancer), which aims to train individuals to regulate their emotional reactions under conditions of high arousal (Fernandez-Aranda et al., 2012). Players are attached to a battery of biosensors which feedback into the design of the challenging scenarios. Low levels of arousal are reinforced by visual feedback or by the ease in which individuals can move to the next level.

The aim of the present study was to compare the facial emotional expression in patients with eating disorders with healthy controls when playing the game. Based on the literature, our hypothesis was that there would be but a greater subjective anger but reduced facial expression of both anger and joy in ED when compared with healthy eating controls,

Method

Participants

The total sample consisted of 23 ED (11 AN, 12 BN) patients and 11 HCs. All patients were diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (APA, 1994) criteria using the SCID-I (First, Gibbon, Spitzer, & Williams, 1996) conducted by experienced psychologists and psychiatrists. Patients were consecutive referrals for assessment and treatment at the Department of Psychiatry of the Bellvitge Hospital in Barcelona, Spain. The HCs were recruited from students' volunteers from the same catchment area. The exclusion criteria were the following: male, having a primary psychiatric or neurological disorder that can interfere with the game perfor- mance (e.g., psychotic disorders, bipolar disorders, major depres- sive disorders, substance abuse-dependence disorders, etc.); on psychoactive medication and having a current or lifetime diagnosis of behavioral technological addictions (namely internet or video game addiction). The Ethics Committee of our Institution approved this study and informed consent was obtained from all participants (ref. PR098/09).

Instruments and procedure

The baseline assessment included:

1. Anthropometric variables: In addition to height and weight body composition was measured by means of a body composition analyzer (TANITA MC180-MA, http://www. bl-biologica.es/).

2. Psychometrical questionnaires:

A structured clinical interview (SCID-I, First et al. (1996), was used to establish the ED diagnosis and to measure current/lifetime of substance abuse.

Internet addiction was assessed by means of a 20 item scale (Young, 1998) and video-game addiction, by means of a 8 item self-report screening scale (Griffiths & Hunt, 1998).

The Eating Disorder Inventory-2 (Garner, 1991) is a reliable and valid 91-item multidimensional self-report questionnaire of eating disorder symptoms and behaviours This instrument was validated in a Spanish population (Garner, 1998) with a mean internal consistency of 0.63 (coefficient alpha).

The State-Trait Anger Expression Inventory-2 (STAXI-2, Spielberger, 1996) is a 44-item self-report instrument that examines the experience and expression of anger. It entails six scales and two subscales, which provides a general index of the expression of anger (derived from the Anger Expression- In, the Anger Expression-Out and the Anger Control scales). The STAXI-2 has been found to have good psychometric properties (including reliability and clinical validity) across a range of normal and clinical populations (Spielberger, 1996). This instrument was validated in a Spanish population with Cronbach's alpha coefficients ranging between 0.63 and 0.95 (Fernández-Abascal & Martin, 1995; Miguel-Tobal, Casado, Cano-Vindel, & Spielberger, 1997).

The Temperament and Character Inventory-Revised (TCI-R; Cloninger, 1999) is a 240-item, reliable and valid questionnaire that measures, 5-point Likert scale, as in the original TCI version (Cloninger, Svrakic, & Przybeck, 1993). The performance on the Spanish version of the original questionnaire (Gutierrez et al., 2001) and the revised version (Gutiérrez-Zotes et al., 2004) has been documented. The scales in the latter showed an internal consistency (coefficient alpha) of 0.87.

The SymptomChecklist-Revised-90-Revised (SCL-90-R; Derogatis, 1990) contains 90 items measuring: Somatization, Obsession- Compulsion, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. This scale has been validated in a Spanish population (Derogatis, 2002); obtaining a mean internal consistency of 0.75 (coefficient alpha).

The video game intervention A detailed description of the Island Video game is available in Fernandez-Aranda et al. (2012) and Jimenez-Murcia et al. (2009). The overall aim of this game is to improve emotional regulation by using bio-sensors feedback to raise awareness of arousal and to train to control this through relaxation, planning skills, biofeedback of both physiological reactivity and emotions, positive reinforce- ment, and self-control strategies. During the video game, the player is confronted with several challenging situations. As the player completes the various tasks of the game, he/she can advance to a higher level of difficulty. The game consists of three mini-games: a) The Face of Cronos – A game in which the player climbs up a cliff and high arousal (based on biofeedback) increases the number of obstacles; b) Treasures of the Sea – A game in which the player swims under water, gathering artifacts and balloon fish. The player has to maintain his/her oxygen level in order to keep on playing. This task is made more difficult if there is high arousal. A rise in heart rate, pulse rate, respiration rate, and facial expres- sions of anger emotion produce more difficulties (e.g. it is harder to catch fish and the oxygen runs out faster). c) Sign of the Magupta – A relaxation game in which a constellation of stars is drawn corresponding to the level of calmness of the player (based on breathing parameters). Slow breathing leads to a pathway connecting stars with each other, along different constellations. The system consisted of a Desktop PC on which the PlayMancer Desktop application was executed.

Biosensors (physiological reactivity measures)

The biosensors included: a) ECG for heart rate b) A TMSi resistive respiration belt for breathing rate; c) The NoninW pulse-oximeter finger-clip sensor for blood flow. The sensors were linked to the Desktop application via BluetoothW. This facial emotional recognition software was composed into two main components Facial Feature Tracking and Affect Classi- fication(Figure 1). The video input from the camera is processed by the facial tracking component. This component extracts the facial features and tracks them over time. The resulting spatial information of the facial features is then processed by the affect classification component.

The facial feature tracking component (Figure 2) detects and tracks the locations of the facial fiducial points (such as corners of the eyes, corners of the mouth, etc.) over time. In our approach we employ the Active Shape Model (ASM) to extract the shape information of the face in a video sequence. ASM, which was introduced by Cootes (Cootes & Taylor, 2004) is an algorithm that matches a set of shape points to an image constrained by the statistical model of the shape.

The detection and the tracking using ASM takes several steps. In the initialization stage, a Viola & Jones based face detection (Viola & Jones, 2004) and feature detection (eyes, nose and mouth) (Castrillón, Déniz, Guerra, & Hernández, 2007) is performed on the video frame. The ASM shape is aligned with respect to the position of the detected facial features. After the alignment, the shape is fitted iteratively to the face, where for every model point the best match (by taking gradients into consideration) with respect to the shape parameter constraints. Our approach is based on (P. JIA, 2010a) and (P. JIA, 2010b) where instead of using one gradient vector along one direction; two gradient vectors along two orthogonal directions are used. After the initialization stage, the resulting shape of each frame is used in the next frame for refitting. In case of lower accuracy, the ASM shape is automatically reinitialized (further information in attached online information).

For this experiment we used Anger and Joy, as they represent a positive and a negative basic emotions. Using a positive and a negative emotion is a commonly used method in the current literature in the field (Davies et al., 2011; Nandrino et al., 2012). Anger is one of the triggering negative emotions of impulsive behaviors in ED patients (e.g., bingeing; Kjelsås, Børsting, & Gudde, 2004; Vanderlinden et al., 2004). To calibrate our software and the facial emotion recognition component, several previous experiments were conducted. For further information on that, please look at supplementary online information in this article.

The experimental intervention

The experiment took place in a 12m2 room, on a computer with 20' screen with integrated video camera at the top (see Figure 3). Every participant performed the videogame individually while the therapist, who was present in the room, supervised the whole process.

Biosensor assessment measures are taken before, during and after the Islands videogame. Each session lasts 26minutes (3minutes for each baseline and 20minutes game experience). The first 3minutes baseline phase was used for calibration of the software/ individual. During the 20minutes of play emotional facial expres- sions and physiological reactions were monitored by biosensors.

Statistical analyses

The data-analyses were performed by means of SPSS 19 for Windows. One-way Analysis of Variance (ANOVA) compared the means scores for the criteria (Playmancer Joy-Anger Expression in seconds, the STAXI-2 scales and the TCI-R) between diagnostic subtypes (AN, BN, and NC), and Scheffé post-hoc comparisons estimated contrasts (f) to explore all possible pair-wise comparisons of means to detect which were the diagnostic subtypes different from each other.

Results

Clinical data are shown in Table 1. As expected, both eating (by means of EDI-2) and general psychopathology (by means of SCL-90R) scores were statistically different between the groups ($p < .001$), with the highest means for BN patients, followed by AN and HC.

Baseline TCI and staxi

People with BN had significantly higher baseline scores on State- Anger, Sentiment, and Verbal Expression compared to both AN and HCs, and significantly higher scores on Trait-Anger compared to HCs. The three groups did not differ on the dimension Anger-Expression.

Table 2 shows the emotional reactions [behavioural Joy/Anger expression (measured in seconds) and self report] during the game. Joyful facial expression were of similar duration in all groups There was much more variation in the means for angry facial expressions, ED patients had lower expression of anger but this only reached significance in the AN group ($p = .024$, $f= 238.2$, 95% CI: 27.9 to 448.5).

An additional ANOVA with repeated measures (implemented into a General Lineal Model analysis in SPSS) was used to test if the diagnostic subtype (group: AN-BN-HC) was associated to the differences in the facial expression (joy and anger, measured with the time means in seconds). There was a main effect for the type of expression, in the sense that joy was expressed more than Anger (mean difference =807.9 seconds; 95% confidence interval: 596.8 to 1019.0). No main effect for the group was found ($F (2,31) =1.73$, $p= .193$). No interaction effect (group expression) emerged ($p= .508$). The power to detect significant results for each outcome were between very poor to poor (power ranged from 0.09 to 0.68).

Discussion

The aim of the present study was to measure subjective emotional reactivity and facial emotional expression in patients with eating disorders and healthy controls whilst playing a video game. Our hypotheses were confirmed in part in that there was increased subjective anger in people with ED and a reduced facial expression of anger in AN patients (a similar trend was found for BN). On the other hand joyful expression was similar across groups.

As far as we know, this is the first study, which investigates emotion expression in ED patients by means of a computerized tracking device during task performance.

The reduced negative emotional reaction parallels the reduced expression of sadness elicited by sad films in AN (Davies et al. (2011). This supports the hypothesis, which suggests that ED patients inhibit or avoid negative emotions.

The failure to replicate Davies finding of reduced expressions of pleasure may be due to the more interactive aspect of videogames have a high capacity to produce enjoyment while people are playing them (Boyle, Connolly, Hainey, & Boyle, 2012).

Emotion expression either positive or negative is a key factor in social interaction gives information about others' emotional states and intentions. This incongruence between self reported anger in ED patients and facial displays of anger may lead to inefficient social communication.

Given the strengths of our study, some limitations must also be addressed. First, the number of patients in our study is seriously limited and the lack of statistical power does not allow the detec- tion of statistical differences, so replication in larger samples is necessary to further corroborate our findings. Secondly, our study is performed in female ED patients and HCs, and needs further replication in male EDs and HCs. Thirdly; we only measured anger and not joy by self-report during the experiment. Finally, the presence of the therapist during the PLAYMANCER perfor- mance can have differentially acted on the expression of anger between groups. Notwithstanding these shortcomings, our study is the first pilot-study to show reduced facial emotion expression of ED patients by means of an online tracking system for facial expression during a video-game and further investigation to gain more insight into emotion expression, experience and regulation is needed.

REFERENCES

American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental Disorders-Revised (3rd edn). Washington, DC: APA.

Boyle, E.A., Connolly, T.M., Hainey, T., & Boyle, J.M. (2012) Engagement in digital entertainment games: A systematic review. Computers in Human Behavior, 28(3), 771–780.

Cardi, V., Matteo, R. D., Corfield, F., & Treasure, J. (2012). Social reward and rejection sensitivity in eating disorders: An investiga- tion of attentional bias and early experiences. The World Journal of Biological Psychiatry. DOI: 10.3109/15622975.2012.665479

Castrillón, M., Déniz, O., Guerra, C., & Hernández, M. (2007). ENCARA2: Real-time detection of multiple faces at different resolutions in video streams. Journal of Visual Communication and Image Representation, 18, 130–140.

Cloninger, C. R. (1999). The Temperament and Character Inventory– Revised. St. Louis, MO: Center for Psychobiology of Personality, Washington University.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psycho- biological model of temperament and character. Archives of General Psychiatry, 50, 975–990.

Cootes T. & Taylor, C (2004). Statistical models of appearance for computer vision. Technical report, Imaging Science and Biomedical Engineering, University of Manchester, March 8.

Cserjési, R., Vermeulen, N., Lenard, L., & Luminet, O. (2011). Reduced capacity in automatic processing of facial expression in restrictive anorexia nervosa and obesity. Psychiatry Research, 188, 253–257.

Davies, H., Schmidt, U., Stahl, D., & Tchanturia, K. (2011). Evoked emotional expression and experience in anorexia nervosa. International Journal of Eating Disorders, 44, 531–539.

Derogatis, L. (1990). SCL-90-R. A bibliography of research reports 1975–1990. Baltimore, MD: Clinical Psychometric Research.

Derogatis, L. (2002). SCL-90-R. Cuestionario de 90 sintomas-Manual. Madrid: TEA Ediciones.

Fassino, S., Daga, G., Piero, A., Leombruni, P., & Rovera, G. (2001). Anger and personality in eating disorders. Journal of Psychoso- matic Research, 51, 757–764.

Fernández-Abascal, E.G., & Martin, M.D. (1995). El síndrome AHA y su relación con los trastornos cardiovasculares.Ansiedad y Estrés 0, 25–36.

Fernandez-Aranda, F., Jimenez-Murcia, S., Santamaria, J.J., Gunnard, K., Soto, A., Kalapanidas, E., et al. (2012). Video games as a comple- mentary tool in mental disorders: Playmancer a European multi- center study. Journal of Mental Health, 21(4), 364–374.

First, M., Gibbon, M., Spitzer, R., Williams, J. (1996). Users Guide for the Structured Clinical Interview for DSM IV Axis I Disorders — Research Version (SCID-I, Version 2.0). New York, NY: New York State Psychiatric Institute.

Fox, J. R. E., & Harrison, A. (2008). The relation of anger to disgust: The potential role of coupled emotions within eating pathology. Clinical Psychology & Psychotherapy, 15, 86–95.

Garner, D.M. (1991). Eating Disorder Inventory-2: Profession Manual. Odessa: Psychological Assessment Resources.

Garner, D.M. (1998). EDI-2 Inventario de trastornos de la conducta alimentaria. Madrid: TEA Ediciones.

Griffiths, M. D., & Hunt, N. (1998). Dependence on computer games by adolescents. Psychological Reports, 82, 475–480.

Gutierrez, F., Torrens, M., Boget, T., Martin-Santos, R., Sangorrin, J., Perez, G., et al. (2001). Psychometric properties of the Temparaments and Character Inventory (TCI) questionnaire in a Spanish psychiatric population. Acta Psychiatrica Scandinavica, 103, 143–147.

Gutiérrez-Zotes, J. A., Bayón, C., Montserrat, C., Valero, J., Labad, A., Cloninger, R. C., et al. (2004). [Temperament and Character Inventory-Revised (TCI-R). Scalement and normative data in a general population sample]. Inventario del Temperamento y el Carácter-Revisado (TCI-R). Baremación y datos normativos en una muestra de población general.Actas Españolas de Psiquiatría, 32, 8–15.

Harrison, A., Genders, R., Davies, H., Treasure, J., & Tchanturia, K. (2011). Experimental measurement of the regulation of anger and aggression in women with anorexia nervosa. Clinical Psychology & Psychotherapy 18, 445–452.

Harrison, A., Sullivan, S., Tchanturia, K., & Treasure, J. (2010a). Emotional functioning in eating disorders: Attentional bias, emotion recognition and emotion regulation. Psychological Medicine, 40, 1–11.

Harrison, A., Sullivan, S., Tchanturia, K., & Treasure, J. (2010b). Attentional bias, emotion recognition and emotion regulation in anorexia: state or trait? Biological Psychiatry, 68, 755–761.

Jimenez-Murcia, S., Fernández-Aranda, F., Kalpanidas E., Konstantas, D., Ganchev, T., Kocsis, O., Lam, T., et al. (2009). Playmancer Project: A Serious Videogame as an Additional Therapy Tool for Eating and Impulse Control Disorders. Studies in Health Technology and Informatics, 144, 163–166.

Joos, A.A.B., Gille, M., Hartmann, A., Unterbrink, T., Wetzler-Burmeister, E., Scheidt, C., et al. (2012). Emotional Perception in Patients with Eating Disorders in Comparison with Depressed Patients. European Eating Disorders Review, 20(6). DOI: 10.1002/erv.1132

Kjelsås E., Børsting, I., & Gudde, C.B. (2004). Antecedents and consequences of binge eating episodes in women with an eating disorder. Eating and Weight Disorders, 9, 7–15.

Krug, I., Bulik, CM., Nebot Vall-Llovera, O., Granero, R., Agüera, Z., Villarejo, C., Jiménez-Murcia, S., & Fernández-Aranda, F. (2008). Anger expression in eating disorders: Clinical, psycho- patholocial and personality correlates. Psychiatry Research, 161(2), 195–205.

Miguel-Tobal, J.J., Casado, M.I., Cano-Vindel, A., & Spielberger, C.D. (1997). El estudio de la ira en los trastornos cardiovas- culares mediante el empleo del Inventario de Expresión de Ira-Estado- Rasgo (STAXI). Ansiedad y Estrés, 3, 5–20.

Nandrino, J. L., Berna, G., Hot, P., Dodin, V., Latree, J., Decharles, S., et al. (2012). Cognitive and physiological dissociations in response to emotional pictures in patients with anorexia. Journal of Psychosomatic Research, 72, 58–64.

Oldershaw, A., Hambrook, D., Stahl, D., Tchanturia, K., Treasure, J., & Schmidt, U. (2011). The socio-emotional processing stream in Anorexia Nervosa. Neuroscience and Biobehavioral Reviews, 35, 970–988.

P. JIA. (2010a). Audio-visual based HMI for an Intelligent Wheelchair. PhD thesis, University of Essex, Oct 21.

P. JIA. (2010b). 2D Statistical Models. Technical Report of Vision Open Working Group, 2st Edition, Oct 21.

Soussignan, R., Jiang, T., Rigaud, D., Royet, F.P., & Schaal B. (2010). Subliminal fear priming potentiates negative facial reactions to food pictures in women with anorexia nervosa. Psychological Medicine, 40, 503–514.

Spielberger, C. (1996). State-Trait Anger Expression Inventory: Professional manual. Florida: Odessa.

Vanderlinden, J., Dalle Grave, R., Fernandez, F., Vandereycken, W., Pieters, G., & Noorduin, C. (2004). Which factors do provoke binge eating? An exploratory study in eating disorder patients. Eating and Weight Disorders, 9, 300–305.

Viola, P., & Jones, M. J. (2004). Robust Real-Time Face Detection. International Journal of Computer Vision, 57, 137–154.

Waller, G., Babbs, M., Milligan, R., Meyer, C., Ohanian, V., & Leung, N. (2003). Anger and core beliefs in the eating disorders. International Journal of Eating Disorders, 34, 118–124.

Young, KS. (1998). Internet Addiction: The Emergence of a New Clinical Disorder. Cyberpsychology & Behavior, 1(3), 237–244. DOI: 10.1089/cpb.1998.1.237

Table 1

	AN (N = 11)		BN (N = 12)		HC (N = 11)				Post-hoc comparisons[†]			Eta	Power
	Mean	(SD)	Mean	(SD)	Mean	(SD)	$F_{(2, 31)}$	p	AN vs BN	AN vs HC	BN vs HC	squared	value
Age (years-old)	32.5	9.7	29.2	10.5	28.1	5.4	0.477	.758	3.38	4.45	1.08	.047	.163
Onset of ED (years-old)	20.8	10.8	19.9	10.4			0.032[‡]	.859[‡]	0.88	---	---	.002	.960
Duration of ED (years-old)	9.4	7.2	10.5	7.6			0.096[‡]	.761[‡]	−1.06	---	---	.006	.960
Body mass index (kg/m[‡])	16.3	1.4	26.7	5.8			15.03[‡]	.001[‡]	−10.4*	---	---	.500	.960
EDI: Drive for thinness	10.55	7.65	14.92	5.65	2.00	4.50	10.46	<.001	−4.37	8.55*	12.92*	.428	.962
EDI: Body dissatisfaction	9.09	6.98	21.75	5.51	2.25	5.20	27.60	<.001	−12.66*	6.84	19.50*	.663	.990
EDI: Interoceptive awaran.	7.45	6.04	13.33	6.30	0.50	1.07	13.74	<.001	−5.88*	6.95*	12.83*	.495	.960
EDI: Bulimia	3.18	3.60	12.00	4.84	0	0	29.10	<.001	−8.82*	---	---	.675	.827
EDI: Interper. distrust	3.91	4.35	5.92	5.38	0	0	4.66	.018	−2.01	---	---	.250	.601
EDI: Ineffectiveness	6.09	4.53	12.75	7.57	0.25	0.46	12.88	<.001	−6.66*	5.84	12.50*	.479	.985
EDI: Maturity fears	7.00	5.18	8.75	5.10	3.00	3.42	3.54	.043	−1.75	4.00	5.75*	.202	.710
EDI: Perfectionism	5.09	4.97	7.33	4.75	3.00	2.93	2.32	.117	−2.24	2.09	4.33	.142	.498
EDI: Impulse regulation	4.64	4.97	8.25	6.51	0.25	0.71	6.028	.007	−3.61	4.39	8.00*	.301	.908
EDI: Ascetism	6.00	2.45	8.42	3.73	1.13	1.36	15.93	<.001	−2.42	4.88*	7.29*	.532	.960
EDI: Social insecurity	4.64	3.75	9.17	4.57	0.50	0.76	13.79	<.001	−4.53*	4.14	8.67*	.496	.998
EDI: Total score	67.6	36.4	123.2	39.9	12.9	15.4	32.68	<.001	−55.53*	54.73*	110.3*	.678	.998
SCL-90: Somatization	1.34	1.15	2.22	1.29	0.49	0.36	8.07	.002	−0.88	0.85	1.73*	.342	.801
SCL-90: Obsessive/compuls.	1.12	0.64	2.22	0.86	0.55	0.39	18.81	<.001	−1.10*	0.57	1.67*	.548	.997
SCL-90: Interpers. sensitivity	1.37	0.88	2.24	1.08	0.35	0.38	14.41	<.001	−0.87	1.02*	1.89*	.482	.981
SCL-90: Depressive	1.62	1.09	2.29	1.07	0.48	0.36	11.41	<.001	−0.66	1.14*	1.80*	.424	.938
SCL-90: Anxiety	1.10	0.71	2.06	1.20	0.30	0.28	12.83	<.001	−0.96*	0.80	1.76*	.453	.963
SCL-90: Hostility	0.83	0.55	1.82	1.22	0.21	0.32	11.49	<.001	−0.96*	0.62	1.61*	.426	.939
SCL-90: Phobic anxiety	0.54	0.56	1.31	1.19	0.09	0.18	7.12	.003	−0.77	0.45	1.22*	.315	.735
SCL-90: Paranoid Ideation	0.80	0.70	1.71	0.93	0.33	0.50	10.37	<.001	−0.90*	0.47	1.37*	.401	.910
SCL-90: Psychotic	0.75	0.49	1.59	0.92	0.13	0.13	16.32	<.001	−0.85*	0.62	1.46*	.513	.991
SCL-90: GSI score	1.15	0.67	2.02	0.99	0.34	0.23	15.97	<.001	−0.87*	0.81*	1.68*	.507	.990
SCL-90: PST score	51.4	21.0	68.4	21.0	23.7	17.0	14.79	<.001	−17.05	27.64*	44.67*	.488	.983
SCL-90: PSDI score	1.87	0.62	2.50	0.64	1.19	0.43	15.12	<.001	−0.63*	0.68*	1.31*	.494	.986
TCI-R: Novelty seeking	96.00	12.4	98.75	17.6	101.5	11.8	0.401	0.673	−2.75	−5.46	−2.71	.025	.101
TCI-R: Harm avoidance	105.2	16.7	124.4	19.6	89.64	14.6	10.96	<.001	−19.2*	15.55	34.76*	.430	.977
TCI-R: Reward dependence	104.9	14.6	95.20	10.0	112.0	7.8	5.92	.007	9.71	−7.09	−16.80*	.290	.817
TCI-R: Persistence	120.5	11.3	113.5	29.7	120.4	14.2	0.431	.654	7.04	0.18	−6.86	.029	.096
TCI-R: Self-directedness	136.6	19.8	110.5	12.5	153.4	13.6	19.65	<.001	26.14*	−16.73	−42.89*	.575	.999
TCI-R: Cooperativeness	141.3	16.0	134.1	13.8	141.1	14.8	0.775	.470	7.17	0.18	−6.99	.051	.135
TCI-R: Self-transcendence	59.45	14.7	71.20	24.3	58.09	10.5	1.808	.182	−11.75	1.36	13.11	.111	.281

Table 2

	AN (N = 11)		BN (N = 12)		HC (N = 11)				Post-hoc comparisons[†]			Eta	Power
	Mean	(SD)	Mean	(SD)	Mean	(SD)	$F_{(2, 31)}$	p	AN vs BN	AN vs HC	BN vs HC	square	value
Playmancer-Joy (seconds)[‡]	809.1	(405.3)	989.2	(551.4)	907.3	(483.5)	0.394	.678	−180.1	−98.2	81.9	.02	0.09
Playmancer-Anger (seconds)[‡]	6.36	(15.7)	30.83	(65.3)	244.6	(330.3)	5.185	.011	−24.5	−238.2*	−213.7	.25	0.55
STAXI_Sentiment	6.00	(2.68)	9.18	(4.19)	5.45	(0.69)	5.299	.011	−3.18*	0.55	3.73*	.261	0.68
STAXI_ Physical Expression	5.09	(0.30)	6.45	(3.30)	5.00	(0.00)	1.998	.153	−1.36	0.82	1.46	.118	0.28
STAXI_ Verbal Expression	5.27	(0.90)	8.09	(3.75)	5.18	(0.40)	5.989	.006	−2.82*	0.09	2.91*	.285	0.69
STAXI-State Anger	16.36	(3.88)	23.73	(9.92)	15.64	(0.67)	5.804	.007	−7.37*	0.73	8.09*	.279	0.70
Angry Temperament	9.55	(3.93)	11.36	(4.32)	7.73	(2.45)	2.717	.082	−1.82	1.82	3.64	.153	0.45
Reactions to Criticism	12.73	(4.15)	15.18	(3.89)	11.18	(2.93)	3.279	.052	−2.46	1.55	4.00	.179	0.52
STAXI-Trait Anger	22.27	(7.51)	26.55	(7.01)	18.91	(4.85)	3.748	.035	−4.27	3.36	7.64*	.200	0.59
Anger Expression_Out	10.91	(2.07)	12.27	(3.20)	11.09	(2.70)	0.830	.446	−1.36	−0.18	1.18	.052	0.14
Anger Expression_In	12.82	(3.09)	12.73	(2.69)	10.73	(2.87)	1.844	.176	0.09	2.09	2.00	.109	0.26
Anger Control_Out	15.64	(3.83)	15.27	(4.00)	18.55	(3.39)	2.519	.097	0.36	−2.91	−3.27	.144	0.37
Anger Control_In	12.91	(4.85)	12.91	(3.70)	14.91	(3.59)	0.879	.426	0.00	−2.00	−2.00	.055	0.14
STAXI-Anger Expression	31.18	(10.15)	32.82	(9.29)	24.36	(8.35)	2.562	.094	−1.64	6.82	8.46	.146	0.39

Figures 1-2-3

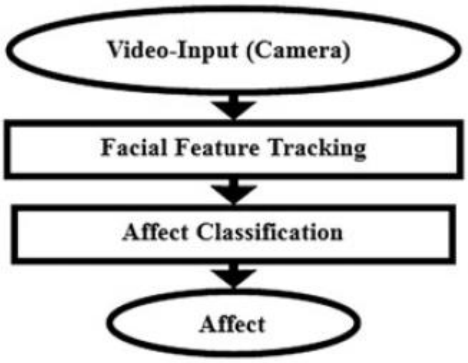

Figure 1 Facial Affect Recognition component architecture

Figure 3 Procedure used to detect face-expression with Playmancer

Figure 2 Geometrical point's detection and tracking