

# NASAL THERMAL ACTIVITY DURING VOLUNTARY FACIAL EXPRESSION IN A PATIENT WITH CHRONIC PAIN AND ALEXITHYMIA: A CASE REPORT

David Alberto Rodríguez Medina<sup>1</sup>, Benjamín Domínguez Trejo<sup>2</sup>, Irving Armando Cruz Albarrán<sup>3</sup>, Luis Morales Hernández<sup>4</sup>, Gerardo Leija Alva<sup>5</sup>, Patricia Zamudio Silva<sup>6</sup>

<sup>1</sup> Postgraduate in Health Psychology, Faculty of Psychology, UNAM, Mexico City, Mexico

<sup>2</sup> Division of Postgraduate Studies, Faculty of Psychology, UNAM, Mexico City, Mexico

<sup>3</sup> Postgraduate in Mechatronics, Faculty of Engineering, UAQ, San Juan del Río, Mexico

<sup>4</sup> Division of Postgraduate Studies, Faculty of Engineering, UAQ, San Juan del Río, Mexico

<sup>5</sup> Interdisciplinary Center of Health Sciences, IPN - Santo Tomás, Mexico City, Mexico

<sup>6</sup> Regional Hospital Ignacio Zaragoza, ISSSTE, Mexico City, Mexico

**Resumen:** La presencia de alexitimia (dificultad para reconocer y expresar emociones y sentimientos), es uno de los factores psicológicos que se ha estudiado en los pacientes con dolor crónico. Para su manejo se han utilizado diferentes estrategias psicológicas; sin embargo, ninguna de ellas regula la actividad autonómica. Presentamos el caso de una paciente femenina de 74 años de edad con diagnóstico de artritis reumatoide con alexitimia. Desde hace doce años ingiere pregabalina para el dolor. El objetivo principal de este estudio de caso fue realizar una evaluación biopsicosocial del dolor (nivel de concentración de interleucina 6, para evaluar el aspecto inflamatorio; evaluación psicofisiológica térmica nasal y medidas psicosociales asociadas al dolor). Se le presentaron videos con escenas afectivas de diversas emociones (alegría, tristeza, miedo, dolor, enojo). Los resultados muestran que, cuando la paciente observa los videos existe poca variabilidad térmica nasal. Sin embargo, cuando se le inducen movimientos faciales durante 10 segundos de una expresión facial se alcanza una variación térmica alrededor de 1° C. Las expresiones faciales inducidas que decrementaron la temperatura son las de ira y dolor, las cuáles coinciden con las necesidades prioritarias de la paciente de acuerdo al perfil biopsicosocial. Los resultados se discuten en el contexto clínico del uso de las expresiones faciales para promover la regulación autonómica en esta población.

Palabras-chave: Temperatura nasal; Perfil Biopsicosocial de Dolor; Expresiones Faciales

**Abstract:** The presence of alexithymia (difficulty in recognizing and expressing emotions and feelings) is one of the psychological factors that has been studied in patients with chronic pain. Different psychological strategies have been used for its management; however, none of them regulates the autonomic activity. We present the case of a 74-year-old female patient diagnosed with rheumatoid arthritis with alexithymia. For twelve years she has been taking pregabalin for pain. The main objective of this case study was to perform a biopsychosocial evaluation of pain (level of interleukin 6 concentration, to evaluate the inflammatory appearance, psychophysiological nasal thermal evaluation and psychosocial measures associated with pain). Videos with affective scenes of various emotions (joy, sadness, fear, pain, anger) was presented. The results show that, when the patient observes the videos, there is little nasal thermal variability. However, when facial movements are induced for 10 seconds of a facial expression, a thermal variation is reached around 1° C. The induced facial expressions that decrease the temperature are those of anger and pain, which coincide with the priority needs of the patient according to the biopsychosocial profile. The results are discussed in the clinical context of the use of facial expressions to promote autonomic regulation in this population.

Keywords: Temperature; Biopsychosocial Profile of Pain; Facial Expressions

**INTRODUCTION**

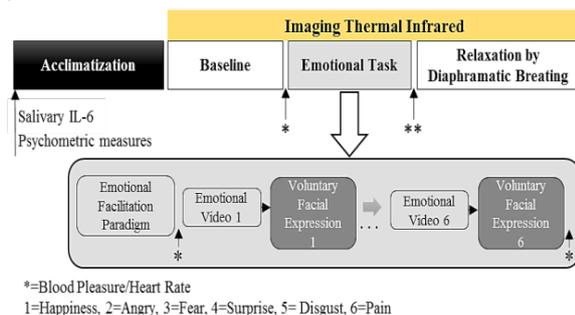
Several experimental and clinical studies have evaluated temperature changes in the tip of the nose during negative emotional situations, finding a decrease in temperature.<sup>1, 2, 3, 4</sup> However, the clinical thermal effect of reproducing emotional facial expressions on a nasal temperature has not been evaluated. This is of special psychophysiological interest in a patient with alexithymia (difficulty recognizing and expressing emotions and feelings) due to the limitations of communicating emotionally with other people, even with a treating doctor.

The presence of alexithymia in a patient with chronic pain influences a greater perception of pain intensity, psychological distress (depression, disability).<sup>5, 6, 7</sup> For their management, some studies reported different psychological treatments.<sup>8</sup> Although there are differences between alexithymic and non-alexithymic subjects in peripheral nervous activity during exposure to emotional stimuli, psychological treatments have not incorporated autonomic activity as a biomarker of the effectiveness of their interventions.

There are studies that have evaluated the effects of voluntary emotional facial expression on peripheral nerve activity.<sup>9</sup> Even in patients with acquired brain injury, facial recognition skills have been trained.<sup>10, 11, 12</sup> The present study proposes a psychophysiological treatment based on the induction of voluntary emotional facial expression to evaluate the effect of autonomic activity (nasal temperature and heart rate) in a patient with chronic pain with a high level of alexithymia.

**CASE REPORT**

As part of a pilot study of the biopsychosocial effects of training in the recognition and emotional facial reproduction in patients with chronic pain, we requested the voluntary participation of a 74-year-old female patient diagnosed with rheumatoid arthritis. The patient was cured under fasting conditions (8h) in a room at a constant ambient temperature of  $20 \pm 2^\circ\text{C}$ , as established by the studies reviewed by Sillero et al.<sup>13</sup> Upon arrival, a salivary sample of IL-6 was collected and were taken their vital signs of heart rate and blood pressure pre-test with a digital baumanometer Citizen CH-656C. Then the psychological scales were administered. To evaluate the intensity and interference of pain we applied the Brief Pain Inventory (BPI) and Short Form of Questioning Mc Hill Pain (SF-MPQ). To assess the psychosocial area associated with pain, the patient responded to the Hospital Anxiety and Depression Scale (HADS), the Expression feature of anger trait-state version 2 (STAXI-2), Toronto Alexithymia Scale (TAS-10), the Emotional Questionnaire Regulation (EQR), UCLA Loneliness Scale (Version 3). All the psychological measures are validated for Mexican population.<sup>14</sup> Additionally, we evaluated the emotional facial recognition ability through the FEEL Test, which is a behavioral measure to confirm the difficulty of recognizing facial emotions. All the above measures make up the biopsychosocial evaluation of pain.<sup>15</sup>



**Figure 1** Design study

A single case design was used, which is illustrated in **Figure 1**. The nasal thermal psychophysiological record was performed every 10 seconds in each experimental condition with the thermal camera FLIR A320, at a distance of 1.2m from the tip of the nose.

The **Figure 1** shows the scheme of the psychophysiological evaluation protocol, which is described below:

1. Acclimatization (15 min.)
2. Baseline (2 min.)
3. Emotional Facilitation Paradigm (EFP) (2 min.), is a cognitive-affective task of measuring reaction times to discriminate valence (positive/negative) between congruent-incongruent facial stimuli<sup>16, 17</sup> whose effectiveness is related to the level of alexithymia<sup>17</sup>.
4. Exposure of emotional videos (1:30 min)
5. Induction of Emotional Facial Expression Voluntary (5-10 seconds per emotion) using facial action units<sup>18</sup>
6. Diaphragmatic breathing (2 min).

Because skin temperature is a response that depends on cardiovascular activity<sup>19</sup> heart rate and blood pressure were recorded at the end of each phase. The latter became the mean arterial pressure.

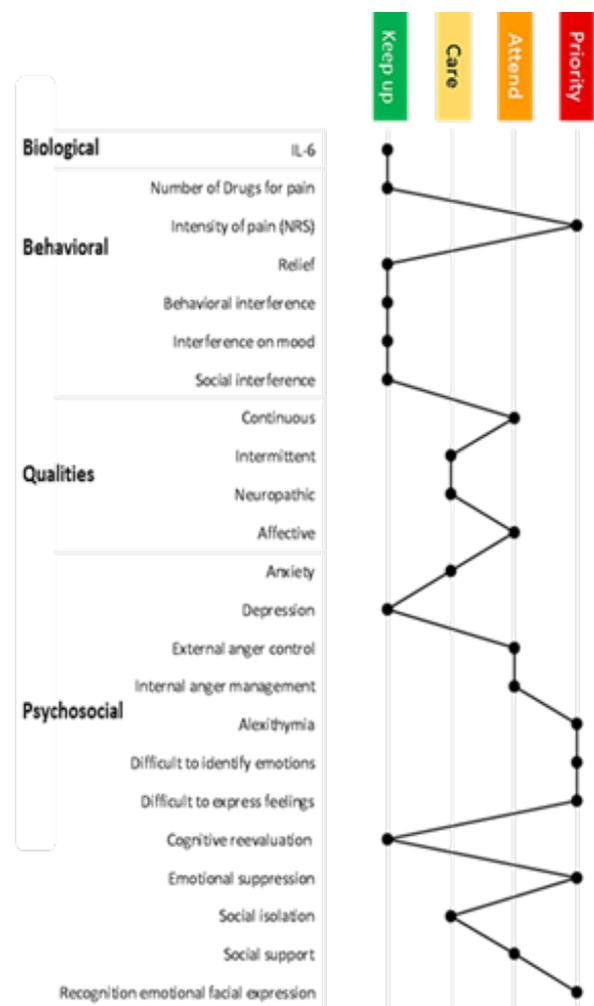
The data indicate a woman with a normal IL-6 concentration, a high level of pain intensity, moderately continuous, low control of anger, without anxiety or depression, but with a high level of alexithymia, emotional suppression and moderate support and social isolation (**Figure 2**).

The biopsychosocial profile of pain shows that the patient's clinical care priorities are pain level and alexithymia.

The autonomic results of the patient with chronic pain and alexithymia during the emotional task are shown in Figures

3 and 4. The systolic pressure showed an increase, compared to the baseline, during the emotional task; and a decrease during relaxation through diaphragmatic breathing (Higher graph, **Figure 3**).

The cardiac rate showed variability associated with emotional task and relaxation exercise, consistent with changes in systolic pressure, probably due to baroreceptor reflex (Lower graph, **Figure 3**)



**Figure 2** Clinical Biopsychosocial Profile of Pain. NRS= Numerical Rating Scale

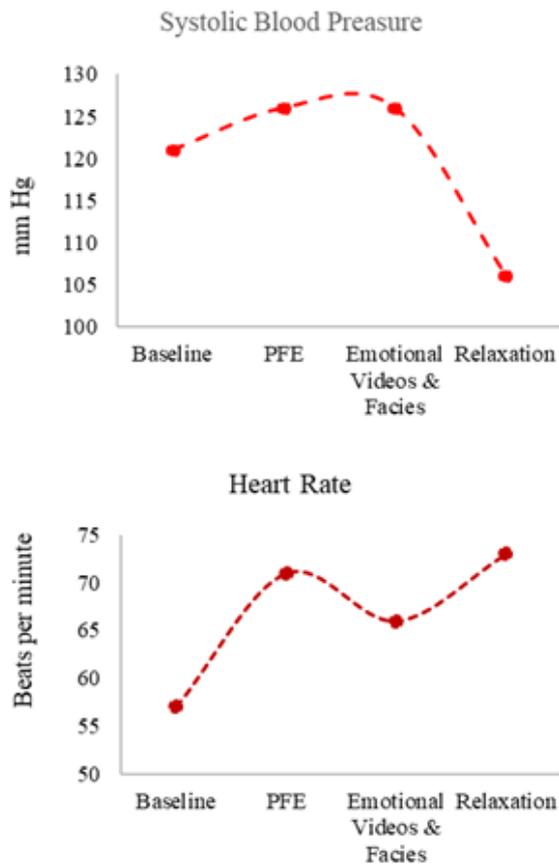


Figure 3 Changes in blood pressure and heart rate during emotional task and relaxation . PFE=Paradigm of Emotional Facilitation (Priming Affective)

In order to evaluate in detail, the autonomic changes that occur in this training in emotional facial induction, **Figure 4** shows the thermal variations in the tip of the nose according to the parable of emotional facilitation, the exposure of videos with affective load and the induced faces voluntarily; and finally, relaxation.

**DISCUSSION**

The biopsychosocial profile of the patient with chronic pain establishes the clinical priorities to deal with the specialists. In particular, anger management, emotional suppression, and alexithymia are the focus of clinical care that the clinical pain specialist should pay attention to.

The profile results justify the use of

psychophysiological strategies for anger management, such as training in diaphragmatic breathing. Because there is little nasal thermal variability in the patient when performing the task of priming emotional facial discrimination and exposure of videos with affective load, we implemented a behavioural strategy of emotional facial induction that allowed to increase the thermal variability. The purpose of inducing facial expression will help to improve low social support.

The main purpose of this case study was to examine changes in nasal temperature during emotional facial expression in a patient with difficulty recognizing and expressing emotions and feelings. Autonomic nasal thermal variability only increased during emotional facial induction. This is consistent with other research on autonomic changes. However, its clinical utility had not been documented to promote psychophysiological strategies that promote the mobility of resources in a patient with alexithymia. Some studies have evaluated the effect of psychological interventions on alexithymia; However, the results are not uniform because of the measures to identify alexithymic subject.

An intervention based on thermal nasal biofeedback would be useful to promote cognitive interception resources that allow the patient with alexithymia to identify the affective load of a given situation. Because alexithymia influences chronic pain, an alternative to relaxation is the emotional expression that facilitates the autonomic changes associated with less sympathetic activity. Training in emotional facial reproduction could have a psychosocial impact, both in anger management (decreasing associated facial muscle activity) and emotional expression in social support.

Of course, it is necessary to evaluate the thermal activity in other regions of interest, such as the frontal muscles, or the chin

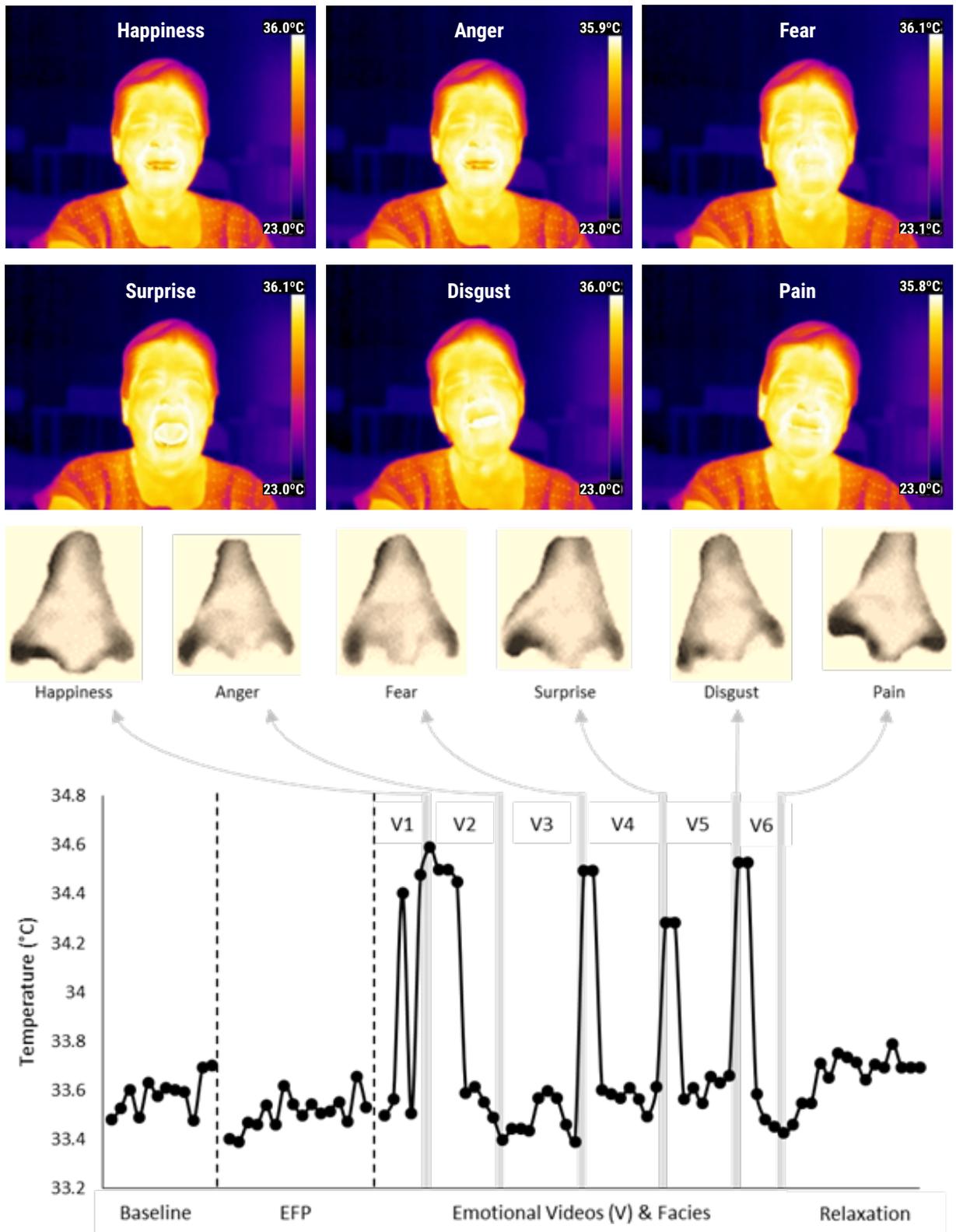


Figure 4 Changes in temperature in the nose. V1=Video of Joy, V2=Video of Anger, V3=Video of Fear, V4=Video of Surprise, V5=Video of Disgust, V6=Video of Pain. Gray bars indicate the induction of emotional facial expression.

for full biological feedback. Additionally, to evaluate the variability of the heart rate, which has been one of the gold standards for the measurement of autonomic sympathetic/parasympathetic balance.

## CONCLUSION

Training in emotional facial reproduction produces temperature changes in the nose. Facies of anger and pain showed an increase in sympathetic activity (reducing nasal temperature). Precisely the focus of clinical attention in this patient with alexithymia indicated the biopsychosocial profile. This finding suggest that biopsychosocial evaluation of chronic pain could be helpful in the design of the treatment program for the patient with chronic pain.

## REFERÊNCIAS

1. Kano F, Hirata S, Deschner T, Behringer V, Call J. Nasal temperature drop in response to a playback of conspecific fights in chimpanzees: A thermoimaging study. *Physiology & Behavior*. 2016; 155:83-94.
2. Dezechache G, Zuberbühler K, Davila-Ross M, Dahl C. Skin temperature changes in wild chimpanzees upon hearing vocalizations of conspecifics. *Royal Society Open Science*. 2017;4(1):160816.
3. Rodríguez-Medina D, Cruz I, Domínguez B, Morales L, Leija G, Cortés P. Psychophysiological facial thermal assessment of the relaxation in a patient with osteoarthritis. *Pan American Journal of Medical Thermology*. 2017; 3(1):33-36.
4. Di Tella M, Castelli L. Alexithymia in Chronic Pain Disorders. *Current Rheumatology Reports*. 2016; 18(7).
5. Salazar-López E, Domínguez E, Juárez Ramos V, de la Fuente J, Meins A, Iborra O et al. The mental and subjective skin: Emotion, empathy, feelings and thermography. *Consciousness and Cognition*. 2015;34:149-162.
6. Saariaho A, Saariaho T, Mattila A, Joukamaa M, Karukivi M. The role of alexithymia: An 8-year follow-up study of chronic pain patients. *Comprehensive Psychiatry*. 2016; 69:145-154.
7. Shibata M, Ninomiya T, Jensen M, Anno K, Yonemoto K, Makino S et al. Alexithymia Is Associated with Greater Risk of Chronic Pain and Negative Affect and with Lower

Life Satisfaction in a General Population: The Hisayama Study. *PLoS ONE*. 2014; 9(3):e90984

8. Cameron K, Ogrodniczuk J, Hadjipavlou G. Changes in Alexithymia Following Psychological Intervention. *Harvard Review of Psychiatry*. 2014; 22(3):162-178.
9. Levenson R, Ekman P, Friesen W. Voluntary Facial Action Generates Emotion-Specific Autonomic Nervous System Activity. *Psychophysiology*. 1990; 27(4):363-384.
10. Radice-Neumann D, Zupan B, Tomita M, Willer B. Training Emotional Processing in Persons with Brain Injury. *Journal of Head Trauma Rehabilitation*. 2009; 24(5):313-323.
11. Pedrosa Gil F, Ridout N, Kessler H, Neuffer M, Schoechlin C, Traue H et al. Facial emotion recognition and alexithymia in adults with somatoform disorders. *Depression and Anxiety*. 2009; 26(1):E26-E33.
12. Ozturk A, Kilic A, Deveci E, Kirpinar I. Investigation of facial emotion recognition, alexithymia, and levels of anxiety and depression in patients with somatic symptoms and related disorders. *Neuropsychiatric Disease and Treatment*. 2016; 1047.
13. Fernández-Cuevas I, Bouzas Marins J, Arnáiz Lastras J, Gómez Carmona P, Piñonosa Cano S, García-Concepción M et al. Classification of factors influencing the use of infrared thermography in humans: A review. *Infrared Physics & Technology*. 2015;71:28-55.
14. Rodríguez D, Domínguez B. PERFIL BIOPSIKOSOCIAL DEL DOLOR CRÓNICO ONCOLÓGICO Y EFECTOS Y LA IMAGEN INFRAROJA DE LA EXPRESIÓN FACIAL EMOCIONAL. In: Padilla M, Galán S, Camacho E, ed. by. *Investigación en Psicología básica y aplicada: avances y perspectivas* [Internet]. 1st ed. San Luis Potosí: Universidad Autónoma de San Luis Potosí; 2016 [cited 10 October 2017]. p. 498-503. Available from: [https://www.researchgate.net/publication/306034844\\_PERFIL\\_BIOPSIKOSOCIAL\\_DEL\\_DOLOR\\_CRONICO\\_ONCOLOGICO\\_Y\\_EFECTOS\\_Y\\_LA\\_IMAGEN\\_INFRAROJA\\_DE\\_LA\\_EXPRESION\\_FACIAL\\_EMOCIONAL](https://www.researchgate.net/publication/306034844_PERFIL_BIOPSIKOSOCIAL_DEL_DOLOR_CRONICO_ONCOLOGICO_Y_EFECTOS_Y_LA_IMAGEN_INFRAROJA_DE_LA_EXPRESION_FACIAL_EMOCIONAL)
15. Rodríguez-Medina D. TRAINING IN FACIAL RECOGNITION AND PLAY ON EMOTIONAL EMOTIONAL CONTROL. Presentation presented at; 2015; Mexico City. Available from: [https://www.researchgate.net/publication/293377268\\_TRAINING\\_IN\\_FACIAL\\_RECOGNITION\\_AND\\_PLAY\\_ON\\_EMOTIONAL\\_EMOTIONAL\\_CONTROL](https://www.researchgate.net/publication/293377268_TRAINING_IN_FACIAL_RECOGNITION_AND_PLAY_ON_EMOTIONAL_EMOTIONAL_CONTROL)
16. Morales G, Octavio Lopez E, Castro-Campos C, Charles D, Mezquita-Hoyos Y. Contributions to the Cognitive Study of Facial Recognition on Down Syndrome: A New Approximation to Exploring Facial Emotion Processing Style. *Journal of Intellectual Disability - Diagnosis and Treatment*. 2014; 2(2):124-132.
17. Yamashita Y, Fujimura T, Katahira K, Honda M, Okada M, Okanoya K. Context sensitivity in the detection of changes in facial emotion. *Scientific Reports*. 2016; 6(1).

18. Jongen S, Axmacher N, Kremers N, Hoffmann H, Limbrecht K, Traue H, Kessler H. An investigation of facial emotion recognition impairments in alexithymia and its neural correlates. *Behavioural Brain Research*. 2014; 271:129-139.
19. Kreibig S. Autonomic nervous system activity in emotion: A review. *Biological Psychology*. 2010;84(3):394-421.

