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# Gandra-BARTA for the Assessment of Facial Emotion Recognition in Acquired Brain Injury

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## SUMMARY

**Background:** Patients with acquired brain injury (ABI) may experience social difficulties more specifically in the emotional recognition of faces. The present research aims to test the discriminative validity of Gandra-BARTA to the changes in the emotional recognition of faces after ABI and to perceive its connection with the general cognitive functioning, executive functioning and other variables associated with ABI.

**Material/ Methods:** The sample consists of two groups, the Clinical Group (n=20, ABI participants) and the Control Group (n=16, healthy participants). All participants underwent a global cognitive assessment through the Montreal Cognitive Assessment (MoCA), executive functioning was measured by INECO *Frontal Screening* and the evaluation of emotional recognition of faces through Gandra-BARTA.

**Results:** The results demonstrate that Gandra-BARTA presents discriminative capacity for the evaluation of the emotional recognition of faces in patients with acquired brain injury. We observed differences between the two groups in the capacity of emotional recognition especially in the identification of emotions such as anger, disgust, happiness and surprise. The study also shows the existence of a decline in the identification of emotions with age, in the recognition of the disgusting stimuli presents a deficit related to the age and executive functioning, while with the rage the decline is related to the age and schooling. The emotional recognition of faces presents improvements with time after injury. Identification of the neutral expression demonstrates an improvement over time after injury.

**Conclusions:** The discriminative ability of Gandra-BARTA allows it to be an instrument to be used in the evaluation of the emotional recognition of faces in patients with acquired brain injury. Individuals with brain injury have difficulties in identifying anger, disgust, happiness and surprise. Emotional recognition differs in relation to age, executive functioning, schooling, and time after injury.

**Key words:** emotions, stroke, anger, disgust, happiness, surprise

# INTRODUCTION

Interpersonal communication includes nonverbal language such as facial expressions (Busso et al., 2004). The perception and emotional recognition of expressions is essential in social interaction, having a great influence on the regulation of behavior and the communication of important information and social signals (Chan, 2009; Damásio, 2011). Correct identification of emotional expression provides clues to determine which is the appropriate response to social interaction (Grossman & Johnson, 2007) and it can be affected by several factors inside or outside the face (Lipp, Craig & Dat, 2015).

The face shares information regarding the individual's internal emotional state (Chan, 2009) through the change of movement of the face's muscles, in the communication of different emotions (Busso et al., 2004). In order to identify the transmitted emotions, complex brain and cognitive operations are necessary through the reacquisition of the specific information stored about the emotion and the perception through the face and/or voice of the diverse elements provided (Grossman & Johnson, 2007). Emotional recognition becomes increasingly important, having been included in DSM-V as part of the examples of evaluations of the cognitive domain of Social Cognition, being one of the utmost importance in its inclusion within the social cognition test batteries (Chiu et al., 2015).

Emotional recognition based on neural pathways that work in parallel, but separately can be considered a multiple-stage process (Spreengelmeyer, Rausch, Eysel & Przuntek, 1998) that can be selectively damaged by neurological disease or trauma (Green, Turner & Thompson, 2004).

The group of structures involved in the emotional recognition of faces is diverse, such as the occipitotemporal cortex, orbitofrontal cortex, right parietal cortex, basal ganglia, amygdala, and others (Adolphs, 2002).

Individuals with lesions in the left hemisphere, apparently do not have difficulties in emotional recognition in comparison to patients with lesions in the right hemisphere (Adolphs, Damásio, Tranel & Damásio, 1996). The regions most related to this difficulty are the right parietal cortex and the right anterior medial calcarine cortex (Adolphs, Damásio, Tranel & Damásio. 1996). The performance in the identification of emotion is more efficient with the involvement of both hemispheres, due to the importance of interhemispheric transference of information (Tamietto, Adenzato, Geminiani & Gelder, 2007). In this sense, the corpus callosum also plays an important role, and the reduction of its integrity and activity leads to and maintains difficulties in the processing of emotions (Bridgman et al., 2014).

The amygdala is implicated on the emotional recognition of faces through two pathways, a subcortical pathway through the superior colliculus and the pulvinar, and a cortical pathway through the visual neocortex (Adolphs, 2002). The amygdala is activated towards different emotions, both negative and positive (Yang et al. 2002, Derntl et al. 2009). When the amygdala is bilaterally injured, there is a greater difficulty in negative emotion recognition (Adolphs & Tranel, 2003), as well as a greater deficit in the identification of secondary emotions than primaries, with both unilateral and bilateral lesions (Adolphs, Baron-Cohen & Tranel, 2002). The white matter lesion can also damage the emotional recognition of faces (Philippi, Mehta, Grabowski, Adolphs & Rudrauf, 2009).

Different brain structures may be more sensitive to different emotional reactions (Laughead, Gur, Elliot & Gur, 2008). The expression of happiness triggers a higher activation in the thalamus (Laughead, Gur, Elliot & Gur, 2008), in the anterior and posterior cingulate gyrus (Phillips et al., 1998, Killgore & Yurgelun-Todd, 2004) and also in the medial frontal cortex, there is also an increase in the signal within the left supramarginal gyrus (Phillips et al. 1998). These findings are accompanied by bilateral activation of the amygdala (Killgore & Yurgelun-Todd, 2004). Relatively to the emotion sadness there is a greater activation of the left amygdala, the medial temporal gyrus and the right inferior temporal gyrus when compared to the angry emotion (Blair, Morris, Frith, Perrett & Dolan, 1999). The activation of the left anterior cingulate gyrus was also demonstrated (Killgore & Yurgelun-Todd, 2004). The existence of deficits in the recognition of anger was demonstrated in the presence of a lesion at the ventral striatum (Calder, Keane, Lawrence & Manes, 2004), and it was associated to a greater activation in the right orbitofrontal cortex (Blair, Morris, Frith, Perrett and Dolan 1999). Fear presents greater activation in different structures, such as the pulvinar, anterior insula, anterior cingulate (Morris et al. 1998), medial frontal cortex (Fusar-Poli et al., 2009) and thalamus (Laughead, Gur, Elliot & Gur, 2008). When compared with the emotion happiness, fear showed a greater activation in the left amygdala (Morris et al. 1998). The bilateral amygdala showed greater sensitivity in the emotion fear when compared with happiness and sadness (Fusar-Poli et al., 2009). When disgust is displayed, it activates the insula (Schroeder et al, 2004), more specifically the anterior insular cortex (Phillips et al., 1997) and the ventral anterior insula (Krolak-Salmon, 2003). The expression of surprise uses structures of the medial temporal lobe, more specifically the right hippocampal gyrus (Schroeder et al., 2004).

With the involvement of such a diverse set of brain structures in the emotional recognition of faces, it is important to note how individuals with acquired brain injury (Traumatic Brain Injury (TBI), Stroke) may be impaired in this function.

In order to overcome the lack of instruments to identify individual differences in the emotional recognition of faces, the Gandra-BARTA instrument was developed, consisting of 59 colored photographs with universal emotional expressions (happiness, sadness, fear, anger, disgust, surprise and neutral expressions) retrieved from the Bolton Affect Recognition Tri-Stimulus Approach (BARTA) database (Lawrence, Nabi & Charlton, 2011). Each emotional expression is represented in 9 photographs and the neutral expression in 5. Although it is a recent instrument, it has already demonstrated sensitivity in identifying difficulties in emotional recognition in normal and pathological aging (Páris, Carvalho, Lemos & Peixoto, 2014), in schizophrenia (Silva, Pimentel & Monteiro, 2014) and in Parkinson's disease (Rocha & Monteiro, 2013). However, no indicators of discriminative validity in acquired brain injury are known.

Thus, the first major objective of the present investigation is to test the discriminative validity (sensitivity and specificity) of Gandra-BARTA regarding the facial recognition ability in individuals with acquired brain injury. The second objective is to understand the relationships between the capacity for emotional recognition, general cognitive functioning, executive functioning and some variables associated with acquired brain injury.

# MATERIAL AND METHODS

## Participants

The sample was composed by 36 participants divided into two groups, the clinical group and the control group. The clinical group consisted of 20 individuals, 18 males and 2 females, with acquired brain injury, 12 of whom suffered severe closed and diffuse traumatic brain injury and 8 had a first stroke (1 left ischemic, 3 right ischemic, 1 left hemorrhagic, 1 right hemorrhagic, and 2 medium hemorrhagic), with a mean post-injury time of 42.4 months (± 60,17), ages ranging from 23 to 57 years and schooling between 4 and 12 years, 12 are associated to blue collar professions, while the other 8 individuals are associated to white collar professions. The control group consisted of 16 individuals, 15 males and 1 female, with no acquired brain injury, aged between 23 and 53 years and schooling between the ages of 4 and 12, 10 pertaining to the blue collar and 14 to the white collar.

The two groups do not differ in age ($p$=.558), schooling ($p$=.733), gender ($x^2$= .164, $p$=1) and occupation ($x^2$=.023, $p$=1). The characterization of the sample is presented in Table 1.

## Assessment

The following instruments were applied to all participants: Montreal Cognitive Assessment (MoCA) (Freitas, Simões, Martins, Vilar & Santa, 2010); INECO Frontal Screening (IFS) (Caldeira, Baeta & Peixoto, 2011); Gandra-BARTA (Páris, Carvalho, Lemos & Peixoto, 2014). MoCA and IFS were used to determine possible relationships between the emotional recognition of faces, general cognitive functioning and frontal functioning. The total number of correct identifications and time of completion on Gandra-BARTA were taken, as well as the correct number of identifications of each emotion.

Table 1. Characteristics of the sample

| | **Control Group (n=16)** | **Clinical Group (n=20)** |
|---|---|---|
| **Age (M/SD)** | 38.81/10.78 | 36.70/10.51 |
| **Schooling (M/SD)** | 9.19/2.76 | 9.50/2.66 |
| **Gender (M/F)** | 15/1 | 18/2 |

### Procedure

This study was approved by the directorial board of the *Centro de Reabilitação Profissional de Gaia* (CRPG).

The clinical group comprised participants from the neuropsychological rehabilitation program of CRPG. Testing was carried out individually.

Prior to data collection, informed consent was obtained. All the collected data was dealt with anonymously. The control group was assembled in the wider community.

### Statistical Analysis

Statistical analysis was carried out using the program IBM Statistics version 23 for Windows.

Measurements of central tendency and deviation were used to characterize the sample and describe the results obtained in the tests.

The Mann-Whitney *U* Test was used to compare the performance of the groups in the tests.

The discriminative capacity of Gandra-BARTA was further determined through the Receiver Operating Characteristic curve (ROC), with extraction of sensitivity and specificity values relative to different cut-off points.

Spearman's correlation was used to determine the relationship between continuous variables.

The results with $p \leq .05$ were considered significant.

## RESULTS

The results obtained by the two groups in the neuropsychological tests are shown in Table 2.

Table 3 shows the comparisons between the groups on neuropsychological testing. The clinical group obtained lower results on the MoCA, a higher time to complete and a lower number of correct identifications on the Gandra-BARTA. Besides that the clinical group displayed marked difficulties in the identification of specific emotions: disgust, anger, surprise and happiness.

Table 2. Results obtained by the two groups in the neuropsychological tests

| | **Control Group (n=16)** | **Clinical Group (n=20)** |
|---|---|---|
| **MoCA (M±SD)** | 23.63/3.70 | 20.80/4.07 |
| **INECO (M±SD)** | 21.90/3.92 | 19.07/4.71 |
| **Gandra-BARTA Time (M±SD)** | 267.44/88.71 | 553/236.84 |
| **Gandra-BARTA Total (M±SD)** | 42.88/6.89 | 34.30/9.34 |
| **Disgust (M±SD)** | 6.94/1.91 | 5.45/1.90 |
| **Anger (M±SD)** | 8.06/1.24 | 5.25/2.84 |
| **Sadness (M±SD)** | 4.56/2.28 | 3.90/2.07 |
| **Neutral (M±SD)** | 4.50/1.37 | 3.95/1.50 |
| **Fear (M±SD)** | 2.06/2.38 | 2.40/1.72 |
| **Surprise (M±SD)** | 7.81/1.83 | 5.90/1.94 |
| **Happiness (M±SD)** | 8.94/.250 | 7.60/2.04 |

Table 3. Comparison of the performance of both groups in the neuropsychological tests

| | p | U |
|---|---|---|
| **MoCA** | .023 | 230.5 |
| **INECO** | .058 | 219.5 |
| **Gandra-BARTA Time** | .000 | 16 |
| **Gandra-BARTA Total** | .003 | 251.5 |
| **Disgust** | .014 | 237 |
| **Anger** | .001 | 258 |
| **Sadness** | .404 | 187 |
| **Neutral** | .149 | 206 |
| **Fear** | .352 | 130.5 |
| **Surprise** | .002 | 254.5 |
| **Happiness** | .020 | .233 |

The discriminative ability of Gandra-BARTA through the ROC curve depicted in Table 4 and Fig. 1, demonstrated at a cut-off point of 41 correct emotional recognitions, differentiating the control group from the clinical group with a sensitivity of 81.3% and specificity of 75% (see Table 5).

The total number of correct answers on Gandra-BARTA correlates negatively with age and positively with time after injury. The identification of disgust correlates negatively with age and positively with results on INECO. The identification

Table 4. Characteristics of the ROC curve

| Area under the curve | Default Error | p | Confidence Interval |
|---|---|---|---|
| .786 | .078 | .004 | [.633-.933] |

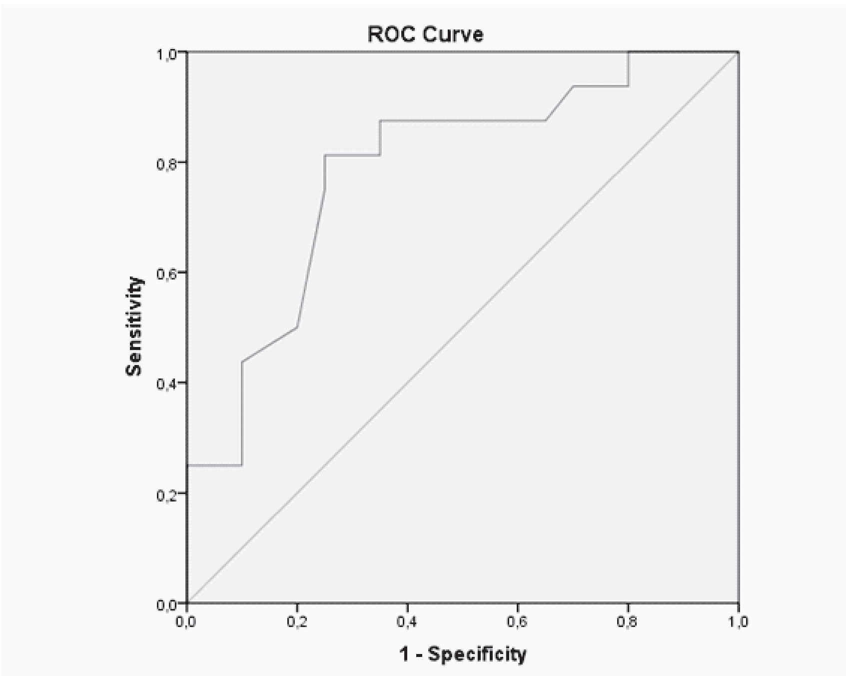


Fig. 1 ROC curve generated by the total number of correct identifications on Gandra-BARTA

Table 5. Cut-off points and sensitivity and specificity values generated in the distinction between the two groups by the number of hits in Gandra-BARTA

| Cut-off Point | Sensitivity (%) | Specificity (%) |
|---|---|---|
| 38 | 87,5 | 65 |
| 39 | 81,3 | 65 |
| 40 | 81,3 | 70 |
| **41** | **81,3** | **75** |
| 42 | 75 | 75 |
| 43 | 50 | 80 |
| 44 | 43,8 | 90 |

Table 6. Correlations between Gandra-BARTA and age, schooling, time after injury, MoCA and INECO Frontal Screening

| | Age | Schooling | Time after Injury | MoCA | INECO |
|---|---|---|---|---|---|
| **Gandra-BARTA Time** | -.104 | -.404 | .185 | -.339 | -.414 |
| **Gandra-BARTA Hits** | -.574** | .396 | .567** | .205 | .337 |
| **Disgust** | .536* | .146 | .338 | .400 | .482* |
| **Anger** | .482* | .453* | .394 | .050 | .149 |
| **Sadness** | -.335 | .318 | .431 | -.248 | .007 |
| **Neutral** | -.316 | .407 | .649** | .208 | .404 |
| **Fear** | -.130 | .112 | .173 | .060 | .089 |
| **Surprise** | -.166 | .310 | .155 | .183 | .220 |
| **Happiness** | -.305 | .043 | .409 | .128 | .152 |

Values expressed in terms of correlation
*p ≤ .01, ** p ≤ .05

of anger correlated negatively with age and positively with schooling. Regarding the identification of neutral faces, a positive correlation was obtained with time after injury (see: Table 6).

# DISCUSSION

The first major objective of this study was to evaluate the discriminative validity of Gandra-BARTA in the evaluation of the emotional recognition of faces in patients with TBI. The Gandra-BARTA demonstrated a good discriminative capacity between controls and patients with acquired brain injury. Gandra-BARTA has some advantages over other instruments such as the FEEL Test, which presents a short presentation stimulus (300 ms) (Braun, Traue, Frisch, Deighton & Kessler, 2005) while in Gandra-BARTA the duration of the stimulus is controlled by the subject. Also in Gandra-BARTA it is possible to identify the emotion during the image visualization, while in the FEEL Test the response is given 500ms after the image disappears (Braun, Traue, Frisch, Deighton & Kessler, 2005) increasing the load of working memory. Another benefit of Gandra-BARTA is that unlike the FEEST that features black and white pictures of the Pictures of Facial Affect Series (Spikman et al., 2013), Gandra-BARTA presents colored images.

Another objective of this study was to understand the relationship of different variables related to acquired brain injury.

In the presence of acquired brain injury, cognitive decline is common (Srikanth et al., 2003; Schretlen & Shapiro, 2003; Rasquin et al. 2004; Wong, et al. 2012). In the present study when comparing the two groups, as expected, there is a difference in the level of the MoCA results. Brain damage patients commonly present deficits in executive functioning (Hart, Whyte, Kim & Vacarro, 2005; Zinn, Bosworth, Hoening & Swartzwelder, 2007) that even in the occurrence of certain improvements over time, continue to demonstrate difficulties (Schretlen & Shapiro, 2003). Unexpectedly the results obtained do not indicate differences regarding the results of the INECO, and may be due to the fact that the clinical group is in the rehabilitation phase in a holistic program of neuropsychological rehabilitation that appears to be related to improvements in the functioning of working memory and components of executive functioning (Guerreiro, 2014). One study suggested that although executive functioning does not seem to affect the difficulties of recognizing emotions, it may influence the subsequent decision-making on how to react to perceived emotion (Yim, Babbage, Zupan, Neumann & Willer, 2013). Despite the possibility of deficits in emotional facial recognition and executive functioning at the same time after brain injury, their low correlation shows that they may be autonomous factors, and there is no association between the two (Spikman et al., 2013). Despite this, the results obtained in this study show a relation between the executive functioning and the capacity to identify the disgust emotion, thus contradicting the current subject literature.

Studies have demonstrated the existence of deficits in the emotional recognition of faces in the occurrence of brain injury. With regard to strokes (Braun, Traue, Frisch, Deighton & Kessler, 2005; Blonder, Pettigrew & Kryscio, 2012; Cooper et al.,2014), lesions in the right hemisphere are more associated with this type of difficulties (Mandal, Tandon & Ashtana, 1991; Kucharska-Pietura, Phillips, Gernand & David, 2003; Yuvaraj, Murugapan, Norlina, Sundaraj & Khairiyan, 2013). Changes in the emotional recognition capacity are equally common in TBI (Spell & Frank, 2000; Milders, Fuchs & Crawford, 2003; Green, Turner & Thompson, 2004; Crocker & McDonald, 2005; Waats & Douglas, 2006; Radice-Neumann;, Zupan, Babbage & Willer, 2007; Ietswaart, Milders, Crawford, Currie & Scott, 2007; Milders, Ietswaart, Crawford & Currie, 2008; Knox & Douglas, 2009; Babbage et al., 2011; Martins et al. 2011; Spikman et al., 2013; Rosenberg, McDonald, Dethier, Kessels & Westbrook, 2014). It is estimated that about 34% of patients with TBI evaluated present deficits in emotional recognition regardless of the type of trauma (Zupan, Babbage, Neumann & Willer, 2014). The results demonstrate that individuals with acquired brain injury present greater difficulties in the emotional recognition of faces when compared with healthy individuals.

Many of the investigations carried out in this area have demonstrated the existence of a greater difficulty in the recognition of negative emotions when compared with positive emotions (Kucharska-Pietura, Phillips, Gernand, & David, 2003; Crocker & McDonald, 2005; Radice-Neumann, Zupan, Babbage & Willer, 2014; Spikman et al., 2013; Rosenberg, McDonald, Dethier, Kessels & Westbrook, 2014). One of the emotions that is most affected in their recognition is disgust (Braun, Traue, Frisch, Deighton & Kessler, 2005; Crocker & McDonald, 2005; Rosenberg, McDonald, Dethier, Kessels & Westbrook, 2014). More specifically a study demonstrates that this decrease occurs when there is an interruption in the functioning of the ventromedial prefrontal cortex (Vandekerckhove, et al., 2014). The identification of anger was also impaired in the results, corroborating investigations carried out previously (Martins et al. 2011; Rosenberg, McDonald, Dethier, Kessels & Westbrook, 2014).

As previously reported, patients with acquired brain injury demonstrate greater difficulty in identifying negative emotions. Contrary to this observation, studies demonstrate the existence of deficits in the identification of happiness (Karow, Marquardt & Marshall, 2001; Braun, Traue, Frisch, Deighton & Kessler, 2005) and the surprise (Martins et al. 2011; Vandekerckhove, et al., 2014), as observed in the research results in which the clinical group presented difficulties, not only in the identification of certain negative emotions (anger and disgust) but also in the positive ones (happiness and surprise). This difference may be due to the fact that the sample is not very wide and contains a variety of lesions. Emotional facial recognition deficits are presented when there is a lesion in the left or right hemisphere (Abbott, Cumming, Fidler & Lindell, 2013), however, the right hemisphere appears to be more involved in emotional recognition. The majority of studies show that in the presence of a right hemisphere lesion, the difficulty in emotional recognition is higher than in lesions in the left hemisphere and in the control group (Yuvaraj, Murugappan, Norlinah, Sundaraj & Khairyah, 2013). When the right hemisphere is damaged, the recognition of negative emotions appears to be more impaired (Adolphs, Jansari & Trunel, 2001; Abbott, Cumming, Fidler & Lindell, 2013) while for the identification of positive emotions there does not appear to be a hemispheric asymmetry (Adolphs, Jansari & Trunel, 2001). Other studies have demonstrated more specifically the existence of a predominance of the right hemisphere in the identification of happiness (Charbonneau, Scherzer, Aspirot & Cohen, 2003; Alves, Aznar-Casanova & Fukusima, 2009), surprise (Charbonneau, Scherzer, Aspirot & Cohen, 2003), anger, sadness (Torro-Alves, Sousa & Fukusima, 2011) and fear (Charbonneau, Scherzer, Aspirot & Cohen, 2003; Alves, Aznar-Casanova & Fukusima, 2009).

The response time in this evaluation also appeared to be differentiated between the groups, presenting a greater slowness in the group with acquired brain injury, already demonstrated in a study in which the group with brain injury presented a slower response in the identification of sadness, fear, anger and surprise (Martins et al., 2011). The processing speed of sensory-perceptual information is one of the most common sequelae after brain injury (Madigan, DeLuca, Diamond, Tramontano & Averill, 2000), this leads to a slower decision-making process (Marleen, et al. 2003), which may justify the differences in the time of emotional identification between the groups.

The present investigation indicates an inverse relationship between age and emotional recognition. The subject literature demonstrates that younger adults and middle-aged adults have similar abilities in emotional face recognition (Khawar, Malik, Maqsood, Yasmin & Habib, 2013), with younger adults having a more accurate ability in this role than the elderly (Horning, 2011). Relatively to the age of the elderly, this function declines (Khawar, Malik, Maqsood, Yasmin & Habib, 2013; Horning, 2011; Moosavian & Borry, 2015), and cognitive aging may differ in the consequences of the recognition of each emotion (Suzuki & Akiyama, 2013). The results obtained are in accordance with the subject literature's results, mainly in the emotions of anger and disgust, and in the decline of recognition capability throughout the age. Several studies have shown that the success rate in anger recognition performance decreases with age (Sullivan & Ruffman, 2004; Orgeta & Phillips, 2007; Ruffman, Henry, Livingstone & Phillips, 2008; Mill, Allik, Realo & Valk, 2009; Ebner & Johnson, 2009; Hunter, Phillips & MacPherson, 2010; West et al. 2012), attesting the obtained results. Another feature of the results concerning the recognition of anger is the increase in performance compared to the levels of schooling, this variable is still poorly studied in the subject literature, but generally the emotional recognition of faces demonstrates performance improvement due to a higher level of schooling (Dodich et al., 2014).

Relatively to the identification of the disgust emotion, there is some divergence in the subject literature regarding its connection with age, different investigations indicate that the recognition of disgust shows preservation along with age (Horning & Cornwell, 2012), showing some improvement (Calder et al., 2003; Suzuki, Hoshino, Shigemasu & Kawamura, 2007; West et al., 2012), but contradicting these results there are studies, like this research, revealing that there is a decline in the identification of this emotion (Sze, Goodkind, Gyurak & Levenson, 2012), occurring essentially from the age of 40 (Moosavian & Borry, 2015) and decreasing gradually with time (Khawar, Malik, Maqsood, Yasmin & Habib, 2013). Although the recognition of neutral expression does not appear to be much studied, the results of this study demonstrate an increase in capacity over time after injury.

The obtained results also demonstrate that the performance in the emotional recognition of faces improves over time following injury, contrary to what the subject literature demonstrates, where the recognition capacity did not show improvements, being the deficit present immediately after the injury and one year subsequently (Ietswaart, Milders, Crawford, Currie & Scott, 2007).

The main limitations of this study are the small sample, both at the clinical and control levels. The increase in the sample would allow the differential analysis of the effects of an acquired cerebral lesion of vascular and traumatic etiology on the different domains of emotional recognition. In future investigations, it would be important to increase the sample size to observe if the differences remain and also to perceive if there are more differences in the facial emotional recognition between different types of injuries and lateralization.

In conclusion, the Gandra-BARTA instrument presents discriminative validity to evaluate the emotional recognition of faces in patients with acquired brain injury. The clinical group differs from the control group at different levels, like cognitive decline, identification of emotions, essentially anger, disgust, happiness, surprise, and response time. The study also shows the existence of a decline in the identification of emotions along with age, in the recognition of the disgusting emotion presents a deficit at the level of age and executive functioning, and anger at the level of age and schooling. The emotional recognition of faces presents improvements in time after injury. Identification of the neutral expression demonstrates improvement over time after injury.

The present study reinforces the importance of using Gandra-BARTA in people with acquired brain injury, due to its discriminative capacity for the evaluation of the emotional recognition of faces in this population. It is also important to emphasize the integration of training programs in the emotional recognition of faces in neuropsychological rehabilitation, for a better integration of the individual at a social level. The programs applied in patients with acquired brain injury demonstrated significant improvements (Bornhofen & McDonalds 2008; Radice-Neumann, Zupan, Tomita & Willer, 2009).

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