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Original article

Assessment of facial emotions recognition in aging and dementia. The development of a new tool

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ABSTRACT

The recognition of emotions from facial expressions is a basic human aptitude. The aging process is related with a decrease of this ability, particularly in the recognition of negative emotions. This decrease is more prominent in the context of dementia. Despite the growing of researches on emotion recognition, there is a lack of instruments capable of identifying individual differences regarding aging and dementia. This work aims to determine the psychometric properties of a facial emotion recognition task (Gandra-BARTA). The sample is composed by three groups: Young Adults (YA) group (n = 12); Old Adults (OA) group (n = 17); Alzheimer's Disease (AD) group (n = 26), made up of subjects with diagnosis of probable AD. The Gandra-BARTA showed good internal consistency. In comparison to the YA, the OA group took more time to complete Gandra-BARTA, had less correct emotional identifications and they have under-recognized facial expressions of rage and neutral emotions. On the other hand, the AD group showed worst performance on every aspect of the Gandra-BARTA when compared to the OA group, except in the identification of sadness and fear. A cutoff score of 24 correct recognitions on Gandra-BARTA differentiate OA from AD subjects with a sensibility of 100% and a specificity of 88.5%. The Gandra-BARTA revealed good internal consistency making it a reliable instrument to assess the ability to recognize emotions from facial expressions. It also proved to be sensitive to changes in aging and dementia with high discriminant validity for AD.

1. Introduction

In the last years, there has been an increase in the number of researches in the field of emotions. Most of the studies are focused on the neuroanatomical grounds of the recognition of emotions from facial expressions [1,2], particularly of the basic emotions such as happiness, surprise, fear, anger, disgust and sadness [3]. The recognition of emotions from facial expressions is a basic human aptitude [4] and it is related to the ability to correctly perceive and understand the emotional state of others [5]. This ability has a key role in the social interaction [6] because it provides the possibility to infer and recognize emotional states based on no-verbal signs [4] and it precedes the understanding of the emotion and the emotional regulation of the subject [5].

The aging process is related with a decrease of this ability [7,8], particularly in the recognition of negative emotions [9] such as sadness [10], anger and fear [7,11]. This decrease is intimately related

to neurobiological changes in aging, namely the reduction of cortical volume of the medial temporal and inferior frontal lobes [12,13]. Several studies have pointed to the decrease of the ability to recognize emotions from facial expressions in the context of dementia, especially in Alzheimer's disease (AD). Fear and sadness are the most affected [14] while the recognition of disgust seems to be unimpaired [15]. These features in emotion recognition may be related to atrophies and neuropathological lesions of limbic areas like the amygdala, temporal and frontal cortexes [16].

Despite the vast number of researches on emotion recognition, there is a lack of instruments capable of identifying individual differences [5] regarding aging and dementia. Therefore, this work aims to determine the psychometric properties of a facial emotion recognition task, composed by 59 photographs derived from the Bolton Affective Recognition Tri-Stimulus Approach (BARTA) [17]. The reliability (internal consistency) and discriminant validity will be determined as well as its correlation with cognitive functioning and depression.

2. Subjects and methods

The sample is composed of three groups: Young Adults (YA) group (n = 12), with ages ranging between 31 and 39 years old;

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Table 1
Characteristics of the sample.

	YA	OA	AD
Age (M/SD)	34.5/3.26	73.65/5.75	77.8/7.4
Gender (Male/Female)	6/6	5/12	5/21
Years of school (M/SD)	8.34/2.56	7.43/4.07	6.9/2.87
MoCA (M/SD)	26.86/1.98	23.57/2.3	11.99/3.43
GDS (M/SD)	6.81/4.49	6.74/4.79	11.01/6.3

YA: Young Adults; OA: Old Adults; AD: Alzheimer's Disease; MoCA: Montreal Cognitive Assessment; GDS: Geriatric Depression Scale.

Old Adults (OA) group ($n = 17$) with ages ranging between 60 and 82 years old; Alzheimer's Disease (AD) group ($n = 26$), made up of subjects with diagnosis of probable AD according to the NINCDS-ADRDA criteria [18], with ages ranging between 60 and 86 years old. The subjects of the YA and OA groups does not present any subjective complain of memory loss and they are autonomous in basic and instrumental daily activities. Individuals with prior history of neuropsychiatric (other than AD in the AD group) or systemic pathologies liable to directly interfere on neurocognitive functioning were excluded. Participants with severe depression were also excluded from the study. Participants of the YA and OA groups with results equal or lower than one standard deviation on the Montreal Cognitive Assessment were also excluded from the sample. The YA and OA groups do not differ according to gender ($\chi^2 = 1.22$; $P = .438$), years of schooling ($U = 82.5$; $P = .173$) and the results on the depression scales ($U = 80.5$; $P = .475$); The OA and AD groups do not differ according gender ($\chi^2 = 0.597$; $P = .481$), age ($U = 85$; $P = .192$) and years of schooling ($U = 80$; $P = .304$). As expected, due to age and to dementia, there are significant differences between groups on the Montreal Cognitive Assessment scores (YA Vs OA: $U = 113$; $P = .007$; OA Vs AD: $U = 442$; $P \leq .001$) and on the Geriatric Depression Scale (OA Vs AD: $U = 103.5$; $P = .003$). Characteristics of the sample are presented in Table 1.

2.1. Neuropsychological assessment

All participants underwent a neuropsychological assessment, comprising general cognitive functioning, depression and emotion recognition from facial expressions.

Montreal Cognitive Assessment (MoCA): MoCA is a screening test that covers eight cognitive domains and it has great sensibility and specificity to mild cognitive impairment and dementia [19]. This test was used in order to ensure that YA and OA subjects did not have any neurocognitive alteration and to correlate its results with the emotional recognition task.

Geriatric Depression Scale (GDS): GDS is a brief depression scale [20]. It was used in order to exclude participants with severe depression and to establish correlations with the emotion recognition task.

Emotional Recognition Task (Gandra-BARTA): this task is composed of 59 color photographs of human faces expressing universal recognized emotions (fear, disgust, anger, happiness, sadness and surprise) and neutral expressions, retrieved from the Bolton Affect Recognition Tri-Stimulus Approach (BARTA) database [17]. Each emotion is represented in 9 faces and the neutrals appear in 5 photographs. The selection of the 59 photographs was based in a pilot study with a normative sample [21]. The stimuli were delivered in a Power-point presentation in a 17" screen. For each photograph the participants were asked to identify the expressed emotion. They were told to answer by verbalizing or pointing to the verbal descriptor or to the cartoon under each descriptor in an A4 sheet placed in front of the subject. There was no time limit for the task and the examiner registered the answers and the time taken by the participants. Prior to the task a pre-test was taken in order to test the subject's understanding of the task by asking: If I show you a happy

Table 2
Descriptive statistics of the results obtained by the group on Gandra-BARTA.

	YA (M/SD)	OA (M/SD)	AD (M/SD)
Time taken on Gandra-BARTA	281.02/54.61	597.79/235.51	862.55/441.59
Correct recognitions (total)	46.97/3.31	40.61/6.43	31.62/6.89
Fear	3.77/2.18	3.45/1.59	3.36/1.96
Rage	8.62/0.6	5.85/2.61	4.39/2
Disgust	7.73/0.59	6.54/2.57	3.44/1.92
Sadness	5.4/2.41	5.84/1.74	5.57/2.45
Happiness	8.91/.32	8.96/0.26	7.9/2.3
Surprise	8.2/1.5	6.91/2.3	4.5/2.75
Neutral	4.81/.51	3.24/1.9	2.01/.6

YA: Young Adults; OA: Old Adults; AD: Alzheimer's Disease.

face what would be your answer? This question was made for each emotion. If participant's verbalization or pointing were incorrect at any given emotion, the participant would be excluded.

2.2. Procedure

The research was approved by the board of administration of the São João de Deus Nursing home and day care center, institution held by the Santa Casa da Misericórdia de Fão (Merciful Holy House of Fão). All of the participants gave their informed consent.

The study was carried out in the geriatric institution and at the home of the participants. The neuropsychological assessment was preformed individually in a closed room.

2.3. Statistical analysis

The statistical analysis was performed by using the statistic software IBM statistic SPSS version 21 for Windows.

The reliability of the Gandra-BARTA was determined by the Cronbach's alpha. Comparisons between groups were made by the Mann-Whitney's U test. Additionally, a receiver-operating curve (ROC) was performed in order to establish sensibility and specificity of the total number of correct recognitions on Gandra-BARTA in differentiating OA and AD. Spearman correlations were made between the results on Gandra-BARTA, MoCA and GDS.

Results with $P < .05$ were considered significant.

3. Results

The Cronbach's alpha for the Gandra-BARTA was .86.

The description of the results obtained by the groups on Gandra-BARTA is presented in Table 2. Comparisons between YA/OA and OA/AD are showed in Tables 3 and 4. In comparison to the YA,

Table 3
Comparisons of the results obtained by Young Adult and Old Adult groups on Gandra-BARTA.

	YA Mean rank	OA Mean rank	U	P
Time taken on Gandra-BARTA	7	20.65	6	<.001
Correct recognitions (total)	20.33	11.24	115	.004
Fear	15.42	14.71	75.5	.845
Rage	21.46	10.44	118	<.001
Disgust	16.67	13.82	85	.394
Sadness	14.83	15.12	74	.948
Happiness	14.79	15.15	63.5	.913
Surprise	17.25	13.41	85	.245
Neutral	19	10.18	116	.004

YA: Young Adults; OA: Old Adults.