Original Article

Facial Emotion Recognition Across Various Age Groups in a Healthy Egyptian Population.

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Abstract:

Background: The world's population is undergoing significant increase in populations of all age groups, including older adults. Social cognition deficits are common in various neuropsychiatric illnesses in all age groups particularly older adults 'population who commonly experience cognitive impairment. However, social cognition assessment remains an underexplored area of research in Egypt. So, the current study aims to obtain normative data for the Arabic version of the Faces Emotion Recognition test for the Egyptian population, as a reference for future clinical and research use in older adult population in Egypt.

Methodology: A cross-sectional study was conducted involving 241 community-dwelling Egyptian adults aged over 20 years. Participants were requested to complete an online survey comprising demographic information questions, patient health questionnaire 2 (PHQ2) questions, instructions for completing the Faces Test, and then the 20 test items.

Results: The mean score of the Faces test is 17.42 (SD = 1.59), with a range from 10 to 20 and a median of 18. Most of the faces achieved optimal recognition percentages by study participants; however, regarding faces 8 (distress), and 18 (interested) only 49.4%, and 62.2%, of participants respectively recognized those two faces correctly. Performance on the Faces test varies significantly, with younger participants achieving higher mean scores compared to older adult individuals.

Conclusion: Facial emotional recognition varies across different age groups. Participants of all age groups in our study had lower item recognition rates than anticipated compared to prior normative data.

Keywords: social cognition, emotional perception, older adults, Face test, Facial expression.

Introduction

According to the World Health Organization (WHO), there is a greying of nations and a trend towards an 'Ageing World'. By 2050, The number of people aged 60 and older will double, reaching up to 2.1 billion. The number will even triple in those who are 80 or older. This change has already started in high-income countries (for example 30% of the Japanese population is over 60). On the other hand, low- and middle-income countries (LMICs) are currently experiencing a greater change so that, two-thirds of the world's population over 60 years will live in LMICs by 2050 [1].

Cognitive impairment is one of the common issues in older adult population. Social cognition impairment is one of the main cognitive domains affected in dementia, considered the hallmark of behavioral variant frontotemporal dementia (bv-FTD), and is impaired early, even before the appearance of atrophic changes in imaging [2]. Studies found impairments in social cognition not only in Alzheimer's disease (AD) [3], but also earlier in patients with mild cognitive impairment (MCI) [4].

Social cognition entails many aspects of cognitive processes and skills affecting successful social interactions like emotion awareness, processing, and theories of mind (ToM). Facial emotion recognition plays a crucial role in social cognition. Deficits in this ability are associated with diminished psychological well-being and impaired social functioning [5].

Ekman and Friesen [6] demonstrated that basic emotional states, such as happiness, sadness, disgust, anger, fear, and surprise, can be reliably identified through facial expressions. Furthermore, Baron-Cohen et al [7], found that more complex emotional states, including revenge, guilt, recognition, threat, regret, and distrust, are also detectable through facial expressions, even across different cultural contexts.

Emotional recognition deficits are common in various neuropsychiatric illnesses, and they manifest differently in different diseases e.g. patients with Parkinson's disease have trouble recognizing anger and fear [8, 9]. Those with major depressive disorder recognize neutral faces as sad ones [10, 11]. The cases with schizophrenia have lower recognition rates for angry, fearful, and even neutral faces [12, 13].

Despite the recognized significance of social cognition assessment, it remains an underexplored area of research in Egypt. Although the Faces Recognition Test has been examined across various cultures and adapted to multiple languages, including Arabic [14], the existing Arabic Lebanese translation was not tested in the Egyptian population. Therefore, the authors' permission to translate the original English version was obtained and using culturally applicable words to describe the emotions were used. The present study is the unique and first one in Egypt for the assessment of facial emotions; translated the original Faces Recognition Test and applied it to a sample of healthy adults to gather normative data.

AIM/ OBJECTIVES

Obtaining normative data for the Arabic version of the Faces Emotion Recognition test for the Egyptian population, as a reference for future clinical and research use in the older adult population in Egypt.

METHODOLOGY:

This study was part of a larger project focused on cross-culturally adapting Arabic versions of social cognition assessment tools

and establishing normative data for Egyptian adults.

Using Epi info 7 and based on an expected frequency of 68% (the lowest item recognition rate reported by Kessels et al.) [15], a 5% margin of error, a design effect of 1, and a 90% confidence interval, the calculated minimum sample size was 235 participants.

Cross-cultural adaptation of each tool was performed according to the stages proposed by Beaton et al, 2000 [16]. The Authors obtained the copyright permissions from the original tools' developers, and this was followed by translating and back-translating the tools. Then an expert panel reviewed the translated version for cultural and conceptual relevance. The tools were initially pretested on a small convenient sample and subsequently refined based on the outcomes of the pilot testing.

Following these adjustments, the finalized tests were administered to a convenient sample of Egyptian adults with intact neurocognitive and mental functions to establish normative data.

A cross-sectional study was conducted during the period of 1/4/2023 to 1/11/2024 involving 241 community-dwelling Egyptian adults aged over 20 years. Participants were required to have the ability to read and write, normal cognitive function as indicated by a Mini-Mental State Examination (MMSE) [17] score of ≥26, and no intellectual, or mental disorders. Participants with uncontrolled medical conditions, functional impairments, or significant hearing or visual impairments that could impede effective communication were excluded from the study.

Following a clinical assessment to confirm participants' eligibility for inclusion in the study, each participant was requested to complete an online survey that comprised questions related to demographic information, questions of patient health questionnaire 2 (PHQ2) [18], instructions for completing the Faces Test, and then followed by the 20 test items.

Faces test (Baron-Cohen et al., 1997) [7]

It is a test for facial emotion recognition through 20 photographs of a full face measuring 10" × 8" in black and white prints, 10 of them representing basic emotions—happiness, sadness, anger, fear, distress, surprise, and disgust—and the other 10 photographs representing complex mental states, including scheming, guilt, thoughtfulness, admiration, curiosity, flirtation, boredom, interest, and arrogance. Participants were instructed to select the correct mental state from two options, choosing the term that most accurately described the emotions or thoughts of the individual depicted in the photograph.

Ethical Considerations:

The study methodology was approved by the ethical committee of the Faculty of Medicine, at Ain Shams University (FMASU R53/2023). An informed consents were obtained through participants' acceptance to continue the survey. The participants were debriefed about the study's aims, method, and its results' value for science. The participation was voluntary, and the participants have the right to withdraw at any time.

Statistical analysis:

The analysis was conducted using SPSS for Windows, version 20.0. Data were summarized as mean and standard deviation, with centiles calculated where appropriate. Categorical data were reported as frequencies and percentages. Differences across age groups were assessed using

analysis of variance (ANOVA) for numeric parametric variables and the chi-squared test for categorical variables.

Results:

The baseline characteristics of the study sample indicate a predominantly female composition (78%) with a younger age distribution as most participants fall within the 20–49-year range. Participants who completed college represented 50.6% and 42.7% held postgraduate degrees. The majority are non-smokers (88.38 %) and 29% of participants screened positive for depression according to the PHQ-2. (Table 1)

The mean score of the Faces test is 17.41 (standard deviation (SD) = 1.59), with a range from 10 to 20. Scores are concentrated between the 5th percentile (14) and 95th percentile (19), with the median at 18, indicating limited variability around the mean. (Table 2), (Figure 1)

In Table 3, the majority of the faces achieved optimal recognition rates; however, faces 8 (distress), and 18 (interested) exhibited lower recognition rates, with values of 49.4%, and 62.2%, respectively.

The distribution of males and females across age groups does not differ significantly; however, females are more than males in all age categories. A higher proportion of individuals in the younger age groups (20–39 and 40–49 years) possess college or postgraduate education, whereas the oldest group (≥70 years) shows lower levels of educational attainment. PHQ2 scores do not exhibit significant differences across age groups. (Table 4)

In contrast, performance on the faces test varies significantly, with younger participants achieving higher mean scores compared to older adult individuals (p 0.017).

Recognition rates for specific faces [e.g., Face 1 (happy), Face 2(afraid), Face 4(disgust), Face 5(sad), Face 15(quizzical), and Face 16 (flirting)] differ significantly across age groups (p 0.03, 0.006, 0.001, 0.009, 0.01, 0.007 respectively). All these faces, except Face 2 and face 15, are more easily recognized by younger participants.

Conversely, several faces [e.g., Face 3 (surprise), Face 6 (angry), Face 7 (surprise), Face 8 (distress), Face 9 (happy), Face 10 (angry), Face 11 (scheming), Face 12 (guilt), Face 13 (thoughtful), Face 14 (admiring), Face 17 (bored), Face 18 (interested), Face 19 (interested), and Face 20 (arrogant)] show no statistically significant differences, indicating stable recognition performance across age groups for these faces. (Table 4)

Discussion:

Social cognition was one of the six cognitive domains included for diagnosing neurocognitive disorders in the American Psychiatric Association's Diagnostic and Statistical Manual for Mental Disorders-5 (DSM-5) [19] criteria more than 10 years ago. It is affected early in the behavioral variant of frontotemporal dementia (bv-FTD) [20] [and] therefore assessment of social cognition is of utmost importance in geriatric cognitive assessment. However, social cognition tests are not included in many formal neuro-psychological assessments, and scarce studies reported normative data and validated facial emotion perception or TOM in different healthy age groups including the older adult population. Our study's main objective was to find normative data for the face recognition test to give reference to use it in clinical contexts of evaluating social cognition which may be impaired in several conditions especially

older adults suffering from neurodegenerative diseases like dementia.

Faces recognition test was used to assess social/emotional perception which is defined as the ability to perceive basic social and emotional cues e.g. facial emotional expressions. Decoding and interpreting emotional expressions are of utmost importance for successful social engagement [21]. Difficulties in emotion recognition are thus a significant factor contributing to ineffective communication and interpersonal difficulties.

While we initially aimed for balanced sex and age representation, practical challenges in distributing online surveys for neuropsychological research in Egypt necessitated the use of convenience sampling. This strategic choice aligned with the study's exploratory nature and resource limitations, allowing us to gain valuable insights despite logistical constraints.

The characteristics of the survey respondents showed a female predominance (78%) with a younger age distribution as most fall within the 20–49-year range. This might reflect specific preferences regarding sex and age groups. A meta-analysis [22] found that "women are better at recognizing female faces". Also, "old females recognized identical pairs of emotions better than old males" [23]. This may partially explain males' lesser preference to respond to the survey. About half of the respondents completed college and 42.7% held postgraduate degrees. The majority are non-smokers (88.38 %). Less than one-third of respondents screened positive for depressive symptoms.

Results showed that the mean score was 17.41 with a standard deviation of 1.59 indicating that most of the results are closer to the mean. All those scores range from 9 to 20, most lying between the fifth (14) and ninety-fifth percentile (19). The median score of 17 is similar to the mean revealing both unimodal and symmetric distribution of data, indicating that it can be standardized into normal distribution. Our findings were different from that of (Baron-Cohen et al., 1997) [7] who found the mean to be 18.51 which is higher than ours (17.41) this difference can be explained by a difference in sample size. Our larger sample size (241) tends to be more accurate and could generalizable and representative of the diverse population and also proved to have unimodal symmetrical distribution as mentioned before. On the other hand, their small sample size would be liable to errors.

Analysis of data in our study revealed better total scores in the Faces test in age groups 40-49 and 50-59 and worst scores in participants ≥ 70 years. Some studies suggested a U-shaped curve for overall Facial emotion recognition performance in healthy participants, reporting a peak in middle age and a decline after that [24, 25]. According to Connolly and colleagues, 2021, face perception ability becomes poorer with advanced age [26].

Recognition rates for some basic emotions like happiness were better in younger participants with sadness, and disgust being worse in the oldest group. In contrast, fear recognition was better in the oldest group (≥ 70 years) and worse in the youngest group (20-39). A study performed by Kessels et al. (2014) reported a linear decline with age which became significant after 60 years of age (using static images for assessment). This was especially for negative emotions like anger, with relatively less decline for other basic positive emotions including happiness [15]. The study assessed morphed facial expressions using an emotion recognition task in healthy participants aged 8 to 75 years. In children, age moderately correlated negatively with Anger recognition

and positively with Happiness (both $p < .01$). In adults, age was negatively associated with Anger, Fear, Happiness, Sadness, and total ERT scores (all $p < .0005$, except Happiness at $p < .01$). These findings highlight that age-related differences in emotion recognition occur across the entire lifespan, not just in older adults.

In a 2012 study by West and colleagues using a dynamic image assessment with participants aged 20 to 89, a significant decline in the perception of anger, sadness, and fear was observed, particularly after age 60. However, there was no decline in recognizing happiness or improvement in prediction accuracy with aging [27].

In contrast, others found improvement in the perception of happiness in the older adult population, studying healthy participants and those with mood disorders (with a maximum age of 65) [28]. Another study reported that fear recognition was higher in young participants [23].

According to Sze et al., 2012 older adults performed worse than younger adults in recognizing certain emotions—specifically sadness and disgust—from facial images and in interpreting emotions from older eyes, with middle-aged adults showing intermediate performance [29].

In their systematic review, Ruffman and colleagues attributed the selective age-related decline in basic emotion recognition to the differential impact of aging on specific neural structures and circuits. It is well-established that neural circuits underlying different emotions are distinct. Research suggests that the basal ganglia and insula are specialized for the processing of facial expressions of disgust, whereas the amygdala is primarily involved in the recognition of fearful expressions. The amygdala, the cingulate cortex, and particularly the orbitofrontal cortex are responsible for facial anger recognition [30]. While aging is associated with gradual global brain atrophy, there is more selective atrophy in the frontal and temporal regions with the amygdala being highly sensitive to this change leading to age-related emotion recognition difficulties [25].

According to Ekman and colleagues, the basic emotions were universal and could be expressed and processed similarly across cultures [31]. while complex emotions that are aggregates of expressions of two or more others e.g. hate and embarrassment were expressed differently in different cultures. However, this universality of basic emotions was contradicted by a more recent study conducted in Asia [32].

In our study, there were small number of older adults above 70 (6 participants) who all correctly recognized fear, making it as if the older adults in general are better at recognizing fear. This could not represent the broader population of older adults. Moreover, Barbieri et al., 2022 found that, emotional recognition including fear in young participants and healthy older controls (as in our sample) were not affected in comparison to older adults with MCI [33].

Our study also showed that young adults also were more able to recognize complex emotions. This was significant in face 16 (flirting). Very scarce studies explored the effect of age on these types of emotions. It can be expected that similar to basic emotions older adults would also be less able to recognize complex ones which need more attention to the face than basic emotions especially the eye part as demonstrated by (Baron-Cohen et al., 1997) [7] in their research about the language of the eyes". He found that while basic emotions can be detected more easily by the whole face than either the eyes or mouth alone, in complex emotions, the eyes alone were as important as the whole face rather than the mouth

alone. Also, in our study, a small proportion of older adults may have limited the true effect of this age category. Further studies are needed to explore the effect of aging on recognizing complex emotions.

Overall, the participants of our study, across all age groups, had lower item recognition rates than expected compared to previous normative data [7]. This difference could be attributed to cultural differences.

This study is the first to provide normative data for emotional perception as a social cognition domain in an Egyptian adult population. It further emphasizes the role of culture in shaping the perception of both basic and complex emotions. While the sample size for older adults was relatively small, the findings suggest potential age-related differences in overall performance and specific item recognition abilities.

Limitations of the study

The limited number of older adult people. Including participants who screened positive for depression. The use of a cross-sectional design would affect the causality of different factors that affect face recognition. Future studies involving longitudinal designs would truly express this causality especially age-related effects on facial emotional recognition. Moreover, emotional expressions in real life are dynamic rather than static stimuli. In addition, the use of colored emotional stimuli is better suited to real-world emotional perception. The selection of the Faces Test was motivated by its widespread availability and its frequent use in previous research, which would facilitate cross-population comparisons.

Conclusions:

Facial emotion recognition plays a crucial role in social cognition and its impairment negatively affects psychological wellbeing and social functioning. The current study aimed at defining normative data for the Arabic version of Faces for the Egyptian population and concluded that Facial emotional recognition varies across different age groups with some basic emotions like happiness being better in younger participants. In contrast, others like fear recognition were better in the oldest group (≥ 70 years). However, complex emotions were better recognized by young adults. Since this is the first study to present normative data for emotional perception as a social cognition domain in an Egyptian adult population, participants of all age groups in our study had lower item recognition rates than prior normative data in other countries. This could be due to cultural differences. A longitudinal design would be necessary for future studies to fully express the causation, particularly the age-related influence on face-emotional recognition. Furthermore, colored emotional stimuli can be more appropriate for real-world emotional perception than black-and-white prints.

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No conflict of interest is declared.

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Table 1: Baseline characteristics of the participants

Variable		N (%)
Sex	Males	53 (22%)
	females	188(78%)
Age group	20-39 years	85 (35.3%)
	40-49 years	89 (36.9%)
	50- 59 years	42 (17.4%)
	60-69 years	19 (7.9%)
	≥ 70 years	6 (2.5%)
Education	Secondary schools	16 (6.6%)
	College	122(50.6%)
	Postgraduate degree	103 (42.7%)
Smoking status	Non smoker	213 (88.38%)
	Ex smoker	19 (7.88%)
	Current smoker	9 (3.73%)
PHQ2 interpretation	Screened positive for depression	70 (29%)
	Screened negative for depression	171 (71%)

PHQ2 = Patient Health Questionnaire-2

Table 2: The normative data of the faces test

Mean	17.41
SD	1.59
Minimum	10
Maximum	20
5^{th} percentile	14.05
10^{th} percentile	15
25^{th} percentile	17
50^{th} percentile	18
75^{th} percentile	18.75
90^{th} percentile	19
95^{th} percentile	19

SD = Standard deviation

Table 3: Frequency of correct answers in each item of the faces test

Item	Correct answer	frequency
Basic emotions		
Face 1	Happy	225 (93.4%)
Face 2	Afraid	226 (93.8%)
Face 3	Surprise	240 (99.6%)
Face 4	Disgust	239 (99.2%)
Face 5	Sad	238 (98.8%)
Face 6	Angry	221(91.7%)
Face 7	Surprise	189 (78.4%)
Face 8	Distress	119 (49.4%)
Face 9	Happy	232 (96.3%)
Face 10	Angry	233 (96.7%)
Complex mental state		
Face 11	Scheming	189 (78.4%)
Face 12	Guilt	204 (84.6%)
Face 13	Thoughtful	210 (87.1%)
Face 14	Admiring	235 (97.5%)
Face 15	Quizzical	217 (90.04%)
Face 16	Flirting	198 (82.2%)
Face 17	Bored	225 (93.4%)
Face 18	Interested	150 (62.2%)
Face 19	Interested	192 (79.7%)
Face 20	Arrogant	213 (88.4%)
Total Score 20		8 (3.3%)

Table 4: Age group differences in the studied variables

Variable	Age group	20-39 years N=85	40-49 years N=89	50-59 years N=42	60-69 years N=19	≥ 70 years N=6	P value
sex	Male	24(28.2%)	18(20.2%)	6(14.3%)	4(21.1%)	1(16.7%)	0.45
	Female	61(71.8%)	71(79.8%)	36(85.7%)	15(78.9%)	5(83.3%)	
education	Secondary school	4(4.7%)	2(2.2%)	3(7.1%)	6(31.6%)	1(16.7%)	0.001*
	college	42(49.4%)	51(57.3%)	19(45.2%)	8(42.1%)	2(33.3)	
	Post graduate	39(45.9%)	36(40.4%)	20(47.6%)	5(26.3%)	3(50.0%)	
PHQ2 ≥3		22(25.9%)	27(30.3%)	15(35.7%)	4(21.1%)	2(33.3%)	0.7
PHQ2 score		1.91(1.15)	2.07(1.43)	2.21(1.29)	1.84(1.67)	2(1.67)	0.76
Face 1 (Happy)		85(100%)	79(88.8%)	39(92.9%)	17(89.5%)	5(83.3%)	0.03*
Face 2 (Afraid)		73(85.9%)	88(98.9%)	41(97.6%)	18(94.7%)	6(100%)	0.06*
Face 3 (Surprise)		85(100%)	89(100%)	41(97.6%)	19(100%)	6(100%)	0.3
Face 4 (Disgust)		84(98.8%)	89(100%)	42(100%)	19(100%)	5(83.3%)	0.001*
Face 5 (Sad)		84(98.8%)	89(100%)	41(97.6%)	19(100%)	5(83.3%)	0.009*
Face 6 (Angry)		82(96.5%)	82(92.1%)	36(85.7%)	16(84.2%)	5(83.3%)	0.16
Face 7 (Surprise)		67(78.8%)	74(83.1%)	29(69.0%)	15(78.9%)	4(66.7%)	0.42
Face 8 (Distress)		42(49.4%	47(52.2%)	22(52.4%)	6(31.6%)	2(33.3%)	0.46
Face 9 (Happy)		84(98.8%)	84(94.4%)	39(92.9%)	19(100%)	6(100%)	0.31
Face 10 (Angry)		83(97.6%)	86(96.6%)	41(97.6%)	18(94.7%)	5(83.3%)	0.41
Face 11 (Scheming)		61(71.8%)	70(87.7%)	37(88.1%)	16(84.2%)	5(83.3%)	0.28
Face 12 (Guilt)		73(85.9%)	74(83.1%)	38(90.5%)	15(78.9%)	4(66.7%)	0.5
Face 13 (Thoughtful)		75(88.2%)	78(87.6%)	35(83.3%)	16(84.2%)	6(100%)	0.7

Face 14 (Admiring)	83(97.6%)	87 (97.8%)	41(97.6%)	18 (94.7%)	6 (100%)	0.9
Face 15 (Quizzical)	71 (83.5%)	87 (97.8%)	38(90.5%)	15 (78.9%)	6 (100%)	0.01*
Face 16 (Flirting)	71 (83.5%)	78(87.6%)	34(81.0%)	13 (68.4%)	2(33.3%)	0.007*
Face 17 (Bored)	78 (91.8%)	88 (98.8%)	38 (90.5%)	16 (84.2%)	5(83.3%)	0.06
Face 18 (Interested)	55 (64.7%)	48 (53.9%)	28 (66.7%)	14 (73.7%)	5(83.3%)	0.25
Face 19 (Interested)	71 (83.5%)	73 (82.0%)	33 (78.6%)	12 (63.2%)	3 (50.0%	0.1
Face 20 (Arrogant)	77 (90.6%)	81 (91.0%)	35(83.3%)	16 (84.2%)	4 (66.7%)	0.27
Faces test score mean (SD)	17.45(1.52)	17.65(1.50)	17.39(1.28)	16.68(2.16)	15.83(2.56)	0.017*

PHQ2 = Patient Health Questionnaire-2; SD = Standard deviation

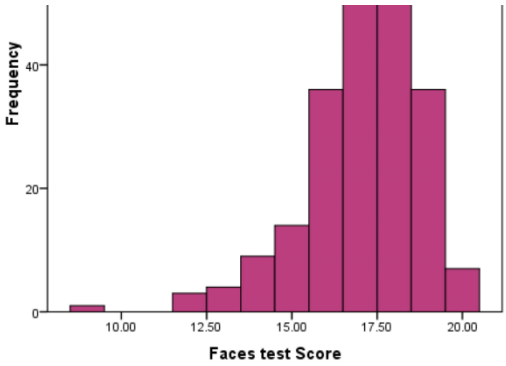

Figure 1: Distribution of Scores on the Faces Test

This histogram represents the distribution of scores on the Faces Test among 241 participants. The data shows a fairly normal distribution with a mean score of 17.42 and a standard deviation of 1.59. The majority of scores fall between 17 and 20, indicating strong performance consistency among participants, with very few outliers on the lower end.

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