Journal of Psychiatry and Psychology Research
JPPR, 6(2): 402-408
www.scitcentral.com

ISSN: 2640-6136

Original Research Article: Open Access

# Face Recognition and Social Cognition in Middle Adult

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*Received March 03, 2020; Revised March 21, 2020; Accepted March 23, 2020*

## ABSTRACT

Face recognition is an important element of human cognition that is studied less often. Face recognition ability of individuals could impact their social cognitive skills. The present study aims to find the relationship between face recognition ability and social cognition in middle adults. The data was collected from middle adults (N=70; male=35 and female=35) living in different cities of India. Data was collected using the Prosopagnosia Index-20 (PI20) and the Social Cognition Questionnaire (SCQ). The data was analyzed using Pearson product moment correlation and two ways MANOVA. The results obtained indicate that there exists moderately significant positive correlation between face recognition ability and social cognition in middle adults. Furthermore, it was also determined from the study that there are no gender and age differences in both face recognition ability and social cognition in middle adults. The study is relevant as it explores the relationship between face recognition skills and social cognition which is a less studied research area and also acts as a reference for further studies of face recognition ability as well as for diagnostic studies related to prosopagnosia and super recognition abilities.

**Keywords**: Face recognition ability, Social cognition, Prosopagnosia, Middle adults

## INTRODUCTION

### Face recognition ability and social cognition

Face recognition is a significant aspect of both human perception and cognition. However, face recognition is often neglected for its importance. Fortunately, face recognition is included as a significant construct of study in recent research conducted in the field of cognitive neuropsychology. The inability of individuals to recognize faces have been conceptualized as a disorder labeled prosopagnosia, which could be both developmental and acquired. The current study aims to explore face recognition ability with regard to developmental prosopagnosia. Congenital or developmental prosopagnosia (DP) is a condition in which individuals lack the ability to recognize faces of familiar people. In developmental prosopagnosia, the face recognition deficiency is lifelong and is expressed since childhood and not caused due to any kind of brain damage [1]. Some individuals with developmental prosopagnosia even fail to recognize their own faces in mirror or photographs.

A study by Kress and Daum [2] addressed about the different models of face recognition in individuals. One among those models was the functional model by Bruce and Young. The initial sub-process of face recognition as proposed in the model is deriving view-centered descriptions from visual inputs which are further transformed into structural encoding through which the inputs are compared with familiar faces in the memory. These are then converted into face recognition units. If the face identified is familiar, the person identity nodes get activated and it permits access to various information about the identified individual [2]. The study also concluded from other models that the temporal neocortex and amygdala are largely associated with face recognition.

Studies have identified that face recognition abilities are fundamentally significant in social interactions [3] and thus can impact social cognition of individuals. Social cognition refers to the cognitive patterns an individual use to interpret the social world along with the strength and frequency of occurrence of these thoughts. Social cognition could be described in terms of the folk theory of mind which proposes that individuals interpret the mental states of others through

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**Citation:** Viswanath P. (2023) Face Recognition and Social Cognition in Middle Adult. J Psychiatry Psychol Res, 6(2): 402-408.

the apprehension of their own cognitive mechanisms [4].

The relationship between social-cognitive abilities and face recognition abilities are studied rarely and thus provides a better scope for further studies based on a correlation of face recognition abilities with different aspects of social abilities and social cognition. Such studies could be significant as it is frequently observed that individuals with deficits in facial recognition are found to be socially withdrawn and those with high face recognition abilities possess better social skills and social interest. Additionally, inability to recognize familiar faces may make such individuals feel embarrassed and thus they may isolate themselves from others and social situations. Face recognition abilities can also facilitate the way individuals interpret others and the world around them as well interpreting emotions and feelings in the social world. Few studies validate this idea by proposing that social cognition and face perception are significantly correlated and that faces are an important aspect of social cognition [5]. It was also identified from a study on children with autistic traits that amygdala dysfunctions would lead to lack of social interest as well as may prevent the development of face specialization [6]. A similar result was obtained from another study which conceptualized that amygdala plays a crucial role in social cognition as well as face perception and recognition of emotional expressions in human faces, along with description of role of orbito-frontal cortex in assessing faces that are involved in social reinforcement [7]. It was also mentioned in the same study that face perception and social interaction abilities are correlated from the pattern of cognitive development of face perception [7]. Children initially pay attention to human faces and develop perception of human faces rather than other objects [8].

However, there are also few studies that contradict these findings. The role of individual differences in face perception and recognition was studied experimentally as an element of social cognition [9], assessing various components of face cognition including face perception, face memory, and speed of face cognition. It was identified that these abilities are different from immediate and delayed memory, mental speed, general cognitive ability, as well as object cognition. Thus, it was concluded in the study that face-processing abilities are not correlated with elements of social intelligence [9]. Correlation of developmental prosopagnosia with social cognition was also analyzed in a group of individuals with facial identity and facial expression deficits along with autistic traits [3]. However, the results indicated that development of social cognitive abilities is independent of the presence of developmental prosopagnosia.

Though studies correlating prosopagnosia and social cognition are comparatively less, there are few studies conducted that aim to identify the relationship between prosopagnosia and emotional valence. From one such study, it is proved that positive emotions can promote processing in prosopagnosia and that covert face recognition depends on emotional valence rather than familiarity [10]. However, in a study on acquired prosopagnosia, it was identified that the condition is not correlated with emotional attention [11].

The present study thus attempts to identify whether there exists any relationship between face recognition ability and social cognition and also to determine whether there exist gender and age differences in both variables. Since the study was conducted in a normal population, diagnosis for developmental prosopagnosia was very less, and since the methodology used was also not experimental, the conclusions of the study are drawn for general abilities of facial recognition and not for prosopagnosia.

**Aim**

To study the relationship between face recognition and social cognition along with exploration of gender and age differences in both the variables.

**Objectives**

1. To determine whether there exists any significant relationship between face recognition ability and social cognition in middle adults.
2. To determine whether there exists any significant gender difference in face recognition among middle adults.
3. To determine whether there exists any significant age difference in face recognition among middle adults.
4. To determine whether there exists any significant gender difference in social cognition among middle adults.
5. To determine whether there exists any significant age difference in social cognition among middle adults.
6. To determine whether there exists any significant difference in face recognition based on the interaction effect of gender and age.
7. To determine whether there exists any significant difference in social cognition based on the interaction effect of gender and age.

**Hypothesis**

1. There is no significant relationship between face recognition ability and social cognition in middle adults.
2. There is no significant gender difference in face recognition ability among middle adults.
3. There is no significant gender difference in social cognition among middle adults.
4. There is no significant age difference in face recognition among middle adults.
5. There is no significant age difference in social cognition among middle adults.

6. There is no significant difference in face recognition based on the interaction effect of gender and age.
7. There is no significant difference in social cognition based on the interaction effect of gender and age.

## METHODS

### Sample

The data was collected from middle aged adults (N = 70; Male = 35 and Female = 35), aged between 40 and 60. The sample was selected using purposive sampling from different cities of India. Individuals below and above the selected age range and those who were unable to comprehend English were excluded from the study.

## TOOLS

### The Socio-Demographic Data Sheet

The subjects were asked to fill a socio-demographic data sheet that collected details regarding their age, gender, qualifications and other relevant information.

### The Social Cognition Questionnaire

The social cognition of the subjects was assessed using the Social Cognition Questionnaire (SCQ) developed by Wells, Stopa, and Clark, in 1993. It consists of 22 items that measures negative self-beliefs, fear of performance failure, and fear of negative evaluation, with respect to strength of belief and frequency of the cognitions. The scale has an internal consistency of 0.72, 0.84, and 0.81, respectively. The test-retest reliability of the scale is satisfactory ($\alpha$ =0.79, $p < 0.01$).

### The Prosopagnosia Index 20 (PI20)

The Prosopagnosia Index 20 (PI20) was developed and validated in a study by Shah et al. [12] to identify individuals with developmental prosopagnosia (DP). The psychometric properties of PI20 scale was obtained from the study of development and validation of PI20 conducted by Shah et al. [12]. Results were obtained through four validation studies to test the construct validity of the scale as well as its correlation with other formal tests of face recognition. The internal consistency of the scale was established to be significant (Cronbach's $\alpha$=0.96). Further, significant correlation was obtained with the formal tests including the Famous Faces Recognition Test (FFRT), the Cambridge Face Memory Test (CFMT), and the Cambridge Car Memory Test (CCMT) along with age matched controls, thereby proving that the PI20 is a valid tool to identify prosopagnosia. Correlation with the ability to recognize famous faces (r=0.81) was significant across age, gender, and location. Correlation with recognition of unfamiliar faces (r=-0.68) was found to be significant only with age and not gender. However, in the validation study 5, it was identified that the PI20 cannot be used as a tool to measure general factors and the conclusion drawn from the study was that PI20 is a valid tool for measuring face recognition ability and not broad factors like general memory ability [12]. Another study conducted by Ventura, Livingston and Shah [13] also verified that the PI20 is moderately to highly correlated with other behavioral measures of face recognition (~r=0.40) and correlated with FFRT (r=-0.39) and CFMT (r=-0.43) along with a correlation with respect to age and gender (r=-0.39 for FFRT and r=-0.43 for CFMT) [14].

## PROCEDURE

The data was collected from individuals using hard copy of the inventories as well as by using Google forms. The collected data were coded using an Excel spreadsheet and were uploaded to spss for further analysis. All data that were incomplete and not meeting inclusion criteria were omitted. The data was analyzed using Pearson product moment correlation and two-way MANOVA using SPSS version 21.

## RESULTS

**Table 1** shows the descriptive statistics obtained for face recognition and social cognition. For this research sample (N=70), the mean score and standard deviation of face recognition and social cognition are 47.69±8.466 and 43.40±14.189 respectively. Skewness and kurtosis for face recognition are -.422 and .646 respectively for face recognition and .919 and .953 respectively for social cognition. Thus the distribution of data is normal for both variables.

**Table 1.** Descriptive statistics for face recognition and social cognition.

| Variables | N | Mean | SD | Skewness statistic | Kurtosis statistic |
|---|---|---|---|---|---|
| **Face recognition** | 70 | 47.69 | 8.466 | -.422 | .646 |
| **Social cognition** | 70 | 43.4 | 14.189 | .919 | .953 |

**Table 2** shows the correlation coefficient of face recognition ability and social cognition in middle adults. There is moderate positive correlation between face recognition ability and social cognition in middle adults (r = 0.527) and it is significant at 0.01 level. Thus, the null hypothesis 1 is partially rejected indicating that there is a moderately significant positive relationship between face recognition ability and social cognition in middle aged adults.

**Table 2.** Correlation between face recognition and social cognition in middle adults.

| Predictor Variables | N | Pearson correlation(r) | Sig (2-tailed) |
|---|---|---|---|
| **Face Recognition** | 70 | .527** | .000 |

***Correlation is significant at the 0.01 level (2-tailed)*

**Table 3** shows the Box's M Test of equality of co-variance matrices which signifies that assumption of equality of co-variance matrices is non-significant (Box's M=12.520, F=1.211, df=9, 823.098, p=0.285 which is >0.05).

**Table 3.** Box's test of equality of covariance matrices of multivariate analysis.

| Box's test of equality of covariance matrices | |
|---|---|
| Box's M | 12.520 |
| F | 1.211 |
| df1 | 9 |
| df2 | 823.098 |
| Sig | .285 |

The Multivariate test table results **(Table 4)** shows that both Gender (Wilks' Lambda Value=0.994, F=0.2, df=2, 65, p=0.819, $\omega^2$=0.006) &age (Wilks' Lambda Value=0.913, F=3.084, df=2, 65, p=0.053, $\omega^2$=0.087) has no significant influence on dependent variables individually. Similarly, there is no significant influence on the dependent variables through interaction effect of gender*age (Wilks' Lambda Value=0.968, F=1.090, df =2, 65, p=0.342, $\omega^2$=0.032).

**Table 4.** Summary of Multivariate Analysis of Variance (MANOVA).

| Variable | Wilk's Lambda | F | Hypo. df | df | Error | Sig. | $D^2$ |
|---|---|---|---|---|---|---|---|
| **Gender** | .994 | .2 | 2 | | 65 | .819 | .006 |
| **Age** | .913 | 3.084 | 2 | | 65 | .053 | .087 |
| **Gender*Age** | .968 | 1.09 | 2 | | 65 | .342 | .032 |

The Levene's test of Equality of Error Variance of the dependent variables are homogeneous (Face recognition: p=0.077 & social cognition: p=0.647) **(Table 5)**.

**The test between-subject effects result describes**

**$H_0$2: There is no significant gender difference in face recognition among middle adults.**

Gender Vs Face recognition: - F=0.067, df=1, $\omega^2$=0.001, p=0.797

The result indicates that p > 0.05, hence the null hypothesis is accepted and there is no significant difference in face recognition among male and female middle adults.

**$H_0$3: There is no significant gender difference in social cognition among middle adults.**

Gender Vs social cognition: - F=0.407, df=1, $\omega^2$=0.006, p=0.526

The result indicates that p > 0.05, hence the null hypothesis is accepted and there is no significant difference in social cognition among male and female middle adults.

**$H_0$4: There is no significant age difference in face recognition among middle adults.**

Age Vs face recognition: - F=6.113, df=1, $\omega^2$=0.085, p=0.016

**Table 5.** Tests of between-subject's effects of (MANOVA) for the independent and dependent variables.

| Source | DV | SS | df | F | *p* | $\eta^2$ |
|---|---|---|---|---|---|---|
| **Gender** | Face recognition | 4.527 | 1 | 0.067 | 0.797 | 0.001 |
| | Social cognition | 78.294 | 1 | 0.407 | 0.526 | 0.006 |
| **Age** | Face recognition | 414.21 | 1 | 6.11 | 0.016 | 0.085 |
| | Social cognition | 78.294 | 1 | 0.407 | 0.526 | 0.006 |
| **Gender*Age** | Face recognition | 0.963 | 1 | 0.014 | 0.905 | 0.000 |
| | Social cognition | 330.335 | 1 | 1.717 | 0.195 | 0.025 |

The result indicates that $p > 0.05$, hence the null hypothesis is accepted and there is no significant age difference in face recognition among middle adults.

**$H_0$5: There is no significant age difference in social cognition among middle adults.**

Age Vs social cognition: $F=0.407$, $df=1$, $\omega^2=0.006$, $p=0.526$
The result indicates that $p>0.05$, hence the null hypothesis is accepted and there is no significant age difference in social cognition among middle adults.

**$H_0$6: There is no significant difference in facial recognition based on the interaction effect of gender and age.**

Gender*Age Vs Face recognition: - $F=0.014$, $df=1$, $\omega^2=0.000$, $p=0.905$

The result indicates that $p > 0.05$, hence there is no significant difference in face recognition based on the interaction effect of Gender*Age.

**$H_0$7: There is no significant difference in social cognition based on the interaction effect of gender and age.**

Gender*Age Vs Social cognition: - $F=1.717$, $df=1$, $\omega^2=0.025$, $p=0.195$

The result indicates that $p > 0.05$, hence there is no significant difference in social cognition based on the interaction effect of Gender*Age.

**Table 6** shows the estimated marginal means of face recognition and social cognition for both males and females which are 45.431 and 46.115 respectively for face recognition and 41.5 and 44.346 respectively for social cognition.

**Table 6.** Estimated marginal means for the dependent variables based on gender.

| DV | Gender | Mean | Std Error |
|---|---|---|---|
| **Face recognition** | Male | 45.431 | 2.195 |
| | Female | 46.115 | 1.48 |
| **Social cognition** | Male | 41.5 | 3.699 |
| | Female | 44.346 | 2.495 |

**Table 7** shows the estimated marginal means of face recognition and social cognition for middle adults aged between 40 to 50 and 50 to 60 which are 42.5 and 49.046 respectively for face recognition and 41.5 and 44.346 for social cognition.

**Table 7.** Estimated marginal means for the dependent variables based on age.

| DV | Age | Mean | Std Error |
|---|---|---|---|
| **Face recognition** | 40-50 | 42.5 | 2.403 |
| | 50-60 | 49.046 | 1.112 |
| **Social cognition** | 40-50 | 41.5 | 4.05 |
| | 50-60 | 44.346 | 1.873 |

**Table 8** shows the estimated marginal means for both face recognition and social cognition based on the interaction effect of gender and age. The results indicate that the mean scores of face recognition are 42 and 48.862 respectively for males aged between 40 to 50 and 50 to 60. The mean scores for face recognition in females aged between 40 to 50 and 50 to 60 are 43 and 49.231 respectively. The results further indicate that the mean scores for social cognition in males aged between 40 to 50 and 50 to 60 are 43 and 40 respectively and for females aged between 40 to 50 and 50 to 60 are 40 and 48.692 respectively **(Figures 1 and 2)**.

**Table 8.** Estimated marginal means for the dependent variables based on gender*age.

| DV | Gender | Age | Mean | Std Error |
|---|---|---|---|---|
| **Face recognition** | Male | 40-50 | 42 | 4.116 |
| | | 50-60 | 48.692 | 1.529 |
| | Female | 40-50 | 43 | 2.482 |
| | | 50-60 | 49.231 | 1.614 |
| **Social cognition** | Male | 40-50 | 43 | 6.936 |
| | | 50-60 | 40 | 2.567 |
| | Female | 40-50 | 40 | 4.182 |
| | | 50-60 | 48.692 | 2.720 |

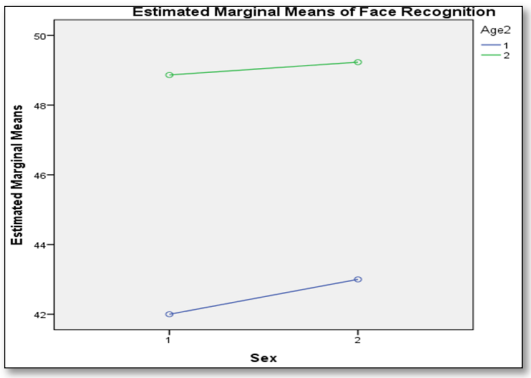


**Figure 1.** Profile plot for estimated marginal means of face recognition.

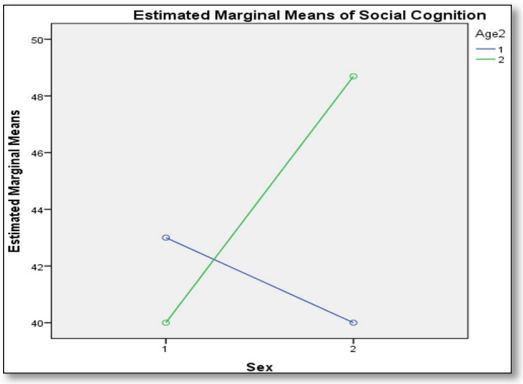


**Figure 2.** Profile [lots for estimated marginal means of social cognition**.**

Thus, it could be observed that there exist higher gender differences in social cognition than face recognition while there exists higher age difference in face recognition than social cognition though none of the differences are significant.

## DISCUSSION

It could be seen from the obtained results that face recognition ability is moderately correlated with social cognition in middle adults. The finding indicates that face recognition ability of individuals does not affect social cognition too strongly. However, there could be an optimal impact of ability to recognize faces on social cognition which is found to be in favor with few existing studies that identified relationship with face recognition ability and social cognition. Furthermore, the study also indicated that there are no gender and age differences in both face recognition ability and social cognition as well as no significant difference in face recognition and social cognition based on the interaction effect of gender and age. However, the estimated marginal means indicated that though the obtained differences are not significant, there exist higher gender differences in social cognition than face recognition while there exists higher age difference in face recognition than social cognition.

There are only few studies that study about the relationship between face recognition ability and social cognition. Thus, this study would be beneficial as the results obtained could be used as a reference for further research related to the

variables used. Moreover, since face recognition is found to be moderately correlated with social cognition, ability for face recognition could be assessed as part of recruitment for jobs or for providing social skills training to those who lack social cognitive skills. The study could further be extended to extensive studies that explore prosopagnosia and super recognition abilities in individuals.

The present study involves few limitations as the analysis was done using data collected from a small sample as well as the sample included were largely from major cities of India. Thus, the study could be expanded by increasing sample size and expanding data collection to other parts of the world. Additionally, the current study was conducted using standardized inventories for social cognition and face recognition which depends on the self-report of individuals. Thus, there could be biases in the study and such errors could be rectified by conducting more extensive experimental studies using formal tests of face recognition and social cognition.

## CONCLUSION

It is determined from the present study that there exists a moderate relationship between face recognition ability and social cognition in middle adults. Furthermore, no gender and age differences were observed in both face recognition ability and social cognition in middle adults.

## ACKNOWLEDGEMENT

I sincerely acknowledge all participants of the study who were cooperative and willing to attentively respond to the items in the inventories.

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