

# Impaired Spontaneous Attention to Gaze Cueing in Obsessive-Compulsive Disorder: Eye Tracking Study



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## SUMMARY

**Objective:** The aim of this study was to determine whether or not patients with obsessive compulsive disorder (OCD) differed from the control group in paying spontaneous attention to gaze cueing

**Method:** The OCD patient and control groups were tested on a shortened version of Social Distance Judgement Task using pictures of two human cartoon figures with their bodies directed toward the observer and their heads facing each other or in opposite directions. Participants were asked to compare the distances between the cartoon figures and between the blocks drawn under each figure, while their eye movements were recorded by eye-tracking equipment. Before the recording, a rectangular area, with its lower side located at the shoulder region of the cartoon figures, was determined as the area of interest for visual fixation. During the test, human cartoon figures were presented on a computer screen, and the number and duration of visual fixations on the area of interest by both patients and controls were recorded and compared with each other.

**Results:** In comparison to the control group, the patients with OCD had less number ( $p=0.029$ ) and duration ( $p=0.051$ ) of visual fixations on the head and surrounding region of the cartoon figures. The number and duration of fixations on the region of interest did not show correlation with the severity of symptoms.

**Conclusion:** Patients with OCD are less likely to pay spontaneous attention to gaze cueing in comparison to healthy individuals. Impairment in spontaneous attention to social cues may underlie the social functioning disorders observed in these patients.

**Keywords:** Obsessive-compulsive disorder, social signs, visual fixation, spontaneous attention, eye tracking, social function

## INTRODUCTION

Patients with obsessive compulsive disorder (OCD) are known to have impaired social functioning (Albert et al. 2010, Huppert et al. 2009). Limited research has been made on the mechanisms of impaired social functioning observed in these patients. Evaluation of OCD patients with tests based on the standard theory of mind have reported conflicting results on the presence (Tulacı et al. 2018) and absence (Sayın et al. 2010) of impairment. It is known that spontaneous attention to social cues is extremely important in daily life for deciphering other people's intentions and emotions (Perrett

1999). One test that is used to assess spontaneous perception of instantaneous social cues is the Social Distance Judgement Task (Jellema et al. 2009). Using a new version of the Social Distance Judgement Task, we had previously found that, in comparison to the controls, the OCD patients were less likely to perceive the distance between the cartoon figures facing each other as being shorter than the distance between the figures that gazed in opposite directions, which was contrary to the expected result. We argued that perceptual effect was weaker in OCD patients in comparison to healthy individuals, indicating that OCD patients were less likely

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to pay spontaneous attention to the face area of the cartoon figures and the direction of their gaze (Tümkiye et al. 2014).

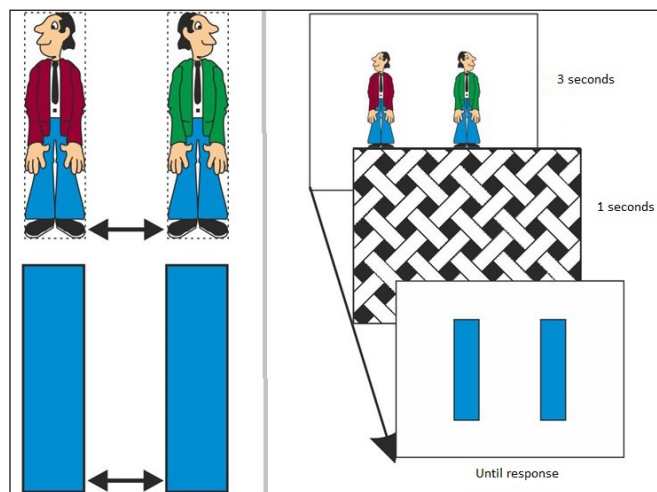
However, an argument in relation to this result was that, for the instantaneous gaze cueing to be effective, the viewer must adapt to the reference frame of the person that they are staring at (Hietanen 2002). Hence, if OCD patients have impairment in instantly adapting to the gaze angle of others, this could result in failure to perceive a closer distance between the cartoon figures facing each other despite adequate instant visual fixation on their facial areas. The methodology used in the previous studies did not show exactly whether OCD patients had a problem related to making such an adaptation or whether they had impairment in spontaneous visual fixation on gaze cueing. Therefore, in this study we tracked the eye movements of the patients and the controls in order to determine intergroup differences in the number and duration of visual fixations on the facial and the surrounding areas of the cartoon figures while viewing them.

With this aim, we used the same cartoon figure positions with bodies directed toward the observer while the heads were directed to the left or right sides (Figure 1), which, in the previous study, enabled determining significant differences in the perceptions of the distance between the figures by the OCD patients and the controls. The contrariness of the forward body direction and left or right gaze direction of these figures was expected to draw visual attention of the participants to the head region of these figures (Hietanen 2002). Our hypothesis, on the basis of our results with the same figures in the previous study, was that the OCD patients would have less number and duration of visual fixations on the face and surrounding region of cartoon figures compared to the controls. If confirmed, this would indicate that OCD patients are likely to have impaired spontaneous attention to gaze cueing. In this study, only a short section of the Social Distance Judgement Task was used, and the responses of participants were disregarded. Our purpose was to record eye movements while participants were trying to judge the distance between the cartoon figures.

## METHOD

### Participants

The OCD group consisted of 10 patients who were selected from those consulting the Anxiety Disorders Clinic of Pamukkale University after confirmation of the OCD diagnoses and the absence of any other psychotic disorder on the basis of the SCID-I for DSM-IV, and elimination of any significant neurological disease. The control group consisted of 11 members of the hospital staff without any psychiatric disorders who were matched with the patient group on the basis of gender, age, and educational level. All participants were informed about the study and asked to provide a written



**Figure 1.** Short Version of the Social Distance Judgement Task (Revised from Jellema et al. 2009.)

consent for participation. The study was performed in line with the Helsinki declaration and was approved by the Ethics Committee of Pamukkale University.

### Measurement Tools

To begin with, the OCD patients were assessed on the Yale Brown Obsession Compulsion Scale (YBOCS), the Hamilton Anxiety Rating Scale (HAM-A), and the Hamilton Depression Rating Scale (HAM-D). Subsequently, the short version of the Social Distance Judgement Task (SDJT) was completed by all participants. During this test, eye movements of participants were recorded with the ViewPoint eye tracking system (USB-220™, Arrington Research®). A rectangular area was impressed on the displayed images of the cartoon figures, by joining the 0.18 and 0.82 coordinates on the X axis and the 0.01 and 0.34 coordinates on the Y axis, taking the right-most point on the X axis of the image as 1, and the lower-most point on the Y axis as 1. The lower side of this rectangle approximately aligned with the shoulder region of the cartoon figures. Visual fixation by the participants inside this rectangle were taken into account for analysis, and was evaluated as attention to the gaze direction of the cartoon figures (Figure 2).

### The Shortened Social Distance Judgement Task (SDJT)

This test is a shorter version of the original SDJT that we had used previously. For the shorter version, the cartoon figure positions with front facing bodies and heads directed to the right or left were used. The participants were shown an image displaying the cartoon figures for three seconds followed by images with masks and blocks until they gave a response (Figure 1). The distances between the cartoon figures and between the blocks were both six cm. The participants were told that the distance between the cartoon figures were not the

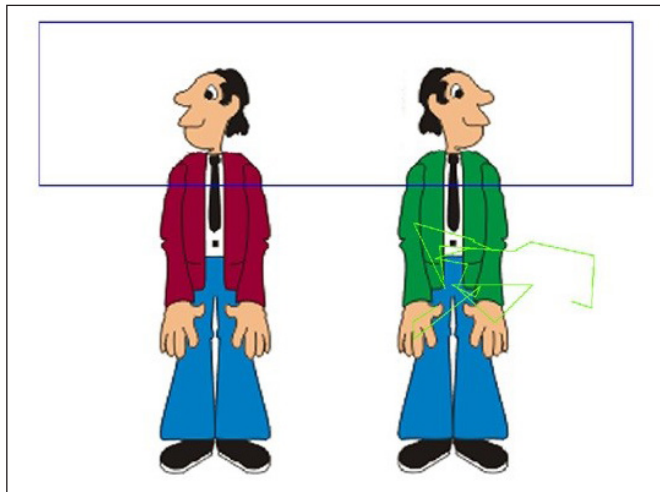


Figure 2. Area of Interest Identified in the Pictures

same with the distance between the blocks, and that there was always some difference even if it was in the millimeter range. The participants were asked whether the distance between the figures were shorter or longer than the distance between the blocks. They were requested to press the “F” key with the index finger of the left hand if they thought the distance was longer, and to press the “K” key with the index finger of the right hand if they thought the distance was shorter. The cycle of cartoon figure-mask-blocks shown in Figure 1 was repeated six times with the cartoon figures facing each other at three of these repeated cycles and away from each other at three of the cycles. The responses of the participants were disregarded at this stage. Our purpose was to determine which regions the participants fixed their attention most to give a response; and, the eye movements of the participants were recorded with an eye tracking device while they performed SDJT.

### The Eye Tracking Equipment

In order to achieve an objective determination of the extent of visual fixations on the facial areas of the cartoon figures, the single-eyed ViewPoint eye tracking system with head-fixing (USB-220™, Arrington Research® - accuracy=0.25-0.5,

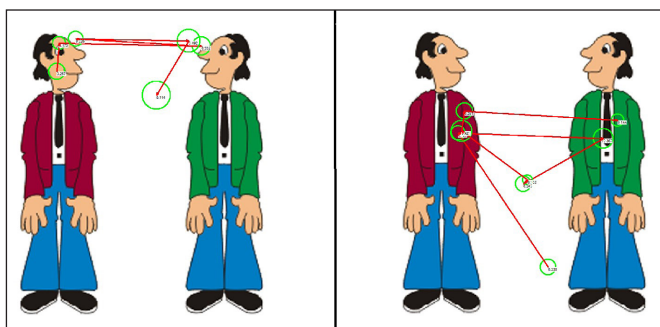


Figure 3. The Visual Fixations of a Healthy Control (Left) and an OCD Patient (Right) During the First 3 Seconds of the Task (The size of the circles indicates the length of the fixation time.)

resolution=0.15) operating at 220 Hz was used. In simple terms, this device marked the iris with infrared light and enabled to record the coordinates of the movements of the marked iris using a high-speed camera. These coordinates were then positioned on the image displayed to the participants, by using a computer software that enabled calculating the duration of visual fixation by the participants on any area of the image.

### The Structured Clinical Interview for DSM-IV Axis I Disorders / Clinical Version (SCID-I/CV)

The SCID-I/CV is a structured clinical interview designed for diagnosing DSM-IV axis I disorders (First et al. 1997). The Turkish language version has the appropriate psychometric properties of the original form (Öztürkçügil et al. 1999).

### The Yale-Brown Obsession Compulsion Scale (YBOCS)

This scale was completed by the clinician to assess the severity of the symptoms. It has 10 items in total, 5 for obsessions and 5 for compulsions, each with a score between 0 and 4. The total scores for obsession and compulsion are obtained separately by adding the scores on each item on obsessions and compulsions, respectively. The maximum available total score is 40 on the YBOCS and the total score of the patient is obtained by adding the scores on all items. High scores indicate the severity of the OCD symptoms (Goodman et al. 1989a, b). Validity and reliability study of the Turkish language version was performed by Tek et al. (1995).

### The Hamilton Depression Rating Scale (HAM-D)

This is a 17-item scale completed by the clinician for assessing depressive symptoms. The total score ranges between 0 and 53. Higher scores indicate increased severity of depression (Hamilton 1967). Validity and reliability study on the Turkish language version was made by Akdemir et al. (1996).

### The Hamilton Anxiety Rating Scale (HAM-A)

This scale is completed by the clinician to assess the severity of the psychic and somatic symptoms anxiety. It consists of 14 items with scores between 0 and 4. The total score is obtained by adding the scores on all the items, the maximum available total score being 56. Higher scores indicate greater severity of anxiety (Hamilton 1959). Validity and reliability study of the Turkish language version was reported by Yazici et al. (1998).

### Procedure

Before the test for acquiring the data, all participants were informed about the procedure and a single practice test was run. Then, the eye tracking device was calibrated using 16 points on the screen and the calibration settings were

transferred to a second computer by means of a USB-flash memory. After fixing the head position of the subject with the eye tracking device, the computer plug of the device was pulled out and the device was plugged to the USB port of the second computer. In this way, the computer in front of the experimenter recorded the tracking data of the right eye while short SDJT was being performed.

While the the SDJT was conducted on a 21.5-inch LED monitor with 1600x900 resolution and refresh rate of 60 Hz., located 50 cm away from the participants of both groups, by using an e-prime software (E-prime Professional 2.0, Psychology Software Tools Inc., Pittsburgh, PA, USA) interfaced with the eye tracking device for the simultaneous recording of the eye movement coordinates. This way, the six intermittent episodes, each lasting for three seconds to display the cartoon figures on the screen, were marked on the eye tracking data and finally the data acquired over the 18-second period were analysed. The 18-second period had been divided into episodes of three seconds with the purpose of imposing a time limitation on the participants for making fast decisions. It was presumed that during this limited time the participants would intentionally pay attention to the areas that intersect with the rectangle in Figure 1 where the cartoon figures were closest to each other in order to compare the distance between the figures to that between the rectangular blocks. Thus, any visual fixations on the facial areas, which were located inside the borders of the rectangle impressed on the picture, would be unintentional. The number and duration of fixations on the face and the surrounding area of the cartoon figures were compared between the two groups.

### Analysis of Eye Tracking Data

For analysing the eye tracking data, the “dispersion centroid mode algorithm” was used as a fixation/saccade algorithm. Minimum fixation time was taken as 100 ms, and maximum dispersion was taken as the 0.2-degree visual angle (Falkmer et al. 2008). If the three second episodes ended while the eye was still fixated on the area of interest, the duration of this last fixation was accepted to end at the end of the episode.

### Statistical Analysis

Statistical analyses were made on the SPSS 16.0 software (SPSS Inc., Chicago, IL, USA). Because of the small number of participants in each group, non-parametric tests were used for comparisons. Comparison of groups regarding gender, which is a non-continuous variable, was made with the Fischer’s exact test, whereas other comparisons were made using the Mann Whitney U test. The number and duration of visual fixations on the area of interest were compared with the Mann Whitney U test. Correlation analyses were made with the Spearman’s correlation test.

## RESULTS

The OCD group of 10 individuals included six males and four females, whereas the control group of 11 individuals included seven males and four females. Distribution of sociodemographic properties across the groups is shown in Table 1. The groups did not show significant differences regarding gender, age, or educational level. In the OCD group, the median age of disease onset was 22.5 (18-33) years; disease duration was 14.5 (1-30) years and the number of hospital admissions was 0.5 (0-3). The mean scores of patients from the were: YBOCS- Obsession, 10 (3-16); YBOCS-Compulsion, 9 (6-13); HAM-D, 8.5 (3-16) and HAM-A 14 (7-19). Patients with OCD had less number and duration of visual fixations on the face area of cartoon figures compared to the controls (Table 2). In the OCD group, disease duration, age of onset, number of admissions and

**Table 2.** Number and Duration of Visual Fixations on the Area of Interest when Cartoons Appear

	OCD		Control		p
	Median (min-max)	Median (min-max)	Median (min-max)	Median (min-max)	
Number of fixations	9 (2-31)	32 (5-50)			0.029*
Duration of fixations	1.84 (0.41-8.80)	5.85 (1.10-13.11)			0.051**

\*U=24.00, Z=-2.187

\*\*U=27.00, Z=-1.972

**Table 1.** Sociodemographic Properties of the Groups

		OCD		Control		p
		n	%	n	%	
Gender	Female	4	40.0	4	36.4	1.000
	Male	6	60.0	7	63.6	
		Median (min-max)		Median (min-max)		
Age		40.50 (21-50)		23 (22-53)		0.173*
Education (year)		12 (5-18)		16 (5-16)		0.349**

\*U=35.00, Z=-1.419

\*\*U=41.00, Z=-1.049

scores from clinical assessment scales did not show correlation with the number or duration of visual fixations on the area of interest ( $p>0.05$  for all). One out of the 10 patients were not using medication. Two patients were on fluoxetine (20 and 60 mg); one patient used sertraline (100 mg); one patient used fluoxetine (60 mg) + clomipramine (75 mg); one patient used paroxetine (40 mg) + aripiprazole (15 mg); one patient used clomipramine (150 mg) + olanzapine (10 mg); one patient used paroxetine (40 mg) + aripiprazole (2.5 mg); one patient used clomipramine (75 mg) + aripiprazole (5 mg) and one patient used the triple combination of sertraline (100 mg) + clomipramine (75 mg) + risperidone (4 mg).

## DISCUSSION

The present study showed that OCD patients have impaired spontaneous attention to facial and gaze cueing. This supports the previous finding that OCD patients are less likely to pay attention to gaze directions of cartoon figures, which was reported in a study that employed the SDJT (Tumkaya et al. 2014). Our findings indicate that patients with OCD might have difficulty in their daily life perceiving rapidly changing social cues like direction of gaze and processing their behavior based on these cues. Impairment in automatic perception of rapidly changing social cues may cause difficulty of understanding the emotions and intentions of other people, thus leading to unsuccessful social relationships. The reason for not finding impairment in several studies related to theory of mind and emotion recognition in OCD patients may have stemmed from measurement of perception of social cues with conscious effort rather than spontaneous perception (Sayın et al. 2010, Parker et al. 2004). Therefore, it would be better to use in future studies on this field materials that are capable of measuring spontaneous perception of instantaneous social cues.

Impairment of spontaneous judgement of social cues is known to be present in autism spectrum disorders (Jellema et al. 2009, Senju et al. 2009). Also, it has been reported that autistic features are commonly observed in OCD patients (Wikramanayake et al. 2018). These reported results raise the possibility that impaired social functioning observed in OCD patients may share common mechanistic aspects with autism spectrum disorder. An alternative explanation to our findings may be that an isolated group among OCD patients with autistic features may have impaired spontaneous attention to gaze cueing. Ardizzone et al. (2010) claimed that there is such a subgroup of OCD patients showing autistic features who are refractory to treatment and have less insight. Impaired spontaneous attention to social cues might be an indicator of this asserted subgroup. In order to investigate this possibility, it would be appropriate for studies testing spontaneous

judgement of social cues in OCD to also utilize materials that measure autistic features as well.

Several studies have reported that the balance between spontaneous/implicit cognitive system and the explicit cognitive system in OCD has shifted towards the explicit cognitive system (Goldman et al. 2008, Kathmann et al. 2005, Deckersbach et al. 2002). According to this view, the explicit cognitive system predominates in OCD while the implicit cognitive system weakens. Based on this view, our finding of impaired spontaneous attention to gaze cueing may be a manifestation of a generally impaired implicit cognitive system in OCD, probably in association with the predominance of the explicit cognitive system. Future studies are needed to elaborate on these subjects.

The major limitation of the present study is the low number of the participants. Not having investigated the patients for the diagnosis and symptoms of autism spectrum disorders was also a limitation of this study. Another limitation is the usage by nearly all patients included in the present study of various types of medications which may have effects on attention. Therefore, it is important that our results are confirmed in larger patient groups who are not on drug therapy and whose autistic features are assessed. In addition, this study did not employ any material to measure the general social functioning of the participants. Utilizing such materials in research in this field may contribute to a better understanding of the effects of spontaneous attention to social cues on overall social functioning. Despite these limitations, the present study is significant on grounds of being the first study to measure spontaneous attention to social cues in OCD. Our results revealed impaired spontaneous attention to gaze cueing in patients with OCD.

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