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Navigating Time Through Space: The Role of Spatial Frames of Reference in Spatial and Temporal Perception in Virtual Reality[*]

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Abstract

This study investigated the intricate relationship between spatial frames of reference (egocentric, or self-centered, versus allocentric, or environment-centered) and content eventfulness on subjective time perception within virtual reality (VR) environments. Additionally, it examined how prior VR experience might influence the sense of spatial presence. Seventy-nine participants were recruited to view four 360° VR videos, each systematically manipulated for spatial frame of reference (first-person egocentric vs. third-person allocentric) and content eventfulness (dynamic/narrative vs. neutral/ambient scenes) in a 2x2 within-subjects design. Participants then ranked these videos by perceived duration and completed a modified spatial presence questionnaire. The findings indicated that participants reported a strong sense of spatial presence, particularly for object/people presence and sound localization, confirming the immersive setup's effectiveness. However, tactile engagement received lower ratings. Crucially, prior VR experience did not significantly affect participants' perceived spatial presence. Regarding time perception, allocentric videos, especially those with eventful content, were more frequently perceived as longer in duration. Conversely, egocentric videos, particularly the uneventful ones, were consistently perceived as shorter, with the egocentric-uneventful condition demonstrating a statistically significant compression of perceived duration. This suggests that egocentric framing might compress subjective time, possibly by enhancing embodiment. The study also clarified that the presentation order of the videos did not significantly influence temporal judgments. This research highlights the complex interaction between spatial framing and content in shaping time perception in immersive environments, reinforcing the idea that space and time are deeply interdependent in human cognition.

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[*] This article was produced from the first author's master's thesis.

INTRODUCTION

Our subjective experience of the world is embedded within the fundamental dimensions of space and time, which have long been the subject of research. While historically treated as distinct domains in psychological research, recent interdisciplinary findings suggest a deep interdependence between spatial and temporal processing. It is known that space and time are interrelated and when making inferences on time durations, one cannot ignore spatial cues in the environment (Robinson et al., 2019). In cognitive neuroscience, both spatial reference frames and temporal judgments have been shown to rely on overlapping neural substrates, notably within the frontoparietal attentional network (Coull et. al., 2000). Psychological research has established that emotional and motivational states impact spatial and temporal perception. Yet, the cognitive and perceptual mechanisms by which spatial context—particularly the frame of reference—modulates temporal perception remain underexplored. The role of egocentric (self-centered) versus allocentric (environment-centered) spatial coding has been well-characterized in domains such as navigation, action planning, and memory. However, how these reference frames influence subjectivetime duration is far less established. At the same time, the event structure or content density of an experience, whether it is filled with dynamic (eventful) or uneventful stimulus has been shown to affect perceived duration. For example, Stojić, Topić, & Nádasdy (2023) found that children and adults diverge in their time estimates depending on the eventfulness of visual scenes, underscoring the developmental plasticity and cognitive complexity of time perception. Building on these observations, emerging studies suggest that spatial and temporal representations are not only correlated but may share representational resources. Clinical evidence from patients with spatial neglect shows impaired representation of past events on the mental timeline (Saj et al., 2013), suggesting that the ability to perceive and mentally represent time may depend on intact spatial processing systems. Additionally, theoretical frameworks such as psychological spacetime (Conway et al., 2016) posit that human cognition may operate within a subjective analog to physical spacetime—modulated by attention, embodiment, and contextual anchors.

Given the growing availability of immersive virtual reality (VR), researchers now can precisely manipulate spatial frames and environmental features while maintaining ecological validity. VR offers an interesting opportunity to investigate how changes in spatial viewing perspective (egocentric vs. allocentric) and content eventfulness modulate temporal judgments, spatial presence, and cognitive integration. This study synthesizes current knowledge on the interaction between spatial reference frames and time perception, emphasizing the relevance of virtual reality as a methodological tool. We critically examine evidence from cognitive psychology, neuroscience, and VR-based studies to:

- Clarify how egocentric and allocentric frames modulate perceived durations,
- Explore the influence of eventfulness and environmental richness on time estimation,
- Highlight gaps in the literature regarding neural mechanisms and multi-modal integration, and
- Propose future research directions leveraging immersive technologies to advance our understanding of subjective time.

Hypotheses

Building on prior work showing that eventfulness and spatial context influence duration judgments (e.g., Stojić et al., 2023), we predicted that spatial reference frame and content eventfulness would interact to shape perceived duration in immersive VR. Specifically:

- Allocentric–uneventful will be perceived as longest: Allocentric viewing encourages broad environmental scanning and self-location relative to surroundings (Gorisse et al., 2017) which in the absence of dense events, may heighten awareness of elapsed time.

- Egocentric–eventful will be perceived as shortest: Egocentric viewing combined with high eventfulness may increase embodiment and attentional engagement, narrow temporal awareness and compressing perceived duration.
- Spatial frame and eventfulness effects will be independent of presentation order, as prior studies have found minimal sequence-related biases in adult samples.
- Prior VR experience will not significantly affect presence ratings, given that immersive environments can produce strong spatial presence even in novice users (Slater & Wilbur, 1997).

SPATIAL FRAMES AND TEMPORAL PERCEPTION: A LITERATURE OVERVIEW

VISUAL AND SPATIAL PERCEPTION

Human visual perception involves an efficient yet selective interpretation of overwhelming sensory input. Our ability to detect, locate, and categorize objects in space supports essential functions such as recognition, interaction, and navigation (Carrasco, 2018; Wade & Swanston, 2013). The visual system must resolve these tasks while operating under significant metabolic constraints, which has led to an evolutionarily tuned system that prioritizes goal-relevant information and filters out non-essential details (Bruce, et al., 2003).

Beyond basic object perception, humans rely on visual-spatial perception—the capacity to process the location and configuration of objects in relation to oneself and other landmarks. This ability is supported by spatial memory, which allows individuals to store and retrieve information about their environment to guide future actions (Iachini et al., 2023). Together, these mechanisms enable complex behaviors such as tool use, locomotion, and interaction with dynamic surroundings.

One of the earliest conceptualizations of internal spatial representation comes from Tolman's notion of the cognitive map (Colombo et al., 2017), which has since been supported with the discovery of place cells in the hippocampus (O'Keefe & Dostrovsky, 1971). These findings underscore the view that spatial knowledge is encoded in internalized, coordinate-based systems—critical for both navigation and episodic memory.

EGOCENTRIC AND ALLOCENTRIC FRAMES OF REFERENCE

Spatial cognition relies on reference frames—coordinate systems that determine how location and movement are encoded. The two dominant systems are egocentric (self-centered) and allocentric (world-centered) frames of reference (Iachini et al., 2023). Egocentric representations encode spatial locations relative to the observer's body (e.g., "the tea cup is to my left") and are continuously updated during movement. These are essential for motor actions like reaching or avoiding obstacles in the direction of objects (Committeri et al., 2004). Allocentric representations code object locations independently of the observer, in relation to other objects or environmental landmarks (e.g., "the tea cup is behind the laptop") (Galati et al., 2000; Zheng et al., 2021). Moreover, the studies showed that egocentric frame of reference is not only limited to the head and overall body position but also associated with haptic perception as the hand and the arm. Importantly, the two systems are not mutually exclusive; they often operate in parallel and interact dynamically depending on task demands (Volcic & Kappers, 2008). There is growing interest in whether they are neurally distinct and how they influence not just spatial processing but also temporal perception.

NEURAL BASIS OF SPATIAL FRAMES

Neurophysiological evidence supports a dissociation between the dorsal and ventral visual streams, corresponding roughly to egocentric and allocentric processing, respectively (Milner & Goodale, 1992; Ruotolo et al., 2019). The dorsal stream, extending from the occipital to parietal cortex, facilitates sensorimotor transformations and egocentric representations. The ventral stream, projecting to the inferior temporal lobe, supports object recognition and allocentric coding.

Studies of lesion patients reinforce this division. For example:

- Patients with optic ataxia (dorsal damage) can recognize objects but have difficulty interacting with them.
- Patients with visual agnosia (ventral damage) show the opposite profile, preserving motor action but losing perceptual access to object identity Whitwell, Milner, & Goodale, 2014).

Functional imaging further demonstrates that egocentric spatial judgments recruit dorsal-frontal networks, while allocentric judgments engage ventral-frontal and medial temporal areas, including the hippocampus (Committeri et al., 2004; Zaehle et al., 2007).

TIME PERCEPTION AND ITS INTERACTION WITH SPACE

The perception of time is a fundamental component of cognition, influencing language, action, emotion, and memory. However, time perception is not purely abstract—it is shaped by sensory, spatial, and affective inputs (Wittmann, 2009; Burr & Morrone, 2006).

Neuroscientific models such as Scalar Expectancy Theory (SET) propose an internal timing system with a pacemaker–accumulator mechanism, modulated by attention and memory load (Di Lernia et al., 2018). Increased attentional engagement is thought to increase pulse accumulation, leading to overestimation of time intervals. Crucially, space and time are not processed in isolation. Numerous studies suggest that spatial context can modulate perceived duration (Bratzke et al., 2023; Whitaker et al., 2022). For example, scenes rich in movement or complexity are often perceived as longer and shifts in spatial perspective can alter subjective time estimates. This link may stem from overlapping neural mechanisms for spatial and temporal attention, particularly within frontoparietal and hippocampal circuits (Coull & Nobre, 1998). Clinical data further underscore this link: patients with spatial neglect often show temporal neglect, failing to represent past events on the "left side" of the mental timeline (Saj et al., 2013). These findings raise the possibility that spatial representations scaffold our experience of time. Despite growing evidence, many questions remain about the precise nature of the space–time interaction—particularly how spatial frames of reference influence temporal judgment. Virtual reality (VR) offers a promising experimental tool to disentangle these variables in controlled yet immersive settings; a topic explored in the next section.

TIME PERCEPTION AND ITS INTERACTION WITH SPACE

The perception of time is a fundamental component of cognition, influencing processes such as language, motor coordination, memory, and decision-making. However, time perception is not purely abstract—it is dynamically modulated by sensory input, emotional salience, and spatial context (Burr & Morrone, 2006; Wittmann, 2009).

Prominent models such as Scalar Expectancy Theory (SET) suggest the existence of an internal pacemaker–accumulator mechanism, wherein subjective time is estimated by counting accumulated pulses over an interval. This internal clock is sensitive to attentional resources and memory load: greater attentional focus increases pulse accumulation and leads to longer duration judgments (Di Lernia et al., 2018). Importantly, temporal perception does not operate in isolation from spatial cognition. A growing body of research highlights that spatial cues—such as motion, viewpoint, and environmental layout—can systematically distort time judgments (Bratzke et al., 2023; Whitaker et al., 2022). For example, complex or dynamic scenes are often judged as lasting longer than simpler, static ones. These perceptual distortions may result from shared mechanisms underlying spatial and temporal attention, particularly in frontoparietal and hippocampal circuits (Coull & Nobre, 1998).

Clinical studies further support this connection. Patients with left spatial neglect not only misrepresent visual space but also neglect the "left side" of time, underestimating events located on that part of their mental timeline (Saj et al., 2013). Such findings imply that spatial representations scaffold temporal cognition, and that disruptions in one domain may impair the other. Despite these

insights, the precise nature of how spatial frames of reference (egocentric vs. allocentric) influence subjective time remains underexplored. Addressing this gap is particularly feasible through the use of virtual reality (VR) technologies, which allow precise manipulation of spatial perspective in immersive, ecologically valid environments.

METHODS

PARTICIPANTS

Seventy-nine participants (56 females, 23 males), aged 18 to 35 years (M = 22.91, SD = 3.66), were recruited for the study. Most participants had at least a bachelor's degree (57%), followed by master's degree holders (18%) and high school graduates (8.8%). The sample was recruited through university networks (primarily Eötvös Loránd University) and social media platforms (e.g., WhatsApp and Facebook student groups). Inclusion criteria required participants to be over 18, fluent in English, and free of any known neurological or psychiatric disorders. Ethical approval was granted prior to data collection by the ELTE Ethical Research Committee (approval number 2023/315). Participation was voluntary, and no financial compensation was provided; refreshments were offered post-session. Informed consent was obtained in accordance with institutional guidelines.

APPARATUS AND STIMULI

VIRTUAL REALITY SETUP

Stimuli were presented via Oculus Quest 2 head-mounted display and hand controllers, allowing full 360-degree immersive video playback. The headset and controllers were sanitized between uses. Volume levels were fixed at 70% for all videos.

STIMULI AND EXPERIMENTAL CONDITIONS

Four VR videos (sourced from publicly available YouTube 360° content) were selected in consultation with the research supervisor to manipulate two independent variables:

- *Spatial Frame of Reference*: Egocentric (1st-person perspective) vs. Allocentric (3rd-person perspective),
- *Content Eventfulness:* Eventful (dynamic narrative) vs. Uneventful (neutral or ambient scenes).

Table 1. *2 × 2 Within-subjects Design.*

Condition	Allocentric (3rd person)	Egocentric (1st person)
Eventful	Jailbreak (JA)	Jailbreak (JE)
Uneventful	Maldives (MA)	Liminal Spaces (LE)

The order of four videos was randomized and was shown for equal durations (1-minute-long), a fact that is unbeknown to the participants. The scenes are neutral with respect to any ethical, religious, or political views. The videos did not feature any sensitive media such as children, disease, or other stimuli that might trigger anxiety or phobia.

PROCEDURE

Each experimental session lasted approximately 25–30 minutes. Upon arrival, participants were welcomed, informed about the study, and asked to provide written or electronic informed consent. Following consent, participants were fitted with the VR headset and given brief familiarization time with the device and the testing environment. The study took place in a soundproof laboratory room, with a 2×2 meter clear space designated for safe movement. Participants remained standing during the video presentations and were encouraged to freely rotate, walk within the boundary, and make natural head and body turns to explore the 360-degree environments.

Participants viewed four 360° VR videos, each corresponding to a unique condition (Eventful–Allocentric, Eventful–Egocentric, Uneventful–Allocentric, Uneventful–Egocentric). The order of video presentation was randomized across subjects. All videos were matched in duration, but participants were not informed of this to minimize bias in duration estimation. To ensure fidelity, each video was mirrored onto a computer screen during playback, allowing the experimenter to monitor participant engagement and confirm exposure to all conditions. After each video, participants were asked to provide an overall spatial presence rating (Lombard et al., 2009) capturing their sense of immersion and interaction with the virtual environment. Upon completion of all four videos, participants were given sorting cards to rank the videos in descending order of perceived duration, from longest to shortest. Finally, participants completed a modified version of the Spatial Presence Questionnaire, adapted from the Temple Presence Inventory (Lombard et al., 2009) to assess perceived immersion across conditions.

TASK

SPATIAL PRESENCE ASSESSMENT

To assess participants' subjective sense of immersion and spatial presence in each VR condition, a modified version of the Temple Presence Inventory (Lombard et al., 2009) was administered. Spatial presence is critical for understanding perceptual distortions in immersive technologies and their implications for judgment, memory, decision-making, and behavior in virtual environments. The modified scale comprised six items, each targeting different aspects of spatial presence such as embodiment, sensory realism, and physical engagement with the environment. Items were rated on a *7-point Likert scale*, with anchors varying between frequency-based (1 = *never*, 7 = *always*) and intensity-based (1 = *not at all*, 7 = *very much*) depending on item wording.

The items were:

1. Object and People Presence: *"How much did it seem as if the objects and people you saw/heard had come to the place you were?"*
2. Object Presence (Avoidance Behavior): *"How often when an object seemed to be headed toward you did you want to move to get out of its way?"*
3. Overall Spatial Presence: *"To what extent did you experience a sense of 'being there' inside the environment you saw/heard?"*
4. Sound Localization: *"To what extent did it seem that sounds came from specific, different locations?"*
5. Touch Presence: *"How often did you want to or try to touch something you saw/heard?"*
6. Perceptual Framing (Movie vs. Window): *"Did the experience seem more like looking at the events/people on a movie screen or more like looking at the events/people through a window?"*
   (Higher scores indicated a more immersive, "window-like" experience.)

Participants completed this questionnaire after the entire session to reflect on their global experience across all four VR conditions.

DATA ANALYSIS

The data collected were analyzed using IBM SPSS Statistics. To explore participants' temporal judgments, frequency counts were used to assess the distribution of rankings for the perceived duration of each video (longest to shortest). To examine potential relationships between categorical variables, Chi-Square (X^2) tests of independence were conducted to determine whether there was a statistically significant association between content type (eventful vs. uneventful) and spatial frame of reference (egocentric vs. allocentric) in perceived duration judgments. In addition, Spearman's rank-order correlation was used to assess whether the order in which the videos were presented was associated with participants' ranked duration estimates, addressing possible order effects. Finally, a

Mann–Whitney U test was performed to compare spatial presence scores between participants with prior virtual reality (VR) experience and those without, as presence scores were not assumed to be normally distributed.

RESULTS

Mean ratings (± standard error) on a 7-point Likert scale for each spatial presence questionnaire item (N = 79). Items included perceptions of object/people presence (Item 1), avoidance reaction (Item 2), overall spatial presence (Item 3), sound localization (Item 4), desire to touch (Item 5), and perceived realism (Item 6).

Figure 1. *Mean Spatial Presence Ratings Across Questionnaire Items*
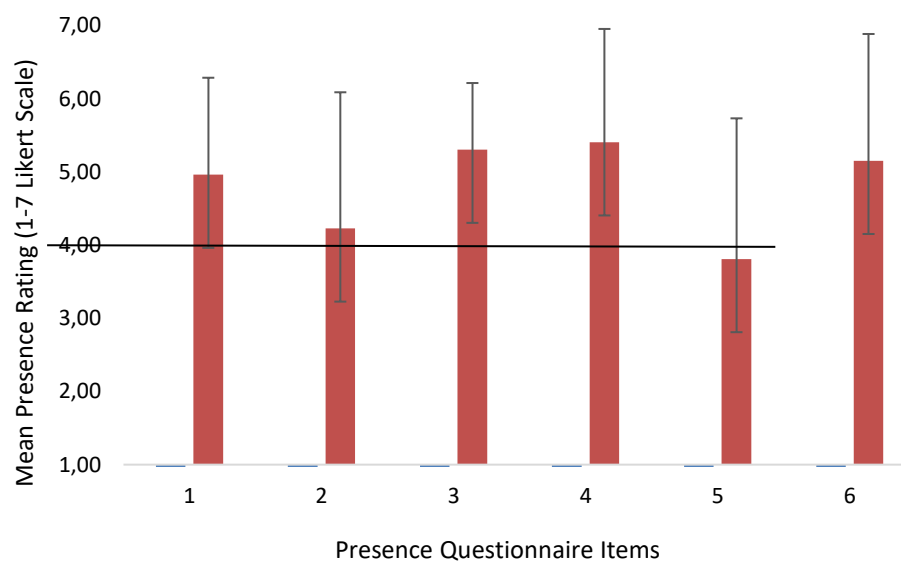
As shown in Figure 1, participants generally reported moderate to high levels of presence across most items, with several scores exceeding the median of 4.0 on the 7-point Likert scale. The horizontal line at 4.0 was added to facilitate interpretation of participant responses relative to the scale midpoint. Item 1 (Object and People Presence) received a mean score of M = 4.96 (SD = 1.32), with a median of 5.00, suggesting that participants perceived a relatively strong sense of co-presence with virtual people and objects. In contrast, Item 2 (Avoidance Reaction)—assessing participants' instinct to move away from approaching virtual objects—had a lower mean of M = 4.23 (SD = 1.86), with a median of 4.00, indicating a more moderate response.

Item 3 (Overall Spatial Presence) received one of the highest scores, M = 5.30 (SD = 0.91), with a median of 5.00, highlighting a strong subjective experience of "being there" within the VR environment. Notably, Item 4 (Sound Localization) had the highest mean rating of M = 5.41 (SD = 1.55), and a median of 6.00, suggesting that spatialized audio played a significant role in enhancing the immersive experience. Conversely, Item 5 (Desire to Touch) yielded the lowest mean rating, M = 3.81 (SD = 1.92), with a median of 4.00, indicating that participants felt relatively less inclined to physically interact with virtual objects. Finally, Item 6 (Window vs. Movie)—measuring perceived realism—was rated at M = 5.15 (SD = 1.73), with a median of 6.00, suggesting that participants experienced the VR content more as a "window into a real world" rather than simply watching a screen-based video.

Taken together, these findings demonstrate that participants reported a strong sense of spatial presence, particularly in terms of sound localization and overall presence. However, the lower tactile engagement (Item 5) indicates that virtual touch remains a limitation in immersive experiences like these.

Figure 2. *Frequencies of Each Video Across Four Perceived Duration Ranks from Longest (1st) to Shortest (4th).*

	1st (Longest)	2nd	3rd	4th (Shortest)
JA	26	18	14	21
MA	20	25	20	14
JE	17	22	25	15
LE	16	14	20	29

Perceived Duration Rank
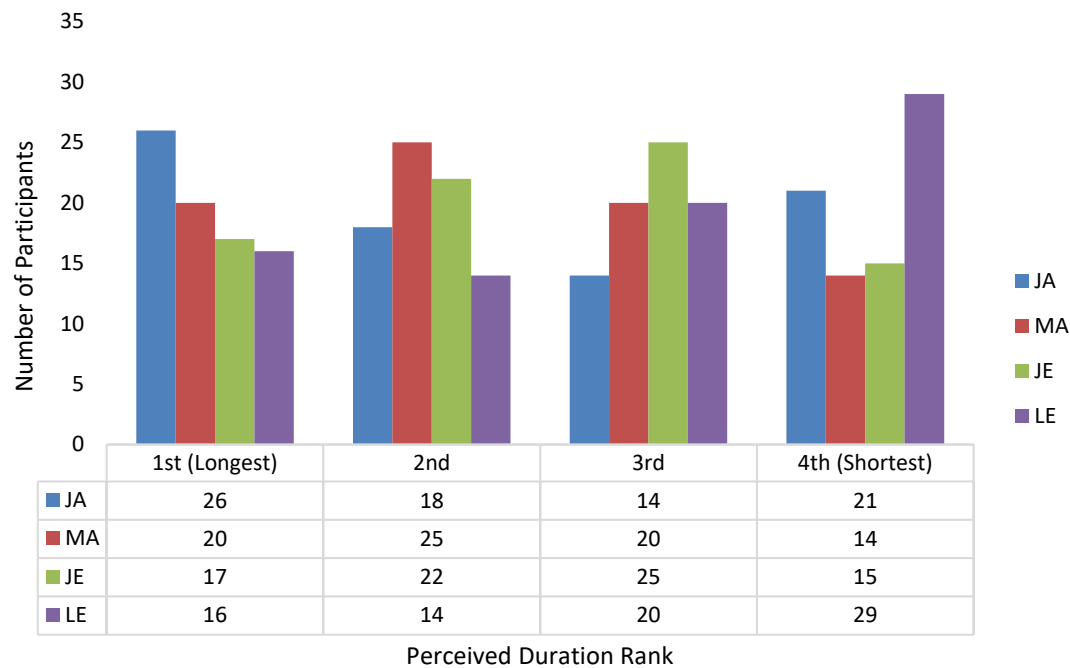
Figure 2 displays how frequently each of the four videos (JA, MA, JE, LE) was assigned to each perceived duration rank by participants (N = 79). As illustrated in the Figure 2, the video "JA" was most frequently ranked as the longest (1st position), while fewer participants placed it in the 2nd, 3rd, or 4th positions. The video "MA" showed a peak in the 2nd position, suggesting it was generally perceived as moderately long. The video "JE" was most commonly placed third, indicating a relatively balanced duration perception. In contrast, the video "LE" was most often ranked as the shortest (4th position), with the highest number of participants assigning it to this category. These patterns suggest that both content and spatial frame of reference may have influenced participants' subjective duration estimates.

Figure 3. *Number of Participants Selecting Each Content × Spatial Frame Condition as the Longest Perceived Video.*
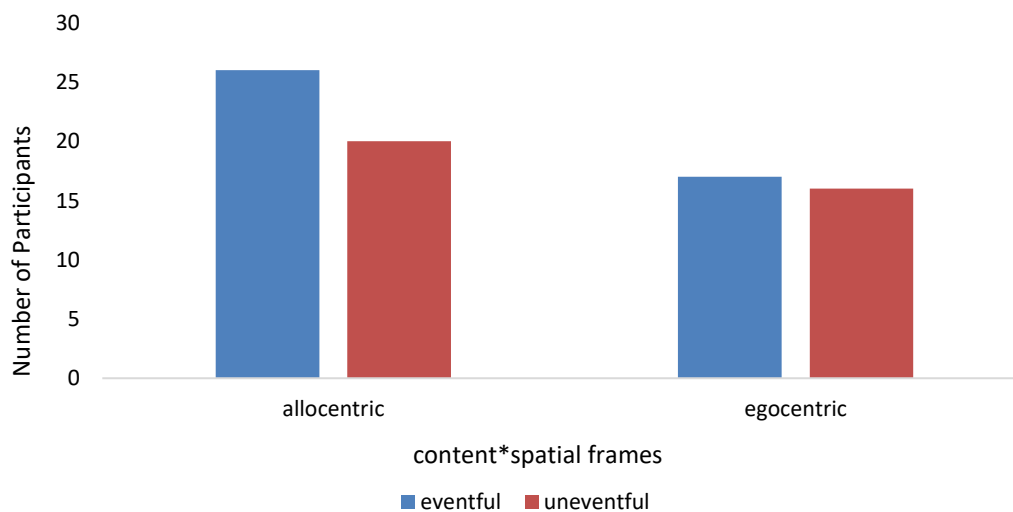
Figure 3 illustrates the number of participants who perceived videos as the longest based on their content (eventful vs. uneventful) and spatial reference frame (allocentric vs. egocentric). The distribution of participants' choices for the longest perceived video (N = 79) revealed that "JA" was selected most frequently, by 26 participants (32.9%), followed by "MA" with 20 participants (25.3%), "JE" with 17 participants (21.5%), and "LE" with 16 participants (20.3%). These values account for 100% of valid responses, excluding missing data, which comprised 16% of the total sample. A Chi-Square test of independence was conducted to examine the relationship between video content (eventful vs. uneventful) and spatial frame of reference (allocentric vs. egocentric) in relation to participants' rankings of the longest perceived video (N = 79). The results revealed no statistically significant association between content × spatial frame and participants' longest-duration judgments, χ^2(1, N = 79) = 0.194, p = .659.

Figure 4. *Frequencies for Each Content × Spatial Frame Condition Selected as the Second Longest Video.*
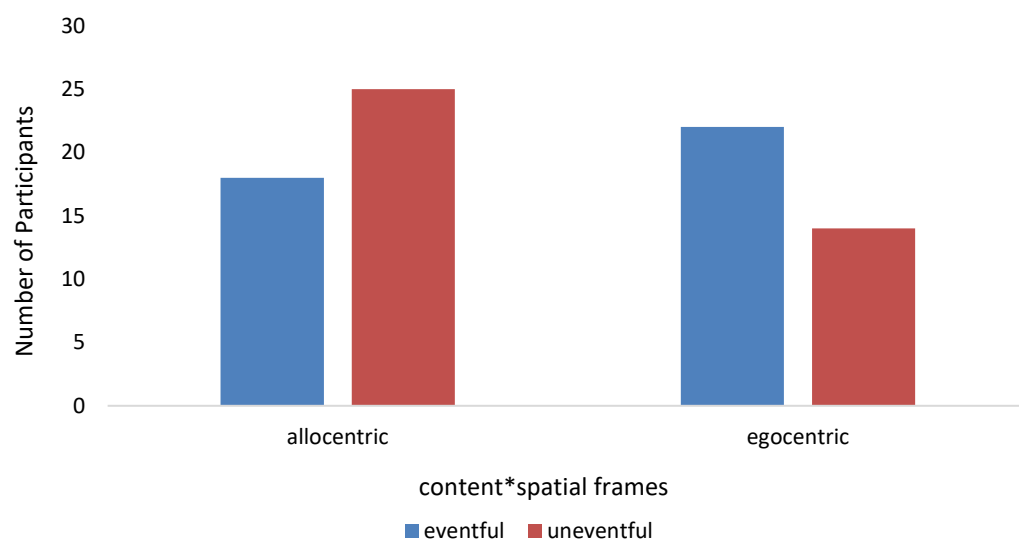
Figure 4 displays the number of participants who selected each content and spatial frame combination as the second longest in perceived video duration. Figure 4 illustrates a consistent trend in which allocentric videos were more frequently perceived as longer than egocentric ones, although the margin was narrower compared to first-order rankings. This suggests that allocentric spatial frames may generally contribute to an extended perception of time. In contrast, the influence of eventfulness in the content appeared less pronounced in second-order rankings. This may indicate that spatial framing exerts a more consistent effect on duration perception than content alone.

Descriptive analysis of participants' second-longest video choices (N = 79) revealed that "MA" was the most frequently selected, with 25 participants (31.6%), followed by "JE" with 22 participants (27.8%), "JA" with 18 participants (22.8%), and "LE" with 14 participants (17.7%). To explore the relationship between video content (eventful vs. uneventful) and spatial frame of reference (allocentric vs. egocentric) in participants' second-longest video selections, a Chi-Square test of independence was conducted (N = 79). The result indicated that there was no statistically significant association, χ^2(1, N = 79) = 2.91, *p* = .088.

Although the result approached significance, it does not meet the conventional threshold of *p* < .05, suggesting only a marginal trend that may warrant further investigation with a larger sample.

Figure 5. *Frequencies for Each Content × Spatial Frame Condition Selected as the Third Longest Video.*
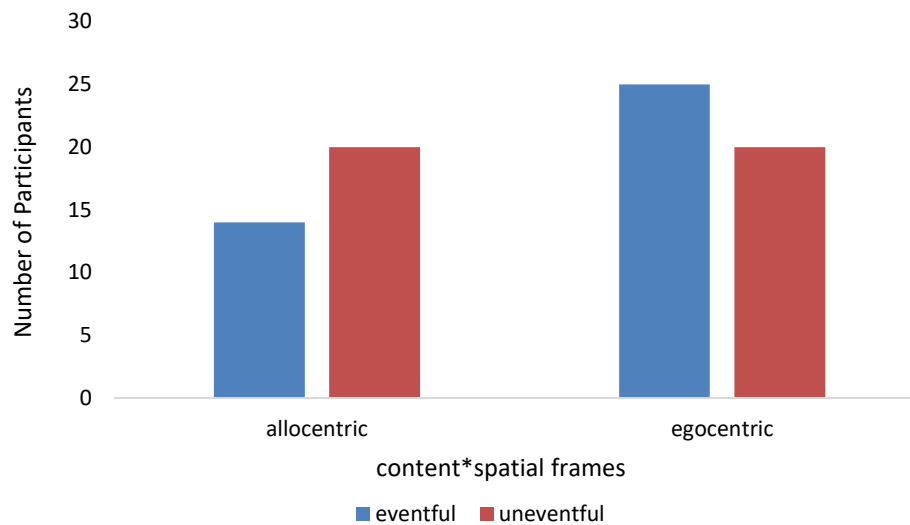
Figure 5 presents the frequency distribution of participants who perceived each video condition as the third longest in duration. The figure reveals a shift in perceived duration, with egocentric videos being more frequently associated with shorter durations compared to allocentric ones. In both eventful and uneventful conditions, participants tended to rank egocentric representations as shorter, with the egocentric–eventful condition receiving the highest frequency in the third-order ranking. This contrasts with earlier patterns, where allocentric frames were more dominant, suggesting a diminishing influence of allocentric perspectives on extended time perception in later rankings. Descriptive analysis of third-order rankings (N = 79) showed that "JE" was selected most often (n = 24, 30.4%), followed by "LE" (n = 21, 26.6%), "MA" (n = 20, 25.3%), and "JA" with the fewest selections (n = 14, 17.7%). To examine whether video content (eventful vs. uneventful) and spatial frame of reference (allocentric vs. egocentric) influenced participants' third-order video rankings, a Chi-Square test of independence was conducted (N = 79). The results showed no statistically significant association between content × spatial frame and third-order duration judgments, χ^2(1, N = 79) = 1.60, *p* = .206.

Figure 6. *Distribution of Responses for Each Content × Spatial Frame Condition when Identifying the Shortest Video Perceived.*
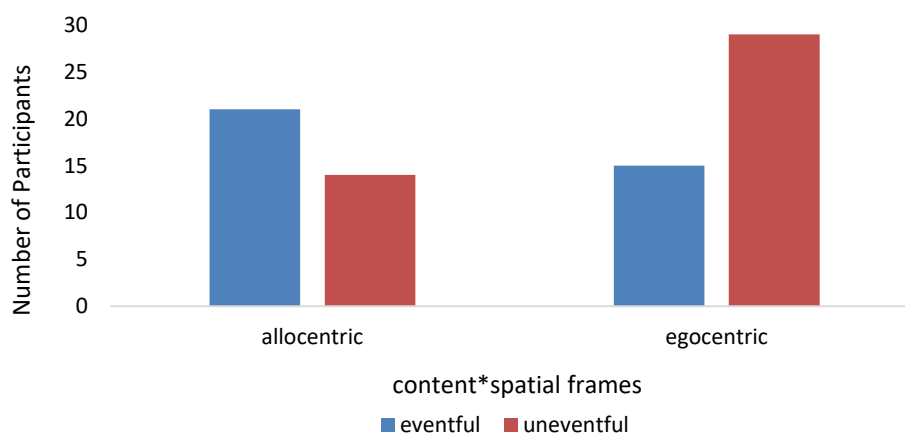
Figure 6 shows that the egocentric-uneventful condition was most frequently identified as the shortest in perceived duration. The figure illustrates a clear shift, with egocentric videos, particularly

the egocentric–uneventful condition (LE), most frequently perceived as the shortest in duration. This pattern reflects a notable decline in the frequency of allocentric videos (both eventful and uneventful) from first to last rank, reinforcing the idea that egocentric perspectives may compress subjective time perception. Interestingly, LE, which had previously received fewer selections as the longest video, emerged as the most frequently selected as the shortest.

Descriptive analysis of the shortest video choices (N = 79) showed that LE was rated as the shortest by 29 participants (36.7%), followed by JA (n = 21, 26.5%), JE (n = 15, 18.9%), and MA (n = 14, 17.7%). This ranking pattern suggests a consistent perceptual bias toward shorter durations in egocentric–uneventful conditions, highlighting the impact of both spatial perspective and content sparsity. A Chi-Square test of independence was conducted to examine the relationship between video content (eventful vs. uneventful) and spatial frame of reference (allocentric vs. egocentric) in participants' selection of the shortest perceived video (N = 79). The result revealed a statistically significant association between content × spatial frame and shortest video perception, χ^2(1, N = 79) = 5.28, p = .022. This finding suggests that the combination of content type and spatial reference frame had a meaningful impact on participants' judgments of which video felt shortest in duration.

Figure 7. *Distribution of Participants' Combined Video Ranking Orders*
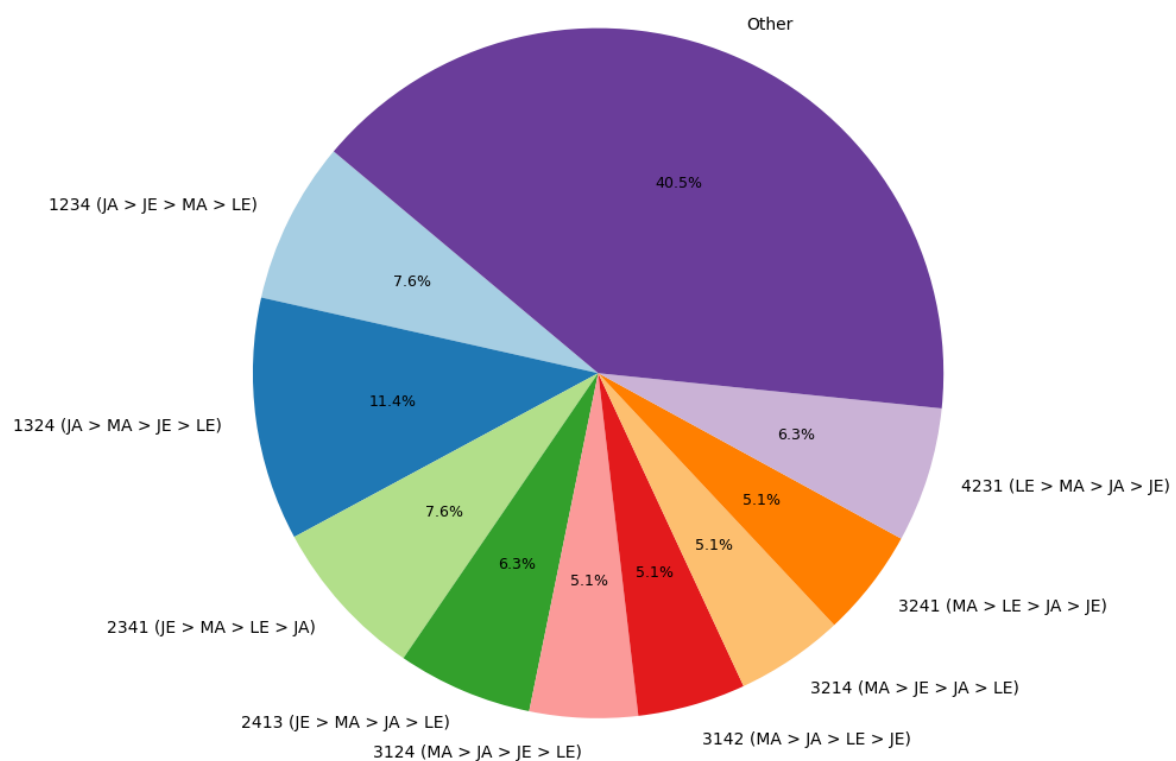
Figure 7 displays the percentage of participants who selected each unique ranking combination of the four videos. Only combinations endorsed by ≥5% of participants are individually labeled; the rest are grouped as "Other." The analysis revealed that the order "1324" (JA > MA > JE > LE) was the most frequently selected, representing 11.39% of participant responses. This was followed by "1234" (JA > JE > MA > LE) and "2341" (JE > MA > LE > JA), each chosen by 7.59% of participants. These orders suggest that participants tended to perceive the eventful-allocentric videos (e.g., JA) as longest and egocentric-uneventful videos (e.g., LE) as shortest.

Conversely, some ranking patterns such as "4213", "4123", and "3412" occurred in less than 2% of the sample and were grouped into the "Other" category, indicating these sequences were less preferred or more idiosyncratic. Overall, the combined ranking data supports the general trend that spatial framing—particularly allocentric perspectives—may contribute to the perception of extended duration, though individual differences in judgment remain evident.

RELATIONSHIP BETWEEN PRESENTATION ORDER AND PERCEIVED DURATION

To examine whether the presentation order of each video influenced how participants perceived their duration, Spearman's rank-order correlations were computed between the shown order and perceived rank order for each video (JA, MA, JE, and LE). Results are presented in Table 2.

Table 2. *Spearman's Rank-Order Correlations between Video Presentation Order and Perceived Rank*

Video	ρ (rho)	N	p-value
JA	0.124	79	.275
JE	0.043	79	.706
MA	0.114	79	.316
LE	0.144	79	.206

Table 2 presents the correlation coefficients (ρ), sample sizes (N), and associated p-values for each video. All correlations were weak and statistically non-significant, suggesting that the order in which a video was shown did not systematically affect participants' time judgments. These findings indicate that presentation sequence alone did not significantly influence participants' duration judgments, supporting the interpretation that other factors (e.g., content and spatial framing) may have played a more substantial role.

SPATIAL PRESENCE RATINGS AND PRIOR VR EXPERIENCE

To determine whether previous experience with virtual reality (VR) influenced participants' sense of spatial presence during the video viewing, a series of Mann–Whitney U tests were conducted comparing presence scores for each video between participants with and without prior VR experience. Presence ratings were derived from a modified version of the Temple Presence Inventory. Table 3 displays the test statistics (U and Z values) and associated p-values comparing presence scores between participants with and without prior VR experience for each video. Results in Table 3 indicated no statistically significant differences in perceived spatial presence between the two groups for any of the four videos.

Table 3. *The Effect of Previous Experiences with Virtual Reality (vr) on participants' Spatial Presence Perception while Watching Videos*

Video	U	Z	p (2-tailed)
JA	167	−0.063	.95
JE	152	−0.524	.60
MA	163.5	−0.170	.865
LE	125	−1.366	.172

These findings suggest that prior exposure to VR technology did not significantly influence participants' subjective feelings of spatial presence within the experimental virtual environments. This reinforces the robustness of the stimuli design in eliciting spatial immersion regardless of individual differences in VR familiarity.

DISCUSSION

This study investigated how spatial framing (egocentric vs. allocentric) and content type (eventful vs. uneventful) within virtual reality (VR) environments influence subjective duration judgments and the sense of spatial presence. Additionally, we evaluated how prior VR experience may modulate the perceived immersion using a modified version of the Temple Presence Inventory.

SPATIAL PRESENCE IN VR

Participants reported strong spatial presence across VR conditions, particularly in terms of object and people presence as well as auditory localization, confirming the effectiveness of the immersive setup. However, tactile presence received lower ratings, suggesting a sensory gap in current VR implementations. This finding is consistent with previous literature highlighting the importance of multi-sensory integration in generating presence (Slater & Wilbur, 1997). The lack of tactile stimuli likely limits full embodiment and highlights an important area for future development in VR technology. Enhanced haptic feedback may improve overall presence and affect temporal perception more robustly.

PERCEIVED DURATION AND SPATIAL FRAMING

Although the majority of statistical comparisons between conditions were non-significant, meaningful trends emerged. Videos framed allocentrically particularly those with eventful content were more likely to be perceived as longer, especially in first and second ranking orders. This aligns with prior findings suggesting that motion-rich and spatially complex scenes are associated with time dilation effects (Gorisse et al., 2017; Verde et al., 2019).

Interestingly, egocentric videos, especially those depicting uneventful content, were consistently perceived as shorter, and the egocentric–uneventful condition was the only one to produce a statistically significant result in terms of being selected as the shortest. This may be due to egocentric framing inducing a stronger sense of embodiment and immersion, thus diminishing awareness of time passage (Gorisse et al., 2017). Moreover, the perceived time difference diminished in later ranking orders (3rd and 4th), suggesting that the influence of spatial frame and content may attenuate with repeated exposure or cognitive fatigue, or that participants relied less on spatial cues and more on heuristic impressions as the task progressed.

INTERACTION OF PRESENTATION ORDER AND DURATION JUDGMENTS

A series of Spearman's rank-order correlations examined whether the order in which videos were presented influenced participants' perceived duration rankings. Across all four videos (JA, JE, MA, LE), correlations were weak and statistically non-significant. These results suggest that presentation order did not meaningfully affect temporal judgments, reinforcing the interpretation that content and spatial characteristics were more influential than sequence effects.

SPATIAL PRESENCE AND PRIOR VR EXPERIENCE

Contrary to expectations, a Mann–Whitney U test revealed no significant differences in spatial presence scores between participants with and without prior VR experience. Presence ratings remained comparably high across both groups, indicating that the immersive experience was effective regardless of participants' previous exposure to VR. This finding has practical implications: well-designed VR environments can elicit strong subjective presence even in novice users, supporting the use of VR for research and applications in populations without prior VR familiarity.

CONCLUSIONS AND FUTURE DIRECTIONS

This study contributes to our understanding of how spatial frames and content interact to shape time perception and spatial presence in VR. These findings offer important insights into the design and application of immersive technologies. For instance, allocentric framing and eventful

content may be leveraged to enhance perceived duration, which could benefit training simulations where prolonged engagement or deeper memory encoding is desired (e.g., firefighting or surgical training). Conversely, egocentric–uneventful scenarios may serve to reduce the perceived length of an experience, which could be useful in therapeutic VR settings where prolonged exposure might otherwise feel overwhelming (e.g., exposure therapy for phobias or pain distraction protocols).

In addition, these findings may inform clinical and patient-centered applications. For example, patients undergoing lengthy medical treatments such as chemotherapy, dialysis, or physical rehabilitation often experience extended periods of discomfort or inactivity. Egocentric and calming VR content in these contexts may help reduce the subjective duration of such procedures, improving patient comfort and compliance. Conversely, when a sense of extended duration is desirable such as in cognitive training or mindfulness interventions allocentric and eventful VR content might help amplify perceived time, increasing the subjective richness of an experience without extending its actual duration. These insights highlight the potential for tailored VR content design in healthcare and therapy settings to enhance patient experience and engagement.

Furthermore, the finding that VR-naïve users reported comparable spatial presence supports the broader accessibility of VR technologies across age groups and populations unfamiliar with immersive systems. Designers developing content for cognitive training, education, or therapy can focus on spatial and narrative elements without requiring prior user expertise with VR interfaces. Although most statistical effects were not significant, emerging trends suggest:

- Allocentric framing and eventfulness may promote time dilation
- Egocentric framing may compress perceived duration, possibly through increased embodiment
- Content and spatial frame may influence time judgments independently of video order
- VR-naïve users can still experience strong spatial presence

LIMITATIONS

As a thesis study, the sample size was constrained by available resources, limiting generalizability. The use of pre-existing YouTube VR videos, rather than custom-designed stimuli, constrained experimental control. Additionally, temporal judgments were assessed behaviorally, without neurophysiological or physiological correlates.

RECOMMENDATIONS FOR FUTURE RESEARCH

Building on the current findings, future research should aim to refine and expand our understanding of how spatial framing and content modulate temporal perception and presence in VR. First, incorporating custom-designed VR content with tight control over pacing, camera movement, and visual complexity would allow for more precise manipulation of spatial and temporal variables. This would overcome limitations posed by using pre-existing videos and allow for experimental designs that directly isolate key features.

Second, increasing sample size and demographic diversity is essential to improve the generalizability of results, especially considering that factors such as age, gaming experience, or cognitive style may moderate VR-related effects. Larger datasets would also allow for more robust statistical testing and interaction modeling.

Third, integrating physiological and neurophysiological measures—such as EEG, galvanic skin response (GSR), or heart rate variability could provide insights into the underlying mechanisms of perceived time distortion and immersion. These methods would allow researchers to move beyond self-report and link subjective experience to objective neural and autonomic activity.

Additionally, future studies should explore how attentional load, memory encoding, and emotional salience interact with spatial framing to influence perceived duration. For instance,

emotionally charged or cognitively demanding scenes might differentially affect time judgments depending on the viewer's spatial perspective. Finally, it would be valuable to disentangle the roles of individual sensory modalities—such as visual, auditory, and haptic input—in driving spatial presence and time estimation. Multisensory VR environments can enhance presence but understanding how each modality contributes will help tailor applications in domains like rehabilitation, cognitive training, and virtual storytelling.

FINAL REMARKS

This research underscores the importance of spatial framing and content in shaping temporal perception in immersive environments. These findings suggest that VR developers can manipulate user experience not only through narrative pacing but also through perspective and sensory immersion. By combining virtual reality with cognitive paradigms, we can better understand how humans construct internal representations of time and space—and how these constructions are modulated by technology. This has broad implications for fields ranging from education and rehabilitation to entertainment and mental health interventions, where time perception and immersion are critical components of effectiveness.

AUTHOR CONTRIBUTION

First author has made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. The second author, as the supervisor of the study, has been involved in drafting the manuscript or revising it critically for important intellectual content. Both authors have given final approval of the version to be published.

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The Role Of Organizational Transparency Levels In Schools On Teachers' Organizational Citizenship Behaviors[*]

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Abstract

This study aims to examine the role of organizational transparency in schools on teachers' organizational citizenship behaviors (OCBs). Designed within the correlational design, the study involved 351 teachers working in public primary, secondary, and high schools in Kütahya, Türkiye. Conducted during the 2024–2025 academic year, the research employed convenience sampling. Data were collected with the School Transparency Scale and the Organizational Citizenship Behavior Scale, and analyzed using Independent Samples t-Test, One-Way ANOVA, Pearson Product-Moment Correlation, and Hierarchical Regression Analysis. Descriptive analyses indicated that teachers perceived high levels of organizational transparency and demonstrated high levels of OCBs. In terms of demographic variables, transparency perceptions differed significantly by gender, school level, number of teachers at the school, and length of service at the same school. Similarly, OCB levels varied significantly with respect to gender, school level, years of professional experience, and length of service at the same school. Furthermore, a moderate, positive, and significant correlation was found between organizational transparency and OCBs. Hierarchical regression analysis revealed that information flow and accountability were the significant predictors of OCB, while participation in decision-making was not. The results suggest that school leaders can foster OCBs by reinforcing accountability and ensuring effective information flow, two key dimensions of organizational transparency identified as significant predictors. Establishing teacher feedback mechanisms and formally recognizing voluntary contributions may further promote organizational citizenship behaviors. At the policy level, efforts should aim to standardize transparency practices across schools to support a more unified and participatory educational environment.

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INTRODUCTION

Organizational Citizenship Behavior (OCB) demonstrated by teachers plays a critical role in the achievement of school objectives. OCB refers to "extra-role" behaviors performed voluntarily for the benefit of the organization, beyond formal job descriptions and without the expectation of any personal reward. In the school context, such behaviors are considered indispensable elements for fostering a positive school climate, ensuring quality education, and enhancing overall school success. Examples of OCBs include cooperating with colleagues, mentoring newly appointed teachers, and embracing a strong sense of school commitment (DiPaola & Hoy, 2005; Hoy & Miskel, 2012; Lunenburg & Ornstein, 2013; Polat, 2007). Although the personality traits and interpersonal relations of organizational members may contribute to the development of OCB, school-related contextual factors such as organizational culture, organizational structure, and organizational trust are also regarded as significant antecedents (Karaaslan, Ergun Özler & Kulaklıoğlu, 2009). Among these antecedents, organizational trust is closely linked to organizational transparency. Transparent practices within the school setting enhance teachers' trust in school administration and reinforce their perception that decisions are made fairly (Arlı, 2011; Bryk & Schneider, 1996). Teachers who work in an atmosphere of trust become more willing to go beyond their formal job descriptions and make sacrifices for the success of the school. In the literature, it is emphasized that practices of organizational transparency support teachers' voluntary behaviors (Klein, 2012). Similarly, the study conducted by Timuroğlu and Çokgören (2019) revealed a significant relationship between organizational trust and OCB, indicating that higher levels of trust were associated with increased levels of citizenship behaviors. In the same vein, the study by Tosun and Çelik (2024) also identified significant relationships between organizational transparency and organizational trust. Organizational transparency is defined as the presentation of information, decisions, and processes in an open, accessible, and understandable manner to all stakeholders. In schools, transparency enables stakeholders such as teachers, students, and parents to comprehend and monitor what is happening within the institution. This implies that school administrators communicate openly with teachers and regularly share decisions made. A transparent management approach reinforces the sense of trust between teachers and administrators and supports perceptions of fairness (Addi-Raccah & Arviv-Elyashiv, 2008; Rawlins, 2009). The relationship between organizational transparency and OCB can be explained through perceptions of organizational trust and justice. Kahveci and Babayiğit (2024) emphasize that trust in school administration increases teachers' motivation and willingness to contribute to school-related tasks. Accordingly, the literature suggests that trust built on organizational transparency may promote teachers' extra-role behaviors. In this regard, the main purpose of this study is to examine the role of organizational transparency in schools on teachers' OCB. In line with this purpose, the key variables of the study are explained in detail below.

CONCEPTUAL FRAMEWORK

This chapter presents the conceptual framework of the study by outlining two central constructs: organizational transparency and organizational citizenship behavior. Each concept is introduced with reference to its theoretical foundations and relevance to educational settings. The chapter also sets the stage for exploring the relationship between these constructs in the context of school administration.

ORGANIZATIONAL TRANSPARENCY

The concept of transparency originates from the Latin word *transparere*, meaning "to be seen through" (Costa, Prior & Rogerson, 2008). It has gained significant prominence in the literature, particularly in relation to anti-corruption efforts, openness in decision-making, and accountability (Piotrowski & Van Ryzin, 2007). Organizational transparency is most simply defined as the open, accurate, and accessible sharing of information related to the organization (Rawlins, 2009). In this

respect, it goes beyond mere information dissemination and is grounded in ethical values such as trust, accuracy, and openness (Selimoğlu, 2010). Transparency has become a fundamental element in today's organizations in terms of organizational culture, employee motivation, and the democratization of decision-making processes. Core principles such as timely access to information, stakeholder participation in decision-making, and managerial accountability form the cornerstone of a transparent management approach (Hatch, 2013). Associated with elements such as openness, honesty, and traceability, transparency contributes to the development of organizational trust and reinforces employees' sense of belonging (Grimmelikhuijsen, 2012). In this context, transparency is regarded not merely as a technical procedure but also as a management culture and a governance philosophy (Meijer, 2013). In the school context, transparency refers to the sharing of decisions with teachers, access to performance-related information, and the openness of administrative practices (Demirtaş & Güneş, 2002). A transparent school administration facilitates teachers' involvement in processes and promotes institutional belonging and collaboration. Beyond its practical applications in schools, transparency has also been conceptualized through various theoretical frameworks in the literature. Balkin (1999) described transparency in terms of information sharing, participation, and accountability, while Rawlins (2009) emphasized access to critical information, stakeholder involvement in processes, reduction of secrecy, and managerial responsibility. Schnackenberg and Tomlinson (2016) proposed three core dimensions of transparency: disclosure, accuracy, and clarity. In the present study, organizational transparency is examined in three dimensions: participation in decision-making, which reflects teachers' active involvement in administrative processes; information flow, which refers to the consistent and comprehensible sharing of information from administrators to teachers; and accountability, which entails administrators openly sharing the rationale behind their decisions with teachers (Tosun, 2022).

ORGANIZATIONAL CITIZENSHIP BEHAVIOR

Organizational citizenship behavior refers to the voluntary contributions made by employees beyond their formal job descriptions to enhance the overall effectiveness and social climate of the organization (Organ, 1988). As a form of extra-role behavior, OCB encompasses employees' sincere and creative efforts. It contributes to organizational effectiveness, facilitates the adaptation of newly recruited members, and reflects a spirit of altruism. Also described as proactive task engagement, OCB involves constructive and voluntary organizational efforts, emerging spontaneously in a purposeful and change-oriented manner (Çetin, Yeşilbağ & Akdağ, 2003). Extra-role behaviors are characterized by positivity and voluntarism. Although they are typically not directly tied to formal reward mechanisms, they contribute positively to the functioning and psychological climate of the organization. The distinguishing features of OCB lie in the individual's voluntary engagement and the potential of these behaviors to benefit the organizational structure or administrative dynamics (Organ, 1997). The roots of OCB can be traced back to the foundational work of early theorists such as Barnard (1938) and Katz and Kahn (1966), who emphasized the impact of efforts beyond standard roles on organizational success. The term OCB and its systematic examination began in the 1980s with the studies of Organ and his colleagues (Bateman & Organ, 1983; Smith, Organ & Near, 1983), and its theoretical foundations were strengthened by Organ's (1988) comprehensive analysis. Subsequent studies have emphasized the importance of OCB by revealing its positive relationships with key outcomes such as employees' organizational commitment, job satisfaction, and overall organizational performance (Organ, 1990; Podsakoff, MacKenzie, Paine & Bachrach, 2000). Academic interest in OCB within the context of schools has notably increased since the late 1990s (DiPaola & Tschannen-Moran, 2001). Studies in this area have demonstrated that the voluntary extra-role behaviors exhibited by teachers and other educational staff significantly contribute to overall school success by enhancing the school climate, increasing managerial efficiency, and strengthening collaboration among colleagues (DiPaola & Tschannen-Moran, 2001; Somech & Drach-Zahavy, 2000). Moreover, teachers who engage in OCB are often found to demonstrate higher levels of job satisfaction as well as a stronger sense of

organizational commitment. (Bogler & Somech, 2004). At this point, it is emphasized that supportive and trust-based leadership styles adopted by school administrators play a critical role in the development of OCB (DiPaola & Hoy, 2005). The dimensions of OCB include altruism, courtesy, conscientiousness, and civic virtue. Altruism refers to teachers' voluntary support for their colleagues (Organ, 1988). Courtesy involves adopting a constructive and tolerant attitude in the face of negative situations (Podsakoff, Whiting, Podsakoff & Blume, 2009). Conscientiousness encompasses the meticulous fulfillment of duties that contribute to the overall order and functioning of the school (Polat, 2007). Finally, civic virtue reflects active participation in decision-making processes in collaboration with school administration (Oğuz, 2011). These forms of behavior foster solidarity within schools, enhance institutional efficiency, and elevate teachers' levels of job satisfaction. Consequently, OCB is regarded not merely as an individual disposition but also as a strategic component influencing the overall success of the school (Somech & Drach-Zahavy, 2000).

As the aforementioned explanations suggest, a transparent management approach—through open information flow, participation in decision-making processes, and principles of accountability—enhances employees' trust in the institution and reinforces their sense of belonging. This environment fosters teachers' willingness to contribute beyond formal job descriptions, paving the way for the exhibition of OCBs. In schools, the adoption of a transparent administrative style by school leaders supports teachers' voluntary collaboration, sense of responsibility, and contributions to institutional development. In this regard, the study is expected to raise awareness among school administrators regarding the importance of transparent practices and citizenship behaviors. Furthermore, the number of studies that examine these two concepts together in the literature remains limited. Accordingly, this research aims to reveal the role of organizational transparency in schools on teachers' OCBs.

PURPOSE OF THE STUDY

This study aims to investigate the relationship between teachers' perceptions of organizational transparency in schools and their organizational citizenship behaviors (OCBs). In line with this aim, the following research questions were addressed:

1. What is the perceived level of organizational transparency among teachers in schools?
2. Do teachers' perceptions of organizational transparency significantly differ by their gender, school level, years of professional experience, educational background, number of teachers at school, and length of service at the same school?
3. What is the level of teachers' OCBs?
4. Do teachers' levels of OCB significantly differ based on their gender, school level, years of professional experience, educational background, number of teachers at school, and length of service at the same school?
5. Is there a significant relationship between teachers' perceptions of organizational transparency and their OCBs?
6. Do teachers' perceptions of organizational transparency significantly predict their OCBs?

METHOD

This section outlines the methodological framework adopted for the study. It includes details about the research design, study population and sampling method, data collection instruments, and statistical analysis techniques. The primary aim is to ensure transparency and clarity in the procedures followed, thereby allowing for the accurate examination of the relationship between organizational transparency and teachers' organizational citizenship behaviors.

RESEARCH DESIGN

The study was designed using the relational scanning model, as it aims to reveal the relationship between teachers' perceptions of organizational transparency in schools and their organizational citizenship behaviors. The correlational survey model is a quantitative research design that not only describes the current situation as it is but also seeks to determine the degree of relationship between two or more variables.

POPULATION AND SAMPLE

The population of the study consists of teachers working in public schools in Kütahya, Türkiye, during the 2024–2025 academic year. A total of 351 teachers were reached and included in the study through the convenience sampling method. The descriptive characteristics of the participating teachers are presented in Table 1.

Table 1. *Demographic Characteristics of Teachers*

Variable		*f*	*%*
Gender	Female	218	62.1
	Male	133	37.9
School level	Primary school	101	28.8
	Secondary school	130	37.0
	High school	120	34.2
Years of professional experience	1- 10 years	114	32.5
	11- 20 years	137	39.0
	21 years or more	100	28.5
Educational background	Associate/Bachelor's degree	211	60.1
	Graduate degree	140	39.9
Number of teachers at school	1- 20 teachers	163	46.4
	21 teachers or more	188	53.6
Length of service at the same school	1- 3 years	181	51.6
	4 years or more	170	48.4
Total		351	100

As shown in Table 1, the majority of the participating teachers were female (62.1%, n = 218), while male participants accounted for 37.9% (n = 133). In terms of school level, 28.8% (n = 101) worked in primary schools, 37.0% (n = 130) in middle schools, and 34.2% (n = 120) in high schools. Regarding years of professional experience, 32.5% (n = 114) had 1–10 years, 39.0% (n = 137) had 11–20 years, and 28.5% (n = 100) had 21 years or more. As for educational background, 60.1% (n = 211) held an associate or bachelor's degree, while 39.9% (n = 140) held a graduate-level degree. In relation to number of teachers at school, 46.4% (n = 163) worked in schools with 1–20 teachers, and 53.6% (n = 188) in schools with 21 or more. Lastly, in terms of length of service at the same school, 51.6% (n=181) had been teaching at the same school for 1–3 years, and 48.4% (n=170) for 4 years or more.

DATA COLLECTION

Data for the present study were collected using two primary instruments—the School Transparency Scale (Tosun, 2022) and the Organizational Citizenship Behavior Scale, as adapted by Polat (2007)—which were selected based on the psychometric properties reported in their respective development and adaptation studies. The following sections provide a detailed description of each instrument, including their structures, dimensions, and the reliability analyses conducted for this study.

SCHOOL TRANSPARENCY SCALE

The School Transparency Scale, developed by Tosun (2022), is a five-point Likert-type instrument comprising 16 items across three dimensions: participation in decision-making, information flow, and accountability. The Cronbach's alpha coefficients obtained in this study were α = .91 for participation in decision-making, α = .93 for information flow, α = .95 for accountability, and α = .97 for the overall scale. According to the commonly accepted classification in the literature, values above .90 are considered "excellent," those between .80 and .90 are "very good," and those between .70 and .80 are "adequate" (Büyüköztürk, 2018). In this regard, the reliability coefficients in this study closely resemble those in Tosun's (2022) original scale and meet the reliability criteria stated in the literature.

ORGANIZATIONAL CITIZENSHIP BEHAVIOR SCALE

The Organizational Citizenship Behavior Scale, adapted into Turkish by Polat (2007), is a five-point Likert-type instrument consisting of 20 items across four dimensions: altruism, courtesy, conscientiousness, and civic virtue. In the present study, the Cronbach's alpha coefficients were α = .89 for the overall scale, α = .89 for altruism, α = .80 for courtesy, α = .78 for conscientiousness, and α = .84 for civic virtue. According to the reliability criteria proposed by Büyüköztürk (2018), alpha values above .70 indicate sufficient reliability. These findings demonstrate that the scale possesses strong internal consistency and is suitable for use in this research. Furthermore, the reliability coefficients obtained in this study are consistent with those reported during the Turkish adaptation of the scale by Polat (2007), supporting the scale's reliability for the current sample.

DATA ANALYSIS

To determine the suitability of parametric tests, both graphical and statistical indicators of normality were examined. Visual assessments of the histograms and Normal Q-Q plots showed that the data were approximately normally distributed, without severe deviations. Although the Kolmogorov-Smirnov test yielded statistically significant results for both organizational transparency (p = .024) and organizational citizenship behavior (p = .041), the skewness and kurtosis coefficients were subsequently examined for a more robust assessment. These values were all found to be within the acceptable range of –3 to +3 according to Kline (2015). Therefore, the data were ultimately considered suitable for parametric analysis. Descriptive statistics regarding these distributions are presented in Table 2.

Table 2. *Skewness and Kurtosis Values for the Study Variables*

Dimension	Skewness	Kurtosis
Participation in Decision-Making	-.593	-.195
Information Flow	-.918	.483
Accountability	-.249	-.714
Organizational Transparency (Total)	-.589	-.185
Altruism	-.909	1.682
Courtesy	-1.591	2.885
Conscientiousness	-1.393	2.910
Civic Virtue	-.552	.022
Organizational Citizenship Behavior (Total)	-.787	1.227

As shown in Table 2, the data met the assumption of normality; therefore, parametric tests were used in the analyses. Independent samples t-tests were conducted to examine group differences based on gender, educational background, number of teachers at school, and length of service at the same school. For school level and years of professional experience, one-way analysis of variance (ANOVA) was employed. The assumption of homogeneity of variances was initially tested using Levene's test. When this assumption was met (p > .05), the Tukey HSD test was applied as a post hoc procedure to

identify the source of the significant difference. The significance level was set at .05 for all analyses. In addition, Pearson product–moment correlation coefficients were calculated to examine the relationship between teachers' perceptions of organizational transparency and their organizational citizenship behaviors. Finally, hierarchical regression analyses were conducted to evaluate the predictive power of the dimensions of organizational transparency on OCBs.

FINDINGS

This chapter presents the study's findings in four main parts. First, it details the descriptive statistics for organizational transparency and organizational citizenship behavior, along with analyses of how these variables differ across demographic groups. Second, it presents the results of the correlational analysis examining the relationship between these two main constructs. The chapter concludes by reporting the findings from the hierarchical regression analysis, which tested the study's predictive model.

FINDINGS RELATED TO ORGANIZATIONAL TRANSPARENCY

This section presents the descriptive findings regarding teachers' perceptions of organizational transparency in schools. These findings are provided in Table 3.

Table 3. *Teachers' Perception Levels of Organizational Transparency*

Dimensions	$\bar{x}$	SD	Level
Participation in Decision-Making	3.51	1.029	High
Information Flow	3.82	.936	High
Accountability	3.20	1.113	Moderate
Organizational Transparency (Total)	3.84	.965	High

As shown in Table 3, teachers' perceptions of organizational transparency in schools were high in the dimensions of *participation in decision-making* ($\bar{x}$ = 3.51) and *information flow* ($\bar{x}$ = 3.82), as well as in total organizational transparency ($\bar{x}$ = 3.84). On the other hand, their perceptions in the *accountability* dimension were at a moderate level ($\bar{x}$ = 3.20).

The findings regarding teachers' perceptions of organizational transparency in schools based on demographic variables are presented below. According to the results of the independent samples t-test based on gender, a statistically significant difference was observed in overall organizational transparency perceptions [$t_{(349)}$ -3.803; p < .001]. Male teachers ($\bar{x}$ = 3.75) reported higher levels of perception compared to female teachers ($\bar{x}$ = 3.36). Similarly, significant differences favoring male teachers were also found in participation in decision-making [$t_{(349)}$ = -3.491; p = .001], information flow [$t_{(349)}$ = -3.336; p = .001], and accountability [$t_{(349)}$ = -3.820; p < .001].

In terms of school level, the ANOVA results indicated a significant difference in overall perceptions of organizational transparency [$F_{(2, 348)}$ = 3.676; p < .05]. Specifically, significant differences were found in participation in decision-making [$F_{(2, 348)}$ = 3.846; p < .05] and accountability [$F_{(2, 348)}$ = 4.770; p < .05], with primary school teachers exhibiting higher levels of perception than high school teachers. However, no significant difference was observed in the information flow [$F_{(2, 348)}$ = 1.921; p > .05].

The results of the ANOVA conducted based on years of professional experience revealed no statistically significant differences in overall transparency perceptions [$F_{(2, 348)}$ = .722; p > .05]. Likewise, no significant differences were found in participation in decision-making [$F_{(2, 348)}$ = .011; p > .05], information flow [$F_{(2, 348)}$ = 1.248; p > .05], and accountability [$F_{(2, 348)}$ = 1.090; p > .05].

Regarding educational background, the t-test results indicated no significant differences in overall transparency perceptions [$t_{(349)}$ = -.158; p > .05]. Similarly, no significant differences were found in participation in decision-making [$t_{(349)}$ = -.006; p > .05], information flow [$t_{(349)}$ = -.356; p > .05], and accountability [$t_{(349)}$ = -.063; p > .05].

With respect to the number of teachers at the school, significant differences were found in overall transparency perceptions [$t_{(349)}$ = 3.042; p < .05]. Teachers working in schools with 1–20 teachers reported significantly higher perceptions in participation in decision-making [$t_{(349)}$ = 3.681; p < .05], information flow [$t_{(349)}$ = 2.439; p < .05], and accountability [$t_{(349)}$ = 2.714; p < .05] than those working in schools with 21 or more teachers.

Finally, the results based on length of service at the same school revealed a significant difference in overall transparency perceptions [$t_{(349)}$ = 2.292; p < .05]. Teachers with 1–3 years of experience at the same school (x̄ = 3.63) demonstrated higher perceptions than those with 4 or more years (x̄ = 3.39). Significant differences were also observed in participation in decision-making [$t_{(349)}$ = 2.039; p < .05] and accountability [$t_{(349)}$ = 2.412; p < .05], while no significant difference was found in information flow [$t_{(349)}$ = 1.936; p > .05].

FINDINGS RELATED TO ORGANIZATIONAL CITIZENSHIP BEHAVIOR

This section reports the findings derived from the statistical analyses conducted to explore teachers' organizational citizenship behaviors in schools. Descriptive statistics regarding these behaviors are presented in Table 4.

Table 4. *Teachers' Levels of Organizational Citizenship Behavior*

Dimensions	$\bar{x}$	SD	Level
Altruism	4.02	.702	High
Courtesy	4.31	.759	Very High
Conscientiousness	4.37	.634	Very High
Civic Virtue	3.92	.799	High
Organizational Citizenship Behavior (Total)	4.13	.529	High

As shown in Table 4, teachers' OCB levels were generally high. The mean scores were 4.02 for *altruism*, 4.31 for *courtesy*, 4.37 for *conscientiousness*, 3.92 for *civic virtue*, and 4.13 for total OCB. Among these dimensions, courtesy and conscientiousness were reported at a very high level by teachers.

The findings regarding teachers' perceptions of organizational citizenship behavior based on demographic variables are presented below. According to the Independent Samples t-Test results based on gender, no statistically significant difference was found in teachers' total OCB levels [$t_{(349)}$ = 1.211, p > .05]. Likewise, no significant differences were observed in altruism [$t_{(349)}$ = 1.236, p > .05], courtesy [$t_{(349)}$ = 1.168, p > .05], and civic virtue [$t_{(349)}$ = −.936, p > .05]. However, a significant difference emerged in conscientiousness [$t_{(349)}$ = 2.102, p < .05], where female teachers (x̄ = 4.43) reported higher levels than male teachers (x̄ = 4.28).

According to the One-Way ANOVA results based on school level, a significant difference was found in overall OCB levels [$F_{(2, 348)}$ = 2.542, p < .05]. Primary school teachers (x̄ = 4.19) reported significantly higher levels than high school teachers (x̄ = 4.04). Among dimensions, only civic virtue showed a significant difference [$F_{(2, 348)}$ = 7.890, p < .05], with primary and middle school teachers reporting higher levels than their high school counterparts. No statistically significant differences were found in altruism [$F_{(2, 348)}$ = 2.475, p > .05], courtesy [$F_{(2, 348)}$ = 1.348, p > .05], or conscientiousness [$F_{(2, 348)}$ = .001, p > .05].

With regard to years of professional experience, the results revealed a significant difference in total OCB levels [$F_{(2, 348)}$ = 3.173, p < .05]. Teachers with 11–20 years of experience (x̄ = 4.20) reported higher levels than those with 1–10 years (x̄ = 4.03). Among the dimensions, only civic virtue showed a significant difference [$F_{(2, 348)}$ = 4.228, p < .05], again in favor of teachers with 11–20 years of experience. No statistically significant differences were observed in altruism [$F_{(2, 348)}$ = 2.550, p > .05], courtesy [$F_{(2, 348)}$ = .996, p > .05], or conscientiousness [$F_{(2, 348)}$ = 2.694, p > .05].

The t-Test results based on educational background revealed no significant differences in total OCB levels [$t_{(349)}$ = −.010, p > .05] or altruism [$t_{(349)}$ = −.602, p > .05], courtesy [$t_{(349)}$ = 1.002, p > .05], conscientiousness [$t_{(349)}$ = 1.708, p > .05], and civic virtue [$t_{(349)}$ = −1.279, p > .05].

Similarly, based on number of teachers at school, no significant difference was found in total OCB levels [$t_{(349)}$ = 1.355, p > .05]. However, a significant difference was found in the altruism dimension [$t_{(349)}$ = 2.166, p < .05], with teachers working in schools with 1–20 teachers (x̄ = 4.10) reporting higher levels than those in schools with 21 or more teachers (x̄ = 3.94). No significant differences were observed in courtesy [$t_{(349)}$ = −.052, p > .05], conscientiousness [$t_{(349)}$ = −1.008, p > .05], or civic virtue [$t_{(349)}$ = 1.541, p > .05].

Finally, according to the results based on length of service at the same school, a significant difference was found in total OCB levels [$t_{(349)}$ = 2.292, p < .05]. Teachers with 1–3 years of experience at the same school (x̄ = 4.15) reported slightly higher levels than those with 4 or more years (x̄ = 4.10). However, no statistically significant differences were observed in altruism [$t_{(349)}$ = .699, p > .05], courtesy [$t_{(349)}$ = 1.806, p > .05], conscientiousness [$t_{(349)}$ = −.450, p > .05], or civic virtue [$t_{(349)}$ = −.040, p > .05].

FINDINGS RELATED TO THE CORRELATION BETWEEN ORGANIZATIONAL TRANSPARENCY AND ORGANIZATIONAL CITIZENSHIP BEHAVIOR

This section presents the correlation results regarding the relationship between teachers' perceptions of organizational transparency and their levels of organizational citizenship behavior. The relevant findings are displayed in Table 5.

Table 5. *Correlation Analysis Results Concerning Teachers' Perceptions of Organizational Transparency and Their Organizational Citizenship Behavior*

	Organizational Citizenship Behavior				
Organizational Transparency	*Altruism*	*Courtesy*	*Conscientiousness*	*Civic Virtue*	*OCB (Total)*
Participation in Decision-Making	.290**	.320**	.122*	.365**	.386**
Information Flow	.309**	.339**	.167**	.371**	.413**
Accountability	.358**	.245**	.142**	.391**	.413**
Organizational Transparency (Total)	.344**	.314**	.155**	.401**	.432**

*p< .05; **p< .01

As shown in Table 5, a statistically significant and moderate positive correlation was found between teachers' perceptions of organizational transparency and their organizational citizenship behavior levels (r = .432, p < .01). Similarly, moderate and significant relationships were observed with altruism (r = .344, p < .01), courtesy (r = .314, p < .01), and civic virtue (r = .401, p < .01). The correlation with conscientiousness was also significant but relatively low (r = .155, p < .01). These results suggested that higher levels of perceived organizational transparency were associated with increased levels of OCB.

FINDINGS RELATED TO THE PREDICTIVE ROLE OF ORGANIZATIONAL TRANSPARENCY ON ORGANIZATIONAL CITIZENSHIP BEHAVIOR

Hierarchical regression analysis was conducted to examine the predictive power of organizational transparency dimensions on teachers' organizational citizenship behavior, as shown in Table 6.

Table 6. *Hierarchical Regression Analysis Results on The Predictive Role of Perceived Organizational Transparency in Schools on Teachers' Organizational Citizenship Behavior*

Predictor Variables	Organizational Citizenship Behavior					
	Model 1		Model 2		Model 3	
	ß	t	ß	t	ß	t
Model 1						
Information flow	.413	8.482*	.229	2.728*	.215	2.342*
Model 2						
Accountability			.226	2.689*	.206	2.077*
Model 3						
Participation in decision-making					.036	.364
R^2	.171		.188		.188	
ΔR^2	.171		.017		.000	
F	71.938*		40.227*		26.795*	

*p< .001

As shown in Table 6, hierarchical regression analysis was employed to determine the extent to which dimensions of teachers' perceptions of organizational transparency predict their organizational citizenship behavior. According to the results of the three-step model, the independent variables significantly explained 18.8% of the total variance in OCB (R^2 = .188, F = 26.795, p < .001). In Model 1, information flow alone explained 17.1% of the variance (ΔR^2 = .171, p < .001). In Model 2, the inclusion of accountability led to an additional 1.7% of variance explained, which was also statistically significant (ΔR^2 = .017, p < .001). However, in Model 3, the addition of participation in decision-making did not result in a significant increase in the explained variance (ΔR^2 = .000, t = .364, p > .05). These results indicate that information flow and accountability were significant predictors of teachers' organizational citizenship behavior, whereas participation in decision-making was not found to be a significant predictor.

DISCUSSION, CONCLUSION AND IMPLICATIONS

This study examined the relationship between teachers' perceptions of organizational transparency and organizational citizenship behavior (OCB), aiming to reveal the role of organizational transparency in schools on teachers' OCBs.

According to the research findings, teachers' perceptions of organizational transparency were generally found to be high. This result may be interpreted in light of organizational trust theory, which suggests that when communication is open and decision-making is inclusive, trust in leadership increases (Rawlins, 2008). Such trust can reinforce positive perceptions of transparency within educational institutions. Our finding is also consistent with various other studies conducted in educational settings. Kalman and Gedikoğlu (2014) revealed that school administrators were perceived as transparent by teachers, particularly in terms of accountability and information sharing. Similarly,

Gökçe (2020) emphasized that administrators' inclusion of teachers in decision-making processes strengthens perceptions of transparency. In a study by Ayral (2020), it was highlighted that teacher participation in decision-making is a key component of organizational transparency. Likewise, Elekoğlu (2021) stated that trust in school administrators and their communicative attitudes reinforce teachers' perceptions of transparency. Particularly, the high perception levels in the dimensions of information flow and participation in decision-making indicate the development of a school structure grounded in open communication and participatory management. Erdem (2021) emphasized that informing teachers about administrative decisions in a timely and sufficient manner enhances their trust in the management. Similarly, Tavşancıoğlu (2022) revealed that involving teachers in decision-making processes contributes positively to the perception of transparency in school leadership. These results suggest that the recent shift toward participatory management and improved communication tools may have helped strengthen teachers' perceptions of transparency. This aligns with democratic leadership theory, which highlights the importance of shared governance and participative practices in promoting perceptions of fairness and openness (Hoy & Tarter, 2008; Pateman, 1970). However, the study revealed that perceptions regarding the accountability dimension were comparatively lower than those of the other dimensions. This indicates a shortfall on the part of school administrators in offering transparent justifications for their decisions, assuming responsibility, and communicating performance outcomes effectively. This gap can be explained within the framework of ethical leadership theory, which emphasizes the importance of transparency, accountability, and moral justification in leadership processes (Brown & Treviño, 2006). According to this perspective, when leaders fail to clearly explain their decisions or take responsibility for outcomes, it can undermine trust and weaken perceptions of organizational transparency. Schnackenberg and Tomlinson (2016) define organizational transparency as a multidimensional construct and emphasize that perceptual differences may occur among its dimensions. Nevertheless, the fact that the perception of accountability, one of the core components of transparency, remains low indicates a need for improvement in this area. Furthermore, this result implies that administrators are more visible in day-to-day operational practices, while their presence appears limited in areas that require managerial transparency, such as fulfilling accountability responsibilities.

According to the findings, teachers' perceptions of organizational transparency were also analyzed across various demographic variables, revealing significant differences for some. In terms of gender, the analysis revealed that male teachers perceived significantly higher transparency levels across all dimensions compared to female teachers. These findings may also be interpreted using gender role theory, which suggests that social expectations shape how men and women act and how they are treated in organizations. According to Eagly and Karau (2002), traditional gender roles often link men with leadership, confidence, and involvement in decision-making. Because of this, male teachers may be more likely to perceive transparency—either because they are more often included by school leaders, or because they tend to engage more actively in decision-making processes. This result also aligns with Ekin (2019), who noted that male teachers were more frequently informed about decision-making processes. Similarly, Ayral (2020) stated that male teachers demonstrated higher levels of participation in administrative practices, which in turn enhanced their perceptions of transparency. On the other hand, Elekoğlu (2021) emphasized in his study that female teachers held more positive perceptions of transparency. In contrast, Gökçe (2020) found no significant difference based on gender. Similarly, the study conducted by Palanski et al. (2011) reported that gender did not have a determining effect on organizational transparency perceptions. These gender-based differences in perception may be shaped by cultural norms or institutional dynamics. Alternatively, this situation may be related to male teachers' more frequent communication with school administration or their more active roles in decision-making processes. Additionally, the findings revealed that primary school teachers had higher levels of transparency perception compared to high school teachers, a result consistent with Tosun (2022). On the other hand, Ayral (2020) did not identify a

significant difference based on school type. This difference may be explained by the fact that primary schools are settings where communication is more frequent, allowing teachers easier access to administrators and more direct involvement in decision-making processes. Furthermore, the closer and more interactive relationships between administrators and teachers in primary schools may serve as a factor that enhances perceptions of transparency. The study also revealed that perceptions of organizational transparency were higher in schools with fewer teachers (1–20 staff members). Similarly, Tosun (2022) reported that information flow was more effective in schools with fewer teachers, which in turn strengthened perceptions of transparency. This finding aligns with the present study's result indicating higher transparency perceptions in such settings. This may be because decision-making is often more collaborative in smaller schools, where teachers work more closely with administrators. It was found that teachers who had been working at their current school for a shorter period (1–3 years) reported higher levels of organizational transparency perceptions, a finding that contrasts with Tosun (2022). A possible explanation is that newly appointed teachers may hold more positive initial impressions, with expectations regarding administrative practices potentially declining over time. Furthermore, new teachers often approach school administrators with fewer preconceptions and a stronger motivation to foster a sense of belonging, which could enhance their perceptions. Conversely, neither professional experience nor educational background significantly affected teachers' perceptions of organizational transparency. This outcome aligns with findings from Tosun (2022), Gökçe (2020), and Elekoğlu (2021), which similarly reported no significant differences. However, some studies have reported significant findings for particular dimensions or within varied contextual settings. For instance, Ekin (2019) emphasized that this relationship is highly complex and that evaluations should be interpreted with sensitivity to contextual factors. In this regard, it is plausible that as teachers gain more professional experience, they may develop a more critical stance toward administrative practices or their expectations may shift over time, which could explain the absence of significant differences based on professional seniority.

The findings regarding the other variable in the study indicate that teachers' levels of OCB are generally high. This result is consistent with previous studies conducted in educational settings. For example, Polat (2007), who developed the Organizational Citizenship Behavior Scale for teachers in Türkiye, found that teachers commonly demonstrate high levels of OCB, considering it a professional and ethical responsibility. Similarly, DiPaola and Tschannen-Moran (2001) emphasized that teachers often exhibit OCBs voluntarily to support their schools' functioning, even when not formally required to do so. These findings indicate that teachers often go beyond their formal job descriptions, reflecting a professional culture that values commitment, cooperation, and organizational contribution, which makes high levels of OCB usual among them. This is well-documented in the national literature. For instance, Baykal (2013) highlighted teachers' voluntary engagement in institutional responsibilities. Further supporting this perspective, Kaya (2015) and Alarçin (2023) emphasized teachers' proactive involvement in operational processes and their willingness to offer support beyond assigned duties. The high levels of altruism and conscientiousness observed in the present study's data also underscore a strong sense of dedication, collaboration, and institutional belonging among teachers, a point also affirmed by Aycan (2020), Erdoğan (2021), and Yücesan (2022). However, other studies have reported more moderate levels of OCB. For instance, Çetin (2011) noted that teachers often limit such behaviors to formal job expectations, while Yılmaz and Bökeoğlu (2008) demonstrated that voluntary efforts tend to be situational and conditional. These contrasting findings underscore the influence of contextual and individual factors on teachers' willingness to engage in citizenship behaviors. According to Polat (2007), Tezer (2015), and Lunenburg and Ornstein (2013), such variance in OCB may result from differences in school climate, leadership styles, and individual motivation. These scholars emphasize that OCB is not a static characteristic but a dynamic behavior influenced by both internal dispositions and external conditions.

In the study, OCB levels were also analyzed in terms of demographic variables, revealing overall limited but statistically significant differences. In terms of gender, our findings indicated no statistically significant differences in teachers' overall OCB levels or across its dimensions, except for the conscientiousness dimension, where female teachers scored higher than male teachers. This result aligns with studies by Çetin (2011), Kaya (2015), and Aycan (2020), who reported that male and female teachers demonstrate comparable levels of citizenship behaviors, suggesting that gender does not significantly influence teachers' OCB levels. However, it's also important to acknowledge that some studies in the literature suggest gender can lead to significant differences in OCB. For instance, Çimili Gök (2010) reported that female teachers exhibited higher levels of citizenship behaviors in dimensions such as conscientiousness and altruism. The finding that female teachers scored higher in the conscientiousness dimension in the current study may be attributed to their sensitivity driven by social role expectations and a stronger sense of moral responsibility. Regarding school type, a statistically significant difference was found only in the civic virtue dimension, favoring primary school teachers. This finding aligns with the results of Mercan (2022), who reported that primary school teachers participated more actively in intra-school social responsibility activities. Similarly, Yücesan (2022) noted that teachers working in primary schools more frequently demonstrated civic virtue behaviors through student–parent interactions and collaborations with various school stakeholders. This may be attributed to the typically smaller and more interactive environments of primary schools, which foster closer relationships with administrators and create more opportunities for engagement in the school's social life—factors that naturally enhance civic virtue behaviors. Nevertheless, there are also studies that did not find any significant differences in OCB based on school type. Okalaner (2023) emphasized that teachers' OCBs are shaped more by personal attitudes and the prevailing school climate than by school type. In parallel, Alarçin (2023) reported no significant variation in OCB across different school levels. In the present study, a statistically significant difference emerged in teachers' OCB levels with respect to their years of professional experience. Notably, those with 1–10 years of experience differed from those with 11–20 years in both the civic virtue dimension and overall OCB scores. This suggests that as professional experience accumulates, teachers may develop a stronger sense of belonging and a greater willingness to contribute beyond formal responsibilities. Aycan (2020) also emphasized that increased professional experience can strengthen a sense of organizational accountability. In contrast, Çetin (2011) reported a decline in OCB with more years of experience. These divergent findings suggest that the relationship between experience and OCB may be shaped by additional contextual or motivational factors and does not necessarily follow a linear pattern. While experienced teachers might demonstrate a heightened sense of responsibility, factors such as burnout, decreased motivation, or resistance to organizational change may lead to a reduction in their engagement in citizenship behaviors. The findings revealed that teachers' educational background—particularly their latest academic degree—did not significantly influence their OCBs. This is consistent with studies emphasizing that such background variables may not play a decisive role in predicting OCB. For instance, Alanoğlu and Demirtaş (2019) argued that OCB levels among teachers are more influenced by personal dispositions and leadership styles within the school context than by academic qualifications. Similarly, Okalaner (2023) found limited evidence linking educational background to OCB, highlighting instead the influence of contextual and organizational variables. Therefore, this result may indicate that OCBs are more likely to emerge from teachers' interactions with their professional environment rather than from their formal education alone. In terms of number of teachers at school, the findings indicated a significant difference only in altruism dimension. This behavior was observed to be more prominent in schools with fewer teachers. Such a pattern may be explained by the closer social relationships that tend to develop among teachers in smaller schools, which in turn foster a more cooperative and supportive working environment. In these settings, it appears more common for teachers to share responsibilities, show solidarity, and engage in voluntary acts to support one another. Furthermore, the findings based on the variable of length of service at the same school indicated a statistically significant difference only in the total OCB scores. Specifically,

teachers who had been working at their current school for a shorter period (1–3 years) demonstrated higher levels of OCBs. It is plausible that early-career teachers exhibit higher motivation to integrate into the school community and demonstrate their commitment, thereby enhancing their engagement in OCB. Their efforts to build good relationships with school administrators and to establish their professional identity within the institutional environment could contribute to increased engagement in such behaviors. On the other hand, this result contradicts the findings of Erdoğan (2021), who reported no significant difference with regard to the same variable.

The significant positive correlation found between organizational transparency and OCBs is consistent with foundational theories like Social Exchange Theory, which posits that employees reciprocate an organization's positive actions—such as transparency—with beneficial behaviors (Blau, 1986; Cropanzano & Mitchell, 2005). In this theoretical framework, organizational transparency functions as a social mechanism that encourages voluntary participation. When teachers perceive communication as open, fair, and informative, they are more likely to engage in extra-role behaviors as a form of social return. This process is often facilitated by organizational trust; as Rawlins (2008) suggests, transparent communication practices are crucial for promoting this trust, which in turn is a key antecedent of citizenship behaviors. This emphasis on fairness and trust aligns directly with Organizational Justice Theory, as transparency enhances perceptions of procedural and informational justice (Colquitt et al., 2001). In an environment where teachers feel respected and that decisions are fair, they are more willing to engage in efforts beyond their formal job descriptions (Moorman, 1991; Polat, 2007). While the present study does not directly measure mediators like trust or a sense of justice, the findings strongly support a theoretical model where transparency fosters OCBs by creating a just and trusting environment. These findings are consistent with national studies that have revealed a strong link between teachers' perceptions of transparency in administrative processes and their OCBs. Similarly, Arlı (2011), Barutcu (2019), and Öge and Çiftçi (2017) reported that transparent management practices support teachers' voluntary contributions. Beyond national boundaries, the findings of the present study also resonate with international research. For example, Dilini and Rathnasekara (2021) reported that teachers' involvement in both technical and managerial decision-making processes in Sri Lanka positively influenced their OCBs, with empowerment emerging as a mediating factor. Similarly, in a mixed-method study conducted in the rubber industry in Vietnam, Tran and Binh (2024) found that transformational leadership practices contributed to a greater sense of transparency and improved work life quality among employees, which in turn fostered OCBs. These findings suggest that transparency-based management approaches may foster voluntary engagement across diverse professional contexts. Although Maruf and Altıntaş (2021) pointed out that transparency might, under certain circumstances, lead to negative emotions or critical attitudes, the prevailing view in the literature highlights that transparent administrative practices foster teachers' sense of commitment, motivation, and willingness to contribute voluntarily.

The hierarchical regression analysis showed that information flow was the strongest predictor of teachers' OCBs among the transparency dimensions. This dimension alone accounted for 17.1% of the variance, indicating a statistically significant impact. These findings suggest that open communication within schools plays a key role in encouraging teachers' voluntary engagement. In the second step, the accountability dimension contributed 1.7% to the explained variance, and this effect was also statistically significant. This result indicates that consistent and accountable managerial practices can still exert a measurable impact on teachers' behaviors. In contrast, participation in decision-making was not identified as a statistically significant predictor of OCB. This finding suggests that merely providing opportunities for participation may be insufficient to foster voluntary behaviors. According to the literature, for participation to be effective, it must be more than a formal exercise; employees must perceive that they have a genuine impact on the outcomes, a concept known as perceived influence (Spreitzer, 1995). If participation is viewed by teachers merely as a formality, and they do not believe their input has a concrete effect on final decisions, it cannot be expected to foster

the voluntary commitment required for OCB (Pateman, 1970). Therefore, the fact that information flow and accountability emerged as significant predictors suggests that teachers in this sample may place greater value on receiving clear information and observing managerial responsibility than on participating in processes they may not perceive as influential.

Overall, the significant and positive association between all dimensions of organizational transparency and teachers' OCBs confirms that transparency serves as a vital facilitator of voluntary and collaborative behaviors in school settings. Especially the strong predictive role of information flow underscores the value of clear and open communication in fostering teachers' extra-role engagement. This study contributes to the literature by empirically validating the link between transparency and OCB within the educational context and offering theoretical insight into how transparency dimensions differentially influence such behaviors. These findings also provide practical implications for school leaders, highlighting the importance of transparent administrative practices in strengthening teachers' collaboration and facilitating a work environment where extra-role contributions are sustained and valued.

Accordingly, this study outlines a set of targeted implications for key stakeholders-namely policymakers, school-level practitioners, and researchers-aimed at advancing organizational transparency and fostering teachers' organizational citizenship behaviors.

IMPLICATIONS FOR POLICYMAKERS

• Establishing Clear Frameworks: National educational policies should incorporate transparency-based standards across all school levels to minimize implementation disparities and support a unified school culture.

• Strengthening Legal and Structural Accountability: Legal and structural enhancements are crucial to reinforce managerial accountability, thereby contributing to greater organizational transparency throughout educational institutions.

• Mandating Professional Development: In-service training programs for school leaders should be standardized to include modules specifically addressing the relationship between organizational transparency and teachers' organizational citizenship behaviors.

• Promoting Independent Monitoring: Policies should support the independent monitoring of transparency practices in educational institutions, along with the establishment of standardized reporting systems to promote accountability and continuous improvement.

IMPLICATIONS FOR SCHOOL-LEVEL PRACTITIONERS

• Prioritizing Holistic Transparency: Beyond effective information flow and participatory decision-making, administrators must place equal emphasis on the robust implementation of accountability principles. Strengthening these mechanisms can foster a school culture where leaders feel more responsible for justifying their decisions and actions transparently.

• Fostering Trust through Feedback: Regularly collecting teachers' feedback and opinions can significantly help build institutional trust and cultivate voluntary citizenship behaviors.

• Adapting Best Practices: Communication and interaction patterns observed in smaller schools, particularly those that enhance transparency and collaboration, should be analyzed and adapted as best practice models for larger institutions.

• Developing Recognition Systems: School-based reward and recognition systems should be thoughtfully developed to encourage and sustain teachers' engagement in organizational citizenship behaviors, acknowledging their extra-role contributions.

• Leading with Transparency: Actively promote a transparent leadership style that recognizes and values teachers' discretionary efforts, which are vital for a cohesive and effective school environment.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Despite its contributions, this study has certain limitations that should be acknowledged. First, the research adopted a quantitative design, which limited the depth of insight into teachers' subjective experiences; future studies using qualitative or mixed methods could provide a more comprehensive understanding of the dynamics between organizational transparency and OCB. Second, the sample did not distinguish between teachers working in urban and rural schools, which may have obscured context-specific differences in transparency perceptions and citizenship behaviors; future studies could address this limitation by employing a stratified sampling approach to better capture contextual diversity. Lastly, the use of convenience sampling may have limited the representativeness of the findings; employing more rigorous sampling techniques in future research would enhance the generalizability and objectivity of the results.

AUTHOR CONTRIBUTION

- The first author made substantial contributions to the conception and design of the study, data collection, statistical analysis and interpretation of data, manuscript preparation and final version for publication.
- The second author made design of the study, data statistical analysis and interpretation of data, provided critical academic supervision, revised the manuscript and final version for publication.

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Comparing Face Recognition and Visual Scanning Skills in Children With and Without Autism Using Eye-Tracking[*]

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Abstract

This study aimed to compare the visual scanning skills of children diagnosed with autism spectrum disorder (ASD) and typically developing children using eye tracking systems. The study group consisted of 37 children with ASD and 41 typically developing children aged between 3 and 10 years, who met the basic selection criteria of the study. The research applications were carried out at the Human-Computer Interaction Laboratory of the Middle East Technical University. A set of visual materials on visual scanning and recall features were prepared to compare the visual scanning skills of children with ASD and typically developing children. As a result of the statistical analysis of the data obtained from the participant children through the eye-tracking device, it was determined that children with ASD exhibited unusual visual scanning and recall characteristics that were different from those of children with typical development. Children with ASD focus their visual attention on familiar faces and objects, whereas children with typical development focus their visual attention on novel (unfamiliar) faces and objects. Based on this result, it was suggested that in educational materials to be prepared for children with ASD, human faces and stimuli with which they have developed familiarity should be preferred, taking into account the visual focus of attention. Another striking result of this study was that children with ASD tended to focus more on the stimuli (objects) when the human face and the stimuli were presented together.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is characterized by marked social-communicative deficits, repetitive behaviors, and limited interest (American Psychiatric Association, 2013; Mundy & Burnette, 2005). Children with ASD exhibit intense problems in social skills such as making eye contact, initiating and maintaining verbal and non-verbal social interaction, understanding others' intentions and feelings, and adapting to changes (Charman, 2004). Children with ASD are known to exhibit an intense focus on specific sensory stimuli—such as bright lights, repetitive sounds, or moving visual patterns—that align with their individual perceptual preferences and sensitivities in daily life and natural environments (Ceyhun, 2015; Ceyhun, 2023). However, some studies have identified atypical characteristics of children with ASD. Some studies suggest that children with ASD exhibit limited performance in face scanning and recognition and differ from children with normal development in face processing skills (Boucher & Lewis, 1992; Ceyhun & Özdemir, 2014; Chawarska et al., 2007; Chawarska & Volkmar, 2007; Joseph & Tanaka, 2003; Klin et al., 1999; Özdemir et al., 2017). In particular, the different patterns exhibited by individuals with ASD in looking at their faces and eyes are quite remarkable and have been the subject of research in recent years. Face processing skills are known as face scanning and face identification skills for moving, talking people or object images, static people or object images and require visual attention and visual perception skills (Chawarska et al., 2007; Chawarska et al., 2012). In typically developing (TD) infants, the process of face recognition begins at birth (Bedford et al., 2012) and continues with the development of joint attention skills, which become evident at the end of the first year and develop in the 6th and 9th months. After the age of two, TD children can recognize the faces of many people (Pascalis, de Haan, & Nelson, 2002). It has been suggested that children with ASD have limitations in scanning key features of the face during face processing and simple face recognition performance, and that these limitations can be recognized in the first years of life (Chawarska & Shic, 2009; Chawarska & Volkmar, 2007). In fact, when family videos of children who were later diagnosed with autism (regressive autism) were examined retrospectively, atypical social behaviors such as lack of eye contact and lack or absence of mutual gaze were observed in children with ASD (Golarai, Grill-Spector, & Reiss, 2006).

There are different perspectives on the origin of face processing disorders in individuals with ASD: Specific to ASD, the face is not a focal point to which attention is directed and sustained; problems encoding information from the eyes, lack of perception of cues to recognize and process the face; There are opinions that the act of speaking on the face and establishing eye contact does not attract sufficient attention in children with ASD; that these individuals may avoid face-to-face interaction even when an appropriate social environment and interaction partners are present—possibly due to reduced social motivation or atypical processing of social stimuli, rather than merely a lack of experience (Bradshaw et al., 2011; Dawson et al., 2002; Klin et al., 2003; Noris et al., 2012; Schultz, 2005). Delays in face processing skills during the early stages of development can negatively affect other areas of development, particularly social and cognitive development (Pascalis et al., 2002). Visual attention to people, situations and stimuli and eye tracking skills are important components in the development of social and cognitive skills, and limitations in these skills can lead to serious problems in other developmental areas (Shic et al., 2011). Children with ASD spend more time looking at, focusing on, and following facial expressions than typically developing children do (Chawarska et al., 2011; Chawarska & Shic, 2007; Chawarska & Shic, 2009; Chawarska & Volkmar, 2007). In addition, facial processing problems negatively affect the perception of facial expressions (Gross, 2004; Pelphrey et al. 2002). In ASD, limitations in recognizing and understanding information related to social interactions from human faces begin to be observed at an early age (Chawarska et al., 2010). Individuals with ASD have problems in preferring human faces over other stimuli, limitations in receiving emotion-related cues from faces in non-obvious situations, problems in forming joint attention by watching people's gaze, using unusual face scanning strategies, and face processing disorders leading to problems in social interaction (Chawarska et al., 2010). Understanding the source

of these social interaction problems that individuals with ASD exhibit in understanding social and emotional cues from human faces and determining the differences in the strategies used are the subject of studies aimed at better understanding the mechanism underlying social inadequacy and research on early intervention practices (Jones et al., 2008; Rutherford & Towns, 2008). A review of the literature reveals that the concepts of 'visual scanning, ' 'face processing, and 'ye-tracking skills are used interchangeably. While face processing skills focus on the face and facial regions, visual scanning skills focus on the entire stimuli presented, including the facial region. Eye tracking skills refer to the ability to follow presented stimuli with eye movements. Determining the face processing, eye tracking, and visual scanning skills of individuals with ASD and identifying their differences from individuals with typical development is important for studies in many developmental areas, such as social interaction, language, and cognitive development. It is also stated that these studies can shed light on understanding the core characteristics of ASD—such as difficulties in social communication and restricted, repetitive behaviors—as well as how these characteristics emerge and evolve over time during early childhood development (Ceyhun, 2015; Ceyhun, 2023). Thus, it provides important clues for recognizing and following individuals with ASD risk in the earliest period (Ceyhun, 2015; Ceyhun, 2023). Thus, it provides important clues for recognizing and following individuals with ASD risk in the earliest period (Ceyhun, 2015; Ceyhun, 2023).

Recent literature shows that one of the prominent research topics in the field of autism spectrum disorder is the investigation of how individuals with ASD process faces, establish eye contact, and visually scan their environment. In addition to ongoing genetic finding-based or neurological research in individuals with ASD, the measurement of social behaviors of individuals with ASD, which are among the behavioral symptoms of autism, has been a research area that has been emphasized in recent years. In the literature, it has been observed that there is a tendency towards research to determine the level and predisposition of individuals at risk of ASD to perceive social cues, such as eye contact, following other people's gaze, joint attention, and communicative and emotional gestures (Bradshaw et al., 2011; Chawarska & Shic, 2009; Chawarska & Volkmar, 2007; Dawson et al., 2004; Jones, Carr, & Klin, 2008; Rutherford & Towns, 2008; Webb et al., 2010).

The use of eye-tracking technologies, which is a preferred method in many visibility activities such as psychology, market research, media, and advertising, to identify the areas and regions where the target audience concentrates its attention, and to understand the nature of the developmental course of individuals with ASD has attracted the attention of experts in the field in recent years. Research shows that eye-tracking technologies are an effective method for identifying and measuring where individuals focus their attention in complex social situations (Klin et al., 2002). Understanding the attentional patterns of children with ASD through such technologies is especially important, as it provides insights into their social attention deficits, helps differentiate them from typically developing peers, and informs the development of early intervention strategies targeting social and communication skills. The fact that eye-tracking technologies can directly measure visual and social attention (Klin et al., 2002) and the widespread use of this technological application and the ease of access to eye-tracking systems (Sasson & Elison, 2012) have increased the number of eye-tracking studies. Despite the growing literature on face processing, there is limited research examining how familiarity with stimuli influences the visual scanning of children with ASD using eye-tracking in naturalistic contexts. From this perspective, this research is based on the understanding and measurement of visual scanning and face recognition features of children with ASD using eye-tracking technologies. This study aimed to compare the visual scanning skills of children diagnosed with ASD and typically developing (TD) children between the ages of 3-10 years using eye tracking systems. For this purpose, we sought to answer the following question: Do eye-tracking findings differ in the visual scanning skills of children with ASD and typically developing children in terms of visual scanning and recall characteristics?

METHOD

RESEARCH DESIGN

Quantitative research methods were used in this study. This study is a correlational survey model since it examines the visual scanning skills of children diagnosed with ASD and typically developing children through eye-tracking systems. Survey models aim to describe past or present situations as they exist. According to Karasar (2012), the relational survey model aims to determine the existing change between two or more variables and/or the degree of this change, which are interpreted in the context of predicting the other if the situation in one variable is known, rather than a cause-and-effect relationship. There are two types of relational survey model: correlation and comparison. In the comparison type of correlational survey, we examined whether there was differentiation between at least two variables (Karasar, 2012).

STUDY GROUP

Descriptive characteristics of the study groups are presented in Table 1.

Table 1. *Descriptive Characteristics of the Study Group*

TD (Age)	TD	TD Total Age (%)	TD Min-Max looking at screen (%)	TD looking at the screen (%)	ASD (Age)	ASD	ASD Total. Age (%)	ASD Min-Max looking at screen (%)	ASD looking at screen (%)
3	7	17.0%	50-71	63.2%	3	6	16.2%	10-19	13.3%
4	5	12.2%	67-77	73.4%	4	6	16.2%	22-31	25.0%
5	4	9,7%	61-84	78,0%	5	5	13.5%	27-38	33.6%
6	3	7.3%	75-82	78,6%	6	3	8,1%	41-43	41.6%
7	4	9,7%	76-90	83.0%	7	6	16.2%	40-46	43.6%
8	6	14.6%	75-91	82.6%	8	4	10,8%	46-57	50,7%
9	7	17.0%	87-95	90,8%	9	3	8,1%	48-56	51.6%
10	5	12.2%	90-97	94.2%	10	4	10,8%	46-72	56.2%
Total	41		50-97	80,3%		37		10-72	36.9%

The study group consisted of 78 children residing in Ankara, 37 children between the ages of 3 and 10 years who were diagnosed with ASD and 41 children with typical development (TD). The main selection criteria for children with ASD included in the study group were that they were diagnosed with ASD according to the DSM-V diagnostic criteria, had no additional disability or visual defect, participated in any activity for at least 10 min, and had no problem behaviors or sensory sensitivity that would affect the research process. In children with TD, the inclusion criterion was the absence of any suspicion of disability or visual defects, in accordance with the parental report. Parents of the children in both groups consented to participate in the study.

When the descriptive characteristics of the study group are analyzed in Table 1, it is seen that there were a total of 29 girls in the study group, including 6 girls diagnosed with ASD and 23 girls with typical development, while there were a total of 49 boys in the study group, including 31 boys diagnosed with ASD and 18 boys with typical development. In addition, the percentages of looking at the screen on the eye-tracking device of the children participating in the study were 80.3% in TD children and 36.9% in children with ASD. While the minimum and maximum percentages of looking at the screen were between 10-72% in children diagnosed with ASD, the percentages were between 50-97% in TD children.

DATA COLLECTION TOOLS

*Participant Information Form***:** This contains information about the participating children (chronological age, developmental history, regressive autism, gender, birth order, birth order, health status, etc.) developed by the researcher to record personal information about the research participants and to determine the basic selection criteria for forming the study group.

*Gilliam Autistic Disorder Rating Scale-2-Turkish Version (GOBDÖ-2-TV)***:** It is a rating scale that aims to assess individuals between the ages of 3-23 who exhibit behaviors characteristic of autism spectrum disorder.GOBDÖ-2-TV; 1) identifying and diagnosing individuals with ASD; 2) assessing severe behavioral problems; 3) determining/evaluating behavioral progress; 4) determining goals for Individualized Education Plan (IEP), and 5) it can be used to collect data for scientific research GOBDÖ-2-TV (Gilliam Autism Rating Scale-2 - Turkish Version) is a standardized scale adapted to Turkish by Diken, Ardıç and Diken (2012). It is designed to help identify individuals with autism spectrum disorder by evaluating behavioral characteristics in areas such as communication, social interaction, and stereotyped behaviors. The scale has been reported to have high reliability and validity in Turkish samples. In this study, as a result of the application of the GOBDÖ-2-TV scale, the mean subscale standard scores (X = 13.4), range values (Xmin-Xmax = 10-17; ss = 1.9), autistic disorder index value (X = 118.7; ss = 9.7), and range values (Xmin-Xmax = 103-138) achieved in children with ASD. According to the data on the subscale standard scores and ASD index values of the scale, it was determined that the probability of ASD was quite high in all children with ASD in the study group, in line with the decision guide of the scale.

*Eye Tracking Device and Software***:** Eye tracking is a method that provides data on where, how long, and how often a person looks at visual stimuli, offering insights into attention, perception, and cognitive processes. It is implemented using an eye-tracking device that detects the pupil via infrared technology and tracks gaze direction and duration. This allows for the creation of heat maps, gaze paths, and statistical reports on visual attention. In this study, eye movements of children with ASD and typically developing peers were recorded using a Tobii T120 eye tracker (17-inch screen, 60 Hz) and analyzed with the Tobii Studio 3.3 software. This program converts infrared reflections into visual and numerical data and enables detailed analysis of variables such as fixation frequency and duration. The system uses pupil/corneal reflection techniques, and gaze direction is calculated based on the relative position of these reflections. Tobii Studio also allows synchronized recording of screen images, participant views, and gaze patterns during the task.

RESEARCH ENVIRONMENT

The pilot and main implementation process of this research was conducted at the Middle East Technical University Human and Computer Interaction Research and Application Laboratory. The laboratory has two rooms, an outer room and an inner room, separated by an observation mirror. The outer room was organized for the researcher to follow the implementation process and for parents to watch their children, while the other room, the inner room, was the practice environment. In this room, there is a Tobii eye-tracking device for collecting eye-tracking data, as well as a table and chair. The windows were covered with dark blinds and the walls were covered with black Styrofoam, which prevented light reflection and sound permeability. The room was illuminated to ensure precise measurements during the eye-tracking process, and there were no stimuli that could distract the participants. The laboratory has one eye-tracking device (Tobii T120) that provides information about where, how long, and how many times the user looks at the screen during the test and records eye movements. The computer to which the user will perform the test, to which this device is connected, was also connected to another computer in the observer room that recorded the user's screen image. There is a control unit that controls the 360° rotating cameras connected to a monitor that shows the screen images of the user and observer computers, together with the images taken by the two

cameras. There are two moving cameras in the test room, one showing the user's face and the other showing the keyboard usage.

MATERIALS

In addition to the Tobii T120 eye-tracking device and software program, a visual material set was used to determine the differential effects of visual scanning skills of children with ASD and typically developing children in terms of visual scanning performance. This set of materials was prepared by the researcher to determine visual scanning features, such as focusing on familiar and unfamiliar human faces, familiar and unfamiliar stimuli, stimulus and face recognition, and recall/novelty preference. The Face Scanning and Recognition Set was presented with a flow fiction consisting of nine photographs and three sets. First, a picture with a model (face) and an object (target face-target object) is presented on the screen. After a 10-second examination (familiarity development) phase, a blank gray screen was presented on the screen for 5 s, and a red dot image was presented on the blank gray screen for 1 s, which is called the re-centering stimulus. In the next stage of editing, the face in the first picture (target face) and another similar model (face) were displayed on the screen for 5 s. Likewise, the object in the first picture (target object) and a pair of pictures with another similar object appeared on the screen for 5 s for recognition and examination. In this set of materials, four different models and four different object pictures are used to prevent the development of familiarity. The objects in each set had similar characteristics (e.g., red and white cars). Likewise, the appearance characteristics of the models for each set, such as hair color, eye color, facial expression, and clothing, were similar to each other. In addition, in the presentation of each set, we tried to ensure internal validity by changing the position (right-left) of the pictures and objects of the old and new faces. In addition, the order in which the models and objects appeared on the screen was also changed in each set to affect the recall. This set of materials remained on the screen for 108 seconds in total. An example of the static picture recognition setup is shown in Figure 1.

Figure 1. *Example of Static Pictures Recognition Material Set Setup (Set I)*
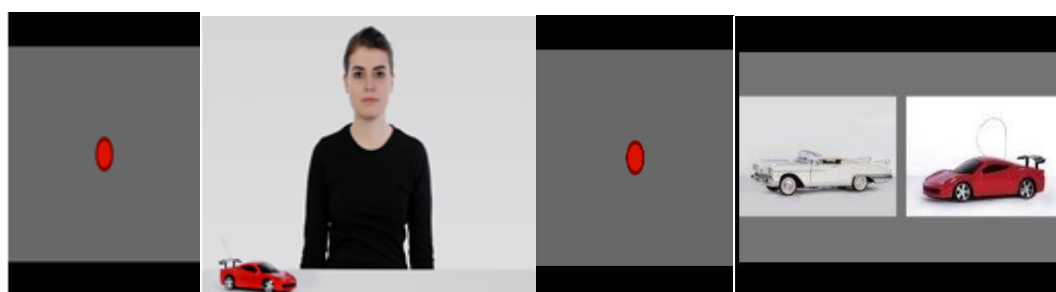
Two expert panels consisting of experts (special education specialists, visual communication specialists, psychologists, and graphic designers) were organized to evaluate the suitability of this visual material for research purposes. During the expert panel, the suitability of the visual material prepared for the purpose of the research was evaluated using an expert opinion evaluation form based on a 3-point Likert scale. Some pictures were modified in line with the opinions of the expert panelists. Suitable photographs were rearranged by a graphic designer, taking into account the elements of color, light, distance proximity, and brightness. To prevent the queue effect in the examination of the visual materials used in the study, they were randomly uploaded to the Tobii Studio program in a mixed order. In accordance with the purpose of the research, nine photographs were used in three sets.

*Data Collection Period***:** In the process of collecting eye-tracking data, each participant child was tested individually in an inner room at the Middle East Technical University Human and Computer Interaction Research and Application Laboratory. The researcher managed the implementation process for each child in the study group. The child was seated in a comfortable chair 50-80 cm away from the computer screen at a 25° angle to the screen. Before the visual materials were shown, to ensure that the children focused on the screen, verification trials called calibration, which requires

tracking five consecutive dots on the screen with eye movements, were performed by the software to ensure that the focus on the screen was achieved with a high level of accuracy. To perform the calibration process, children were asked to look at the computer and follow the dots appearing in five different regions of the computer screen with their eyes. After the children looked at the five points appropriately and reliable calibration data were obtained, the application was initiated. Before the application, it was explained to the children that they would watch a short (20 s) animated cartoon that they would have fun. At the beginning of the intervention, all children in the study group were given the instruction "You are watching the screen with all your attention without taking your eyes off the screen." When the children were distracted or took their eyes away from the screen, the instruction was repeated, and the instruction to look at the screen was given to ensure that all the children directed their attention to the screen. For children aged 3-4 years of age, the researcher modeled the appropriate way to look at the screen to ensure that they fulfilled the verbal instructions correctly. The experimental process was completed by placing the child in the room where the application was performed, sitting in the appropriate position, explaining the application, performing the calibration process, and showing the visual materials.

Conducting the Pilot Application: After determining the participant group and finalizing the materials in line with expert opinions, a pilot study was conducted to test the applicability of the research. In this context, a total of 12 children, 6 children with typical development, and 6 children diagnosed with autism participated in the pilot study. In line with the pilot study, distracting stimuli were controlled in a laboratory environment. For example, it was observed that children were distracted when they saw their own reflections in the observation mirror, which divided the laboratory into two separate sections. To prevent this, the observation mirror was covered with a black curtain and distracting stimuli, such as an air conditioner button. It was observed that the children were hesitant to enter the laboratory environment because the walls and windows were blacked out for sensitive eye tracking in the laboratory environment. When the actual implementation of the research was carried out, the corridor where the laboratory was located and the outer door of the laboratory were decorated with balloons to eliminate this situation and to encourage the children. In addition, it was observed that some of the young children did not want to be separated from their mothers during the pilot implementation; therefore, in the main implementation, the environment was organized to ensure that their mothers were close to their children during the laboratory practices so that the children felt safe. During the implementation, reinforcers were given to the children to help them fulfill the instructions given. Conducting the Main Implementation: In the main intervention, typically developing children and children with ASD in the study group participated on separate days. Each child in the study group participated individually in the study. The families of the children selected for the study were given detailed information about the implementation process of the study. During the implementation process of the study, families were told that they could accompany their children if they wished to do so, and it was ensured that the child felt comfortable and safe, especially with the participation of the parents of young children. Eye tracking calibration of the children was performed at the beginning of the research. After it was determined that all children's eye calibrations were at the appropriate level for eye tracking, they were shown images in line with the research objectives. During the implementation process of the study, the research applications could not be conducted with two children who had physiological problems with eye calibration. During the implementation process, children who moved their eyes away from the screen to avoid losing their eye movements were warned and their attention was directed to the screen. Therefore, an experimental environment was created in which the researcher could supervise the experimental process during the implementation.

VALIDITY AND RELIABILITY

To control for factors that might threaten the validity and reliability of the study, the experimental process was carried out in a standardized manner with each child in the study group. To

prevent the order effect when each of the visual materials used in the study was examined by the children in the study group, the visual materials were shown randomly in a mixed order. Thus, we tried to control for the effect of the order in which the visual materials used in the study appeared on the screen on the duration of focusing on the visual material. Additionally, expert panels were organized to ensure the reliability of the visual material sets used in the study, and expert opinions were obtained. The material sets were scored to ensure interobserver reliability. Inter-observer reliability data were obtained using the formula "Agreement / (Agreement + Disagreement) X 100" (Kırcaali-İftar & Tekin, 1997). The photo sets with a consensus above 80% were re-examined by two coders. At this stage, the visual material sets with the highest score among the photo sets were determined with an 86% consensus among the observers.

DATA ANALYSIS

To obtain eye-tracking data of the children in the study group regarding the visual materials, the visual materials of the study were categorized into areas of interest. Areas of interest were determined in accordance with the characteristics to be measured in the study and the regions in which visual attention was distributed. While determining the areas of interest in each visual field, care was taken to ensure that the areas did not overlap. Thus, each gaze of the children was measured in only one region, and there were no intersection points between the regions. The Tobii Studio 3.3. computer program used in the study was used to analyze the eye-tracking variables of all stimuli in the visual material set after data entry according to the codes specified in the user manual. In the analysis of quantitative data in the study, the Mann-Whitney U rank difference test was used to compare the looking/focusing tendencies of typically developing children and children with ASD in different regions. This statistical test is used to test the significance of the difference between groups in terms of the characteristics intended to be measured when the data are not normally distributed; therefore, parametric statistics cannot be used. Since the data collected within the scope of the research did not show a normal distribution, and the percentage of missing data was high, this analysis was used for inter-group comparison.

Dependent Variables of the Study: Areas of interest are the visual materials used in the eye-tracking data analysis process. Areas of interest (AOI), which were determined in accordance with the characteristics to be measured in each sub-objective of the study and the regions where visual attention was distributed, were also included in the eye-tracking data in the study, time to first fixation, total fixation duration, and total visit duration. To explain these data, a) time to first fixation: this value indicates the time elapsed before the participants' first gaze fixation within the Area of Interest (AOI) or AOI group. b) Total fixation duration refers to the total duration of each gaze fixation within an Area of Interest (AOI) or the AOI group. c) Total visit duration (total visit duration); indicates the total duration of navigation to each area of interest (AOI /Area of interest) in the gaze focusing performed by the participants within the AOI or AOI group.

RESULTS

For the purpose of this study, time-to-first fixation, total fixation duration, and total visit duration values were analyzed in the Face Scanning and Recognition visual material sets presented to typically developing children and children with ASD. The Mann-Whitney U rank difference test was used to compare the looking/focusing tendencies of typically developing children (TD) and children with ASD in different regions.

TIME TO FIRST FIXATION FINDINGS IN A STATIC FACE SCANNING AND RECOGNITION SET

The results of the Mann–Whitney U analysis examining the time to first fixation measurements in the eye-tracking data reflecting the visual scanning and recall features of the photographs in the static picture recognition sets of the children participating in the study are given in Table 2.

Table 2. *Time To First Fixation Measurements in Static Image Recognition Sets*

	Area	n	$\bar{X}$	Med	SS	Max	Min	n	$\bar{X}$	Med	SS	Max	Min	p
			TD						ASD					
I.SET	Old Object	14	18.11	17.96	0.68	19.49	17.42	9	18.11	17.72	0.73	19.58	17.42	.95
	Old Face	13	22.85	22.82	0.44	23.59	22.36	8	22.99	22.49	1.35	26.29	22.36	.47
	Target Face	13	1.46	1.42	0.1	1.75	1.42	8	3.43	1.49	3.24	8.66	1.42	.06
	Target Object	12	1.85	1.62	0.64	3.52	1.27	9	2.84	1.63	1.58	7.39	1.28	**.04***
	New Face	14	17.57	17.42	0.37	18.82	17.42	8	17.93	17.54	1.01	20.37	17.42	.23
	New Object	12	22.5	22.3	0.25	23.03	22.36	9	23.05	22.54	1.45	26.87	22.36	.23
II.SET	Old Face	13	17.8	17.7	0.47	18.9	17.2	8	18.0	17.6	1.24	20.9	17.2	.59
	Old Object	14	22.5	22.5	0.6	24.3	22.0	7	23.0	22.7	1.08	25.2	22.0	.33
	Target Face	13	1.16	1.14	0.04	1.29	1.14	8	2.35	1.14	2.58	8.44	1.14	.17
	Target Object	12	1.72	1.63	0.28	2.15	1.3	7	2.06	1.64	0.9	3.52	1.23	.80
	New Face	12	17.5	17.3	0.37	18.2	17.2	7	18.0	17.4	1.55	21.5	17.2	.50
	New Object	13	22.2	22.0	0.28	22.7	22.0	8	22.3	22.4	0.33	23.0	22.0	.59
III.SET	Old Face	13	22.4	22.0	0.46	23.2	22.0	6	22.6	22.0	1.23	25.1	22.0	.70
	Old Object	14	17.7	17.3	1.23	21.9	17.0	8	17.8	17.3	1.13	20.6	17.2	.89
	Target Face	14	1.73	1.05	2.37	9.96	1.05	8	1.06	1.05	0.04	1.15	1.05	**.03***
	Target Object	9	2.75	1.97	1.76	6.09	1.33	9	2.58	1.49	1.7	6.09	1.43	.83
	New Face	13	22.2	22.4	0.34	23.1	22.0	8	22.7	22.6	0.47	23.6	22.0	.07
	New Object	13	17.6	17.3	0.61	19.1	17.0	8	18.2	17.7	1.36	21.4	17.2	.19

*$p < .05$

When the time to first fixation findings of Set I were analyzed (Table 2), there was a significant difference between children with typical development (n = 12, X < B-> = 1.85, SD = .64) and children with ASD (n = 9, X < B-> = 2.84, SD = 1.58) for the Target Object region (p = .04). In children with ASD, the mean focus on eye tracking in this region was higher.

When the time to the first fixation findings of Set II in Table 2 were analyzed, there was no significant difference between children with typical development and children with ASD.

When the time to first fixation findings of Set III were analyzed (Table 2), there was a significant difference between children with typical development (n = 14, X < B-> = 1.73, SD = 2.37) and children with ASD (n = 8, X < B-> = 1.06, SD = 0.04) for the Target Face region (p = .03). In children with typical development, the mean focus on eye-tracking in this region was higher.

TOTAL FIXATION DURATION FINDINGS IN THE STATIC FACE SCANNING AND RECOGNITION SET

The results of the Mann–Whitney U analysis examining the total fixation duration measurements in the eye-tracking data reflecting the visual scanning and recall features of the photographs in the static picture recognition sets of the children participating in the study are given in Table 3. The source of significant differences in the analysis results is explained.

Table 3. *Total Fixation Duration Measurements in Static Image Recognition Sets*

	Area		TD						ASD					p
		n	$\bar{X}$	Med	SS	Max	Min	n	$\bar{X}$	Med	SS	Max	Min	
I.SET	Old Object	14	1.57	1.63	0.59	2.66	0.25	9	1.32	1.45	0.93	2.7	0.1	.80
	Old Face	13	1.61	1.51	0.75	3.4	0.3	8	1.36	1.32	0.58	2.05	0.27	.32
	Target Face	13	5.1	5.34	2.56	9.18	1.1	8	3.17	2.9	1.92	5.83	0.98	**.04***
	Target Object	12	2.09	1.58	1.5	5.15	0.07	9	2.67	1.83	2.19	7.35	0.43	.64
	New Face	14	2.24	2.33	0.91	3.9	0.54	8	2	2.08	1.1	3.76	0.43	.50
	New Object	12	1.84	1.98	0.73	2.54	0.48	9	1.74	1.93	1.01	2.97	0.06	.94
II.SET	Old Face	13	1.67	1.63	0.66	3.1	0.63	8	1.95	0.8	0.64	2.3	0.12	**.01***
	Old Object	14	1.66	1.64	0.94	3.71	0.18	7	1.27	1.08	0.71	2.51	0.5	.39
	Target Face	13	5.21	6.14	2.62	8.19	0.94	8	2.88	2.62	2.46	7.51	0.09	.09
	Target Object	12	1.83	1.79	1.02	4.31	0.73	7	2.58	2.7	0.73	3.5	1.7	.11
	New Face	12	1.67	1.71	0.91	2.95	0.06	7	1.47	1.07	1.09	3	0.1	.67
	New Object	13	2.44	2.32	0.92	4.22	1.07	8	2.28	2.43	0.97	3.62	0.63	.47
III.SET	Old Face	13	1.03	0.98	0.52	2.1	0.3	6	1.32	0.96	0.99	2.67	0.18	.87
	Old Object	14	2.08	2.25	0.83	3.05	0.09	8	2.16	2.56	1.18	3.1	0.13	**.02***
	Target Face	14	5.59	5.99	3.17	9.67	0.23	8	3.11	2.61	2.74	8.48	0.41	.25
	Target Object	9	1.95	1.91	1.03	3.4	0.38	9	2.42	1.58	1.93	6.51	0.37	.70
	New Face	13	2.64	2.42	0.77	3.98	1.67	8	1.33	1.09	1.27	3.98	0.18	**.03***
	New Object	13	1.87	1.76	0.68	3.33	1.03	8	1.4	1.4	0.69	2.31	0.17	.18

*$p < .05$

When the total fixation duration findings of Set I in Table 3 are analyzed, there is a significant difference between children with typical development (n = 13, $\bar{X}$ = 5.1, SD = 2.56) and children with ASD (n = 8, $\bar{X}$ = 3.17, SD = 1.92) for the Target Face region (p = .04). Typically, developing children have a higher mean eye-tracking focus in this region.

When the total fixation duration findings of Set II are analyzed in Table 3, there was a significant difference between children with typical development (n = 13, $\bar{X}$ = 1.67, SD = 0.66) and children with ASD (n = 8, $\bar{X}$ = 1.95, SD = 0.64) for the Old Face region (p = .01). In children with ASD, the mean focusing in eye tracking in this region was higher.

When the total fixation duration findings of Set III are analyzed in Table 3, there is a significant difference between children with typical development (n = 13, $\bar{X}$ = 2.64, SD = 0.77) and children with ASD (n = 8, $\bar{X}$ = 1.33, SD = 1.27) for the New Face region (p = .03). Children with typical development had higher averages of focusing in eye tracking in this region. For the Old Object region, there was a significant difference between children with typical development (n = 14, $\bar{X}$ = 2.08, SD = 0.83) and children with ASD (n = 8, $\bar{X}$ = 2.16, SD = 1.18, p = .02). In children with ASD, the mean focusing in eye tracking in this region was higher.

TOTAL VISIT DURATION FINDINGS IN THE STATIC FACE SCANNING AND RECOGNITION SET

The results of the Mann–Whitney U analysis examining the measurements of the total visit duration findings in the eye-tracking data reflecting the visual scanning and recall features of the photographs in the static picture recognition sets of the children participating in the study are given in Table 4. The source of the significant differences is explained in the analysis results.

Table 4. *Total Visit Duration Measured in Static Image Recognition Set*

	Area	TD						ASD						p
		n	$\bar{X}$	Med.	SS	Max.	Min.	n	$\bar{X}$	Med.	SS	Max.	Min.	
I.SET	Old Object	14	1.61	1.63	0.62	2.66	0.25	9	1.43	1.54	1.17	3	0.1	.49
	Old Face	13	1.64	1.51	0.77	3.53	0.3	9	1.29	1.31	0.66	2.05	0.27	.49
	Target Face	13	5.37	5.69	2.64	9.49	1.1	7	3.58	3.28	2.45	6.81	0.98	.10
	Target Object	12	2.14	1.8	1.48	5.15	0.07	9	2.66	1.92	2.25	7.35	0.43	**.02***
	New Face	14	2.3	2.36	0.93	3.9	0.54	7	2.03	1.78	1.24	3.76	0.43	.49
	New Object	12	1.92	2.06	0.71	2.85	0.48	9	1.75	1.73	1.1	2.97	0.06	**.04***
II.SET	Old Face	13	1.71	1.74	0.65	3.1	0.75	8	1.86	0.74	0.69	2.3	0.12	**.02***
	Old Object	14	1.66	1.64	0.94	3.71	0.18	6	1.45	1.49	0.66	2.51	0.52	.22
	Target Face	13	5.61	6.98	2.79	9.04	0.94	7	3.38	3.75	2.49	7.71	0.09	.07
	Target Object	12	1.92	1.79	1.13	4.31	0.73	6	2.82	2.84	0.88	3.69	1.93	.08
	New Face	12	1.67	1.71	0.91	2.95	0.06	7	1.47	1.07	1.09	3	0.1	.67
	New Object	13	2.71	2.69	1.06	4.49	1.07	8	2.24	2.5	1.3	4.27	0.3	**.04***
III.SET	Old Face	12	1.06	0.87	0.56	2.1	0.3	5	1.08	0.93	0.9	2.59	0.18	.76
	Old Object	13	2.19	2.37	0.99	3.54	0.09	7	2.24	2.68	1.34	3.54	0.13	**.03***
	Target Face	13	5.83	6.75	3.37	10.07	0.23	7	3.73	3.72	3.14	8.88	0.41	**.04***
	Target Object	8	1.96	1.68	1.07	3.4	0.63	9	1.78	1.4	1.23	3.63	0.37	.83
	New Face	12	2.79	2.9	0.72	3.98	1.71	7	2.12	1.87	1.43	3.98	0.46	**.01***
	New Object	12	1.94	1.81	0.83	3.61	1.03	7	1.27	1.37	0.63	2.07	0.17	.31

p < .05

When the total visit duration findings of Set I are analyzed in Table 4, there was a significant difference between children with typical development (n = 12, $\bar{X}$ = 2.14, SD = 1.48) and children with ASD (n = 9, $\bar{X}$ = 2.66, SD = 2.25) for the Target Object region (p = .02). Children with ASD had a higher average focus on eye tracking in this region. There was a significant difference between children with typical development (n = 12, $\bar{X}$ = 1.92, SD = 0.71) and children with ASD (n = 9, $\bar{X}$ = 1.75, SD = 1.1) for the New Face region (p = .04). In children with typical development, the mean focusing in eye tracking in this region was higher.

When the total visit duration findings of Set II are analyzed in Table 4, there is a significant difference between children with typical development (n = 13, $\bar{X}$ = 1.71, SD = 0.65) and children with ASD (n = 8, $\bar{X}$ = 1.86, SD = 0.69) for the Old Face region (p = .02). The mean focusing in eye tracking in this region was higher in children with ASD. For the New Object region, there was a significant difference between children with typical development (n = 13, $\bar{X}$ = 2.71, SD = 1.06) and children with ASD (n = 8, $\bar{X}$ = 2.24, SD = 1.3, p = .04). In children with typical development, the mean focusing in eye tracking in this region was higher.

When the total visit duration findings of Set III are analyzed in Table 4, there was a significant difference between children with typical development (n = 13, $\bar{X}$ = 5.83, SD = 3.37) and children with ASD (n = 7, $\bar{X}$ = 3.73, SD = 3.14) for the Target Face region (p = .04). In children with typical development, the mean focusing in eye tracking in this region was higher. There was a significant difference between children with typical development (n = 12, $\bar{X}$ = 2.79, SD = 0.72) and children with ASD (n = 7, $\bar{X}$ = 2.12, SD = 1.43) for the New Face region (p = .01). In children with typical development, the mean focusing in eye tracking in this region was higher. There was a significant difference between

children with typical development (n = 13, $\bar{X}$ = 2.19, SD = 0.99) and children with ASD (n = 7, $\bar{X}$ = 2.24, SD = 1.34) for the Old Object region (p = .03). In children with ASD, the mean focusing in eye tracking in this region was higher.

DISCUSSION

When the first focusing time of the regions in Set I is analyzed, it is seen that "target object" is the region where the first focus of attention of children with ASD is directed. However, in Set III, in the "target face" region, the mean initial focusing time of children with typical development was significantly higher than that of children with ASD. In the same sets, no significant difference was found between children with typical development and children with ASD in terms of the first focusing time variable in the other regions and in the regions belonging to set II. This result shows that children with ASD focus their visual attention on objects rather than people, unlike children with typical development.

When the findings of total fixation duration in eye-tracking data reflecting visual scanning and recall features in the photographs included in the static picture recognition sets in the study were analyzed, Children with ASD and typically developing children had different visual scanning characteristics. When the focusing duration findings of Set I were analyzed, it was observed that children with typical development focused on the "target face" region more than their peers with ASD in the Target Face-Target Object photograph pair. Accordingly, it is possible to say that children with ASD look at the "target face" region for less time by directing their visual attention less; in other words, they perform visual scanning by focusing less on the human face. In this set, no significant difference was found between children with ASD and typically developing children in the average total focusing time for the "target object" region. In this regard, children with ASD prefer non-social areas. When the total fixation duration findings of Set II data are analyzed In the image with the Old Face-New Face photo pair, it is possible to say that children with ASD, unlike children with typical development, direct their visual attention more to the "old face" region and look at this region for more time; in other words, they perform visual scanning by focusing more on the familiar face.

This result is consistent with other studies (e.g., Chawarska & Shic, 2009). Accordingly, research has shown that individuals with ASD tend to focus more on familiar faces than their typically developing peers. When the total fixation duration findings of Set III were analyzed, it was observed that children with ASD directed their visual attention more to the "old object" region and looked at this region for a longer period of time in the image with the Old Object-New Object photograph pair, unlike children with typical development; In other words, it is possible to say that they performed visual scanning by focusing more on the familiar object. This result is consistent with those of other studies (Dawson, 2002; Klin et al., 2002). This result shows that individuals with ASD tend to focus more on familiar objects than their typically developing peers do. On the other hand, in the Old Face-New Face photograph pair in the same set, typically developing children directed their visual attention more to the "new face" and spent more time looking at this region; in other words, it is possible to say that they performed visual scanning by focusing more on the new face, which is consistent with the research. This finding shows that typically developing children direct their visual attention to and focus more on new faces.

When the total visit duration findings were examined in the eye-tracking data of the photographs included in the static picture recognition sets reflecting the visual scanning and recall features in the study, Children with ASD and typically developing children exhibited different visual scanning characteristics. In the Target Face-Target Object photograph pair in Set I, it is seen that children with ASD exhibit more time focusing in the "target object" region. Accordingly, it is possible to say that children with ASD direct their visual attention to the "target object" region more, glance more and look at the "target object" region for a longer period of time. This finding suggests that

children with ASD, unlike typically developing children, focus on objects rather than people for longer periods. On the other hand, in the image of the old face–new face photograph pair in the same set, it is possible to say that children with typical development directed their visual attention more to the "new face" region, glanced more and looked at the "new face" for more time. This finding suggests that typically developing children focus on novel faces for longer periods and examine them more. When the dependent variable of total visit duration for Set II was analyzed, it was observed that the mean of the "old face" region of children with ASD is high in the image with the Old Face-New Face photo pair, whereas the mean of the "new object" region of children with typical development was high in the image with the Old Object-New Object photo pair in the same set. Accordingly, it is possible to say that children with ASD tend to examine familiar faces more, whereas typically developing children spend more time looking at novel stimuli. This pattern is consistent with findings in the literature, which indicate that individuals with ASD show a preference for familiar visual stimuli and often display reduced interest in novel social cues (Pierce et al., 2011; Klin et al., 2002; Chevallier et al., 2012).

When the averages of the total visit duration for Set III are analyzed, it is seen that children with typical development tend towards the "target face" in the image with the Target Face-Target Object photo pair, unlike children with ASD. Likewise, it is possible to say that children with typical development directed more attention to the "new face" region in the image of the Old Face-New Face photograph pair, glanced more and looked at the "new face" region for more time. It is possible to say that children with ASD, on the other hand, directed more attention to the "old object" in the image with the Old Object-New Object photo pair, glanced more, and spent more time examining the familiar object. These findings suggest that typically developing children focus on human faces more than objects, whereas children with ASD focus on familiar objects for longer periods.

When the results of the study are evaluated, it is quite striking that children with ASD and typically developing children exhibit different visual attention and focusing characteristics in terms of human face and object preferences in static picture recognition sets. In the literature, it has been stated that children with ASD differ from typically developing children in facial processing features that are expected to develop from infancy, distinguish facial expressions of emotion, and respond appropriately to facial expressions (Bradshaw et al., 2011; Chawarska et al., 2007; Chawarska & Shic, 2009; Chawarska & Volkmar, 2007; Dawson et al., 2004). In a similar study, Chawarska and Shic (2009) examined face recognition and visual scanning features using eye tracking in 30 typically developing children aged 2-4 years and 44 children with ASD. In this study, children were divided into two age groups, and the research was conducted in two dimensions: face familiarity and face recognition. The fact that all older children who participated in the study spent less time examining the face suggests that there is a face processing process that regresses with age. In this context, it may be recommended to examine the age variable in the construct in future research.

It was observed that children with ASD looked at and focused more on familiar objects and human faces in the pictures included in the study. Chawarska and Shic (2009) found that children diagnosed with ASD have different face processing skills than typically developing children, and that they show an atypical face examination pattern when presented with unfamiliar faces. Similarly, Boucher and Lewis (1992) and Klin et al. (1999) reported that individuals with ASD made significantly more errors in recalling photographs of faces—a socially meaningful stimulus—while there was no significant difference in recalling images of objects. According to earlier studies on eye-tracking patterns, children with ASD require more time to perceive the facial features necessary for face recognition (Bradshaw et al., 2011; Chawarska, Macari, & Shic, 2012; Chawarska & Volkmar, 2007; Webb et al., 2010). Recent studies continue to support and extend these findings. For instance, studies by Wagner et al. (2019) and Black et al. (2021) emphasize that children with ASD show delayed and limited fixation on socially relevant areas such as the eyes and mouth, which are essential for facial identity recognition. These atypical patterns are thought to reflect differences in cognitive processes

related to attention, recognition, and memory encoding. Furthermore, research by Keehn et al. (2022) highlights that attention to familiar faces may be a compensatory strategy to reduce social complexity and cognitive load. Therefore, the tendency of children with ASD to focus more on familiar objects and faces may stem not only from recognition-based memory processes but also from a reduced motivation to engage with novel social stimuli.

In the Target Face-Target Object image, which was first presented in the setup in the study, and which participant groups were given more time to examine and remember than the time to examine the other pairs of photographs in the set, it was observed that children with ASD preferred objects as the focus of visual attention more than faces and looked at objects for longer periods of time. Similarly, studies have found that children with ASD can perform better in visual processing of non-social stimuli despite their inability to process social stimuli such as faces (Mottron et al., 2006). In support of this finding, Dawson et al. (2002) compared object and face recognition skills and found that, in face recognition activities, children with ASD concentrated their attention on the face to a lesser extent and within a shorter response time. When the research findings are analyzed, it is observed that children with typical development prefer human faces as the center of attention rather than objects. At the same time, typically developing children tend to look at new objects or human faces in presented visuals. In the literature, this is referred to as the 'novelty preference' (Chawarska & Shic, 2009). This finding shows that individuals with typical development direct their visual attention to novel stimuli and gaze more toward novel areas.

Eye movements provide important information about areas that people pay attention to and ignore, and by observing and interpreting eye movements, it is possible to learn about cognitive processes in the brain (Russell, 2005). For example, it has been stated that the long fixation time of the eye, which is one of the eye movement parameters, expresses an intense mental process, and values such as the number of fixations, average fixation time, and total review time of the gaze are closely related to the learning process (Rayner, 1998). In this context, the fact that the focusing variables of children with typical development towards novel regions in this study were higher than those of children with ASD suggests that children with typical development perform cognitive processing to recognize, understand, or learn novel stimuli by directing their eyes to the novel region.

The results of this study showed that children with ASD had unusual facial examination and visual scanning features compared with typically developing children. According to researchers, children with ASD have limitations in scanning key facial features during face processing and simple face recognition performance (Chawarska & Shic, 2009; Chawarska & Volkmar, 2007). In a study of adults with ASD (Klin et al., 2002), it was found that, when shown images of objects or people in a social setting, individuals with ASD spent more time watching objects and focused on faces for the limited time they spent looking at them. In relation to this research result, it has been suggested that human faces do not attract the attention of individuals with ASD and that individuals with ASD may spend less time on face processing because they do not prioritize human faces and do not find human faces stimulating enough (Chawarska et al., 2003; Chawarska et al., 2010; Volkmar et al., 2004).

As a result of the study, it was strikingly determined that while individuals with ASD focused their visual attention on familiar faces and objects, the visual attention focus preferences of children with typical development were for novel (unfamiliar) faces and objects. Based on this result, it can be suggested that in the educational materials to be prepared for individuals with ASD, human faces and stimuli that they constantly encounter in their environment, in other words, with which they develop familiarity, should be preferred to provide an opportunity to develop visual attention focus. For example, considering the tendency of individuals with ASD to focus on familiar faces, it can be suggested to actively include people familiar with children with ASD in their daily lives in the education process in teaching social interaction skills. In future research, it is believed that the use of familiar faces in visual materials within the scope of technologically based applications (for example, the preference of familiar faces in the preparation of virtual reality applications and avatars) will be

effective in educational applications. In addition, while organizing educational environments to teach academic and social skills to individuals with ASD, planning a teaching process from known to unknown stimulus preferences may be recommended.

Another striking finding of this study was that children with ASD tended to focus more on stimuli (objects) when a human face and stimuli were presented together. This research result may have a two-way reflection on educational practices; firstly, considering that objects may affect the visual attention focus in teaching social interaction skills, it may be recommended to organize structured teaching environments where stimuli are limited. Second, it can be suggested to use visual stimuli that attract interest as visual support to use the visual perceptual skills of individuals with ASD. In future studies, it may be recommended to conduct eye-tracking studies using stimuli with different characteristics to determine which related or unrelated characteristics of the stimuli affect the visual attention focus of individuals with ASD.

The social interaction limitations of individuals with ASD include problems in preferring human faces among other stimuli, limitations in receiving emotion-related cues from faces, problems in forming joint attention by watching people's gaze, using unusual face scanning strategies, and face processing disorders (Chawarska et al., 2010). On the other hand, understanding the source of these social interaction problems that individuals with ASD exhibit in understanding social and emotional cues from human faces and determining the differences in the strategies used provides an opportunity to better understand the mechanisms underlying social inadequacy (Jones et al., 2008; Rutherford & Towns, 2008). Research has shown that eye-tracking technologies are an effective way to see and measure where people focus on complex social situations (Klin et al., 2002).

LIMITATIONS AND RECOMONDATIONS

The fact that the number of children diagnosed with ASD in the study group in this study was limited to 37, the age range of the children varied between 3 and 10 years, and the degree of ASD varied may be a limitation in generalizing the findings of the study in children with ASD. In this context, the limitations of the study group should be evaluated by considering the distribution of children with ASD in the population and the limitations specific to the diagnosis of ASD. The number of typically developing children who participated in the study was 41, and they were selected by chronological age-matching with children with ASD. In comparative studies conducted on children with ASD, the selection of the study group by chronological age matching is also accepted in the literature (Charman, 2004).

Second, the eye-tracking analyses conducted in this study were limited by the selection criteria of the study group. The effects of gender, developmental level, and percentage of children looking at the screen in the study group were not considered. Considering these limitations, future studies should include children with ASD who have a homogeneous distribution in terms of ASD grades, age groups, gender, developmental level, and developmental level. It is important to examine visual scanning skills in sample groups, including children with a similar percentage of looking at the screen, by comparing them to generalize the findings obtained in the study.

Third, the measurement of the visual scanning features that were determined in this research was limited to the visual materials prepared within the scope of the research. This may be a limitation in generalizing the research findings. Therefore, these limitations can be eliminated by adding qualitatively different stimuli and quantitatively enriching the visual material sets used in this study.

Despite the limitations of the research, with the advancement of technology, trying to understand the characteristics of children with ASD through computer and eye-tracking technologies other than traditional methods may guide future studies in many developmental areas, such as social interaction, language, and cognitive development. In addition, it is thought that these studies will shed

light on the nature and development of ASD and will play a key role in recognizing and following up individuals at risk of ASD at the earliest stage.

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AUTHOR CONTRIBUTION

Ayşe Tuba Ceyhun: Conceptualization, Methodology, Data Collection, Analysis, Writing – Original Draft. Selda Özdemir: Supervision, Writing – Review & Editing.

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