Pharmacology & Pharmacy, 2024, 15, 315-326
https://www.scirp.org/journal/pp
ISSN Online: 2157-9431
ISSN Print: 2157-9423

A Study of Pharmacist-Patient Communication: Examining Optimal Distance and Angle Using an Eye-Tracking System

Chika Nakayama[1]*, Saori Gocho[2,3,4], Yukina Miyagi[2,4], Yuka Miyachi[2], Taeyuki Oshima[2]

[1]Department of Pharmacy, Gifu University of Medical Science, Kani, Japan
[2]College of Pharmacy, Kinjo Gakuin University, Nagoya, Japan
[3]Department of Pharmacy, Nagoya Ekisaikai Hospital, Nagoya, Japan
[4]Graduate School of Medicine, Aichi Medical University, Nagakute, Japan
Email: *cnakayama@u-gifu-ms.ac.jp

How to cite this paper: Nakayama, C., Gocho, S., Miyagi, Y., Miyachi, Y. and Oshima, T. (2024) A Study of Pharmacist-Patient Communication: Examining Optimal Distance and Angle Using an Eye-Tracking System. *Pharmacology & Pharmacy*, **15**, 315-326.
https://doi.org/10.4236/pp.2024.1510019

Received: August 30, 2024
Accepted: October 9, 2024
Published: October 12, 2024

Abstract

This study focuses on seating arrangement and interpersonal distance as important aspects of nonverbal communication and aims to elucidate the optimal distance and angle between pharmacist and patient through an analysis based on the subjective evaluation of the patient and the objective evaluation of eye movements. Seven female simulated patients and one male and one female pharmacist cooperated as patients and pharmacists, respectively. The medication teaching scenes were set up with three pharmacist placements (face-to-face at 50 cm and 70 cm, 90-degree at 70 cm) and three hospital rooms (0-degree, 45-degree, 90-degree). Pupil diameter, blink rate, saccades, and fixation rate of the patient at each of these locations were measured using a Tobii Pro Glass 2. The patient's subjective evaluation at each placement was also investigated using the conversation scale, which assesses the optimal distance for conversation. The results for the pharmacy setting revealed that pupils were significantly more mydriatic at the 50 cm point than at the other points. The results for the hospital room setting showed the greatest mydriasis at the 0-degree point. The result of the 50 cm point for the pharmacy setting and the 0-degree point for the hospital room setting was similar to that of the subjective evaluation. When the likelihood of saccades occurrence in the hospital room setting was compared, saccades were found to be most likely to occur when medication instructions were given to patients at the 0-degree point. We believe that using pupil diameter for interpersonal distance, and saccades for angle will enable more accurate determinations of the optimal distance and angle between pharmacist and patient. The results of the present study suggest that the 70 cm face-to-face point in the pharmacy and the 45-degree point in the ward may be suitable for medication instruction.

Keywords

Eye-Tracking System, Nonverbal Communication, Pharmacist Medication Instruction, Eye Movements

1. Introduction

According to the September 1, 2020, revision of the Pharmaceutical and Medical Devices Act [1], pharmacists are required to "understand necessary medication status and provide guidance based on pharmaceutical knowledge not only when dispensing medication, but also throughout the entire medication administration period". For this reason, it is becoming increasingly important for pharmacists to enhance their knowledge and skills as medication experts and effectively utilize those skills and knowledge by building trust with patients and providing better medical care [2]. Against this background, pharmacists are required not only to acquire knowledge and skills but also to use them appropriately and effectively for patients, which in turn requires them to further improve their communication skills.

There are two types of communication: verbal and nonverbal. Verbal communication refers to language as the main means of communication and is considered suitable for acquiring information with logical and intellectual content [3]. By contrast, nonverbal communication refers to things other than language, such as sitting position, posture, facial expressions, line of sight, and tone and speed of voice. It is considered appropriate for emotional content and mutual understanding as a means of giving the other party a sense of security and trust [3]. Since problems such as misunderstandings and false assumptions are likely to occur when making full use of only one type of communication, it is widely believed that a fusion of the two is necessary [4].

Until recently, communication research has focused mainly on verbal communication exchanges, although analyses and investigations have also been conducted on communication in medical settings. Meanwhile, research on nonverbal communication has not yet developed and has not even established measurement methods.

Eye movements in nonverbal communication have been reported to be closely related to emotions and feelings [5]. Of these, changes in pupil diameter and blinking are said to be associated with psychological conditions such as stress [6]-[8]. Moreover, the human eyeball is believed to take in visual information by repeating the eye movements called fixation, in which the line of sight remains stationary, and saccade, in which the line of sight moves at high speeds (100 - 500 degrees per sec) for short periods of time (20 - 80 ms) [9]. Occurring frequently in daily life, saccades are a representative form of eye movement that plays an important role in the formation of our vision [10]; in particular, they are voluntary and serve as indicators of spatial attention to emotional stimuli [5]. Therefore, in case of an indication of mental agitation, such as an unsteady line of sight, its influence could be examined in terms of the incidence rate of saccades. Furthermore, fixation is an eye movement that fixes the line of sight on a target and occurs in situations when persuading others, or as a reaction opposite to "averting one's gaze," which is considered a sign of rejection [11]. It follows that an investigation of eye movements could yield measures for the evaluation of others' comfort and discomfort.

Therefore, this study focuses on seating arrangement and interpersonal distance as important aspects of nonverbal communication and decided to investigate the distance and angle at which patients feel comfortable during pharmacist medication instruction. The optimal distance and angle between pharmacist and patient will be investigated using subjective evaluation by the patient and objective evaluation using pupil diameter, blink, saccade, and fixation using an eye-tracking system that can measure human eye movements. Through this analysis, the study aims to explore improved communication spaces between pharmacists and patients and clarify the communication arrangements that give patients a sense of security and trust.

2. Method

2.1. Survey Using Eye-Tracking System

Eye-tracking devices measure "where, how, and when people see" by exposing the cornea to near-infrared radiation and analyzing images of eye movements based on a measurement method called the corneal reflection method [12]. This study used the Tobii Pro Glasses 2 (Tobii Corp.) (**Figure 1**) eye-tracking system to examine the optimal distance and angle between a pharmacist and a simulated patient (SP) during patient-compliance instructions. This system defines a saccade as movements of the line of sight at a speed of 100 deg/sec within 20 msec, and fixation is defined as a period between saccades. The eye-tracking system consists of the Tobii Pro Glasses 2, a head unit, a scene camera, and a recording unit [13].

Figure 1. Tobii Pro Glasses 2 (Tobii Corp.).

2.2. Subjects

This study was conducted with the cooperation of seven female SPs. To avoid the influence of gender difference, only female SPs were conducted for this study.

Each SP was asked to act out scenarios of diseases specific to women, such as "endometriosis" and "vaginal candida." The corresponding pharmacists were a man in his 40 s (10 years' experience as a pharmacist) and a woman in her 20 s (5 years' experience); regarding the number of times they had met with the SPs, this was mostly their first time. In addition, to avoid the influence of change in tone of voice, the same pharmacist provided all medication instructions.

2.3. Measurement Methods

In previous research on interpersonal distance, Kikuzawa showed in a survey that "the optimal distance during interaction within a residence is 0.8 to 1.2 m" and "the minimum distance during dialog by gender is: female to female at 0.55 m, and this distance is shorter when the direction of approach is from behind" [14]. In addition, Hashimoto *et al.* report that "for people who are not talking to each other, the limit for approaching one another is approximately 1.5 m" [15]. Thus, people have a limit to the distance that others can approach them. Therefore, if the pharmacist gets too close to the patient, it may interfere with medication instruction. Building on these previous studies, in this study, a pharmacy and a hospital room were assumed as the settings where patient interactions would occur. In addition, male and female pharmacists were alternated to provide patient-compliance instructions to each SP. In the sessions between pharmacists and patients that assumed a pharmacy setting, the participants were positioned to face each other across a desk, and measurement positions were set between the pharmacist and the SP at ① 50 cm and ② 70 cm, at ③ 90-degree angle with a 70 cm desk in between for medication instruction in three patterns (**Figure 2**).

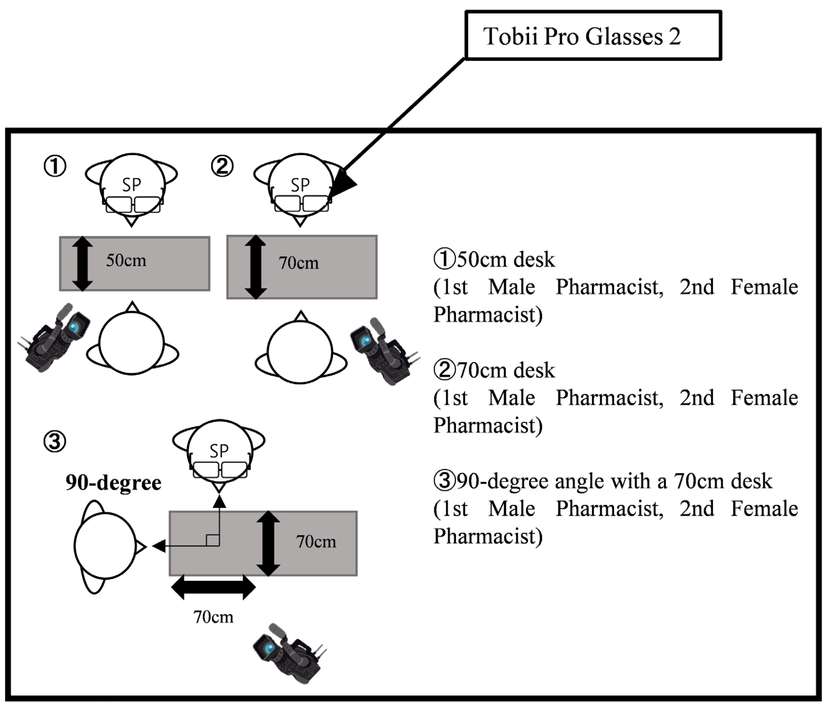

Figure 2. Measurement method assuming pharmacy (6 patterns).

In the investigation between the pharmacist and patient in the hospital room setting, the pharmacist provided medication instructions to a patient sitting in the center of the bed. To determine the pharmacist's optimal position and height, the pharmacist-patient position was measured at three positions: ① 0-degree (just beside), ② 45-degree, and ③ 90-degree (in front). Additionally, male and female pharmacists performed patient-compliance instructions for SPs—while sitting in the 0- and 45-degree conditions, and while standing in the 90-degree condition, for a total of six patterns (**Figure 3**).

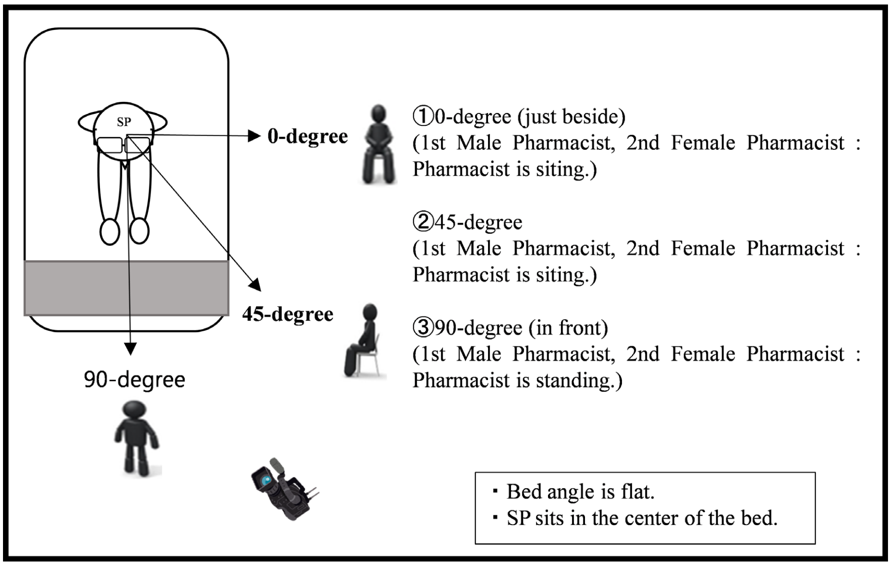

Figure 3. Measurement method assuming a hospital room (6 patterns).

SP eye movements were measured in all 12 patterns of pharmacy and hospital settings as described above, and all SPs were video recorded during the medication instruction.

2.4. Conversation Scale Survey

Hashimoto *et al.*'s "conversation scale" was used to measure SPs' subjective evaluations at each measurement point to assess whether the selected location was appropriate for conversation [15]. Conversation was measured on a 5-point scale, with the left end being "too far away," the center "optimal," and the right end "too close." (**Figure 4**)

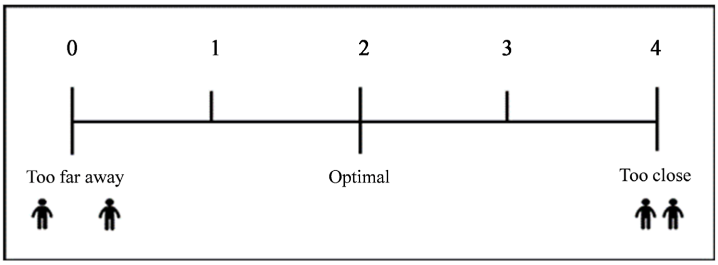

Figure 4. Conversation scale.

2.5. Analytical Methods

The analysis was divided into four scenes: introducing the medication instructions (from confirmation of patient name to patient reply); confirming the reason for the medical examination (today you were seen for [medical condition name] ~); medication guidance (today's medicine ~); and the closing scene (this concludes the explanation ~). The comparative study was then conducted on the two scenes where patients were thought to be more aware of the interpersonal situation: the introduction and confirmation scenes.

The data obtained were linked to video footage and analyzed using the analysis software, Tobii Pro Lab (Tobii Corp.). IBM SPSS ver.26 (IBM Corp.) was used for data analysis.

To account for the effects of individual differences, pupil diameters were compared using the average pupil diameter for the introduction and confirmation scenes for each SP.

Regarding blink count, the number of blinks was visually measured using a counter based on front-facing video of the SP during the medication instructions, and the blink rate per unit time {blink count/time (min)} was calculated. Furthermore, the effects of individual differences were taken into account and compared using the rate of change in the blink rate of each SP {(blink rate at each point − average blink rate at all points (introduction/confirmation scenes only))/average blink rate at all points × 100}.

Regarding saccades, considering the variation in measurement time, the ratio of saccades per total time of each SP introduction/confirmation scene {total saccade time (msec)/total time (msec) × 100} was calculated.

As for fixation, the rate of fixation per total time during the introduction/confirmation scene of each SP {total fixation time (msec)/total time (msec) × 100} was calculated.

The Friedman test and Wilcoxon's signed-rank test were performed in the analysis. After the Friedman test, multiple comparisons were performed on those for which significant differences were observed.

2.6. Ethical Considerations

This study was conducted with the approval of Kinjo Gakuin University Ethics Review Committee (No. H17015).

3. Result

3.1. Subjective Evaluation

Conversation Scale

The conversation scale survey results suggest that, in the pharmacy setting, the pharmacist-patient distance was too close to the pharmacist, which interfered with conversation in situations where the pharmacist-patient was at the 50 cm and 90-degree (Table 1). On the other hand, in the hospital room setting, when the pharmacist was standing in front of the patient, it was suggested that the pharmacist was too far away, which interfered with the conversation (**Table 2**). In addition, when the pharmacist was standing at the 0-degree (just beside), it was suggested that the patient was too close to the pharmacist, which interfered with the conversation (**Table 2**).

Table 1. Results of the conversation scale (pharmacy setting).

Pharmacy setting			Mean ± SD (n = 7)
Sitting position (face-to-face)	①	50 cm (Male pharmacist)	3.1 ± 1.0
		50 cm (Female pharmacist)	3.0 ± 0.8
	②	70 cm (Male pharmacist)	1.9 ± 0.3
		70 cm (Female pharmacist)	1.9 ± 0.6
Sitting position (90-degree)	③	90-degree angle with a 70 cm desk (Male pharmacist)	2.9 ± 0.8
		90-degree angle with a 70 cm desk (Female pharmacist)	2.6 ± 0.5

Table 2. Results of the conversation scale (hospital room setting).

Hospital room setting			Mean ± SD (n = 7)
Sitting position	①	0-degree (just beside) (Male pharmacist)	2.6 ± 0.7
		0-degree (just beside) (Female pharmacist)	2.4 ± 0.7
	②	45-degree (face-to-face) (Male pharmacist)	2.0 ± 0.0
		45-degree (face-to-face) (Female pharmacist)	2.0 ± 0.0
Patient: Sitting position Pharmacist: Standing position	③	90-degree (in front) (Male pharmacist)	0.7 ± 0.5
		90-degree (in front) (Female pharmacist)	0.6 ± 0.7

3.2. Objective Evaluation

3.2.1. Changes in Pupil Diameter

Pupil diameter is understood to increase due to emotional discomfort and/or mental stress [16]. The results for the pharmacy setting showed that the pupils were significantly more mydriatic at the 50 cm point than at the other points ($p < 0.01$). The results for the hospital room setting showed the most mydriasis at the 0-degree point. Mydriasis was also significantly greater at the 0-degree point than at the 90-degree point ($p < 0.01$).

In addition, a comparison of pupil diameter by gender showed that male pharmacists were significantly more mydriatic when they gave medication instructions ($p < 0.01$) (**Figure 5**).

3.2.2. Changes in Blinking

Blinking, the so-called "blink" of the eye, is thought to reflect a person's psychological state and personality traits. It is said to increase when anxiety or anger is felt and be suppressed when looking at an object or staring without looking away [8] [17].

The results for the pharmacy setting showed that blinking occurred more frequently at the 50 cm point than at the other points (**Figure 6**). Comparisons were made for the hospital room setting by gender, but there were no significant differences.

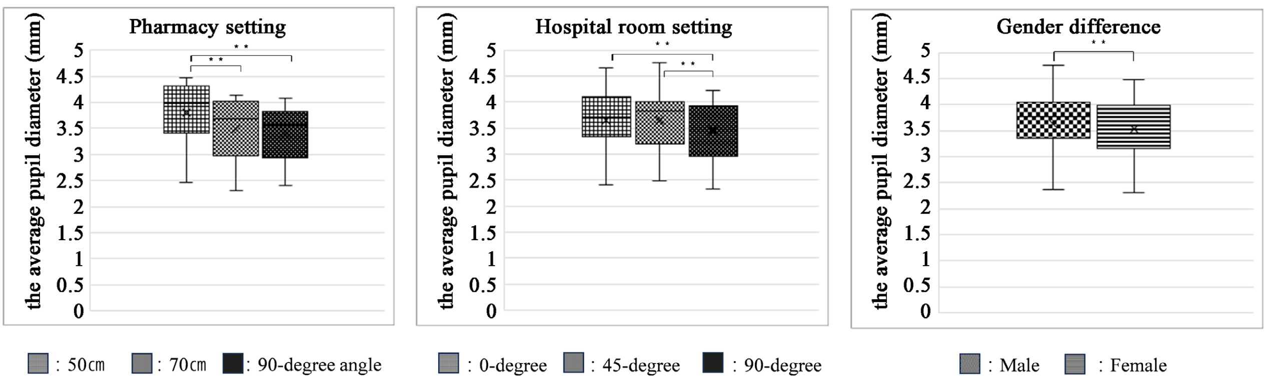

Figure 5. Changes in pupil diameter (n = 7, **p < 0.01).

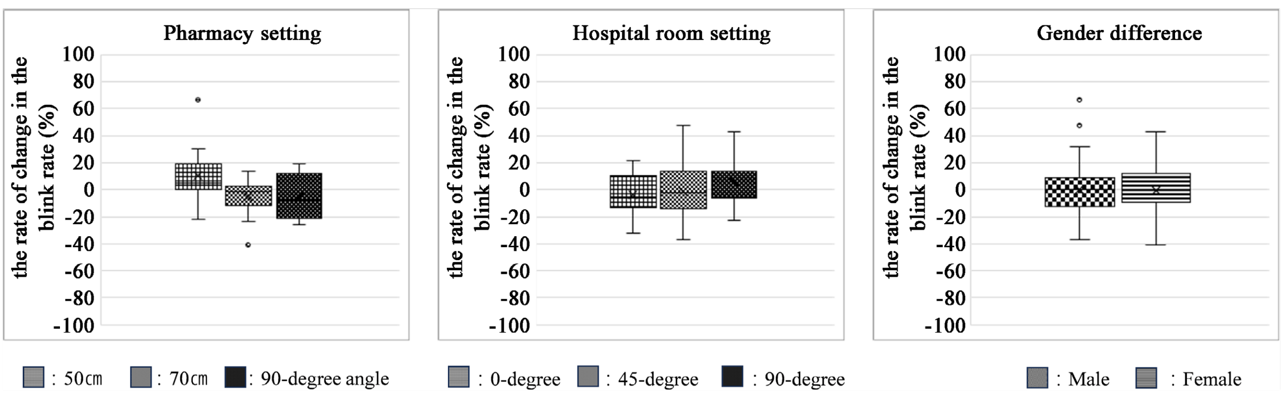

Figure 6. Changes in blinking (n = 7).

3.2.3. Changes in Saccades

Saccades are voluntary movements that can serve as indicators of spatial attention being paid to emotional stimuli [5]. Accordingly, as the gaze becomes unstable when the mind is agitated, we hypothesized that the frequency of saccades would increase in scenes where subjects were distracted and restless. The pharmacy setting results showed no significant difference in the incidence of saccades. On the other hand, When the likelihood of saccades occurrence in the hospital room setting was compared, saccades were most likely to occur when patient medication instructions were given at the 0-degree point and least likely to occur at the 90-degree point. Because the Friedman test showed significant differences, a multiple comparisons test was performed, yielding the following results: significant differences were found between the 0-degree point and 45-degree point, the 0-degree point and 90-degree point ($n = 7$, $p < 0.05$). A comparison by gender of pharmacists giving patient medication instructions showed a significant increase in the occurrence of saccades when the pharmacist giving patient medication instructions was male rather than female ($n = 7$, $p < 0.05$) (Figure 7).

3.2.4. Changes in Fixation

Used to send a signal opposite to "averting one's fixation," a classic sign of rejection, fixation is a physiological reaction, the frequency of which we assumed would increase as subjects' attention is directed toward the other person. A comparison of fixation rates at each point in the pharmacy and hospital room settings showed no differences between points. Comparisons of fixation rates were made for the pharmacy and hospital room setting by gender, but there were no significant differences (Figure 8).

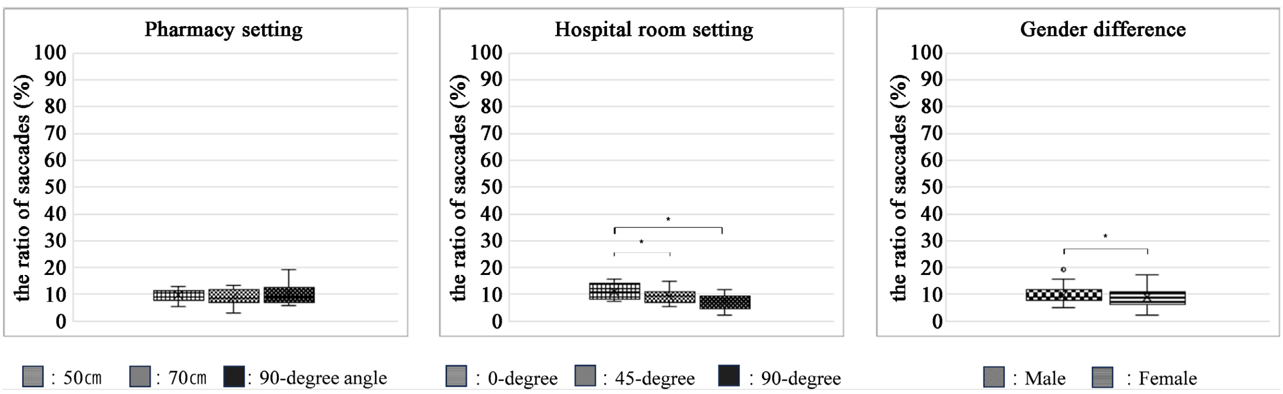

Figure 7. Changes in saccades ($n = 7$, $^*p < 0.05$).

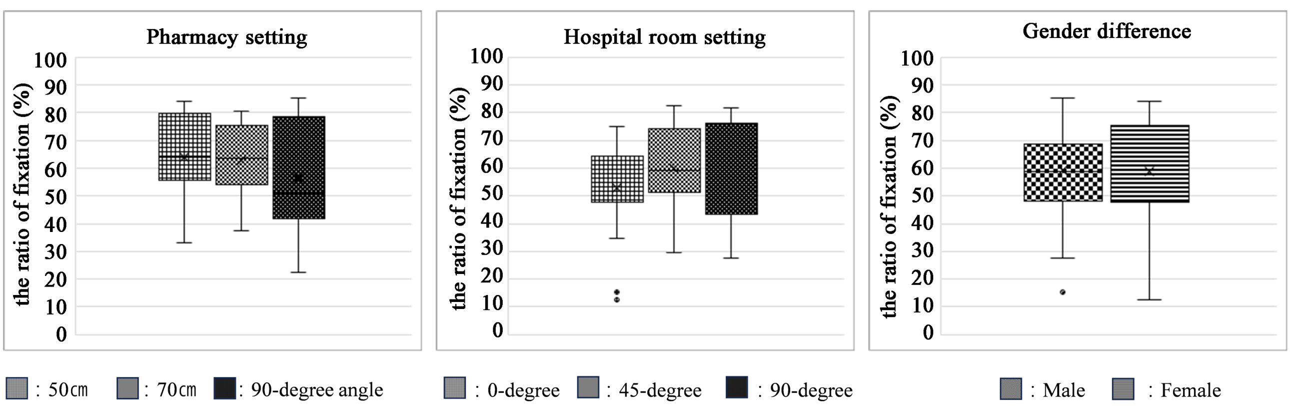

Figure 8. Changes in fixation ($n = 7$).

4. Discussion

In a quest for improved communication spaces between pharmacists and patients, this study focused on nonverbal communication and attempted an analysis based on subjective evaluation, using a conversation scale, objective evaluation, and an eye-tracking system to measure eye movements.

Changes in pupil diameter, the results for the pharmacy setting showed that the pupils were significantly more mydriatic at the 50 cm point than at the other points. The results for the hospital room setting mydriasis were also significantly greater at the 0-degree and 45-degree points than at the 90-degree point. The result of the 50 cm point for the pharmacy setting and the 0-degree point for the hospital room setting was similar to that of the subjective evaluation. The conversation scale and pupil diameter changes suggested that providing medication instructions at a distance of approximately 70 cm from the patient in the pharmacy and at a 45-degree point in the hospital room would result in better patient care. Comparison of pupil diameter by gender showed that male pharmacists were significantly more mydriatic when they gave medication instructions. One possibility is that female SPs feel psychological states, such as anxiety and stress, more intensely when they are in closer proximity to an interlocutor, especially when interacting with pharmacists of the opposite gender. This trend was also shown in another study we conducted [18]. As a result, when interacting with a male pharmacist whom they have not encountered many times before, patients are more likely to feel anxiety and stress—especially if they are female. In addition, in the hospital room setting, pupils were more dilated at the 45-degree point than at the 90-degree point. This suggests that, when evaluating pupil diameter, it is better to consider the influence of distance between pharmacist and patient rather than the angle.

Next, a comparison of blinking at each point showed a tendency for blinking to increase in the pharmacy setting at the 50-cm point, which had been evaluated as unsuitable by the conversation scale. Therefore, as with the results of the conversation scale, the blinking evaluation results suggest that a face-to-face distance of 50 cm in the pharmacy setting is unsuitable for patient care.

Next, a comparison of the likelihood of SP saccades showed that they were significantly more likely to occur when SPs were interacting with a male pharmacist than with a female pharmacist. One possibility is that when the SP is female, she may be in a psychological state of discomfort, especially when dealing with pharmacists of the opposite gender. It follows that male pharmacists should avoid giving the impression of pressuring their patients, especially when interacting with female patients. Furthermore, a comparison of seated pharmacist and SP interaction showed saccades were significantly more likely to occur when patient-compliance instructions were given at the 0-degree point than when given at 45 or 90-degree. These results suggest that when patient-compliance instructions are given by a pharmacist who is positioned beside a patient in a hospital room setting, the patient's line of sight tends to shift when they pay attention to the pharmacist, making it difficult to calmly listen to the explanation. We speculate that this may be because, when patients are shown medical information documents while listening to explanations about their medication, the distance between patient and pharmacist becomes extremely small when they are seated side by side, triggering a reaction.

Finally, as this study's fixation rate results showed no differences across the board, we suggest that it has little utility as an analytical method for objectively evaluating nonverbal communication. In the above discussion, we considered some useful tools for objectively evaluating the appropriate distance and angle between pharmacist and patient. We believe that using pupil diameter for interpersonal distance, and saccades for angle will enable a more accurate determination of the optimal distance and angle between pharmacist and patient. The all results of the present study suggest that the 70 cm face-to-face point in the pharmacy and the 45-degree point in the ward may be suitable for medication instruction.

Going forward, in addition to eye movements, we believe that analyses that link eye movements and the content of conversations will enable us to objectively conduct detailed evaluations of improved communication spaces between pharmacists and patients.

Pharmacists must not only have knowledge as drug experts, but they must also pay attention to their patients as people and provide psychological care. By taking a nonverbal communication perspective to this search for more optimal communication spaces where patients can obtain a sense of security and trust from pharmacists, we hope to have made a contribution to improving pharmacists' communication skills in the future.

5. Conclusion

In conclusion, pupil diameters and saccades, especially, at the 50 cm distance and the 0-degree point for the hospital room setting, were matched to the subjective evaluation. Thus, the eye-tracking system is considered to be able to be used for the evaluation of nonverbal communication.

Acknowledgements

We are thankful to the subjects and pharmacists who cooperated in this study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ministry of Health, Labour and Welfare, Partial Amendment to the Pharmaceuticals and Medical Devices Act in 2019. https://www.mhlw.go.jp/content/11120000/000665345.pdf

[2] Arita, E. and Ideguchi, N. (2024) Pharmaceutical Communication. Nanzando, 1-5.

[3] Tsumura, T. and Yamaguchi, M. (2008) Relationship Training. 2nd Edition, Na- kanishiya Shuppan, 104-107.

[4] Arita, E. (2006) Basic Attitudes When Communicating-Integration of Verbal and Non-Verbal Communication. *Dispensing and Information*, **12**, 66-68.

[5] Kashihara, K., Okanoya, K. and Kawai, N. (2010) Effects of Emotional Pictures on Eye Movements. *IEICE Technical Report*, **110**, 41-46.

[6] Ishikawa, R. and Kaneko, H. (2015) The Changes in Pupil Size Produced by the Emotional Change and the Estimation of Emotional State Based on the Observation of the Changes in Pupil Size. *IEICE Technical Report*, **115**, 13-18.

[7] Hara, N. (2012) Pupillographic Stress, Arousal and Emotion Assessments in Visual Stress. *Japanese Journal of Visual Science*, **33**, 47-51.

[8] Omori, Y., Yamada, F. and Miyata, Y. (1997) Influences of Eyeblinks on Person Perception. *Research in Social Psychology*, **12**, 183-189.

[9] Kaneko, H. (2010) Fixational Eye Movements. *The Journal of The Institute of Image Information and Television Engineers*, **63**, 1538-1539. https://doi.org/10.3169/itej.63.1538

[10] Hayami, T., Matsuo, T., Fukuda, K. and Shidoji, K. (2017) Asymmetry of Acceleration and Deceleration in Saccadic Eye Movements during Repetitive Fixation. *The Proceedings of the Annual Convention of the Japanese Psychological Association*, **81**, 1A-044. https://doi.org/10.4992/pacjpa.81.0_1a-044

[11] Takahashi, M., Isogai, H. and Van Raalte, J.L. (2018) Attempts to Detect Microsaccades from Eye Movements in Anticipatory Response Situations: Introducing Anticipatory Response Tasks toward Tennis Serve. *Journal of Japan Society of Sports Industry*, **28**, 1_13-1_29. https://doi.org/10.5997/sposun.28.1_13

[12] Eye Tracking Technology. https://www.tobiipro.com/ja/whats_eyetracking/

[13] Tobii Pro Glasses 2. https://connect.tobii.com/s/g2-downloads?language=ja

[14] Kikuzawa, Y. (1984) Personal Distances in Living Space (Part 1) Effects of Personal Factors. *Journal of Home Economics of Japan*, **35**, 132-137.

[15] Hashimoto, K., Nishide, K., Takahashi, K. and Takahashi, T. (1996) A Study on the Psychological Territory Based on Experiments of Interpersonal Horizontal Distance. *Journal of Architecture and Planning* (*Transactions of AIJ*), **61**, 135-142. https://doi.org/10.3130/aija.61.135_2

[16] Mori, K., Fukuda, K., Matsuo, T., Shidoji, K. and Hayami, T. (2014) Affective Word Presentation as a Means to Investigate the Relationship between Pupillary Response and Depression-Anxiety among University Students. *Bulletin of the Faculty of Human Sociology, Fukuoka Prefectural University*, **23**, 33-44.

[17] Harris, C.S., Thackray, R.I. and Shoenberger, R.W. (1966) Blink Rate as a Function of Induced Muscular Tension and Manifest Anxiety. *Perceptual and Motor Skills*, **22**, 155-160. https://doi.org/10.2466/pms.1966.22.1.155

[18] Gocho, S., Miyagi, Y., Yamaguchi, N., Nakayama, C., Miyachi, Y., Okada, S., *et al.* (2023) Investigation of Patients' Mood on Their Distance from the Pharmacist during Medication Instruction. *Pharmacology & Pharmacy*, **14**, 145-155. https://doi.org/10.4236/pp.2023.145011