Effect of Peripheral Visual Disturbance on Concentration, Comfort, and Privacy in Shared Space

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Abstract - **In these days, people tend to live and share small space together because of land price escalation. This can often cause conflicts among shared members. For instance, while one member is studying, others might do other activities in the same shared space which can disturb one another. In this study, the investigation of the visual disturbance is conducted. The relationship between direction of peripheral visual disturbance and people's distraction is investigated in order to develop assistance for the peripheral visual disturbance. Five possible configurations of partitions are tested to measure people's concentration, privacy, and comfort. 20 sampling subjects are tested by doing arithmetic task while visual disturbance in peripheral visual field of subjects presented in the simulating testing room. The result shows that each partition configuration has different distractive points of peripheral visual disturbance. The distractive point is on the side which does not have panel of partitions when the configuration of partition is asymmetry. The future research should be an investigation of the audio distractions and a development of further assistance for residents' well-being in shared space.**

Keywords - **peripheral visual disturbance, distraction, concentration, privacy, partition**

I. INTRODUCTION

A house is originally a shelter which physically protects dwellers from outside world. They used to be simple space which provides safety and security; however, as society has been developed, house has been adapted to achieve people's demand for their lifestyle in the society. As a result, current houses are much more complicated than those early forms by the installation of doors and partition walls to protect their privacy. However, nowadays, since the price escalation of property is high, it is more difficult to have enough living space to satisfy these complicated life demands. In many cases in modern city such as Bangkok, many people have to share small space with some other people. For instance, in a residential unit like in Fig.1, 3.5 x 9.7 = 33.95 square meters, three people are living together, a father, his daughter, and his son. In such situation, there are conflicts between shared members. For example, one is studying while others are watching TV in multipurpose room. Moreover, it is difficult to secure privacy of each member in such shared space. Generally, to protect people's privacy, walls and doors have been used; however, in small shared space, these are not suitable but problematic for communication between members.
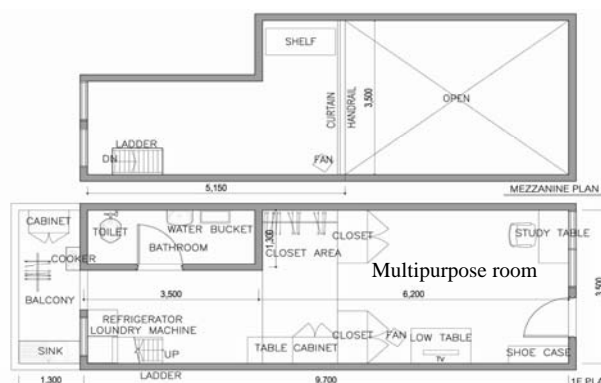

Fig. 1. Example of shared unit in Bangkok

However, there are kinds of privacy which can be achieved even in public space, such as anonymity privacy. Anonymity privacy is a desire not to be noticeable although he or she is among people [1]. For instance, people can concentrate on reading in a crowded coffee shop, and also they feel privacy. In this situation, it can be said that anonymity privacy is secured, and this kind of privacy is suitable for shared space like multipurpose room. Some possible distractions to their concentration and privacy can be acoustic and visual. According to Kitaoci, acoustic and visual isolation affect the level of privacy in architecture [2]. Acoustic isolation can be easily acquired by wearing ear plug or ear phone; however, visual isolation needs some assistance. While people are working with looking down on table, most of visual distraction is in peripheral visual field. Some research about peripheral vision revealed its slower speed of lexical processing than that of fovea vision [3], and no ability to detect motion or discriminate the velocity [4]. Although there are some defects in peripheral vision, according to Posner, peripheral visual stimulus has great effect on people's attention [5]. Therefore, peripheral visual disturbance while studying on desk in multipurpose room requires some kind of visual protection, such as low partition in open-plan office. However, there is no standard configuration of the partition for small shared space like multipurpose room.

Therefore, the research questions are as follows:
1. In which direction does peripheral visual disturbance disturb more in terms of concentration, comfort, and privacy in different configurations?

2. What kind of configurations of protection to peripheral visual disturbance works more effectively in terms of concentration, comfort, and privacy?

II. METHODOLOGY

This study is a basic research and focuses only on the relationship between peripheral visual disturbance and people's concentration, privacy, and comfort about partition. Therefore, controlling other various variables in environment which might possibly affect subjects is important. As a reference research, Stone examined adult students' mood, satisfaction, motivation, and performance by varying the condition of setting (private plan or open-plan), environmental color, and study material [6]. In her study, she tested in simulated study environment to control and eliminate other factors, and used questionnaire to evaluate subjects' feelings. Therefore, to control the other variables, this research also will be an experiment research in a simulated testing room.

The test environment was chosen from classrooms of School of Architecture and Design in King Monghut's University of Technology Thonburi at Bangkok Code (Sathorn campus). The testing area is separated by partition to make the testing area a similar size to a typical multipurpose room (3.558 meters x 6 meters) (Fig.2).

Subjects, age between 20 and 35, male (n=10) and female (n=10), right handed, are randomly assigned, and everyone has a normal visual field. Each subjects' visual field is measured to make sure that her/his field is in standard range by comparing to the visual field of the examiner.

To eliminate other variable factors, in the testing room, there are only a table and chair for subjects. A typical dining table (0.9m x 0.9m) is used for this test because the situation of this study is a multipurpose room of a residential complex. Not to catch subjects' attention, there are nothing different or outstanding colors or objects in the room, and ear plug is used to eliminate any audio stimuli to the subjects.

In the testing room, subjects are assigned to sit on the chair and do a task. According to Style, attention is some kind of limited resource, and when people are required to do divided attention, performance depends on skill and how much resource each task requires [5]. Since subjects are to be distracted by a distracter while they are doing the task, it needs to be something which does not require much resource. To find out an appropriate task, a pre-test was conducted. In the pre-test, a Chinese historical story, popular readings about Japanese culture, and easy arithmetic problems for children of age five to seven were tested. From the pre-test, it was found that arithmetic problems were the easiest and the resource required was small enough to see distraction in their peripheral vision. Therefore, arithmetic problems for children of age five to seven were chosen as a task for this testing.

To regulate the direction of visual disturbance, the five configurations of protection are tested (Fig. 3). The protection is a solid partition which does not transmit any

images. To make complete visual protection, the height of the partition is fixed with 1350 mm, which meets the height that provides privacy when seated (1320.8mm to1422.4mm) [7]. Since one research showed that timing of stimuli affected people's performance [5], visual stimuli of disturbance need to stimulate subjects evenly all around with equal timing. To enable it, visual disturbance is to be artificially created by an examiner walking around subjects with a time series scenario (TABLE I). According to Inui, red is the most attractive color with white background among 10 major hues: red, yellow red, yellow, green yellow, green, blue green, blue, purple blue, purple, red purple [8]. Therefore, the examiner wears red clothes and walks in a time series scenario and certain path to create consistent visual disturbance.
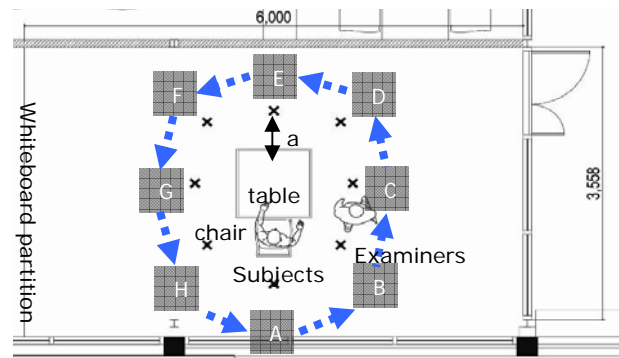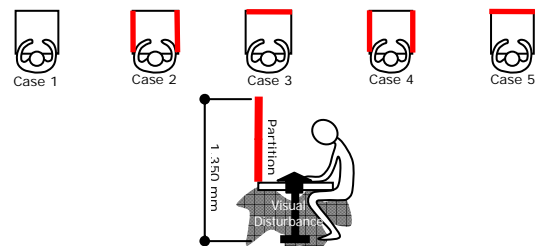

Fig. 2. Testing room layout

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Fig. 3. Five testing configuration and height of visual protection

TABLE I
Time series scenario of examiner

scenario of examiner	time	scenario of examiner	time
explanation of testing	00.00.00		
stay at A	00.00.00	stay at A	00.02.25
walk to B and stay	00.00.30	walk to H and stay	00.02.30
walk to C and stay	00.00.35	walk to G and stay	00.02.35
walk to D and stay	00.00.40	walk to F and stay	00.02.40
walk to E and stay	00.00.45	walk to E and stay	00.02.45
walk to F and stay	00.00.50	walk to D and stay	00.02.50
walk to G and stay	00.00.55	walk to C and stay	00.02.55
walk to H and stay	00.01.00	walk to B and stay	00.03.00
walk to A and stay	00.01.05	walk to A and stay	00.03.05
walk to H and stay	00.01.10	walk to B and stay	00.03.10
walk to G and stay	00.01.15	walk to C and stay	00.03.15
walk to F and stay	00.01.20	walk to D and stay	00.03.20
walk to E and stay	00.01.25	walk to E and stay	00.03.25
walk to D and stay	00.01.30	walk to F and stay	00.03.30
walk to C and stay	00.01.35	walk to G and stay	00.03.35
walk to B and stay	00.01.40	walk to H and stay	00.03.40
walk to A and stay	00.01.45	walk to A and stay	00.03.45
walk to B and stay	00.01.50	walk to H and stay	00.03.50
walk to C and stay	00.01.55	walk to G and stay	00.03.51
walk to D and stay	00.02.00	walk to F and stay	00.03.52
walk to E and stay	00.02.05	walk to E and stay	00.03.53
walk to F and stay	00.02.10	walk to D and stay	00.03.54
walk to G and stay	00.02.15	walk to C and stay	00.03.55
walk to H and stay	00.02.20	walk to B and stay	00.03.56
walk to A and stay	00.02.25	walk to A calling the end	00.04.00

One research result proved that distance between destructors in visual field is important [5], hence the distance between subjects and distraction is to be controlled. The distance (distance "a" in Fig.2) is kept with near phase of personal distance (457.2mm to 762 mm) because there is a possibility of proximity between space sharers, as in living situation that family members possibly get close to one another within this distance.

This test lasts 4 minutes for each configuration, and after that, subjects are asked to do questionnaire and interview. The scopes of measurement explored are as follows:

1. Level of concentration
2. Level of comfort
3. Level of privacy
4. Perception of height
5. Performance
6. Subjects' preference and opinion
7. General information (demographic information)

There are many factors which make people comfortable; however, in this study, comfort expresses only feeling of openness, and privacy means only one which people can have in public, anonymity privacy.

Arithmetic tests for children of age five to seven measure and confirm subjects' concentration and performance. Feeling of concentration, privacy, comfort, perception of height, preference, and general information are collected by questionnaire and interview. All tests are recorded by a video camera to analyze subjects' behavior.

III. RESULTS

A. Concentration, Comfort, and Privacy

For concentration, subjects rated that case 5 (Means=4.25) was the best for concentration, while case 2 (Means=3.65) was the second, and then come case 4 (Means=3.43), case 3 (Means=2.80), and case 1 (Means=2.45) respectively (1 is the least and 5 is the most concentrated).

For comfort, the result showed that subjects evaluated that case 1 (Means=4.40) was the best for comfort; case 3 (Means=3.45) was the second, and then come case 4 (Means=3.05), case 2 (Means=2.95), and case 5 (Means=2.10) respectively (1 is the least and 5 is the most comfort). This ranking order was completely opposite from the result of concentration level.

For privacy, subjects evaluated that the best of privacy are case 5 (Means=4.70); case 2 (Means=3.45) was the second, and then come case 4 (Means=3.28), case 3 (Means=2.83), and case 1 (Means=2.20) respectively (1 is the least and 5 is the most privacy). As in contrast with the comfort level, the ranking order of privacy level was the same as one of the concentration level.
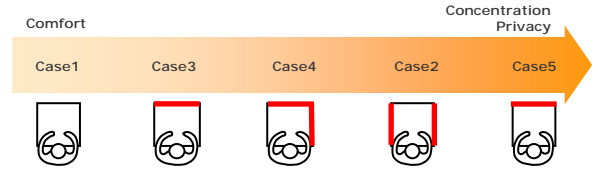

Fig. 4. Comparison between concentration, comfort, and privacy

Based on the Means of these three evaluations, comparison between concentration, comfort, and privacy was showed in Fig. 4. The figure shows that in terms of concentration and privacy, case 5 is the best and case 2 is the second best, whereas in terms of comfort, case 1 is the best and case 3 comes the second.

B. Distractive Points

The distractive points for subjects' concentration were summarized, and the result which majority of subjects evaluated was shown in Fig. 5.

From this result, point A was not a consistently distractive point for the majority of subjects in all cases, whereas point B and H were consistently either the "most" or "more" distractive points in all cases except case 4. It can be summarized that when the partition configuration is symmetrical, such as case 1, 2, 3, and 5, subjects tend to be distracted by distractions from right-hand side more than left-hand side, especially in point B. On the other hand, when the configuration of the partition is not symmetrical, subjects tend to be distracted by the distraction from the side with no partition.
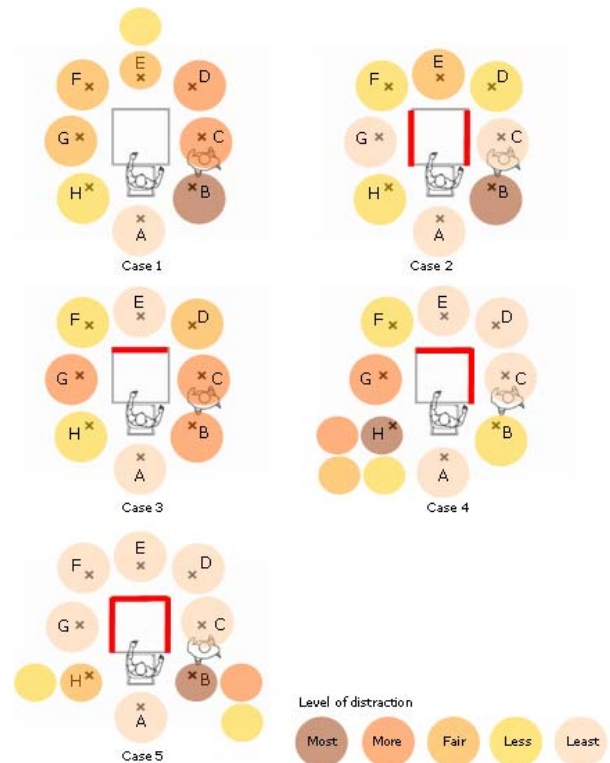

Fig. 5. Distractive points

C. Other Findings

Regarding perception of height, the result showed that subjects perceive the partition height differently in each case. The Means of evaluation values showed that in all cases, for comfort, subjects felt the partition height was little higher than that of concentration and privacy [TABLE II].

TABLE II
Perception of partition height in each case

	Case 2	Case 3	Case 4	Case 5
Concentratio	3.2	2.9	3.2	4.0
Comfort	3.6	3.3	3.2	3.8
Privacy	3.0	2.7	2.9	3.7
Average	3.3	2.9	3.1	3.8

*means scale ranged from 1 to 5.
1=too low, 3=fair, 5=too high

In case 5 and case 2, subjects evaluated the partition height little high for all aspects: concentration, comfort, and privacy. In case 4, subjects felt that the height was little high for concentration and comfort, whereas in case 3, subjects felt the same only for comfort, and rather, felt the height was little low for both concentration and privacy.

There was no convincible correlation between performance and other factors including partition configurations. Moreover, only correlation between concentration level and privacy level was found in case 1 ($p<0.05$), 3 ($p<0.05$), 4 ($p<0.01$), and 5 ($p<0.01$). In case 4, comfort level also correlated with privacy level ($p<0.01$).

Regarding preference, the largest number of subjects voted case 5 for the most favorite case. The second largest number of subjects voted case 2, case 4, case 1, and case 3 respectively.

IV. DISCUSSION

A. Concentration, Comfort, and Privacy

Fig.4. responses to the research question 1, and reveals which configuration is suitable for people's level of concentration, comfort, and privacy. This result can be concluded that case 4 was the most balanced in terms of concentration, comfort, and privacy, and as the number of panels is more, the level of concentration and privacy is higher. In other words, the more sides the panels cover, the more concentration and privacy subjects can have. Regarding case 2 and case 4, they have the same number of panels; however, the subjects evaluated that case 2 has a higher level of concentration and privacy than case 4. This could be seen that the subjects answered in the interview that they could not see the front well, and some of them mentioned that condition of case 5 and case 2 are very close to each other.

In contrast with the concentration and privacy, ranking of evaluation of comfort was completely opposite to the one of concentration and privacy. This can be explained by the number of panels as well. It also can be concluded that the more sides the panels cover, the less comfort subjects can have.

B. Distractive Points

From the observation, there are some subjects whose backs were bended or others whose hair covered their left hand side. However, most of subjects' posture was straight, but some of them tended to turn their heads slightly toward right hand side when they wrote. Moreover, seventeen out of twenty subjects answered that they used their right eye mainly. These might made them catch distraction in peripheral visual field from right hand side more than from that left hand side besides their characteristics of posture.

Moreover, subjects mentioned that they were distracted by distraction of point B because they could see the distraction in their peripheral visual field, but they could not see clearly, which made them feel annoyed and distracted. From these facts, it might be concluded that subjects tended to be distracted by object awareness in peripheral visual field, but especially when objects could not be recognized clearly

The awareness area from the result of interview seems to be like Fig. 6. As showed, most subjects answered that they felt like partitions emphasized or led their attention to the location without them.
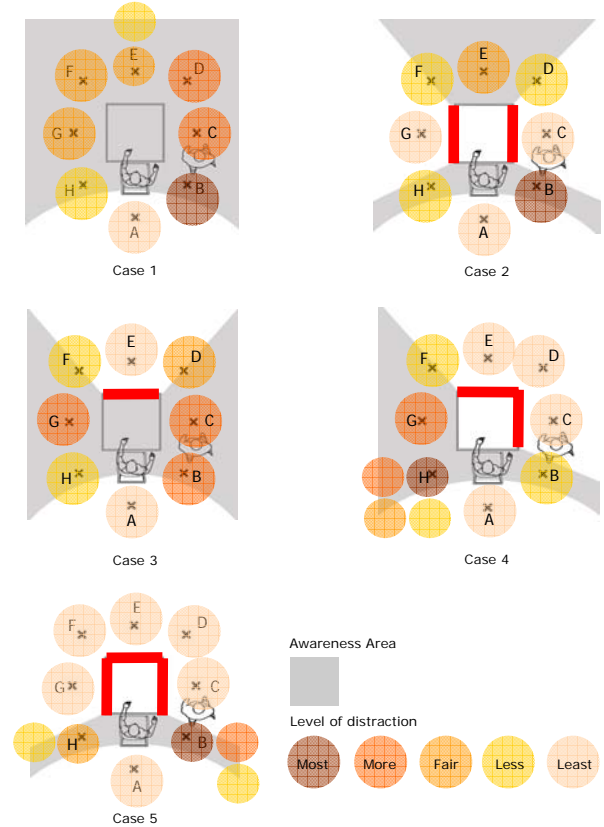

Fig. 6. Awareness area from interview

For instance, in case 1, subjects' awareness area was all around the subjects. However, when there were partitions, their awareness was led by them and went to the direction which did not have partitions. This might be the reason why subjects tended to be distracted by the distraction from the side with no partition when the configuration of the partition is not symmetrical.

In conclusion, it seems that the partitions made them pay attention to the area without them, and the subjects tended to be distracted when distraction was in their awareness area.

C. Other Findings

Although in this study the height of partition was fixed and not investigated deeply, the result revealed that height perceptions varied as partition configurations changed. From the result, lowering the partition height should be considered in case 2 and cases 5, whereas in case 3, the partition can be a little higher to achieve more concentration and privacy if necessary. Regarding case 4, the height can be heightened if privacy is focused, although the average of evaluation is quite "fair." In this test, the height was fixed with the height of Rappoport's "Privacy seated" (1320.8mm to 1422.4mm) [7]. However, the result showed that people felt the height either "too low" or "too high" which depended on partition configuration. Therefore, it will be more complete if the specific height for each configuration, in terms of concentration, comfort, and privacy, are identified.

Regarding to preference, it can be concluded that subjects tend to prefer partition configurations which provide concentration and privacy rather to comfort. However, there is a conflict in case 1 and case 3. Subjects prefer case 1 more than case 3 although case 3 is considered having more concentration and privacy than case 1. The reason of this might be there are some subjects who prefer open space, and show complete rejection against the panels. Moreover, some of subjects answered that if there was only one partition at the front, then no partition at all was better. This might be a reason why more subjects prefer case 1 to case 3.

V. CONCLUSION

The result of this research reveals how people are distracted by destructions from different direction in each different partition configurations. In addition, this result also shows the effective configuration of partition in terms of concentration, comfort, and privacy, and the fact that people have different perception of height in different configuration of partition. Moreover, the subjects' preference of partition configuration was also investigated. These findings can be applied and contributed for well-being in not only multipurpose room but also organizational space such as open-plan office. The result of study may be applied in several methods such as furniture layout, interior design, furniture design, and behavior control. These applications would contribute to assist members' efficiency and effectiveness of living in shared space with reducing conflict between multi activities without separating space by solid walls and doors. Consequently, they can also contribute well-being condition in shared space.

However, in reality, there are many other factors which might intertwine each other and affect people's concentration, comfort, and privacy. Therefore, further investigation on other factors such as audio disturbance, should be investigated for true meaning of well-being in shared space.

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