A Design Solution of Wind Element for Stress Recovery in High Rise Condominium Residents: A Case Study in Bukit Utama 9, Kuala Lumpur, Malaysia

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ABSTRACT

The evolution of a living space is slowly separating us from nature. We were once close to nature from the time of our great ancestors. However, the present world is unconsciously being replaced by man-made structures as it getting overly populated. By being much isolated from nature, little did we know the poorer our health became. Health issues like respiratory illness, heart diseases, and stress are some of the common health issues related to the environment we live in (Cohen, Tyrrell, & Smith, 1994; Glaser & Kiecolt-Glaser, 2005; Kiecolt-Glaser, Marucha, Malarkey, Mercado, & Glaser, 1995). However, a literature shows that being in nature can relieve stress and improve overall health and wellbeing (Ulrich, 1985). A research indicates that experiencing the restorative sounds of nature is an important reason for visiting the great outdoors. Nevertheless, there are still very few findings that have been tested on the relationship between natural sounds and human health (Alvarsson, Wiens, and Nilsson, 2010). In addition, there was previous research done that predicted a possibility of stress recovery using natural sounds and that anthropogenic sounds might lead to an increase in the stress level (Alvarsson, Wiens, and Nilsson, 2010).

This paper aims to increase understanding regarding the positive effects of natural sound on stress recovery based on Stress Recovery Theory (Kaplan, 1995). It specifically focuses on the wind element in stress recovery using real-time heart rate meter and tailored interviews and questionnaires. As a result, a clearer understanding of the effect of wind sounds on the rate of stress recovery will be revealed. Furthermore, a suggested design approach and solution is introduced to provide an additional architecture and design idea that future high rise homes can incorporate in their public spaces for better stress recovery.

KEYWORDS: *Stress Recovery, Wind Element, High Rise*

1. INTRODUCTION

We were in fact close to nature since the time of our great ancestors, but mankind started to build with wood, mud, bricks and now concrete buildings. However, the problem does not lie in the building materials, but lies in the fact that the world we live in now is getting overly populated. When human occupies a land, the environment will be altered. The rate between deforestation and replanting tress are not on par (Chris Elliot, 2014). Therefore, nature is rapidly decreasing, unconsciously our wellbeing as well. Health issues like respiratory illness, heart diseases, and stress are some of the common health issues related to the environment we live in (Cohen, Tyrrell, & Smith, 1994; Glaser & Kiecolt-Glaser, 2005; Kiecolt-Glaser, Marucha, Malarkey, Mercado, & Glaser, 1995).

Stress has also been a cause of chronic disease such as cardiovascular disease (CVD). Not only CVD came from psychological stress, but also the burden from workload and socioeconomic problems (Lee & Lip, 2003). Chronic stress such as significant job strain has been shown to predict sub-clinical atherosclerosis in non-symptomatic men (Hintsanen et al., 2005). In addition, acute life stressors such as deprivation, natural disasters, and trauma are associated with increases in cardiac events (Rozanski, Blumenthal, & Kaplan, 1999). With psychological stress being implied to support the process of CVD, it is important to research and know effective stress reduction methods.

There is an existing body of literature showing that by being in nature, one can relieve stress and improve overall health and wellbeing (Ulrich & Parsons, 1990). Thus, many researches had been done using various forms of nature depiction to relief stress. Among the previous conducted tests, only the sound of wind had yet to be tested. Therefore, this paper will focus on the stress recovery potential in using wind element.

1.2 Modern Living Conditions

A study has shown that the stress between high rise residents and landed property residents differ drastically with various reasons (Robert Gifford, 2007). According to his study, high rise residents have higher stress level as compared to landed property residents. One of the reasons is the lack of a garden and the space constrain that causes the residents to feel confined in a space, not having enough space to de-stress, in other words, not getting a proper allocation of space for nature.

This study also found many other health issues high rise residents are facing and may face in the near future. Despite that, mental restoration and stress recovery may be as doable as walking in the park, viewing nature and hearing the sounds of nature (Berman, Jonides, & Kaplan, 2008; Hartig, Mang, & Evans, 1991; S. Kaplan & R. Kaplan, 1989; Kaplan, 1995; Payne 2007, 2013). Researches had been done and found that we are connected to nature and we need nature to maintain our wellbeing (E.O Wilson, 1980; Kaplan, 1995; Payne 2007, 2013; Ulrich, 1984).

1.3 Stress Recovery Theory

This paper also based the study on the Stress Recovery Theory (SRT). SRT is the restoration or recovery from overly arousing states in both psychologically and physiologically (Ulrich et al., 1991). Stress recovery is a part of the larger concept of restoration, which also involves factors such as recovery from under stimulation and recovery from anxiety (Ulrich, 1993). Ulrich's theory proposes that, after being in a stressful environment, a biological and almost automatic preparedness initiates a response (Ulrich et al., 1991). This in turn, motivates individuals to leave that environment in order to produce a positive emotional change (Ulrich, 1993; Honold et al., 2016) In other words, the positive affect of experiencing nature, shifts an individual's neurophysiological activation, which then triggers nerve impulses that results in adaptive behaviors.

SRT is not the only theory that had been formed to further explain between the natural environment and its restorative qualities. Attention Restoration Theory (Kaplan & Kaplan, 1989) proposes that nature is capable to create a restorative environment. Restoration in this theory is about positive changes in psychological processes and a relief of mental fatigue (S. Kaplan & Talbot, 1983). Both theories agree on nature’s restorative potentials, but the differences lie in the measurement of restoration. While SRT is focused with a recovery from physical and emotional stress, ART is more of a proposition of a cognitive response.

1.4 High Rise Condominium as Stress Recovery Environment

The future of property is in the high rise as human population growth rate is more than threefold since the last century (Worldometers, 2017). High rise may not have been widely accepted a few centuries ago; however, it is widely desirable in the current market. High rise condominiums these days have the facility, from private gym to convenience and connectivity that comes with it. Although parks are still available, the probability of people going to the park for a walk to feel the nature and to de-stress is rare nowadays, even when parks are provided in the high rise condos. Therefore, if the future designers and architects could replace redundant parks with spaces that intertwines with nature, where both human and nature could interact daily would be utterly beneficial.

There is sufficient evidence that viewing natural environments promotes restoration, but less is known about the effects of natural sounds on stress recovery (Berto, 2005; Felsten, 2009; Hartig et al., 1991; Hartig et al., 2003; S. Kaplan & Talbot, 1983; Kaplan & Kaplan, 1989; Tennessen & Cimprich, 1995). Therefore, the main goal in this study is to understand the influence of the wind element on stress recovery. The method is organized by first reviewing the existing literature related to stress recovery and sound. Research questions are then presented, as well as, a case study used to answer those research questions.

2. EXPERIMENT

2.1 Overview

According to Benfield et al. (2014), it states that natural sounds has an improving human affect. This study will utilize three types of sound on participants to measure the rate of stress recovery by using a heart rate monitor. Hence, the tested sounds in this study are mild wind sounds, wind chimes, and anthropogenic sound. In addition, a set of questionnaires is questioned for further understanding regarding the attitudes of the residents on the source of wind and sound in their units.

2.2 Study Location

Due to authorization constraint to use the space of other potential condominiums, the chosen condominium is Bukit Utama 9 located in Kuala Lumpur, Malaysia. The study also has an additional aid to ensure smooth experiment flow and data collection. A specific script and protocol is followed to ensure consistency during the experiment.

2.3 Participants

100 residents from the chosen high rise condominium were tested at the lobby of the condominium. Upon completing the experiment, the study then categorizes the 100 participants into four categories: Gender, age, residential floor and occupation (see Fig. 1). This is to uncover a deeper understanding of the relationship between each category and the heart rate result. The study required participants involved to not have past records of heart attack or fluctuating blood pressure or any illnesses related to it. All participants read through an implied consent and agreed to voluntarily participate in the study.

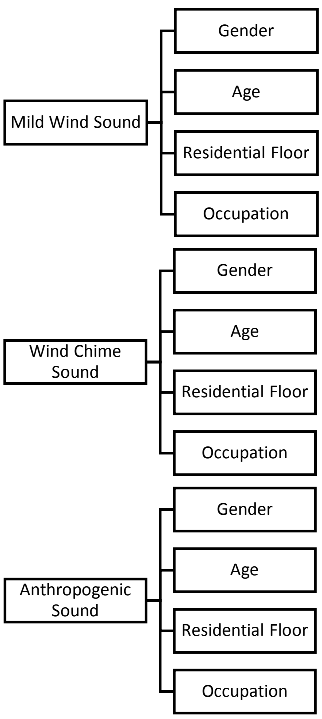


Fig. 1. The division into four categories

2.4 Experimental sounds

During each of the three listening periods, subjects were exposed starting with a natural wind sound, indirect wind sound (wind chimes) and natural sound interrupted by anthropogenic motorized noise (see Fig. 1). Bose Quiet Comfort 25 brand noise canceling headphones were used for all for sounds experiment. Motorcycle sound was chosen as a source of anthropogenic noise because this sound is rated as the most unpleasing sound than other sounds in a natural space (Kariel, 1990; Weinzimmer et al., 2014).

2.5 Questionnaires and Interviews

The purpose of the questionnaires and interviews is to understand the participants more profoundly. Since this experiment is about the wind element, the study seeks to find the relationship between the participants and the window, as the window is the primary access to usher in the wind element into the high rise living space.

Questionnaires. The primary purpose of the questionnaire is to find the probability of the rate of window being opened and the underlying reason why it is and why it isn't. The first set of questionnaire is given to each participant upon completion of all 3 tested sounds.

This set of question aims to reveal the time of day the windows are opened and the reason why the participants open their windows and why do they not. And as for participants who do not occasionally open their windows, an additional open ended question is asked to know what their main concerns are and whether they prefer natural ventilation rather than air conditioning.

Open ended questions. Upon the gathered data, the participants who are seen to be affected by certain sounds are also asked further in a brief interview later in the experiment about why their heart rate increase or drop during certain sounds. Participants are to share freely their information and opinions.

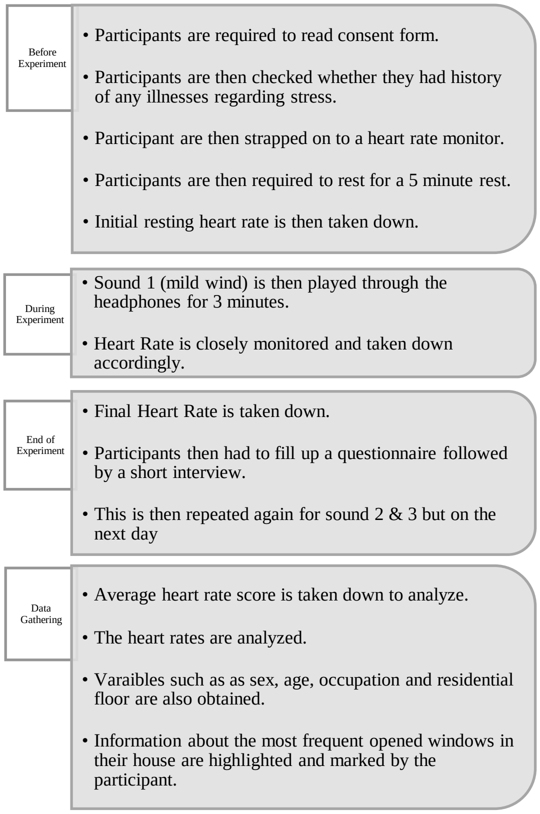
2.6 Experimental Design

The experimental design is made out of three separate sections (see Fig. 2). First, give each participant 5 minutes to rest by having them to sit down. While they are seated down and resting, strap the heart rate monitor unto them. Giving them time to rest allows the participants to cool down from the activity they were doing right before participating in this experiment. This then results to a more accurate resting heart rate.

Secondly, after 5 minutes, the resting heart rate is documented. Following that, place the noise canceling headphone on the participant and then proceed with playing sound 1 (mild wind) for 3 minutes. During the 3 minutes, the heart rate is tracked for each passing minute.

Then, when 3 minutes is up, the final heart rate is documented. Sound 2 and 3 on the following days after, are repeated with the exact same procedure.

Finally, upon gathering all the data, an average score is taken to analyze further. These heart rates are analyzed through the average score per category. Variables such as sex, age, occupation and residential floor; are obtained. Additionally, a set of questionnaires and short interview is conducted.



Information regarding the frequently opened windows in their homes are also highlighted and marked by the participants.

Fig. 2. Experiment Flow

3. RESULTS

3.1 Participant Demographics

The demographics of the participants are grouped accordingly to the four categories mentioned earlier as shown in Fig. 1. There are 100 participants consisting of 50 males and 50 females (see Fig. 3). In the 100 participants, a total of 10 participants are below their 20s, 23 of them are in their 20s, 35 of them are in their 30s, 28 of them are in their 40s and only 4 of them are above 50 (see Fig. 4). The occupation of the 100 participants were classified into four types. 40 of them are office workers, 30 of them are homemakers, 20 of them works as odd jobs and 10 of them are students (see Fig. 5). The residential floor information is also obtained (see Fig. 6). The study groups and divides the acquired information into five groups. Participants living below floor 10 consist of 21 participants. Floor 10 to floor 19 consist of 14 participants. Floor 20 to 29 consist of 32 participants. Floor 30 to 39 consist of 26 participants. Finally, only 7 participants live above floor 40.

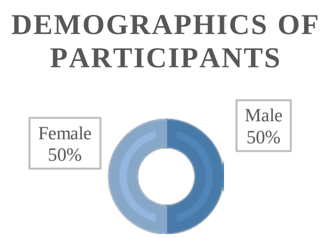


Fig. 3. Demographics of Participants: Gender

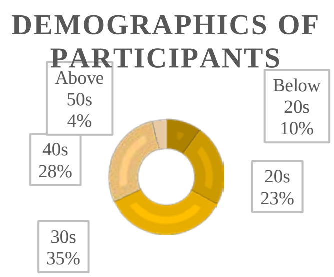


Fig. 4. Demographics of Participants: Age

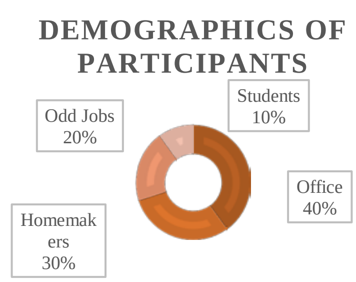


Fig. 5. Demographics of Participants: Occupation

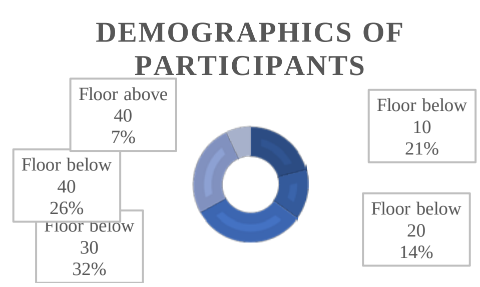


Fig. 6. Demographics of Participants: Residential Floor

3.2 Heart Rate Demographics

The average heart rate graphs are as shown below.

3.2.1 Mild Wind Sound

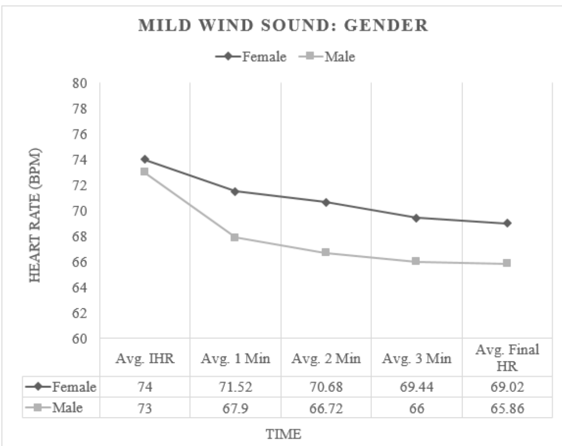


Fig. 7. Heart Rate by Gender: Mild Wind Sound

According to Fig. 7, the male participants are shown to have a lower average heart rate comparing to the female participants. With the difference of 7.14 bpm. from 73 bpm. to 65.86 bpm. for the male participants. In addition, a difference of 4.98 bpm from 74 bpm. to 69.02 bpm. for the female participants.

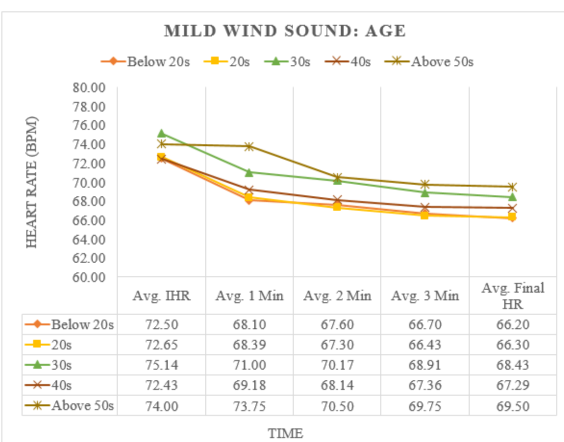


Fig. 8. Heart Rate by Age: Mild Wind Sound

According to Fig. 8, all age groups have a slight decrease in a rather steady state except for the participants in the age group of above 50s. This age group has the most minimal drop of the heart rate during the IHR and the 1 minute.

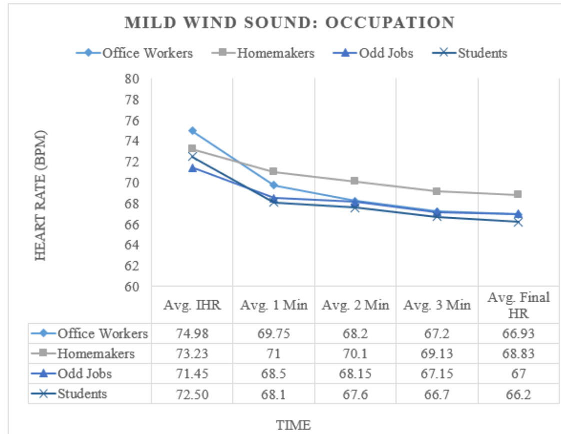


Fig. 9. Heart Rate by Occupation: Mild Wind Sound

According to Fig. 9, the office workers has the highest difference in heart rate. The difference is 8.05 bpm., from the IHR of 74.98 bpm. to 66.93 bpm. The students however come in second with a 6.30 bpm. difference. For the student. there is 6.3 bpm. in the heart rate difference, which is second highest. While the less difference is the homemakers

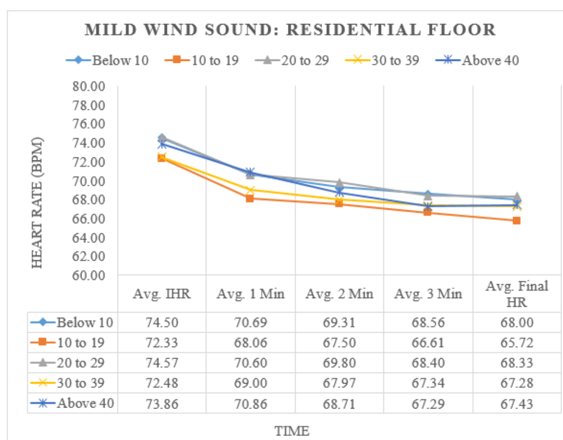
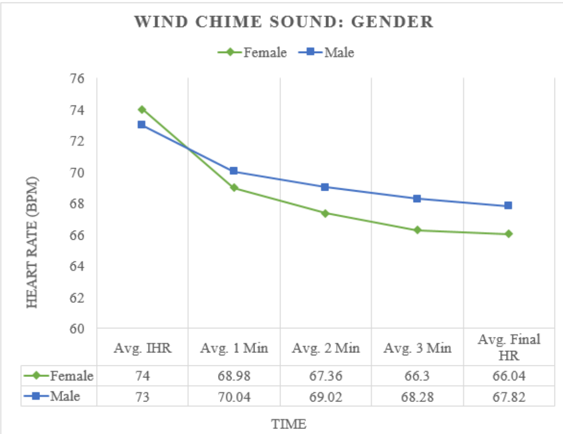


Fig. 10. Heart Rate by Residential Floor: Mild Wind Sound

According to Fig. 10, it is shown that the lower the floor the participants live in, the higher heart rate difference between the IHR and the final heart rate.

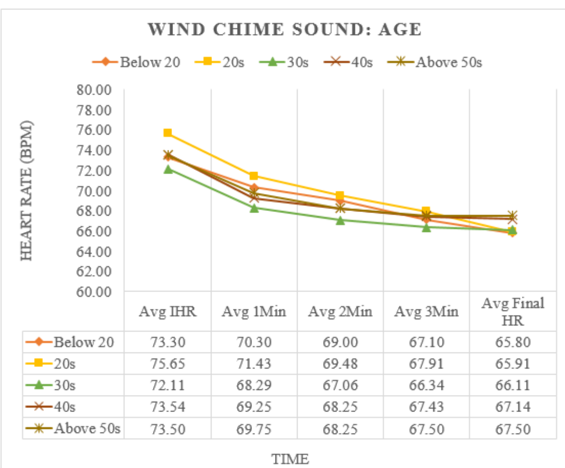
3.2.2 Wind Chime Sound



	Avg. IHR	Avg. 1 Min	Avg. 2 Min	Avg. 3 Min	Avg. Final HR
Female	74	68.98	67.36	66.3	66.04
Male	73	70.04	69.02	68.28	67.82

Fig. 11. Heart Rate by Gender: Wind Chime Sound

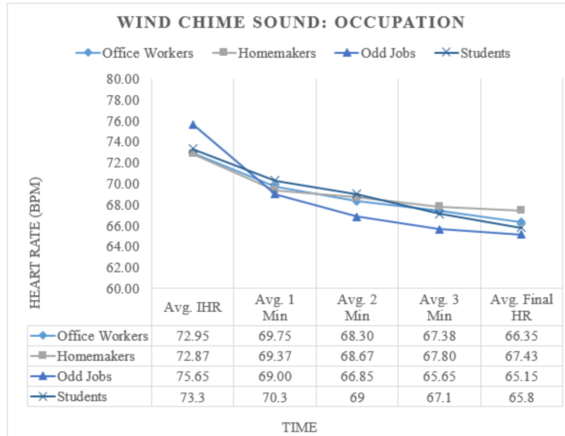
According to Fig. 11, the female participants have a lower average heart rate comparing to the male participants. With the difference of 7.96 bpm. from 74 bpm. to 66.04 bpm. for the female participants. In addition, a difference of 5.18 bpm from 73 bpm. to 67.82 bpm. for the male participants.



	Avg IHR	Avg 1Min	Avg 2Min	Avg 3Min	Avg Final HR
Below 20	73.30	70.30	69.00	67.10	65.80
20s	75.65	71.43	69.48	67.91	65.91
30s	72.11	68.29	67.06	66.34	66.11
40s	73.54	69.25	68.25	67.43	67.14
Above 50s	73.50	69.75	68.25	67.50	67.50

Fig. 12 Heart Rate by Age: Wind Chime Sound

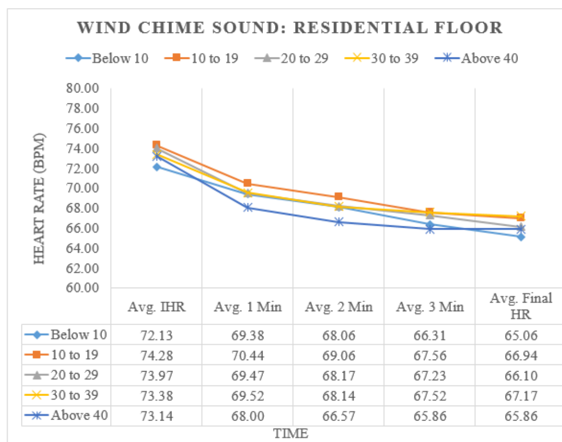
According to Fig. 12, the participants under the age group of 20s has the highest drop difference on the heart rate count among the other age groups. The 20s IHR started off at 75.65 bpm. and then drops to 65.91 bpm., which leaves a total of 9.74 bpm. difference.



	Avg. IHR	Avg. 1 Min	Avg. 2 Min	Avg. 3 Min	Avg. Final HR
Office Workers	72.95	69.75	68.30	67.38	66.35
Homemakers	72.87	69.37	68.67	67.80	67.43
Odd Jobs	75.65	69.00	66.85	65.65	65.15
Students	73.3	70.3	69	67.1	65.8

Fig. 13. Heart Rate by Occupation: Wind Chime Sound

According to Fig. 13, the odd jobs workers has the highest difference in average heart rate bpm. The difference is 10.5 bpm., from the IHR of 75.65 bpm. to 65.15 bpm. The students' heart rate; however, is the second drop which is 7.5 bpm. difference.



	Avg. IHR	Avg. 1 Min	Avg. 2 Min	Avg. 3 Min	Avg. Final HR
Below 10	72.13	69.38	68.06	66.31	65.06
10 to 19	74.28	70.44	69.06	67.56	66.94
20 to 29	73.97	69.47	68.17	67.23	66.10
30 to 39	73.38	69.52	68.14	67.52	67.17
Above 40	73.14	68.00	66.57	65.86	65.86

Fig. 14. Heart Rate by Residential Floor: Wind Chime Sound

According to Fig. 14, the average heart rate of all residential floor drop in similar direction. The average of all group between the IHR and final heart rate totals is 7.15 bpm.

3.2.3 Anthropogenic Sound

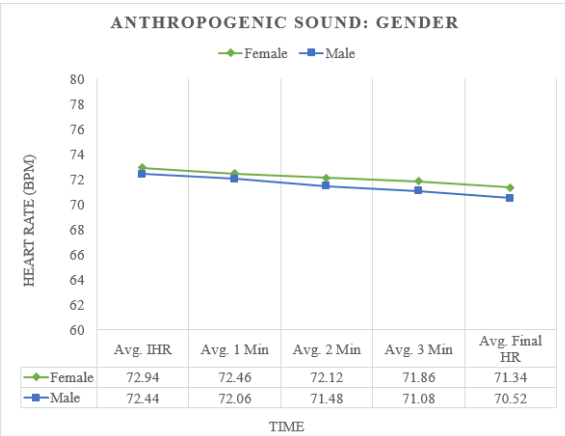


Fig. 15. Heart Rate by Gender: Anthropogenic Sound

According to Fig. 15, the male participants are shown to have a slightly higher drop rate than female participants. With the difference of 1.92 bpm. from 72.44 bpm. to 70.52 bpm. for the male participants. In addition, a difference of 1.60 bpm from 72.94 bpm. to 71.34 bpm. for the female participants. Both groups show a little difference in heart rate drop.

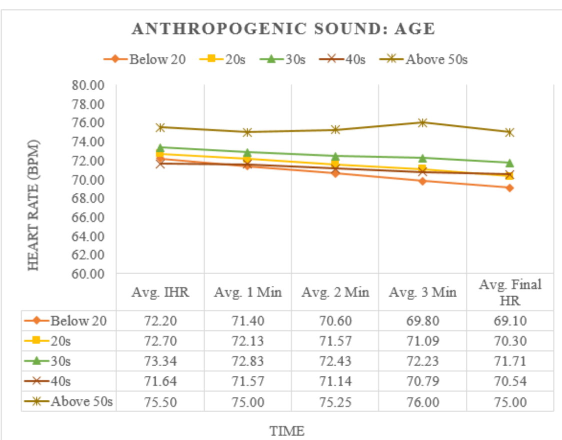


Fig. 16. Heart Rate by Age: Anthropogenic Sound

According to Fig. 16, all ages shows a very low drop rate. Participants above the age of 50 in particular, is seen to have the lowest drop rate of 0.50 bpm.

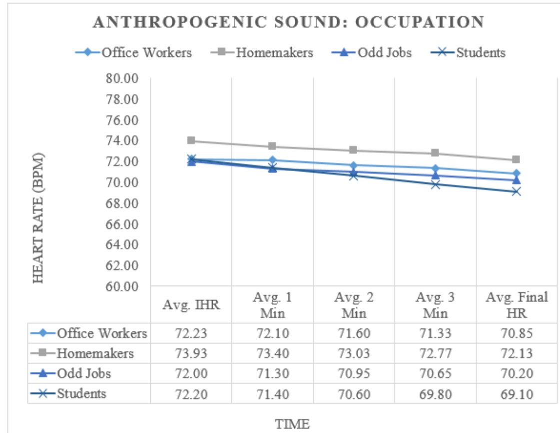


Fig. 17. Heart Rate by Occupation: Anthropogenic Sound

According to Fig. 17, the students are seen to have the most significant drop rate as compared to the other occupational groups. The average heart rate drop is 3.10 bpm. While other groups, the average heart rates drop between 1.38 - 1.80 bpm.

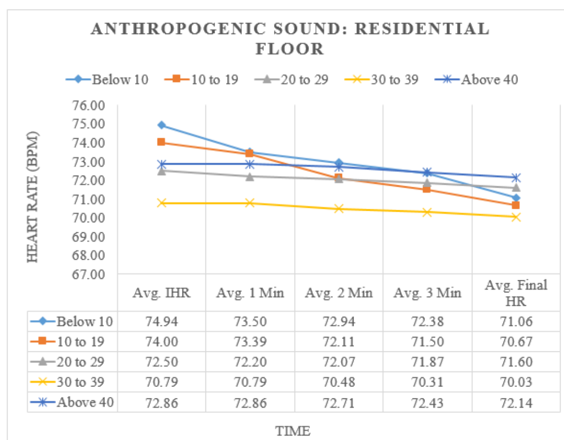


Fig. 18. Heart Rate by Residential Floor: Anthropogenic Sound

According to Fig. 18, the graph reveals that the average heart rate decreases as the participants live higher off the ground.

3.3 Questionnaire

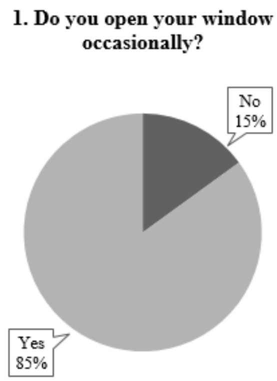


Fig. 19. Results from Question number 1

Among the 100 participants, 85% of them open the window occasionally and the other 15% do not and almost rarely (see Fig. 19).

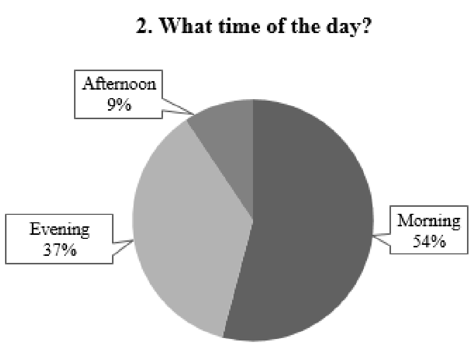


Fig. 20. Results from Question number 2

According to the previous question (see Fig. 20), among the 85% that answered “yes”, 54% (46 participants) open the window during the morning hours. In the evening; however, the percentage of participants opening the window sums up to 37% (31 participants) and only a small fraction of 9% (8 participants) opens in the afternoon.

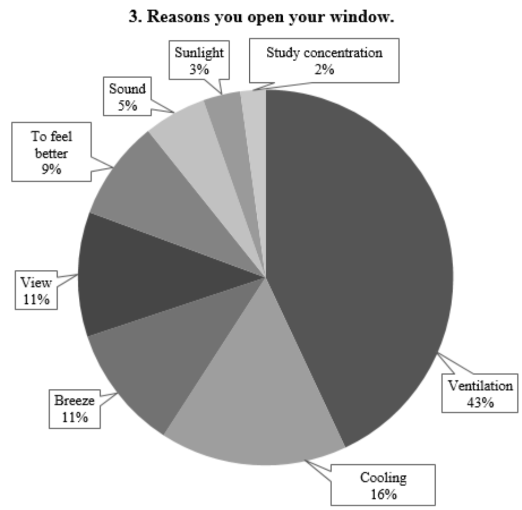


Fig. 21. Results from Question number 3

This question allows participants to select more than one answer (see Fig. 21). It is shown that the majority 43% opens the window for ventilation purposes. 16% open for cooling purposes. 11% open for both breeze and for the view. 9% open to feel better. 5% open to hear the sound of the environment. 3% open for the sunlight. Lastly, 2% open for study concentration.

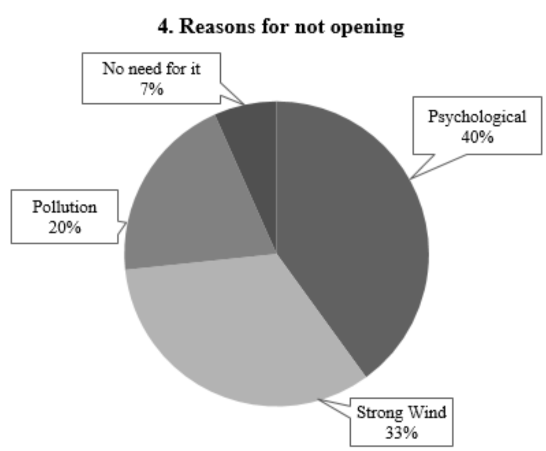


Fig. 22. Results from Question number 4

Among the 15 participants who answered “no” when asked whether they do occasionally open the window, they are allowed to answer more than one answer. 40% of them answered that because of psychological reasons, they rather close it. 33% close it due to strong wind encounters. 20% choose to close it to prevent pollution. 7% of them have no reason for opening the window (see Fig. 22).

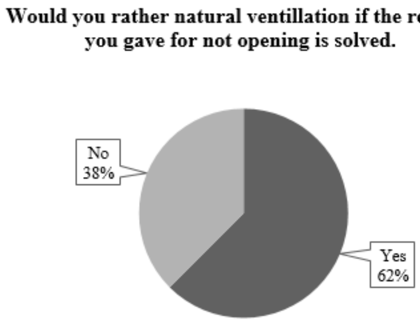


Fig. 23. Results from Question number 5

For 15 participants that answered “no”, an additional question was asked for further information. Participants were asked whether they would rather natural ventilation if the problems they faced are solved, than leaving close and optioning air condition instead. 62% replied stating that they would prefer natural ventilation. And 38% of them rather air conditioning (see Fig. 23).

Fig. 24. The windows the participants usually open

The above floor plan is presented alongside the questionnaire for participants to highlight which window they usually open.

4. DISCUSSION, CONCLUSION AND RECOMMENDATION

4.1 Result Discussion

The following tables shows the drop difference between the average initial heart rate (IHR) and the average final heart rate.

IHR – Final Heart Rate = Drop Difference (DD)

Type of Sound	Mild Wind Sound		Wind Chime Sound		Anthropogenic Sound	
Gender	Male	Female	Male	Female	Male	Female
DD	***7.14 bpm.***	4.98 bpm.	5.18 bpm.	***7.96 bpm.***	***1.92 bpm.***	1.60 bpm.

Table 1. The drop difference in gender on each wind sound

Table 1 shows the conclusion of the drop difference in each gender in Fig. 7, Fig. 11 and Fig.15. According to Table 1, the males are seen to have higher heart rate difference as compared to female in both mild wind sound and anthropogenic sound. Whereas females have higher drop rate when it comes to the sound of the wind chimes.

To understand this further, a briefly interview inquires both genders. The majority of the males think of the beach and countryside when the sound of the mild wind is played, thus, they feel rather calm. For the females; however, majority think of their house chores and bad weather. This presents that the sound of the mild wind works better in lowering stress levels for the males and the sound of the wind chime for the females.

Type of Sound	Mild Wind Sound				
Age	Below 20	20s	30s	40s	Above 50s
DD	6.30 bpm.	6.35 bpm.	***6.71 bpm.***	5.14 bpm.	4.50 bpm.
Type of Sound	Wind Chime Sound				
Age	Below 20	20s	30s	40s	Above 50s
DD	7.5 bpm.	***9.74 bpm.***	6.00 bpm.	6.40 bpm.	6.00 bpm.
Type of Sound	Anthropogenic Sound				
Age	Below 20	20s	30s	40s	Above 50s
DD	***3.1 bpm.***	2.4 bpm.	1.63 bpm.	1.1 bpm.	0.5 bpm.

Table 2. The drop difference in age on each wind sound

Table 2 shows the conclusion of the drop difference in each age group of each sound type in

Fig. 8, Fig. 12 and Fig.16. According to Table 2, participants in the 30s has the highest drop rate while listening to the sound of the mild wind, while participants in the 20s has the highest drop rate while listening the sound of the wind chimes and participants below 20 had the highest drop among the other age group when listened to the anthropogenic sound.

This can be concluded that among the three sound types (see Table 2), the wind chime sound shows the highest in drop rate for all ages except for the participants in their 30s which seems to have a bigger drop when listened to the sound of the mild wind instead. The reason is that the majority of participants that are in their 30s makes up mostly of male office workers. As mentioned earlier, the males feel much calmer in the sound of the mild wind.

A brief interview on the participants in their 20s and below 20s is conducted to understand the results further. The participants in their 20s is the most affected group when listening to the sound of the wind chime. To this, participants in their 20s gave various answers, but there is an answer that is often mentioned was because the sound of the wind chime is rather smoothing to them as compared with the sound of the mild wind.

As for the participants below the age of 20, which consist mostly are school students. They are constantly exposed to anthropogenic sound on a daily basis, thus anthropogenic sound could still aid in feeling slightly calmer. The governmental schools in Malaysia mainly utilize natural air ventilation where students are constantly dealing with anthropogenic sound.

Type of Sound	Mild Wind Sound			
Occupation	Office Workers	Homemakers	Odd Jobs	Students
DD	***8.05 bpm.***	4.40 bpm.	4.45 bpm.	6.3 bpm.
Type of Sound	Wind Chime Sound			
Occupation	Office Workers	Homemakers	Odd Jobs	Students
DD	6.60 bpm.	5.40 bpm.	***10.50 bpm.***	7.50 bpm.
Type of Sound	Anthropogenic Sound			
Occupation	Office Workers	Homemakers	Odd Jobs	Students
DD	1.38 bpm.	1.8 bpm.	1.8 bpm.	***3.1 bpm.***

Table 3. The drop difference in occupation on each wind sound

Table 3 shows the conclusion of the drop difference in each occupation of each sound type in Fig. 9, Fig. 13 and Fig. 17. According to Table 3, the office workers have the highest drop when listened to the mild wind sound. Whereas, the other three occupation types are seen to have the highest drop when listened to the sound of the wind chime.

Due to this result, the brief interview is conducted on all participants. It is found that the majority of the office workers feel calmer because they feel a sense of open space and fresh air, as they have little to no contact with the outdoor on a daily basis. The other three occupations feel that the wind chime has a better calming effect on them because the sound of the mild wind reminds them about how their daily schedules that might be affected.

Type of Sound	Mild Wind Sound				
Residential Floor	Below 10	10 to 19	20 to 29	30 to 39	40 and above
DD	6.50 bpm.	***6.61 bpm.***	6.24 bpm.	5.20 bpm.	6.43 bpm.
Type of Sound	Wind Chime Sound				
Residential Floor	Below 10	10 to 19	20 to 29	30 to 39	40 and above
DD	7.07 bpm.	7.34 bpm.	***7.87 bpm.***	6.21 bpm.	7.28 bpm.
Type of Sound	Anthropogenic Sound				
Residential Floor	Below 10	10 to 19	20 to 29	30 to 39	40 and above
DD	***3.88 bpm.***	3.33 bpm.	0.90 bpm.	0.76 bpm.	0.72 bpm.

Table 4. The drop difference in residential floor on each wind sound

Table 4 shows the conclusion of the Fig. 10, Fig. 14 and Fig. 18 on the drop rate difference. According to Table 4, it is seen that the higher the floor the participants live on, the lower the drop rate between IHR and the final heart rate for the mild wind sound. The exception was the participants living above floor 40. According to the table 4, the drop rate is as good as the participants living on the lower floors. As for the wind chime sound, all floors are seen to have a higher drop rate score comparing with the other sounds.

From the interview, the participants that live below floor 20 regard the mild wind sound as a harmless breeze and a luxury to have a breeze. It is because Malaysia's temperature is much higher than

Thailand. As for the participants that live above floor 40, they mention that they bought one of the top floor units because they enjoy the breeze wind alongside with the view it provides.

4.2 Conclusions

The study hypothesized that natural sounds will promote higher recovery rate then indirect natural sounds, and indirect natural sounds will have a higher recovery rate than anthropogenic sounds. However, this hypothesis was not supported. Results from this study indicated that the indirect sound of the wind (sound of the wind chime) aided stress recovery better than the direct sound of wind (sound of the mild wind) itself while anthropogenic sound had little to no effect.

Comparing the overall drop rates of all the groups, the wind chime sound is shown to possess the ability to create a bigger drop rate than the mild wind sound. Although the mild wind sound seems to have the biggest effect on the males and office workers specifically, the majority of participants however, reported feeling psychologically unease and afraid of the sound of the wind during the brief interview.

In conclusion, the sound of the wind chime seems to be a better stress recovery aid than the sound of nature itself, showing that it slows the heart rate even more so. Like every other sound of nature, the wind sound is rather unpleasant to humans as it might lack in melody and harmony.

In addition, the interpretation of listening the sounds can be different from various factors such as background of persons (age, gender, occupation and where they live). Perhaps with the use of physical wind breeze as an addition to the sound of the wind, it might have a different result. Findings from this conducted experiment provide evidence that the sound of wind chimes can be used for stress recovery, adding to the existing literature of SRT.

4.3 Future Recommendations

Based on this research, it is shown that the indirect sound of wind act as a better stress recovery aid than the sound of wind itself. Therefore, the sound of wind chimes should be redesigned in a way to incorporate into a building space as a permanent yet controlled feature.

After observing and experimenting in Bukit Utama 9 condominium, the lift lobby space is by far the most optimal space to incorporate the sound of wind chimes into. This space not only has ample wind flowing through, it is also a space where the residents have to interact in while waiting for a lift. Therefore, instead of restlessly waiting for the lift to arrive, the residents' time could be put to good use instead. The wind chime sound can be heard to de-stress and/or to feel calmer upon leaving or returning home.

The wind chimes could be designed as a part of the window structure as highlighted in a dash box (see Fig.25, Fig.27, Fig.28). A permanent yet controlled feature, so that the chime sound can be controlled during the day and night. Fig. 25 shows the panoramic view of the current lift lobby area on the 14th floor. As it is shown, the windows are highlighted in yellow, are installed at each end of the lobby in Fig. 26, thus natural ventilation is constantly available. Fig.27 and Fig. 28, shows the close up shot of the window and where the wind chimes feature could be installed.

Fig. 25 Lift Lobby area of Bukit Utama 9

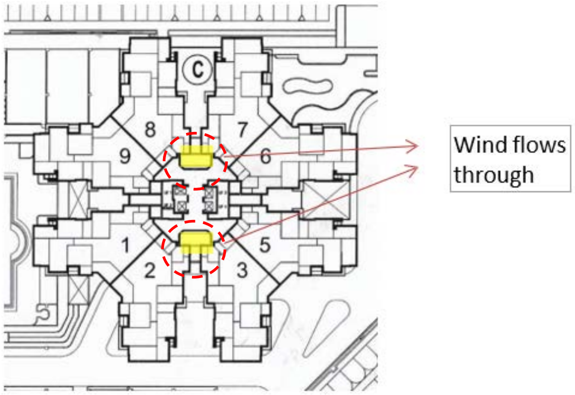


Fig. 26 Floor Plan of the Condominium

Fig. 27 Close up shot of the window area and proposed wind chime placement

Fig. 28 Close up shot of the window area and proposed wind chime placement

4.4 Limitations

There are some factors limiting this study. Firstly, the demographic samples are unvaried, as this study is only conducted in a condominium. In further improving this study, it would be beneficial to test the same methods but on a larger multitude. A prototype of the wind chime window could also be created with the aid of engineers and sound acoustic designer as the next step following this experiment.

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