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CLUSTERING STUDENTS BASED ON THEIR ACOUSTICAL-RELATED PREFERENCES OF STUDY PLACES

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ABSTRACT

Students are exposed to various environmental stimuli at their home study places. However, different students have different preferences in terms of indoor environmental quality (IEQ) aspects and psychosocial aspects of these places. A previous study on students' preferences of their study places resulted in nine profiles based on their IEQ and psychosocial preferences of their study places. It was found that there are profiles that were not highly concerned with sounds at their study places, while other profiles are concerned about sounds. Accordingly, this present study aims at clustering students based on their acoustical-related preferences of their study places. A questionnaire survey was completed by 451 first-year bachelor students at the Faculty of Architecture and the Built Environment at TU Delft. TwoStep cluster analysis was performed, and five unique profiles were identified. These are: 1) sound extremely concerned introvert, 2) sound unconcerned introvert, 3) sound partially concerned introvert, 4) sound concerned extrovert, and 5) sound unconcerned extrovert. The outcomes of this study showed that TwoStep cluster analysis facilitate researchers to better understand the different profiles of students based on their acoustical-related preferences in study places.

Keywords: *Acoustical-related preferences, psychosocial preferences, TwoStep cluster analysis, study places.*

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1. INTRODUCTION

Research has shown that university students are spending most of their studying time, except attending lectures, at their homes or educational building [1], [2]. These spaces are important destinations for students [3]. Therefore, understanding students IEQ and psychosocial preferences is important to provide a healthy and comfortable indoor environment for them. In fact, students differ in their IEQ and psychosocial of their study places. For instance, students preferences of study places may vary based on study activity. A study concluded that students prefer to study at home while performing individual study activity, while they prefer to study at the university while doing a collaborative study activity [4].

In a lab study on sound environment of open-plan study environment was found that most university students did not prefer the presence of background sounds, such as speech while they are studying for an exam [5]. On the contrary, a recent study resulted in nine unique profiles of university students based on both IEQ and psychosocial preferences of their study places. It was concluded that there are profiles of students who were concerned with sounds and in other profiles they were not concerned with sounds at their study places [6]. Accordingly, this study is a follow-up on that study which aims at re-clustering the students based on the sound-related preferences of their study places. Hence this study aims at answering the research question: Can we identify students profiles based on acoustical-related preferences of their study places?

2. MATERIALS AND METHODS

2.1 Questionnaire

Bachelors students (n = 451) at the Faculty of Architecture and the Built Environment completed the questionnaire in March 2021, October 2021, and March 2022 [6]. This

questionnaire was built in Qualtrics XM platform in Dutch and English languages. "My Study Place" questionnaire consists of seven sections that are: 1) personal information, 2) psycho-social aspects, 3) most used study place, 4) preferences, 5) comfort perception, 6) lifestyle, and 7) health. The most used study place section includes the preferences question (IEQ and psychosocial preferences). This question is on a scale from 1 to 10, in which 1 means "not important at all"; 10 means "extremely important".

2.2 Data management and analysis

After data was collected, it was exported to SPSS Version 26.0 software (SPSS Inc, Chicago, IL, USA). Then, TwoStep cluster analysis, which is a segmentation method, was conducted to cluster the students based on their acoustical-related preferences of their study places. In a number of previous studies, TwoStep cluster analysis was used to explore clusters of occupants based on their preferences in different contexts, such as primary school children in classrooms [7], outpatient staff in hospitals [8], office workers in workplace [9], and university students in study places [6]. In this study, five input sound-related preferences variables are included: 1) sounds from the outside, 2) sounds from the inside, 3) presence and company of others, 4) ability to control or adapt the place, and 5) privacy.

TwoStep cluster analysis was based on choosing the loglikelihood, determination of the number of clusters automatically, and Akaike's information criterion (AIC). After that, four validation steps were performed: 1) the silhouette measure of the cluster model to test whether it is greater than 0.2 (fair and above); 2) Chi-square tests to test the significant relations between the input variables of the cluster model membership variable, in which p-value is less than 0.05; 3) the predictor importance scores of the input variables are greater than 0.02; and 4) the dataset was randomly split into two parts (50%) to re-do the TwoStep cluster analysis for each half, to ensure that each of the two half models are similar to the final model. Once the cluster analysis model was validated, descriptive analysis was conducted to calculate the frequencies, percentages, and standard deviation (SD) for different variables of each cluster (e.g., gender, health, comfort perception). Furthermore, both Chi-square and ANOVA tests (for nominal and continuous variables, respectively) were conducted to test the statistically significant differences of these variables between the clusters (with p-value less than 0.05).

3. RESULTS

Five unique profiles where identified (**Figure 1**), which are: 1) sound extremely concerned introvert (n = 70), 2) sound unconcerned introvert (n = 78), 3) sound partially concerned introvert (n = 87), 4) sound concerned extrovert (n = 116), and 5) sound unconcerned extrovert (n = 89).

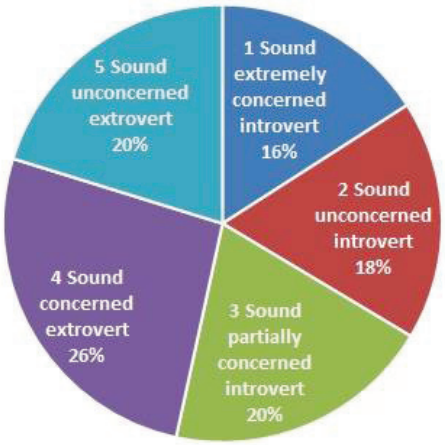

Figure 1. Students profiles based on their acoustical-related preferences of study places.

Table 1 includes the acoustical-related preferences among the five profiles. The sound extremely concerned introvert scored the highest importance scores for the sounds from the outside (8.3), sounds from the inside (8.7), ability to adapt or control the place (7.5), and privacy (8.8). The sound unconcerned introvert scored the lowest importance scores for sounds from the outside (3.9) and sounds from the inside (4.1). The sound partially concerned introvert students are the least concerned with presence and company of others (3.4). In contrast, the sound concerned extrovert students are the highest concerned with presence and company of others (7.5). Besides, they are the second group that scored highest importance scores for the sounds from the outside (7.1), sounds from the inside (7.7), and ability to control or control the place (6.5). The sound unconcerned extrovert students scored the lowest importance level for the privacy (3.6). However, these students scored the second lowest scores for the sounds from the outside (5.6) and sounds from the inside (6.2).

Table 1. Preferences of the five students profiles.

Mean (SD)	1	2	3	4	5
Sounds from the outside	8.3 (1.4)	3.9 (1.9)	6.7 (1.3)	7.1 (1.4)	5.6 (2.1)
Sounds from the inside	8.7 (1.1)	4.1 (2.2)	7.0 (1.3)	7.7 (1.3)	6.2 (2.1)
Presence and company of others	4.0 (1.9)	3.5 (2.0)	3.4 (1.6)	7.5 (1.3)	7.1 (1.9)
Ability to adapt or control the place	7.5 (1.5)	6.4 (2.2)	4.4 (1.8)	6.5 (1.5)	4.9 (2.1)
Privacy	8.8 (1.2)	7.7 (2.0)	6.9 (1.5)	7.1 (1.3)	3.6 (1.4)

4. DISCUSSION AND CONCLUSIONS

The outcome of this study showed that TwoStep cluster analysis can be used to identify profiles of clusters based on their acoustical-related preferences. While in previous studies [1], [5] it was concluded that in general students prefer to study in a quiet environment without the presence of background sounds, in this study two profiles were identified that are not concerned with sounds and three profiles were identified that are concerned with sounds of their study places. Furthermore, in a previous study students prefered to study in quiet and private study places with less contact with others [10]. However, in this present study students in some profiles prefer to study, either private or in presence of others, in quiet environments, while students in other profiles, either private or in presence of others, prefer to study in non-silent environments. Therefore, understanding the different profiles of students based on their acoustical-related preferences is fundamental for providing a good IEQ in their study places.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] R. Beckers, T.V.D. Voordt, and G. Dewulf, "Why do they study there? Diary research into students' learning space choices in higher education," *Higher Education Research & Development*, vol. 4360, 2016, doi: 10.1080/07294360.2015.1123230.

[2] V. Ramu, N. Taib, and H.M. Massoomeh, "Informal academic learning space preferences of tertiary education learners," *Journal of Facilities Management*, 2021, doi: 10.1108/JFM-05-2021-0047.

[3] A.M. Cox, "Space and embodiment in informal learning," *Higher Education*, no. September 2017, pp. 1077–1090, 2018, doi: 10.1007/s10734-017-0186-1.

[4] R. Beckers, T.V.D. Voordt, and G. Dewulf, "Learning space preferences of higher education students," *Building and Environment*, vol. 104, pp. 243–252, 2016, doi: 10.1016/j.buildenv.2016.05.013.

[5] E. Braat-Eggen, J. Reinten, M. Hornikx, and A. Kohlrausch, "The Effect of Background Noise on a 'Studying for an Exam' Task in an Open-Plan Study Environment: A Laboratory Study," *fronties in Built Environment*, vol. 7, no. July, pp. 1–12, 2021, doi: 10.3389/fbuil.2021.687087.

[6] A. Hamida, A. Eijkelenboom, and P.M. Bluyssen, "Profiling Students Based on the Overlap between IEQ and Psychosocial Preferences of Study Places," *Buildings*, vol. 13, no. 1, p. 231, Jan. 2023, doi: 10.3390/buildings13010231.

[7] D. Zhang, M.A. Ortiz, and P.M. Bluyssen, "Clustering of Dutch school children based on their preferences and needs of the IEQ in classrooms," *Building and Environment*, vol. 147, no. October 2018, pp. 258–266, 2019, doi: 10.1016/j.buildenv.2018.10.014.

[8] A. Eijkelenboom and P.M. Bluyssen, "Profiling outpatient staff based on their self-reported comfort and preferences of indoor environmental quality and social comfort in six hospitals," *Building and Environment*, vol. 184, no. May, p. 107220, 2020, doi: 10.1016/j.buildenv.2020.107220.

[9] M.A. Ortiz and P.M. Bluyssen, "Profiling office workers based on their self-reported preferences of indoor environmental quality and psychosocial comfort at their workplace during COVID-19," *Building and Environment*, vol. 211, no. January, p. 108742, 2022, doi: 10.1016/j.buildenv.2021.108742.

[10] X. Wu, Z. Kou, P. Oldfield, T. Heath, and K. Borsi, "Informal Learning Spaces in Higher Education: Student Preferences and Activities," *Buildings*, pp. 1–27, 2021.