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Student Research Report

Wood in Study Spaces: Impact on Student Mood and Preference

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Executive summary

It is well known that people have an affinity to nature and previous research has found that biophilic designs are correlated to higher individual satisfaction (Nyrud et al., 2014); however little is known about the effect of wood in study environments. An online volunteer sample of 157 participants were presented with images of one of five fictional study rooms in a between subject design. The five rooms had differing amounts of wooden surfaces (independent variable), from no wooden surfaces, to having both wooden floors and four wooden walls. They were then asked to complete a short PANAS and preference questionnaire (dependent variables). No significant results were found regarding the impact of wooden design elements on student preference or mood. Therefore, the effect of wood on preference cannot be definitively extended to study environments. Future research with larger participant samples and a higher statistical power are required.

Introduction

Since many people spend a lot of time in indoor environments, it is important to research how indoor design elements may affect people's well-being. Prior research has investigated whether biophilic design elements (i.e. natural design elements) using wood are preferred over non-biophilic design elements and are beneficial to one's well-being (Zhong et al., 2022). A study conducted by Nyrud et al. (2014) investigated the preferences of hospital staff for patient rooms with different amounts of wooden walls. They found the room with an intermediate amount of wood, that being, the room with one wooden wall and a wooden floor was most preferred. Thus, Nyrud et al. (2014) were able to conclude that using a specific amount of wooden design elements lead to increased individual preference for these patient rooms. Prior research has also discovered that wooden design elements can increase positive emotions. A study by Demattè et al. (2018) examined participants' emotions and perceptions while in either a full size plaster room or wooden room. It was found that the wooden room resulted in more positive emotions, demonstrating the importance of biophilic design elements on well-being (Demattè et al., 2018). Furthermore, a review of empirical studies by Nyrud and Bringslimark (2009) claimed that elements of nature, both inside and outside, have a positive effect on health and well-being. This review found that participants tended to have a preference for wood and that natural elements can evoke a response of aesthetic liking that can lead to an increase of positive feelings (Nyrud and Bringslimark, 2009). Previous literature examining the effect of wood elements on individuals has not looked into exactly how much wood is needed to see benefits on participants or applied it to the student population to close this knowledge gap. Therefore, our study aims to determine the specific amount of wooden biophilic design elements that would impact students' mood and preference of a given study space. Driving forces include enhancing students' mood through the use of wooden elements in a study space to improve students' academic performance (Rogaten et al., 2013). A restraining force is that our clients do not know the optimal amount of wood to elicit an increase in student mood.

Research question and hypothesis

The aim of our study is to support previous literature regarding natural design elements, specifically Nyrud et al.'s (2014) study, which found that rooms with an intermediate amount of wooden surfaces (i.e. wooden floor and one wooden wall) were preferred. Little previous research has directly examined student perceptions and the use of study spaces; therefore, the aim of this study was to research whether the amount of wooden surfaces in a study environment influences students' mood and preference for the study space. Following the findings of Nyrud et al. (2014), we specifically hypothesised that a study environment with an intermediate amount of wooden surfaces (wooden floors and one

wooden wall) will result in the most positive mood and be the most preferred room, compared to study environments with less or more than an intermediate amount of wood.

Methods

Participants

In order for our results to be statistically significant, a sample size of 305 participants was required. This number was based on a power calculation with a power of .8, an alpha of .05 and an effect size of .2. However, the final sample consisted of 157 participants. Of the 157 participants, 113 (72%) were students, 37 (24%) were not students and 7 (5%) did not answer this question. Within the participants who were students, 41 (26%) were UBC students, and 72 (46%) were not UBC students, meaning that most of our participants were not UBC students. The largest age group of participants in this study was ages 18-24 with a total of 89 (57%) participants, followed by ages 25-34 with 36 (23%) participants. Most of our participants, a total of 112 (71%), were female, while 25 (16%) participants were male and 2 answered "other". In regards to race and ethnicity, 84 (54%) participants were Caucasian, 18 (11%) participants were Indigenous, and 15 (10%) participants were Asian.

Conditions

Our study consisted of five conditions. Each condition showed images which included 4 different angles of a single study space. The independent variable was the amount of wooden surfaces in the study spaces shown. Condition A had no wooden elements, condition B had a wooden floor, condition C had a wooden floor and one wooden wall, condition D had a wooden floor and two wooden walls and condition E had a wooden floor and four wooden walls. All other aspects of the room, such as furniture, lighting and time of day, were kept constant in all conditions. The images of the rooms in the five conditions were generated through the software "The Sims 4" and can be found in Figure 1-5 in Appendix B.

Measures

The two dependent variables in the study were participants' mood and preference for the study space. Mood was measured using the Short PANAS scale (Thompson, 2007). The Short PANAS scale included 5 items on positive affect, which were *inspired*, *alert*, *excited*, *enthusiastic* and *determined*, and 5 items on negative affect which were *afraid*, *upset*, *nervous*, *scared*, and *distressed*. These items were measured using a 5-point Likert scale. Preference for the study space was measured with a 7-point Likert scale ranging from strongly disagree to strongly agree. Using this scale, participants rated their preference for studying in the room by answering three questions, see Appendix A. To investigate what would make the study space more preferable, participants were also asked a qualitative question regarding what changes they would make to the space and why they would make those changes. The order of the measurements of mood and preference were randomised within each condition to avoid an order effect.

Procedure

Participants were first presented with general information about the study and a consent form. Once they confirmed their consent, participants completed an online survey through Qualtrics where they were randomly assigned to one of the five conditions to avoid an order effect. Participants were asked to look at the images of a room, which varied depending on their condition, and imagine they were studying in the room. They then answered questions pertaining to either mood or preference, the order of which was randomised within each condition. Participants were again presented with the images of the room within their condition and answered the remaining set of questions on either mood or preference. They then answered a question about changes of the study space and questions regarding their demographic information.

Results

A correlation analysis with Pearson's r for the three preference questions showed a strong correlation ($r(300) > 0.6$, $p < .001$), see Table 1 in Appendix B. Therefore, scores from the three preference questions are summed into a single preference measure in the analysis. The hypothesis is rejected due to non-significant results by one-way ANOVA: Preference $F(4,152) = .918$, $p = .455$, positive affect $F(4,152) = .245$, $p = .912$, and negative affect $F(4,152) = .047$, $p = .996$, see Figure 1. Therefore, the amount of wooden surfaces does not influence affect and preference for the study space. Furthermore, plots of mean and standard error for preference is a U-shape and it thus shows a tendency for participants to prefer either no wooden surfaces (condition A) or all wooden surfaces (condition E). A second correlation analysis shows a significant negative correlation ($r(300) = -0.38$, $p = < .001$) between preference and negative affect (NA score) and a significant positive correlation ($r(300) = .43$, $p = < .001$) between preference and positive affect (PA score), see Table 2 in Appendix B. Therefore, a room with a lower negative affect score is less preferred, whereas one with a higher positive affect score is more preferred. The correlation between positive and negative scores is small and insignificant ($r(300) = .06$, $p = .468$), see Table 2 in Appendix B.

A qualitative analysis was conducted to investigate specific changes participants would like to make in the design of the study space. A thematic analysis inspired by Braun and Clarke (2008) was conducted, which followed the process of familiarisation with data, generating codes, and reviewing and defining codes. Therefore, an iterative process of coding and defining codes to investigate new patterns and generalising these was used. Descriptive coding was chosen to categorise physical design features as codes (Miles et al., 2014). The advantage of using descriptive coding is to identify specific recommendations for design of study spaces at UBC. Seven general codes were defined: *Individual study space*, *Furniture*, *Colour*, *Decoration*, *Type of space*, *Lighting* and NA, see Table 3 in Appendix B. The codes with the highest amount of comments were *Individual study space* and *Furniture*. Participants wished for more individual study space in terms of having more private and screened study spaces to avoid distractions from other students. In addition, there were many comments about having smaller tables as individual study spaces and adding power plugs.

ANOVA - PA score

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
condition	16.807	4	4.202	0.245	0.912	0.006
Residuals	2607.881	152	17.157			

Note. Type III Sum of Squares

ANOVA - NA score

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
condition	2.272	4	0.568	0.047	0.996	0.001
Residuals	1826.671	152	12.018			

Note. Type III Sum of Squares

ANOVA - preference

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
condition	77.749	4	19.437	0.918	0.455	0.024
Residuals	3216.888	152	21.164			

Note. Type III Sum of Squares

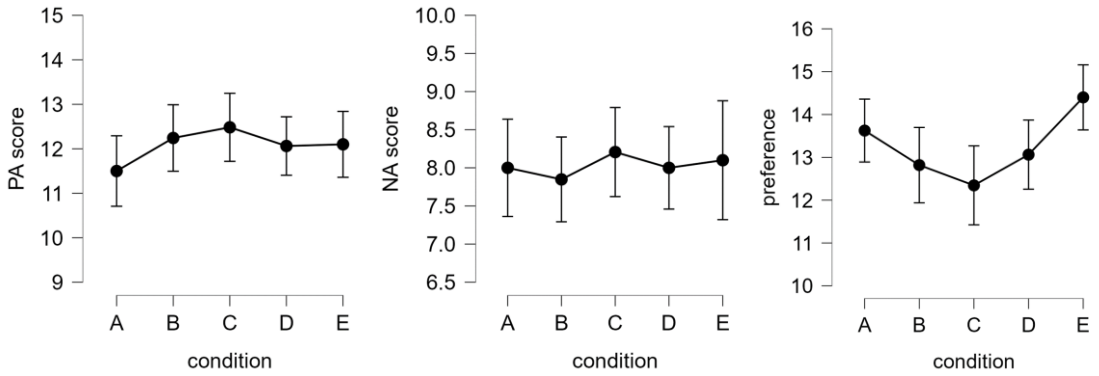

Figure 1: Results of one-way ANOVA and plots of mean and error bars with standard error for each of the three measurements: Positive affect (PA score), negative affect (NA score) and preference. X-axis shows the five conditions: A-E.

Discussion

Results show that our hypothesis was not supported and there were no significant differences between participants' positive and negative affect scores across conditions. This suggests that the amount of wooden surfaces in the study space does not impact positive nor negative affect. These findings appear to contradict that of previous studies, which demonstrated that participants in a wooden room had higher positive affect than participants in a room made with plaster (Demattè et al., 2018). There was also no significant difference found in the relationship between the amount of wooden surfaces and participants' preference scores. However, while insignificant, a U-shaped relationship was observed, meaning that study spaces with no wooden (condition A) or all wooden surfaces (condition D) were the most preferred. This heavily contradicts Nyrud et al. 's (2014) findings, which indicated that rooms with an intermediate amount of wooden surfaces were the most preferred and least preferred are rooms with no wooden or all wooden surfaces. A correlational analysis between affect and preference for the study space yielded significant results. Reasons for the results above will be further discussed in the limitations section.

In regards to the qualitative analysis conducted in this study, wishes for changes into more screened individual study space with smaller tables with power plugs are presumably affected by the participants' own expectations of a study space based on their knowledge of familiar study spaces, which may differ between universities. Participants include students from different universities (i.e. not UBC students), thus the study could be replicated to solely UBC students to avoid possible difference in expectations. On the other hand, individual study spaces may enable the student to concentrate while studying and most students use computers to study. Therefore, the desire for individual study spaces with power plugs are assumed to be broadly applicable to both UBC and not UBC students. Moreover, the findings are potentially applicable to people in general, who wish to perform a task on computers and have a similar workload to that of a student. Additionally, group work might require a different setup, thus results are influenced by the view of studying as an individual activity. Exploring the design of a study space for group work is recommended in future studies. More research can also be conducted to evaluate the importance of each code in the qualitative analysis when designing a new study space with wooden surfaces. Additionally, more iterations of coding the qualitative data are desirable to reach saturation.

There are several limitations in this study. First, due to time constraints, we recruited fewer participants than what was needed based on the power calculation. Therefore, the current study had a small sample size and was heavily underpowered. The small sample size may be a reason for the lack of significant results in this study. Future research can prevent this by recruiting the required number of participants based on the power calculation.

Another limitation is that our study did not account for the contrast between wooden and non-wooden surfaces as a potential factor that could impact participants' preference scores. A study by Cho and Suh (2020) found that compared to rooms with an extreme or minimal level of contrast between colours among components (e.g. walls and floors) in a room, participants preferred to stay in a room with an appropriate level of contrast between colours. This is because similar colours make a space appear more coherent, while extreme levels of contrast can make a space appear disharmonious. Furthermore, the study found that brown tones in a room increased participants' desire to stay in the room. These results may explain why conditions with an intermediate amount of wooden surfaces (i.e. conditions B, C and D) were preferred less than conditions A and E in our current study. The contrast between the brown wooden walls and the white non-wooden walls might have made the study space appear disharmonious. On the other hand, conditions A and E both use colours with less contrast than conditions B, C and D. Moreover, since condition E not only has less contrast between colours but also the most amount of brown surfaces, Cho and Suh's (2020) finding that brown tones increase participants' desire to stay in a room may also provide insight into why condition E appeared to be preferred over conditions B, C and D. However, it is important to note, it may be hasty to draw conclusions due to the fact that our results were insignificant. Future studies could consider colour contrast among surfaces as a variable and use colours of wood that contrast less with the non-wooden surfaces.

Our current study has implications for designing study spaces that promote better academic performance for students. A study by Rogaten et al. (2013) emphasises the importance of students' affect when studying on academic performance. They discovered that having positive emotions when studying predicted better overall academic performance, while having negative emotions when studying during the second half of a semester predicted worse overall academic performance. Considering that the current study found a correlation between mood and preference for a study space, it may be important to design study spaces that students prefer visually because a preferred study space is linked with higher levels of positive affect, and experiencing positive affect when studying is predictive of better academic performance.

The results can be applicable to a larger population than solely students, since the 23.5% of participants in our study were not students. This larger population might include people working in indoor environments with materials similar to what is used for studying, but future research is needed to replicate the study with these populations. Additionally, the minority of students in the study is UBC students (26%). Therefore, results might be applicable to other university students to a larger extent than UBC students.

Recommendations

Even though results are insignificant between preference and mood for the five conditions, participants tended to prefer study spaces in condition A and E. However, further research is necessary before seriously considering these recommendations.

Secondly, since positive mood and preference are positively correlated, spaces should be designed to enhance a positive mood because these designs are more preferred. Likewise, students will have a more positive mood when studying in a study space that they prefer. Therefore, it is recommended to either measure user preference or mood before building a new study space to explore the level of preference and mood for the study space before spending resources on building. This knowledge can be used to test requirements for mood and preference in an iterative design process to ensure user requirements are met.

Thirdly, design of future study spaces should focus on creating screened individual study spaces that are equipped with power plugs to avoid distractions.

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Appendix

The appendix provides additional information for the project “Wood in Study Spaces: Impact on Student Mood and Preference”:

A) Survey Questions
B) Additional tables and figures
C) Explanation of contribution of each team member

A) Survey Questions

Imagine you are studying in the room in the picture. Please take your time to look at each picture before you answer the questions in order to get a sense of the room.

Please answer the following questions based on how you feel in the present moment.

Distressed

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Alert

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Scared

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Enthusiastic

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Upset

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Nervous

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Inspired

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Determined

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Afraid

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

Excited

Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
○	○	○	○	○

I like the interior of this room.

Strongly disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

This room is well-suited for a study environment.

Strongly disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

I would like to study in this room.

Strongly disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

Would you change anything about the design of this study space? IF yes, what would you change and why?

How old are you?

- ◯ 18-24 years old
- ◯ 25-34 years old
- ◯ 35-44 years old
- ◯ 45-54 years old
- ◯ 55-64 years old
- ◯ 65+ years old

Which gender do you identify with?

- ◯ Male
- ◯ Female
- ◯ Non-binary
- ◯ Transgender
- ◯ Two spirited
- ◯ Other

With which of the following do you identify? (select all that apply)

(Please select all that apply)

- [ ] Asian
- [ ] Black
- [ ] Hispanic/Latinx
- [ ] Indigenous
- [ ] South Asian
- [ ] White/Caucasian
- [ ] Other
- [ ] Prefer not to say

Are you a student?

- ◯ Yes, I am a UBC student
- ◯ Yes, but I'm not a UBC student
- ◯ No

What faculty are you enrolled in?

What is your Major? (write na if you do not have a major)

Which of the following best describes your political views?

- ◯ Strongly liberal
- ◯ Liberal
- ◯ Slightly liberal
- ◯ Middle of the road
- ◯ Slightly conservative
- ◯ Conservative
- ◯ Strongly conservative

Generally speaking, how stressed are you regarding climate change?

- ◯ No stress at all
- ◯ A negligible amount of stress
- ◯ A small amount of stress
- ◯ A noticeable but tolerable amount of stress
- ◯ A just manageable amount of stress
- ◯ A slightly stressful amount of stress
- ◯ A noticeable amount of stress
- ◯ A considerable amount of stress
- ◯ An overwhelming amount of stress

B) Additional tables and figures

Figure 1: Condition A, angles 1 (top left), 2 (top right), 3 (bottom left), and 4 (bottom right)

Figure 2: Condition B, angles 1 (top left), 2 (top right), 3 (bottom left), and 4 (bottom right)

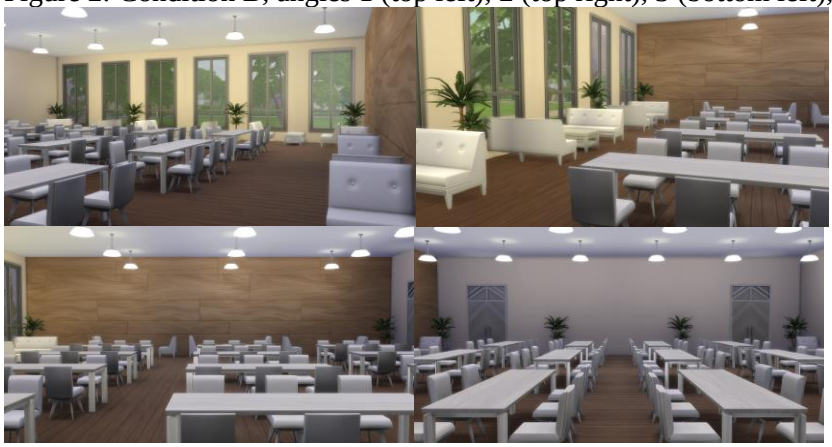

Figure 3: Condition C, angles 1 (top left), 2 (top right), 3 (bottom left), and 4 (bottom right)

Figure 4: Condition D, angles 1 (top left), 2 (top right), 3 (bottom left), and 4 (bottom right)

Figure 5: Condition E, angles 1 (top left), 2 (top right), 3 (bottom left), and 4 (bottom right)

Pearson's Correlations

Variable		pref1	pref2	pref3
1. pref1	Pearson's r	—		
	p-value	—		
2. pref2	Pearson's r	0.604	—	
	p-value	< .001	—	
3. pref3	Pearson's r	0.638	0.789	—
	p-value	< .001	< .001	—

Table 1: Correlation analysis by Pearson's r for three preference questions: Pref1: How do you like the room? Pref2: Is the room well suited for a study environment? Pref3: How much would you like to study in this room?

Pearson's Correlations

Variable		preference	NA score	PA score
1. preference	Pearson's r	—		
	p-value	—		
2. NA score	Pearson's r	-0.382	—	
	p-value	< .001	—	
3. PA score	Pearson's r	0.429	0.058	—
	p-value	< .001	0.468	—

Tabel 2: Correlation analysis by Pearson's r for all three measurements: Positive mood (PA score), negative mood (NA score) and preference.

Code	**Definition**
Individual study space	Screened and separate study spaces to avoid being distracted by other students.
Furniture	Amount and design of tables, chairs, power plugs and windows.
Colour	Colour of furniture and decorations.
Lighting	Both the amount and style of natural and artificial lighting.
Decoration	Examples include carpets, art and plants.
Type of space	Describing the type of space as a cafeteria/ communal area or wishes for a more living room-like space.
NA	No changes or participants don't know what to answer.

Table 3: Codes and definitions from the qualitative analysis of the question: "Would you change anything about the design of this study space.if yes what would you change and why?".

C) Contributions

Content	**Team members**
Writing the proposal	Courtney Cheung, Devanshi Gupta, Emma-Sofie Hestbech, Laina Dustyhorn, Lily Tillinghast, Sierra Hazelton
Running data collection	Courtney Cheung, Devanshi Gupta, Emma-Sofie Hestbech, Laina Dustyhorn, Lily Tillinghast, Sierra Hazelton

Running data analysis	Courtney Cheung, Emma-Sofie Hestbech
Making presentation	Devanshi Gupta, Lily Tillinghast, Courtney Cheung, Emma-Sofie Hestbech, Laina Dustyhorn
Writing final report	Courtney Cheung, Devanshi Gupta, Emma-Sofie Hestbech, Laina Dustyhorn, Lily Tillinghast, Sierra Hazelton