University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

That's my type! Exploring student well-being and planting strategies at UBC

Prepared by: Caitlyn Chan, Will Partridge, Anna Sawada, Doris Sun, Jeff Teo, Taishi Yamada

Prepared for:

Course Code: PSYC 421

University of British Columbia

Date: 14 April 2022

That's my type! Exploring student well-being and planting strategies at UBC

Caitlyn Chan, Will Partridge, Anna Sawada,

Doris Sun, Jeff Teo, Taishi Yamada

Department of Psychology, University of British Columbia

PSYC 421: Environmental Psychology

Dr. Jiaying Zhao

14 April 2022

Executive Summary

This study attempted to investigate how different planting strategies (dense versus sparse, trees versus shrubs) affected student preferences, moods, and stress levels towards green spaces on UBC Campus. To test this, participants were randomly assigned to view a green space, and answered questions relating to preferences, positive and negative affect, and perceived stress levels. Our survey was distributed online and in-person to random UBC students, and we obtained 212 usable responses. We found that participants preferred trees over shrubs, and favoured higher plant densities. We also found a significant difference in preference scores between participants who viewed dense and sparse trees, but not between participants who viewed dense and sparse shrubs. Unexpectedly, we also found that shrubs evoked more positive affect among participants compared to trees. These findings point towards the influence of functionality in determining preferences, and highlights the possible distinction between implicit and explicit expressions, as well as the independent nature of preferences and emotions. We hope that these findings will contribute toward suggesting novel methods of conducting future research for SEEDS, and support UBC to better understand the value of green spaces amongst students, and consider mixed planting strategies for future development of campus green spaces.

Keywords: green space, preferences, trees, shrubs, dense, sparse, stress, mood

Introduction

Exposure to green spaces has been shown to be beneficial toward improving various aspects of human health and well-being[1,2,3]. Green spaces have been incorporated in a variety of settings such as urban landscapes and hospitals to improve the moods of individuals and promote physical and psychological healing [4,5]. In particular, recent research has examined the effect of green spaces on school campuses and their effect on students[6,7]. Hipp and colleagues[8] examined the relationship between green spaces on university campuses and self-reports on quality of life, and found that students who experienced more green spaces on campus were more likely to report a higher quality of life, which included measures on physical, psychological and social facets of health. This finding was consistent with Ibes and Forestell's[9] study that found a reduction of mood disturbance in participants who were in green spaces compared to individuals who were indoors.

While extant research has largely focused on examining the health and well-being outcomes from the presence versus absence of green spaces[10], studies have rarely compared different types of greenery that were present in green spaces, and how these different types of plants can have varying effects on human health and well-being. When examining a number of green space characteristics, including the densities of plants, researchers also found them to be significant in affecting individuals' well-being; individuals tended to prefer slightly open planting densities when having to choose between planting designs featuring two layers of vegetation[11]. Despite this, less is known about the specifics of how green spaces provide benefits on health and well-being, namely, how various characteristics interact to influence students' mood and stress levels - which constitutes the basis for this current study.

Since the University of British Columbia Point Grey's campus has a wealth of green spaces, efficient and tailored planting strategies can amplify health and mood benefits[12], cognitive improvements[13], and restorative effects[14] to students who utilize these green spaces while on campus. By determining which plant types and densities best help promote positive moods and reduce stress levels among students, UBC SEEDS can adjust their planting strategies and policies accordingly, and direct resources into appropriate areas. Given the monetary costs and time needed to cultivate a "new" landscape, it would be prudent for UBC SEEDS to proceed with their planting strategies after taking into account the differential benefits brought about by the various types and aspects of green spaces.

Research Question and Hypothesis

We formulated our research question based on the current gaps in the existing literature, and recorded common measures that are associated with well-being. We aim to study the effects of different planting strategies in green spaces, particularly dense or sparse spacing, and trees or shrub plant types, in affecting student preferences, mood and stress levels. This led to the formulation of three main hypotheses in our study:

H1: Students who looked at plants of high densities would report higher preference scores, lower stress levels, and higher positive and lower negative affect levels relative to students who looked at sparse plants.

H2: Students who viewed trees will report higher preferences, lower stress levels, and higher positive and lower negative affect levels relative to students who viewed shrubs.

H3: The differences in preference scores, stress levels, and levels of positive and negative affect between students who viewed trees of high or low densities will be greater than the difference between students who viewed shrubs of high and low densities.

Methodology

Participants

Using a 95% power level with a .25 effect size, a minimum sample size of 212 was calculated. Our survey collected a total of 280 responses. 78 responses were excluded due to failure to complete the survey and our total usable responses were 212 (M_{Age} = 22.26, 60.5% Female, 38% Male, 1.5% Non-Binary) UBC students. All participants gave informed consent as overseen by the university's institutional review board.

Conditions

Our survey aimed to measure the effect of planting strategies, namely the density and height of plants. We used a 2 x 2 between-subjects design with 4 conditions: 2 (density: high vs. low) x 2 (vegetation: trees vs. shrubs). Trees were defined as any woody vegetation of at least 7.62 cm in diameter at 137 cm off the ground[15] , and shrubs as any non-woody plants or vegetation with multiple stems under 4 m[15]. We defined high density as ≤ 1 m apart (trees) and ≤ 10 cm apart (shrubs), and low density as ≥ 5 m apart (trees) and ≥ 20 cm apart (shrubs).

Trees selected for our survey conditions were based on what species were dominant on the Point Grey campus for familiarity and fit in the Pacific Northwest landscape. As maples are among the most common trees on campus at 22%[16], we included tree stands with maples in both dense and sparse conditions. The dense tree image featured maples and *Alnus*, and the sparse tree image featured maples and *Platanus x acerifolia*. For shrubs, our main selection criteria was to find shrubs that were densely and sparsely arranged in an obvious manner, as most of the shrubs found on campus were densely packed. Pictures matching the selection criterion were either taken from Google Maps or were images taken by the researchers at various locations on UBC's Point Grey Campus.

Procedure

We conducted intercept interviews with random UBC students at the Vancouver campus in person, and distributed our survey online through social media sites such as various UBC Facebook groups. Data was collected from March 2, 2022 to March 17, 2022, for a total of 15 days. We did not distinguish between undergraduate or graduate students. After participants finished reading the informed consent form, they were asked to confirm whether or not they were UBC students - the survey would end if they declared that they were not UBC students. Participants were then randomly assigned into one of the four conditions, and were instructed to look at the picture of their assigned condition (Appendix A) for an unspecified duration of time. Participants then filled out their responses using a 5-point Likert Scale on preferences, the PANAS-SF, and the PSS-10. At the end of the survey, students were asked to complete a demographics section.

Measures

Participants were asked to rate their preferences toward the picture they had seen using a 5-point Likert scale, with 1 being "Disliked very much" and 5 being "Liked very much"[17]. Participants were then asked to rate their mood on the PANAS-SF, which consisted of 5 items measuring positive affect and 5 items measuring negative affect. These items were scored on a 5-point scale from 1 (Never) to 5 (Always) based on the participant's general

feelings[18]. The higher scores for each scale would indicate either an elevated positive mood or an elevated negative mood. Cronbach's Alpha (α) registered at .80 for positive affect, and .72 for negative affect. In addition, participants were asked to rate their perceived stress levels using the PSS-10 scale, a 10-item survey asking about their stress levels scored on a 5-point scale ranging from 0 (Never) to 4 (Very often). Four of these items were reverse-coded, and a total score ranging from 0 to 40 was recorded. Higher scores indicated higher stress levels experienced by the participants. Similar to the PANAS-SF, the PSS-10 demonstrated high reliability with a Cronbach's Alpha (α) of .86[18]. Moreover, the PSS-10 was found to have a high predictive validity as prior research observed that scores were higher after experiencing more catastrophic life events[19].

Results

The survey data was split accordingly by dependent measures (preference, positive affect, negative affect and perceived stress levels). Using the JASP statistical software, a two-way between subjects ANOVA was computed. This study also computed Pearson's correlation coefficient (*r*) to assess the linear relationship between the various dependent measures. Effects are reported to be significant when $p < .05$.

Support was obtained for the first set of hypotheses on preference scores - where there was a significant main effect of plant type, $F(1, 208) = 37.877$, $p < .001$, $\eta_p^2 = .154$ and plant density $F(1, 208) = 20.871$, $p < .001$, $\eta_p^2 = .091$, with participants preferring trees more over shrubs, as well as favouring higher plant densities. In addition, there was a marginally significant interaction effect of plant type x plant density observed, $F(1, 208) = 3.809$, $p = .052$, $\eta_p^2 = .018$. Post-Hoc comparisons using Tukey HSD tests revealed that the preference for dense trees ($M = 4.264$, $SD = .738$) differed significantly from sparse trees ($M = 3.417$, $SD = .986$), while dense shrubs ($M = 3.211$, $SD = 1.048$) did not appear to significantly differ from sparse shrubs ($M = 2.870$, $SD = .972$). Therefore, the results suggest that the effect of plant density on preference scores is only observed for trees, and do not significantly increase liking scores for shrubs. Other hypotheses relating to scores on positive affect, negative affect, and levels of perceived stress did not show significant differences, with an exception for the scores measuring positive affect, where there was a marginally significant main effect of plant type observed, $F(1,208) = 2.816$, $p = .095$, $\eta_p^2 = .013$. Further analysis revealed a surprising finding of shrubs evoking more positive affect in comparison to trees.

Lastly, the analyses looked at the relationship between the various dependent measures collected in the study. Similar to prior research, the study obtained a positive correlation between the scores on perceived stress and negative affect, $r(210) = .48$, $p < .001$, and a positive correlation between scores of positive affect and liking, $r(210) = .17$, $p = .013$. Upon a further visual inspection of this scatter plot, however, it appeared that Pearson's r scores misrepresented the relationship between positive affect and liking (see Appendix B, Figure 15), and it appeared highly likely that there was no clear relationship between these two measures. The study unexpectedly also obtained a positive correlation between the scores on positive and negative affect, $r(210) = .21$, $p = .002$. The analyses of the scores on all other combinations of dependent measures were found to be insignificant.

Discussion

The results obtained from preference, stress, and affect scores show insights into the effect green spaces may have on participants. Firstly, in support of our hypothesis, plant type is shown to have a significant main effect on preference with trees scoring higher than shrubs.

The association between trees and its numerous effects, such as reducing air pollution, providing green infrastructure, as well as other cognitive and health benefits, may have led to a greater preference for trees[20]. We also see a significant main effect in preference of dense over sparse trees and shrubs, which can be explained by the prospect-refuge theory[21], in which dense ecology can provide our ancestors a better opportunity to observe surroundings and offer hiding places. This theory also accounts for the interaction effect of preferring higher densities for trees but not shrubs, as it has been shown that individual preferences for green spaces are largely associated with functionality[22]. Therefore, while individuals have higher preferences for dense trees that provide more shade and safety from the weather[23], preferences for shrubs appear relatively unchanged across densities. This is because the functionality of shrubs is not congruent on their densities, but rather on other factors, such as location, etc. As such, it implies that density is an important variable in planting trees, but not as important when planting shrubs.

Secondly, the results showed a marginally significant effect of plant types on positive affect scores, albeit in an opposite direction from what we hypothesized - that shrubs had generated more positive affect over trees. This result appears to support Orion's Savannah Hypothesis[24], an evolutionary hypothesis that links human physiology (i.e. bipedalism) and innate preferences to savannah ecology because it provided cover and nutrients for our ancestors[24]. In accordance with previous literature, we propose the use of future studies to investigate the claim that not only have humans developed explicit preferences for trees because of their functionality[23], but the claim that savannah-associated vegetation also has an unconscious influence on positive affect.

Furthermore, the visual inspection of the scatter plot showing the relationship between preference and positive affect scores possibly indicated that the emotions elicited by these images are independent from the preferences of individuals. This notion is further supported by the literature, in which it is hypothesized that the relationship between preferences and emotions is influenced by psychological mechanisms shaped in a specific environment[25]; greenery depicted in our images will not elicit positive emotions via savannah effect, but phenomena such as the familiarity principle, in which innate responses are moderated by experience[26], will nevertheless generate preference for trees. Therefore, rather than displaying contradictory results, emotions and preferences merely represent independent constructs that are operating under different psychological mechanisms.

Finally, no evidence was found to support the effects of plant type and density on negative affect and perceived stress levels, and an unexpected positive correlation was also found between positive and negative affect scores. Possible explanations are stated below.

Limitations

The validity of the results obtained could be impeded by how our survey was framed. Due to the wording of the PANAS-SF (see Appendix D), participants may have been primed to view their emotions as a "trait", rather than a "state"[27]. Therefore, rather than reporting their emotions after completing our survey, participants could instead be reporting the emotions they feel toward green spaces in general. This could explain the unexpected positive correlation obtained between the positive affect and negative affect scores of participants, where participants may have recalled instances of both positive and negative affect being evoked at varying instances of coming into contact with green spaces over a period of time.

Another limitation is the medium that our survey was conducted on. Unlike other studies that allowed their participants to view multiple images of green spaces or experience the green spaces[5,13], due to limited time and resources, our study only showed a picture of the condition to participants. This limited the ability of other aspects of the green space (e.g.

sounds and smells) toward influencing preferences, affect, and stress scores among our participants. The inclusion of a "true" experience of green spaces could result in a stronger operationalization in our measures. This more immersive experience could also solve another challenge, which is the inability to control the amount of time students spend looking at their green space condition. Because the amount of time may influence the effect the condition has on participant responses, the subsequent lowering of internal validity could also explain why there were no significant effects found for plant type and density on stress.

Lastly, this study was conducted solely among UBC students, which may lower external validity as studies have shown that age, gender, culture and ethnicity can also play a role in influencing attitudes toward green spaces[28,29,30]. Therefore, it is important that these factors are taken into account when generalizing the results of this study to a larger population and conducting similar studies in the future.

Recommendations

Based on our findings, we invite UBC SEEDS to take a closer look at the current planting strategies. Instead of engaging in an overhaul of campus greenery, we recommend gradually adopting a mixed planting strategy to increase the benefits of future development. For example, outdoors, the Point Grey campus features a wide array of landscapes across the character districts, which guides the species and character of vegetation planted[31]. While students and other users prefer trees in outdoor green spaces, we recommend that more diverse greenery can be introduced indoors by planting suitable shrubs in appropriate spaces given the effectiveness of shrubs over trees in producing positive moods among students.

A second recommendation is to continue exploring the area of student values surrounding campus green spaces. Our findings suggest that trees and shrubs planted in different densities do affect their preferences and well-being. As such, it is imperative that UBC achieves a balance between accommodating student opinions and choosing plants that have a proven effect in reducing student stress levels and improving student moods. Further research in this direction can fill in urban forest data gaps as outlined in the Next Steps of the Urban Forestry document[16], helping us better understand the social and cultural value of campus green spaces.

Third, to better determine which characteristics of plants and green spaces are actually effective in improving well-being, we suggest that UBC SEEDS consider additional approaches and methods toward collecting data and user opinions on green spaces. Alongside surveys and in-person studies, UBC SEEDS could partner with Emerging Media Lab to incorporate Virtual Reality (VR) technology in future projects to immerse participants in hypothetical green spaces. Self-report stress and mood data from surveys can be complemented with qualitative tools such as heart rate monitors and sweat gland sensors[9] to quantify the physiological changes in stress levels or well-being. Findings from the suggested studies can provide an implicit, uncontrollable measure that cannot be affected by human biases or environmental factors, which increases the validity of the results obtained.

Given that the above mentioned recommendation requires significantly more resources such as funds and staffing, it should only be adopted when traditional data and methods have consistently failed to produce significant and conclusive data. Furthermore, it is also important that UBC SEEDS take into account other considerations not examined in this study, such as the functionality of green spaces in their planting strategies. Ultimately, it is important to note that the accrued, overall benefits of making changes to the current green spaces are numerous and multi-dimensional in nature, outweighing the downsides of keeping the green space as it is.

References

1. Berto R. The role of nature in coping with psycho-physiological stress: A literature review on restorativeness [Internet]. Behavioral sciences (Basel, Switzerland). U.S. National Library of Medicine; 2014 [cited 2022Mar31]. Available from: https://pubmed.ncbi.nlm.nih.gov/25431444/

2. Dyment JE, Bell AC. Grounds for health: The intersection of Green School Grounds and health-promoting schools. Environmental Education Research [Internet]. 2007Oct22 [cited 2022Mar31];14(1):77–90. Available from: https://academic.oup.com/her/article/23/6/952/551561?login=true

3. Vujcic M, Tomicevic-Dubljevic J, Zivojinovic I, Toskovic O. Connection between urban green areas and visitors' physical and mental well-being. Urban Forestry & Urban Greening [Internet]. 2019 [cited 2022Mar31];40:299–307. Available from: https://www.sciencedirect.com/science/article/pii/S1618866717304703

4. Nisbet, E., & Zelenski, J. (2011). Underestimating Nearby Nature. Psychological Science, 22(9), 1101-1106. Available from: https://doi.org/10.1177/0956797611418527

5. Ulrich RS. View through a window may influence recovery from surgery. Science [Internet]. 1984 [cited 2022Mar31];224(4647):420–1. Available from: https://pubmed.ncbi.nlm.nih.gov/6143402/

6. Elsadek M, Liu B, Lian Z, Xie J. The influence of urban roadside trees and their physical environment on stress relief measures: A field experiment in Shanghai. Urban Forestry & Urban Greening [Internet]. 2019 [cited 2022Apr4];42:51–60. Available from: https://www.sciencedirect.com/science/article/pii/S1618866718306356

7. Peker E, Ataöv A. Exploring the ways in which Campus open space design influences students' learning experiences. Landscape Research [Internet]. 2019 [cited 2022Mar31];45(3):310–26. Available from: https://www.tandfonline.com/doi/pdf/10.1080/01426397.2019.1622661?needAccess=true

8. Hipp JA, Gulwadi GB, Alves S, Sequeira S. The relationship between perceived greenness and perceived restorativeness of university campuses and student-reported quality of life. Environment and Behavior [Internet]. 2016 [cited 2022Mar31];48(10):1292–308. Available from: https://journals.sagepub.com/doi/10.1177/0013916515598200

9. Ibes DC, Forestell CA. The role of campus greenspace and meditation on college students' mood disturbance. Journal of American College Health [Internet]. 2020Apr1 [cited 2022Mar31];70(1):99–106. Available from: https://www.tandfonline.com/doi/pdf/10.1080/07448481.2020.1726926?needAccess=true

10. Elsadek M, Liu B, Lian Z, Xie J. The influence of urban roadside trees and their physical environment on stress relief measures: A field experiment in Shanghai. Urban Forestry & Urban Greening [Internet]. 2019 [cited 2022Apr4];42:51–60.

Available from:
https://www.sciencedirect.com/science/article/pii/S1618866718306356

11. Du H, Zhou F, Cai Y, Li C, Xu Y. Research on public health and well-being associated to the vegetation configuration of urban green space, a case study of Shanghai, China. Urban Forestry & Urban Greening [Internet]. 2021 [cited 2022Apr5];59:126990. Available from:
https://www.sciencedirect.com/science/article/pii/S1618866721000157

12. Alcock I, White MP, Wheeler BW, Fleming LE, Depledge MH. Longitudinal effects on mental health of moving to greener and less green urban areas. Environmental Science & Technology. 2014;48(2):1247–55. Available from:
https://doi.org/10.1021/es403688w

13. Berman MG, Jonides J, Kaplan S. The cognitive benefits of interacting with nature. Psychological Science. 2008;19(12):1207–12. Available from:
https://www.jstor.org/stable/40064866

14. Yin J, Yuan J, Arfaei N, Catalano PJ, Allen JG, Spengler JD. Effects of biophilic indoor environment on stress and anxiety recovery: A between-subjects experiment in virtual reality. Environment International. 2020;136:105427. Available from:
https://doi.org/10.1016/j.envint.2019.105427

15. Kuhns M. [Internet]. What is a tree? n.d. [cited 2022Mar31]. Available from:
https://forestry.usu.edu/tree-identification/what-is-a-tree

16. Luker E, Richer L, Moreau T, Kwan B, Miao A, Madden J. [Internet]. UBC Vancouver campus in a changing climate: urban forest edition. 2021 Jan [cited 2022Apr4]. Available from:
https://sustain.ubc.ca/sites/default/files/SEEDS%20Uploads/201210_Urban%20Forest%20Report_DIGITAL.pdf

17. Bergkvist L, Rossiter JR. The predictive validity of multiple-item versus single-item measures of the same constructs. Journal of Marketing Research. 2007;44(2):175-84. Available from: http://www.jstor.org/stable/30162466

18. Thompson ER. Development and validation of an intentionally reliable short-form of the positive and negative affect schedule (panas). Journal of Cross-Cultural Psychology. 2007;38(2):227-42. Available from: https://doi.org/10.1177/0022022106297301

19. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. Journal of Health and Social Behavior. 1983;24(4):385-96. Available from:
https://doi.org/10.2307/2136404

20. Turner JB, Cavender N. The benefits of trees for livable and sustainable communities. New Phytologist Foundation. 2019; 1(4): 323-335. Available from:
https://doi.org/10.1002/ppp3.39

21. Lis A, Iwankowski P. Why is dense vegetation in city parks unpopular? The mediative role of sense of privacy and safety. Urban Forestry & Urban Greening, 2021; 59: 126988. Available from: https://doi.org/10.1016/j.ufug.2021.126988

22. García-Llorente M, Martín-López B, Iniesta-Arandia I, López-Santiago CA, Aguilera PA, Montes C. The role of multi-functionality in social preferences toward semi-arid rural landscapes: an ecosystem service approach. Environmental Science & Policy. 2012;19:136-146. Available from: https://doi.org/10.1016/j.envsci.2012.01.006

23. Gerstenberg T, Hofmann M. Perception and preference of trees: A psychological contribution to tree species selection in urban areas. Urban Forestry & Urban Greening. 2015;15:103-111. Available from: https://doi.org/10.1016/j.ufug.2015.12.004

24. Orians, G. H. Habitat selection: general theory and applications to human behavior. The Evolution of Human Social Behavior. Chicago: Elsevier; 1980: 49-66.

25. Moura JM, Ferreira Júnior WS, Silva TC, Albuquerque UP. The influence of the evolutionary past on The mind: An analysis of the preference for landscapes in the human species. Frontiers in Psychology [Internet]. 2018 [cited 2022Apr11];9. Available from: https://www.frontiersin.org/articles/10.3389/fpsyg.2018.02485/full

26. Hartmann P, Apaolaza-Ibáñez V. Beyond savanna: An evolutionary and environmental psychology approach to behavioral effects of nature scenery in green advertising. Journal of environmental psychology [Internet]. 2010; 30(1):119-28. Available from: https://www.sciencedirect.com/science/article/pii/S0272494409000759

27. Schmukle S. C, Egloff B, Burns LR. The relationship between positive and negative affect in the Positive and Negative Affect Schedule. Journal of Research in Personality.2002;36(5):463-475. Available from: https://doi.org/10.1016/S0092-6566(02)00007-7

28. Grigoletto A, Mauro M, Campa F, Loi A, Zambon MC, Bettocchi M, Nieuwenhuijsen M. Attitudes towards Green Urban Space: A Case Study of Two Italian Regions. International Journal of Environmental Research and Public Health.2021;18(12):6442. MDPI AG. Available from: http://dx.doi.org/10.3390/ijerph18126442

29. Wan C, Shen G. Q. Encouraging the use of urban green space: The mediating role of attitude, perceived usefulness and perceived behavioural control. Habitat International.2015;50:130-139. Available from: https://doi.org/10.1016/j.habitatint.2015.08.010

30. Özgüner H.Cultural differences in attitudes towards urban parks and green spaces. Landscape Research.2011;36(5):599-620. Available from: https://doi.org/10.1080/01426397.2011.560474

31. Campus + Community Planning. [Internet]. Vancouver Campus Plan part 3: Design guidelines. 2020 [cited 2022Apr12]. Available from: https://planning.ubc.ca/sites/default/files/2020-12/PLAN_UBC_VCP-Part3-2020Update.pdf

Appendix A (Survey)

Link: https://ubc.ca1.qualtrics.com/jfe/form/SV_74LUPfRLcaufhSC

Take a moment to imagine yourself in that space. Whenever you feel ready, click "Next" to continue.

(Condition 1: trees in high density)

Take a moment to imagine yourself in that space. Whenever you feel ready, click "Next" to continue.

(Condition 2: trees in low density)

Take a moment to imagine yourself in that space. Whenever you feel ready, click "Next" to continue.

(Condition 3: shrubs in high density)

Take a moment to imagine yourself in that space. Whenever you feel ready, click "Next" to continue.

(Condition 4: shrubs in low density)

How much do you like or dislike this landscape?

1=Dislike very much	2	3	4	5=Like very much
O	O	O	O	O

(Survey Question: 5-point Likert scale)

Thinking about yourself and how you normally feel, to what extent do you generally feel:

	1=Never	2	3	4	5=Always
Upset	O	O	O	O	O
Hostile	O	O	O	O	O
Ashamed	O	O	O	O	O
Nervous	O	O	O	O	O
Afraid	O	O	O	O	O
Alert	O	O	O	O	O
Determined	O	O	O	O	O
Inspired	O	O	O	O	O
Attentive	O	O	O	O	O
Active	O	O	O	O	O

(Survey Question: PSS-10)

In each case, please indicate your response by choosing how often you felt or thought a certain way in general:

	1=Never	Almost Never	Sometimes	Fairly Often	5=Very Often
How often have you been upset because of something that happened unexpectedly?	O	O	O	O	O
How often have you felt that you were unable to control the important things in your life?	O	O	O	O	O
How often have you felt nervous and "stressed"?	O	O	O	O	O
How often have you felt confident about your ability to handle your personal problems?	O	O	O	O	O
How often have you felt that things were going your way?	O	O	O	O	O

(Survey Question: PANAS-SF, Positive affect)

How often have you found that you could not cope with all the things you had to do?	O	O	O	O	O
How often have you been able to control irritations in your life?	O	O	O	O	O
How often have you felt that you were on top of things?	O	O	O	O	O
How often have you been angered because of things that were outside your control?	O	O	O	O	O
How often have you felt difficulties were piling up so high that you could not overcome them?	O	O	O	O	O

(Survey Question: PANAS-SF, Negative affect)

Appendix B (Tables and Graphs of Results)

Descriptives - Liking

Plant Type	Plant Density	Mean	SD	N
Shrub	Dense	3.211	1.048	57
	Sparse	2.870	0.972	54
Tree	Dense	4.264	0.738	53
	Sparse	3.417	0.986	48

(Figure 1: Means and Standard Deviations of Preferences)

ANOVA - Liking

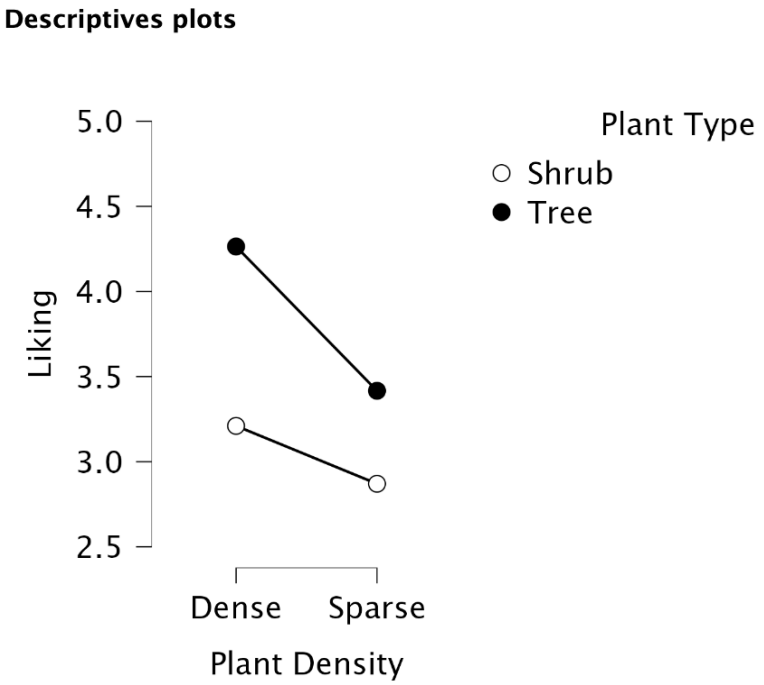
Cases	Sum of Squares	df	Mean Square	F	p	η_p^2
Plant Type	33.786	1	33.786	37.877	< .001	0.154
Plant Density	18.617	1	18.617	20.871	< .001	0.091
Plant Type ✻ Plant Density	3.397	1	3.397	3.809	0.052	0.018
Residuals	185.535	208	0.892			

(Figure 2: ANOVA results for Preferences as a function of Plant Type and Plant Density)

Post Hoc Comparisons - Plant Type ✻ Plant Density

		Mean Difference	SE	t	p_{tukey}
Shrub Dense	Tree Dense	−1.054	0.180	−5.846	< .001
	Shrub Sparse	0.340	0.179	1.897	0.233
	Tree Sparse	−0.206	0.185	−1.114	0.681
Tree Dense	Shrub Sparse	1.394	0.183	7.632	< .001
	Tree Sparse	0.847	0.188	4.503	< .001
Shrub Sparse	Tree Sparse	−0.546	0.187	−2.916	0.020

(Figure 3: Post-hoc Comparisons for preferences)



(Figure 4: Descriptive plot of Preference Scores)

Descriptives - PANAS +ve

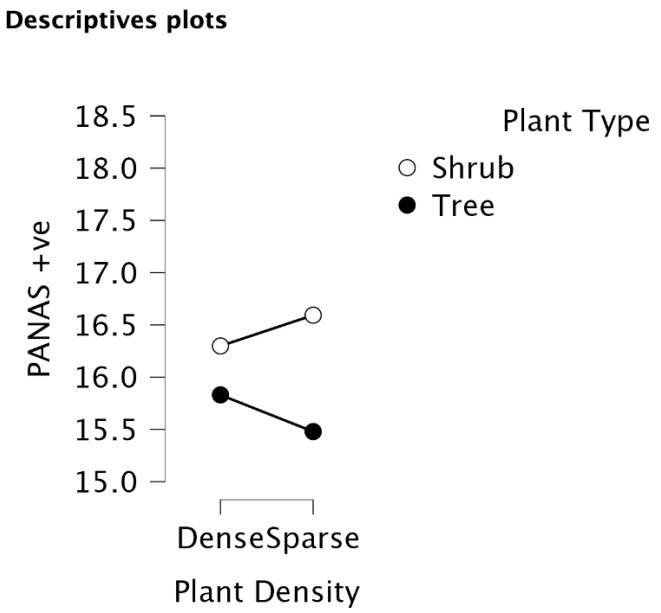
Plant Type	Plant Density	Mean	SD	N
Shrub	Dense	16.298	3.459	57
	Sparse	16.593	3.075	54
Tree	Dense	15.830	3.485	53
	Sparse	15.479	3.679	48

(Figure 5: Means and Standard Deviations of Positive Affect Scores)

ANOVA - PANAS +ve

Cases	Sum of Squares	df	Mean Square	F	p	η_p^2
Plant Type	33.012	1	33.012	2.816	0.095	0.013
Plant Density	0.042	1	0.042	0.004	0.952	1.739e −5
Plant Type ∗ Plant Density	5.497	1	5.497	0.469	0.494	0.002
Residuals	2438.418	208	11.723			

(Figure 6: ANOVA results for Positive Affect Scores as a function of Plant Type and Plant Density)



(Figure 7: Descriptive plot of Positive Affect Scores)

Descriptives - PANAS -ve

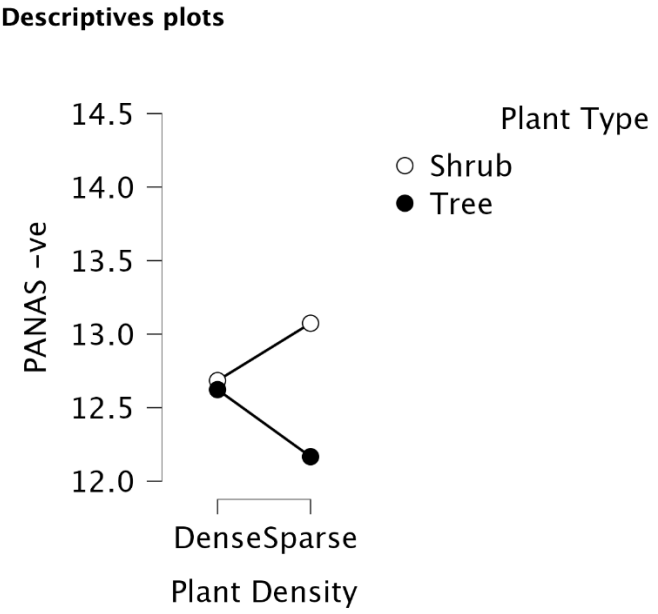
Plant Type	Plant Density	Mean	SD	N
Shrub	Dense	12.684	3.855	57
	Sparse	13.074	3.501	54
Tree	Dense	12.623	3.804	53
	Sparse	12.167	3.244	48

(Figure 8: Means and Standard Deviations of Negative Affect Scores)

ANOVA - PANAS -ve

Cases	Sum of Squares	df	Mean Square	F	p	η_p^2
Plant Type	12.393	1	12.393	0.945	0.332	0.005
Plant Density	0.058	1	0.058	0.004	0.947	2.114e −5
Plant Type ∗ Plant Density	9.443	1	9.443	0.720	0.397	0.003
Residuals	2729.139	208	13.121			

(Figure 9: ANOVA results for Negative Affect Scores as a function of Plant Type and Plant Density)



(Figure 10: Descriptive plot of Negative Affect Scores)

Descriptives - PSS Total

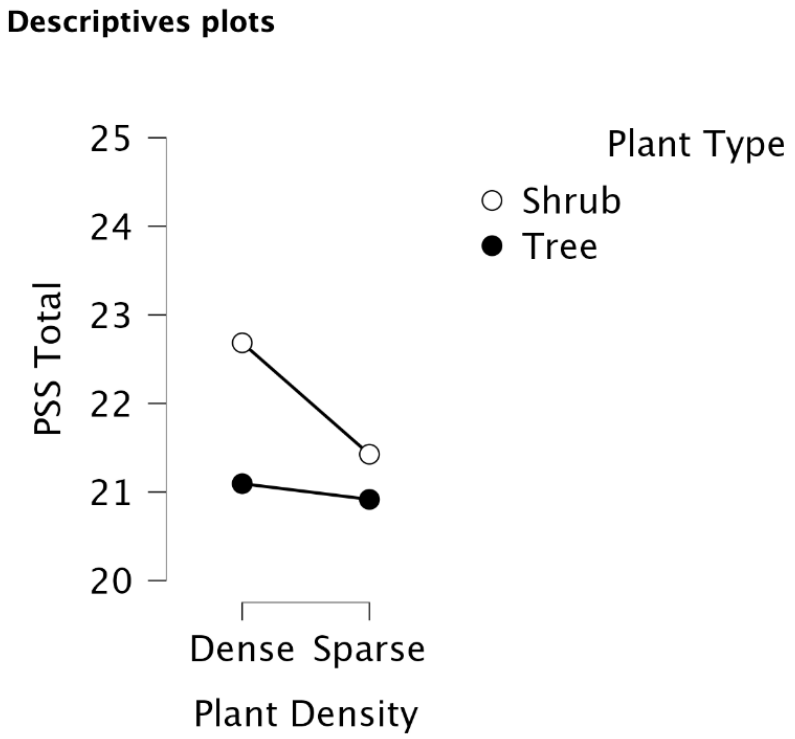
Plant Type	Plant Density	Mean	SD	N
Shrub	Dense	22.684	6.420	57
	Sparse	21.426	5.486	54
Tree	Dense	21.094	5.914	53
	Sparse	20.917	6.205	48

(Figure 11: Means and Standard Deviations of Perceived Stress Scores)

ANOVA - PSS Total

Cases	Sum of Squares	df	Mean Square	F	p	η_p^2
Plant Type	58.159	1	58.159	1.606	0.206	0.008
Plant Density	27.216	1	27.216	0.752	0.387	0.004
Plant Type ✻ Plant Density	15.413	1	15.413	0.426	0.515	0.002
Residuals	7531.714	208	36.210			

(Figure 12: ANOVA results for Perceived Stress Scores as a function of Plant Types and Plant Density)

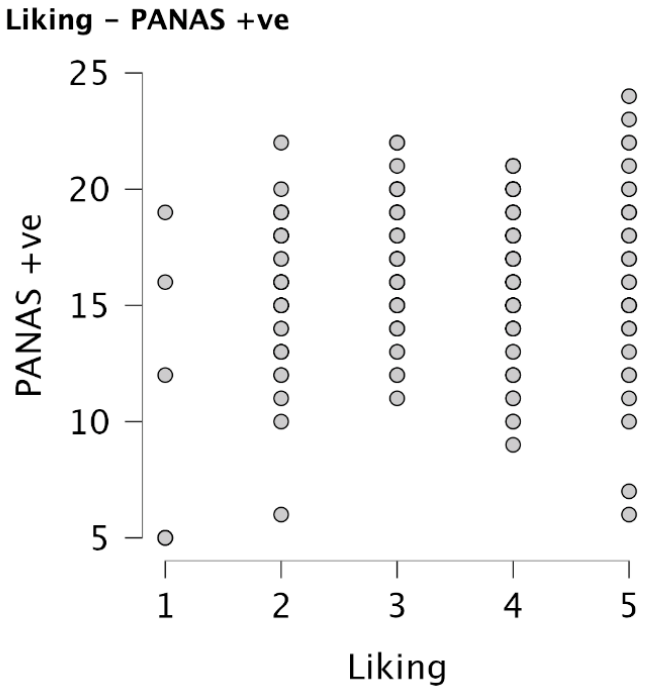


(Figure 13: Descriptive plot of Perceived Stress Scores)

Pearson's Correlations

Variable		Liking	PANAS +ve	PANAS -ve	PSS Total
1. Liking	Pearson's r	—			
	p-value	—			
2. PANAS +ve	Pearson's r	0.170	—		
	p-value	0.013	—		
3. PANAS -ve	Pearson's r	0.069	0.212	—	
	p-value	0.319	0.002	—	
4. PSS Total	Pearson's r	−0.063	−0.093	0.483	—
	p-value	0.365	0.177	< .001	—

(Figure 14: Pearson Correlations among scores of Preferences, Positive Affect, Negative Affect, and Perceived Stress)



(Figure 15: Scatter Plot showing relationship between Positive Affect and Liking Scores)

Descriptive Statistics

	PANAS -ve	PANAS +ve	PSS Total	Liking
Valid	212	212	212	212
Missing	0	0	0	0
Mean	12.651	16.071	21.566	3.434
Std. Error of Mean	0.248	0.235	0.413	0.074
Std. Deviation	3.610	3.426	6.016	1.071
Minimum	5.000	5.000	5.000	1.000
Maximum	25.000	24.000	37.000	5.000

(Figure 16: Descriptive Statistics of scores across Preferences, Positive Affect, Negative Affect, and Perceived Stress)

Appendix C (Student Contributions)

Caitlyn Chan (SID: 14698690): Developed research idea and methods through background research (i.e. recognizing potential confounds and found detailed measurements for conditions) for the proposal, recruiting participants for the study, help leading discussion in group meetings, writing discussion and implication sections for presentation, formatting presentation, presenting to clients and answering questions, correspondence with Professor Zhao, writing discussion section (potential explanations for findings and challenges), editing and formatting with background, methodology, and appendix for final report.

Will Partridge (SID: 29724200): Created Qualtrics survey, contributed to the development of the proposal, gathering Qualtrics survey data, forming and editing the presentation, contributed to the recommendations, contributed to group meetings and discussions, contributed to research question formation, contributed to the executive summary and introduction of the final report, attended group meetings with Professor Zhao,

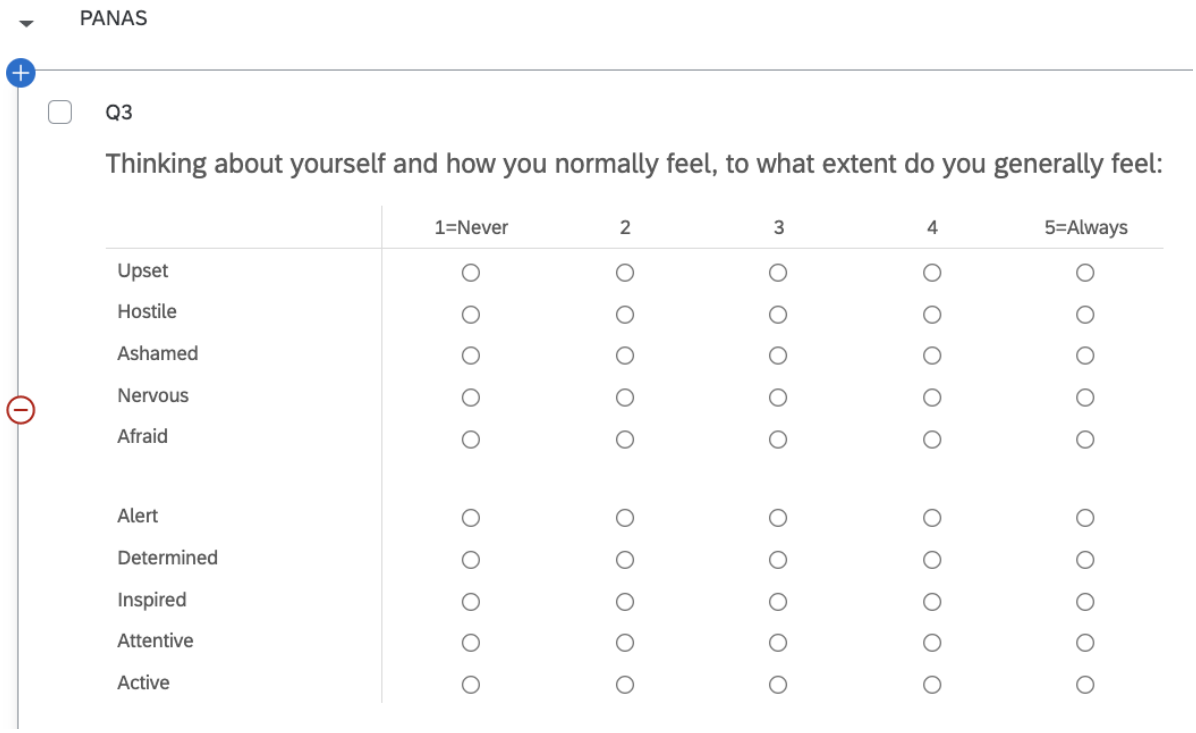
Anna Sawada (SID: 84865690): Contributed during proposal, contributed in discussions regarding research question, helped gather past research papers for background information, helped form hypotheses, attended group meetings online with Professor Zhao, helped find participants for study via social media, gathered Qualtrics survey data, powerpoint presentation building, assisted with writing hypothesis for research report, contributed in discussions regarding recommendations, helped polish final report draft for publishable final report.

Doris Sun (SID: 10952142): Contributed to developing and finalising the research idea (i.e. supplied research questions and respective background research), researching literature review for proposal and report, attending and taking notes in meetings with Professor Zhao, editing and creating the presentation, presenting, in-person and online participant recruitment, designing and editing Qualtrics survey, report writing and editing (in order of time spent): introduction, recommendations, methods, discussion, executive summary, appendix. Hosting group meetings, making meeting notes, and communicating with SEEDS correspondent.

Jeff Teo (SID: 67865493): Contributed to developing the research idea (i.e., the hypothesis and the psychological insight), researching on literature to review, doing the result section of the presentation and designing of the powerpoint, presenting the results of our study to our clients during the presentations, regularly attending both group meetings and meetings with the professor, corresponding with the professor and the TA, finding participants for our study, conducting data analysis (also met with TAs and Dr. Zhao for the data analysis). For the research report, contributions include writing the methods, results, and the recommendation sections. Helped in editing the discussion, introduction and executive summary sections. Wrote the references for articles that I included in the introduction according to the APA guidelines, and formatted the appendix section of the report to include graphs, tables and results of data analyses.

Taishi Yamada (SID: 76042209): contributed to developing the research idea (i.e. driving and restraining forces part), created Qualtrics survey (designing PSS-10 and PANAS-SF questions and finding the pictures for each condition), attended all meetings with Jiaying and group meetings, collected Qualtrics survey data through online and in-person (randomly interviewed UBC students at IKB library), wrote research question, hypotheses, methodology section (participants, conditions, measures, and procedures), edited references, and appendix of the final research report, and presented method section at the presentation.

Appendix D (PANAS-SF wording)



(Limitation example: The use of the word "generally" instead of the alternative "right now")