

University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

The Impact of Building Entrance Colour on Student Stress Levels

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Prepared for: Campus and Community Planning

Course Code: PSYC 421

University of British Columbia

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Executive Summary

This study examines the impact of pale-blue learning-space building floor entrances on stress levels among adult students. The research question asks how exposure to pale-blue coloured building entrances will decrease stress levels in adult students compared to the original beige-coloured building entrance. The research hypothesis suggests that the pale-blue coloured building entrances will have a greater impact on reducing stress levels in adult students than the beige-coloured entrances. The within-subjects experiment involves participants being exposed to both conditions - a photo of the original beige-coloured entrance and a photoshopped version of the original entrance in which the entrance floor is now painted pale-blue. Stress levels are measured using the Perceived Stress Questionnaire, and the colour of the entrance area (i.e., pale-blue vs beige) is the independent variable. The study's participants consist of undergraduate students aged approximately 19-30 years old at UBC, and a minimum of 156 participants is required for the study. The anticipated outcome is that participants who see the pale-blue colour will have a lower Perceived Stress Questionnaire score than those who had seen the beige-colour. If effective, universities and education centres can apply this finding in buildings to reduce student stress on a larger scale. This study also has the potential to be applied in counselling and therapy facilities. The potential challenges include participants' personal biases towards specific colours and their negative emotional experiences towards colours.

Introduction

Student stress has always been a concern for schools, but the sudden onset of the COVID-19 pandemic has had a significant impact on people's psychological wellbeing. Research by Shah, S. M. A. et al. (2021) found that COVID-19 can lead to a range of negative psychological reactions, including fear, worry, and uncertainty. This study also confirms that the stress levels of Canadian students are increasing, making research into ways to reduce stress levels more important than ever before.

While there are many ways to relieve stress, few are readily available in schools due to factors such as funding and environmental limitations. The atmosphere in a school building can also contribute to feelings of depression, which are difficult to change. According to a study by Yildirim, K. et al. (2015), colour can have an impact on people's emotions. Specifically, pale-blue colour has been shown to positively influence people's emotions, making them feel peaceful, calm, and comfortable.

However, Yildirim's study focused on changing the colour of classroom walls, which would be expensive and time-consuming to complete. Our experiment aims to relieve student stress by painting the colour of the floor, specifically the entrance of the building. Painting the floor would be more cost-effective as we would only need to paint one area in the building while still reaching a large audience. Moreover, Koren et al.'s studies in 2020 and 2022 have shown the importance of downward gazing in "way-finding" or finding one's way in a building. As such, the floor can be a powerful way to draw attention when people walk into a building.

Our research question is how will the exposure to a pale-blue-coloured building entrance affect student stress levels compared to the original beige-coloured building entrance? And our hypothesis is the pale-blue-coloured building entrance will reduce student stress levels compared to the beige-coloured building entrances.

Methods

In this experiment, we aimed to recruit 156 participants, which was determined through a power analysis taking into account the effect size, alpha level, and desired power. In a power analysis (assuming a minimum effect size = 0.4, alpha = 0.05, power = 0.8), we need a minimum of 156 participants in total (See Appendix C). We successfully recruited 156 participants with a demographic profile that revealed an average age of 22.19 years old, with 63 males (40.38%), 87 females (55.77%), 2 non-binary individuals (1.92%), 2 individuals who preferred not to disclose their gender (1.28%), and 1 individual identifying as other (0.64%). The majority of the participants, 142 individuals (91.03%), were UBC students, while 14 individuals (8.97%) were not affiliated with UBC.

To examine the independent variable - the colour of the building entrances - our study employed two conditions. The first condition presented participants with the original beige-coloured entrance, while the second condition featured a pale-blue coloured entrance. Our hypothesis was that exposure to the pale-blue entrance would lead to reduced student stress levels in comparison to the beige entrance.

To measure student stress levels, we utilized the Perceived Stress Questionnaire (PSQ), a well-established and validated scale in psychological research. The PSQ comprises various questions, such as "I feel that too many demands are being made on me," "I feel lonely or isolated," "I find myself in situations of conflict," among others. Participants rated their agreement with these statements on a scale ranging from 1 to 4, with options being Not at all, A

little, Somewhat, and A lot. Higher average scores on the scale indicated higher stress levels experienced by the participant.

The data collection process was conducted using an online survey platform, where participants provided their consent to participate in the experiment and were shown pictures of the two building entrance conditions (beige and pale-blue). To minimize potential biases in participant responses, they were not informed of the specific purpose of the experiment. Various channels were employed to recruit participants, including social media platforms, other classes at the university, as well as friends and family members. Data collection took place over a predetermined period, with any challenges encountered during the process addressed accordingly. By presenting participants with pictures of the building entrances and asking them to complete the PSQ, we aimed to measure the impact of the different coloured entrances on their self-reported stress levels. This comprehensive methodology allowed us to gather data that could potentially support or refute our hypothesis, offering valuable insights into the role of environmental design in influencing psychological well-being.

Results

After the participants were randomized, they were evenly assigned to either the experimental (pale-blue) group or the control (beige-coloured) group. Therefore, the two groups' data are independent from each other because the data from one group does not influence the data from the other. Hence, we will run an independent samples t-test.

We used an independent samples t-test to examine the relationship between the different coloured building entrances (beige and blue) viewed by participants and their perceived stress score as measured by the Perceived Stress Questionnaire. The study had 156 participants, with 80 in the pale-blue-coloured building entrance condition and 75 in the beige-coloured building entrance condition.

As shown in Table 1 and Table 2 (See Appendix D), the mean perceived stress score was significantly lower for participants in the pale-blue-coloured building entrance condition ($N = 80$, $M = 1.975$, $SD = 0.756$) compared to those in the beige-coloured building entrance condition ($N = 75$, $M = 2.833$, $SD = 0.807$), $t(153) = -6.84$, $p < .001$, with a large effect size ($d = 1.099$).

Overall, our findings support the hypothesis, suggesting that the colour of a building entrance can significantly impact students' perceived stress levels. Specifically, exposure to a pale-blue-coloured building entrance reduces student stress levels compared to a beige-coloured building entrance (See Figure 1, Appendix D). These findings have important implications for designing and constructing buildings that promote well-being.

Discussion

The results of this study indicate that the colour of a building entrance can have a significant impact on perceived stress levels. The mean perceived stress score for participants in the pale-blue-coloured building entrance condition was significantly lower than for those in the beige-coloured building entrance condition, with a $p < .001$ significance after running the data on JASP. These findings support the hypothesis that the colour of a building entrance can affect student stress levels, and suggest that architects, urban planners, and school administrators may benefit from considering the colour of building entrance ways when creating environments that support human wellness.

However, there are limitations to this study. One limitation is that the study's generalizability is lower because nearly all of the participants were UBC students. This

population may be experiencing a type of life experience and life phase that may not be applicable to the general population. For example, UBC students may be more stressed than the general population due to academic demands and other factors related to their student status. College students have been repeatedly reported to have higher levels of stress compared to the general population and at higher rates than adults in other age groups due to academic demands and other factors related to their student status (American Psychological Association, 2020). To improve the study's generalizability and better understand how building entrance colour affects stress levels in various demographics and environments, future research should include a more diverse sample of participants from different backgrounds and circumstances. For instance, future studies could investigate how entrance colour affects stress levels in different age groups, cultural backgrounds, and geographic locations, as well as in different types of buildings such as hospitals or workplaces. This can provide valuable insights into how entrance colour can impact stress levels across a variety of settings, which can inform the design of more stress-reducing buildings and environments.

Another challenge was controlling extraneous variables outside of the survey. There is a possibility that additional factors that were not considered in the study may have had an impact on students' stress levels. These variables may include life changes or upsetting incidents that may have happened immediately before taking the survey. These major or minor life changes that perhaps occurred close to the time they took the survey may have impacted their baseline level of stress, and in turn their PSQ results as well. Cheng et al. (2017) found that participants who experienced major life events during the intervention, such as a death in the family or a job loss, had significantly higher stress levels than those who did not experience any major life events. This suggests that major life events can significantly impact an individual's baseline level of stress. Minor life changes have been found to have an impact on overall stress levels as well (Almeida, McGonagle & King, 2009). Though a notable difference is that minor life changes can have an accumulation effect, the study did note it's still enough to cause changes in stress level every time they occur. To address this limitation, future research could try using a longitudinal design, which may aid in capturing variations in stress levels over time and taking into consideration outside factors that may have an impact on stress levels. Alternatively, adding more questions asking if the individual had events occurring before the survey that may impact their stress levels in a self-reporting format can also help.

The architecture of the building itself may also influence the effectiveness of the study. Buildings are often constructed with different designs and materials, which can affect lighting, sound, and other environmental factors. As a result, it can be challenging to ensure that all study participants are exposed to the same environmental conditions. Okurame and Jones (2017) found that noise level was a significant predictor of stress levels among office workers, with higher noise levels associated with increased stress. Sundstrom, Town, Rice, and Matthews (1994) found that office workers with access to natural light reported lower stress levels than those without access to natural light. Additionally, a study by Preiser and Smith (2011) found that the spatial configuration and aesthetics of the building can influence stress levels. Specifically, they found that buildings with more visually appealing features were associated with lower stress levels among occupants. Taken together, these studies suggest that the design and environment of a building, including factors such as natural light, and aesthetics, can play a significant role in influencing stress levels among occupants. Because it can be difficult to generalize the findings of a study conducted in one building to other buildings with different designs and environmental

conditions, it is important to consider the potential impact of the building's architecture and environmental factors when interpreting the results of a study.

Researchers could continue exploring how the study's findings can be applied to promote human wellbeing by testing different colours on various settings and promote sustainable architecture. The study's limitations, such as the constraint of being conducted on only one university campus, highlight the need for further research to increase the data's applicability to a larger population. This can lead to important implications for designing more stress-reducing buildings and environments in various settings, which can have a positive impact on both human wellbeing and the environment.

Recommendations for Clients

Ultimately, the findings of this study suggest that a pale-blue entrance area, compared to the original beige-coloured entrance, within a potentially stress-inducing environment, such as a school building, is related to a reduction in student stress levels. On a broader spectrum, these findings also suggest that certain building entrance colours may reduce stress levels more effectively than others, which is in alignment with the findings of pre-existing studies that have addressed the connection between colour and environment (Yildirim et al., 2015). Studies have shown that the colour blue in classrooms evokes feelings of peace and tranquility in students. However, to our knowledge, no research has specifically examined the presence of pale-blue-coloured entrance areas as a stress reduction tool for students.

With the entrance area of a building being the first impression that one gathers of an interior, and one that also receives exposure from virtually every person that enters the building, it is likely that colouring only the entrance area would be more cost-effective than colouring every single classroom, hospital room, or office. Therefore, not only do these findings suggest the ability of colour to reduce student stress levels, but they also provide a potentially more cost-effective solution, reaching a wider "audience" to grant these stress-reducing methods to. Additionally, by reducing stress levels immediately upon entering the building, this approach may be more efficient than addressing stress in the moment of stress exposure. It could potentially be seen as a preventative measure rather than a corrective action.

Based on these current findings, we recommend incorporating pale-blue-coloured entrances into the buildings at the University of British Columbia (UBC). With the high levels of stress that university and general students undoubtedly experience, particularly within stress-inducing environments such as school buildings, it may be particularly helpful for stress-reducing methods to be applied in these spaces as well as in their immediate areas, such as the entrance area or foyer of a building. These findings could also be of value in other high-stress environments, such as hospitals or workplaces, where stress levels and mental health may play a role in productivity levels and overall satisfaction with the experience in that space. These findings may be of value to city planners and architects responsible for designing institutions such as school buildings and workspaces. These individuals may choose to incorporate pale-blue-coloured entrance ways in the design of future schools and workplaces, or consider cost-effective and simple ways to reduce stress levels through an environment's colour.

Further research on this topic is imperative to explain or refute the findings of this study. The results may be constrained in their applicability to other settings or spaces because the study was conducted on just one university campus, with the study involving the manipulation of colour within a UBC-specific setting. Campuses with different architectural designs may have different variations that could potentially affect the results' generalizability. Other variations may

be due to differences in the geographical climate, agriculture, landscape, and cultural norms, all of which can impact how much stress a building's entrance colour can truly reduce. The main focus of our study was very specific; therefore, future research should consider a broader sample of participant voices from different origins and circumstances to address this limitation and gain knowledge on the different elements that contribute to stress reduction, potentially improving the data's generalizability and ultimately offering more insight on how the colour of a building's entrance affects stress levels in various demographics and environments.

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Appendix A - Qualtrics Survey



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Contact for information about the study

This study is being conducted by Dr. Jiaying Zhao, the principal investigator. Please contact her if you have any questions about this study. Dr. Zhao may be reached at (604) 827-2203 or jiayingz@psych.ubc.ca.

Contact for concerns about the rights of research subjects

If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

Consent: Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. You also may postpone your decision to participate for 24 hours. You have the right to choose to not answer some or any of the questions. By clicking the "continue" button, you are indicating your consent to participate; hence, your signature is not required. The researchers encourage you to keep this information sheet for your records. Please feel free to ask the investigators any additional questions that you have about the study.

Ethics ID: H17-02929



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Consent Form

Class Research Projects in PSYC 421 - Environmental Psychology

Principal Investigator: Dr. Jiaying Zhao
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Introduction and Purpose

Students in the PSYC 421 – Environment Psychology class are required to complete a research project on the UBC campus as part of their course credit. In this class, students are required to write up a research proposal, conduct a research project, collect and analyze data, present their findings in class, and submit a final report. Their final reports will be published on the SEEDS online library (<https://sustain.ubc.ca/teaching-applied-learning/seeds-sustainability-program>). Their projects include online surveys and experiments on a variety of sustainability topics, such as waste sorting on campus, student health and wellbeing, food consumption and diet, transportation, biodiversity perception, and exercise habits. The goal of the project is to train students to learn research techniques, how to work in teams and work with UBC clients selected by the UBC SEEDS (Social Ecological Economic Development Studies) program.

Study Procedures

If you agree to participate, the study will take about 10 minutes of your time. You will answer a few questions in the study. The data will be strictly anonymous. Your participation is entirely voluntary, and you can withdraw at any point without any penalty. Your data in the study will be recorded (e.g., any answer you give) for data analysis purposes. If you are not sure about any instructions, please do not hesitate to ask. Your data will only be used for student projects in the class. There are no risks associated with participating in this experiment.

Confidentiality

Your identity will be kept strictly confidential. All documents will be identified only by code number and kept in a locked filing cabinet. You will not be identified by name in any reports of the completed study. Data that will be kept on a computer hard disk will also be identified only by code number and will be encrypted and password protected so that only the principal investigator and course instructor, Dr. Jiaying Zhao and the teaching assistants will have access to it. Following the completion of the study, the data will be transferred to an encrypted and password protected hard drive and stored in a locked filing cabinet. Please note that the results of this study will be used to write a report which is published on the SEEDS library.

Remuneration

There is no remuneration for your participation.



Please choose one of the following options.

I consent to participate in this study and will continue to the experiment.

I do not consent to participate in this study.





Imagine you are heading to an office hour to meet with a professor in this building in the picture below. How would you rate your stress levels right now?



	Not at all(1)	A little(2)	Somewhat(3)	A lot(4)
I feel that too many demands are being made on me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel lonely or isolated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find myself in situations of conflict.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel irritable or grouchy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I fear I may not manage to attain my goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel loaded down with responsibility.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My problems seem to be piling up.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am afraid for the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am under pressure from other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel I'm doing things because I have to not because I want to.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





Imagine you are heading to an office hour to meet with a professor in this building in the picture below. How would you rate your stress levels right now?



	Not at all(1)	A little(2)	Somewhat(3)	A lot(4)
I feel that too many demands are being made on me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel lonely or isolated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find myself in situations of conflict.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel irritable or grouchy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I fear I may not manage to attain my goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel loaded down with responsibility.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My problems seem to be piling up.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am afraid for the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am under pressure from other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel I'm doing things because I have to not because I want to.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Please identify your gender

- Male
- Female
- Non-binary / third gender
- Prefer not to say
- Others

Please fill in your age (Please type in numbers).

Are you a UBC student?

- No
- Yes

Appendix B - Team Member Contribution

Anne for project management, leading the team, presenting, writing out her assigned paper sections, running JASP, and proofreading. Boyu was largely in charge of managing the Qualtrics survey, taking photographs in UBC Buchanan Building, writing assigned paper sections, and organizing data. Zisong conducted data analysis and integration, presented and wrote assigned paper sections. Prescilla was in charge of doing literature research, writing assigned paper sections, and presenting. Jasmine helped with managing data on excel, recruiting participants, and writing assigned paper sections. Karen was in charge of recruiting participants and writing assigned paper sections.

Proposal

Anne → Create and proofread proposal and content integration

Billy → Specially taken on location at the UBC Buchanan Building, and the photographs were then post-processed in Photoshop

Zisong → All integrated analyses on data categories and Statistical Analysis

Jasmine → Jasmine carried out the hosting portion, the proposal Method section, and the concept innovation in the proposal

Karen → The Anticipated Outcomes were analyzed by combining the data sections

Prescilla → Researching and writing background literature

Survey & Data Collection

Anne → Collaborated with Leo on data analysis and JASP integration

Billy → In charge of overseeing the whole Qualtrics process, including the original design of the Qualtrics page, PSQ questions, content organization, and the final data analysis.

Zisong → In charge of running JASP and the entire g-power analysis

Jasmine → Responsible for finding participants and survey organization

Karen → Responsible for finding participants and survey organization

Prescilla → Responsible for finding participants and survey organization

Presentation

Anne → Responsible for explaining the full experiment during live presentation and responding to UBC client inquiries

Billy → Involved in the production, organization, layout, and design of PowerPoint presentations

Zisong → Devoted to opening, data analysis and in charge of the live presentation

Jasmine → Creating PowerPoint presentations with Billy and Karen

Karen → Creating PowerPoint presentations with Billy and Jasmine

Prescilla → Responsible for the presentation of the experimental background literature process and participate in answering questions from the UBC client

Final Report

Anne → Write the discussion section and was responsible for the final paper product by proofreading and editing

Billy → Is accountable for all of the qualitative data, as well as the full method section

Zisong → Responsible for the details of the entire Result

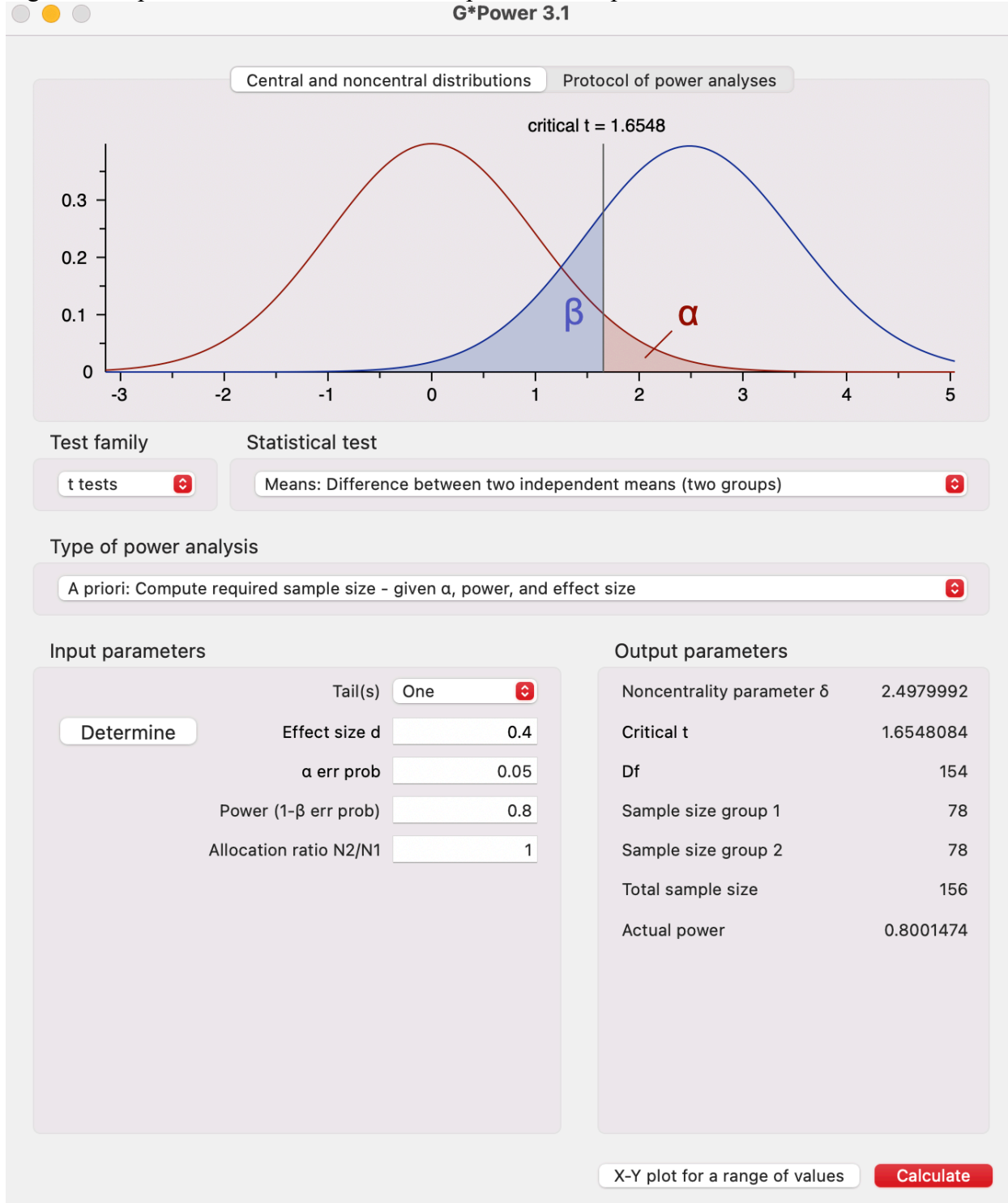
Jasmine → Responsible for the Introduction and Hypothesis section

Karen → Accountable for writing the executive summary, the appendix, and the reference section with everyone's input.

Prescilla → Responsible for writing the Recommendation section

Appendix C - Power Calculation

Figure 1: G*power calculation to determine predicted sample size



Appendix D - JASP Screenshots

Table 1

Independent Samples T-Test ▼

Independent Samples T-Test

	t	df	p	Mean Difference	SE Difference	Cohen's d	SE Cohen's d
Stress Level	-6.837	153	< .001	-0.858	0.126	-1.099	0.183

Note. For all tests, the alternative hypothesis specifies that group *Blue* is less than group *Original*.

Note. Student's t-test.

Table 2

Descriptives

Group Descriptives

	Group	N	Mean	SD	SE	Coefficient of variation
Stress Level	Blue	80	1.975	0.756	0.085	0.383
	Original	75	2.833	0.807	0.093	0.285

Figure 1

Descriptives Plots ▼

Stress Level ▼

