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Environmental Influence on Holistic Health Measures

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Introduction

Place and setting are not often considered as components of a therapeutic medical intervention. Yet the “healthy settings” approach to health promotion reveals that multiple place-based effects significantly influence health and disease status.^{1,2} These effects are holistic in nature and can have significant impact on psychological and physiological measures of mental and physical health.³ Studies have demonstrated that different environmental features influence the outcome of prescribed psychotherapy⁴ and health status⁵, and may be responsible for differences in population-based health measures of morbidity and mortality.^{6,7}

However, many of these studies are either observational or conducted in controlled laboratory settings. To understand how real-world environments impact measures of health and well-being, place-based in actual places where people live are necessary. Therefore, our study was conducted with two goals: 1) to assess data collection feasibility regarding environmental settings’ influence on health in real-world conditions using quantitative and qualitative approaches, and 2) to collect preliminary data on different environmental settings’ effects on physiological and psychological health measures.

Methods

For this study, we recruited seven students from our research program as participants. All met basic screening criteria for age, health status and medication use. They were asked to report to the study lab on three Saturday mornings in late September/early October 2011, and to refrain from any stressful activities or disqualifying substances for 24 hours prior to arrival. They were also asked to not consume any food or beverage for at least one hour prior to each visit.

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At each visit, participants arrived by 9am and were assessed for baseline salivary cortisol (sCort) and Profile of Mood States (POMS) scores. sCort samples were collected using Salivary Oral Swabs (Salimetrics, State College, PA), which participants placed under their tongues for 2 minutes. All swabs collected during the study were stored on ice until the completion of the study visit, and were then centrifuged for 10 minutes at 1500g. Saliva was harvested and stored at -80° C until ELISA analysis was conducted at ZRT Laboratory (Beaverton, OR); all samples were analyzed in duplicate.

After completion of baseline measures, participants were separated into randomized, pre-assigned groups and transported via car to one of three environmental settings (see Figure 1), all located within 9km of the study lab. The three settings used for this study were classified as:

- Nature: a 2.61×10^6 m² heavily forested state park
- Urban: a 2,025 m² city plaza
- Indoor: a 195 m² indoor auditorium

Participants were unaware of their destination until arrival, at which time they were seated and instructed to passively observe their surroundings for 20 minutes. They were asked to sit without any verbal or electronic communication and without engaging in any stress-reduction techniques until the time expired. After 20 minutes, repeat sCort and POMS data were collected and participants were returned to the study lab, where informal, verbal qualitative information was collected per setting group.

Results

Of the 7 participants recruited for this study, only two completed all three study visits (See Table 1). As a result, our intended within-subjects crossover design and subsequent data analysis plan were replaced with a simple one-way ANOVA model, with each participant visit acting as a unique participant exposure ($n = 15$). Although such an analysis does not permit claims of real statistical significance to be made, this approach allowed for a single assessment of the strength of all available data.

Results were calculated as post-minus-pre Change Scores (Score) and statistical significance was set at the $p < 0.05$ level. Effect size (R^2) of environmental setting was determined for each outcome variable and, where effect sizes were large (i.e., $R^2 > .14$), post-hoc between-settings Cohen's d was calculated for pair-wise comparisons of different environmental settings.

No significant sCort differences were detected between settings. POMS demonstrated a trend toward setting differences for the cumulative Total Mood Disturbance (TMD) score, with a large effect size ($R^2 = 0.25$). Individual Cohen's d scores indicate the Nature setting was more effective at reducing TMD than either the Urban ($d = 0.82$) or Indoor ($d = 1.34$) settings. ANOVA revealed this difference was not statistically significant ($F_{2,12} = 2.042$, $p = 0.172$). However, analysis of the POMS subscales did reveal significant setting differences for the Confusion/Bewilderment (C/B) subscale ($F_{2,12} = 7.941$, $p = 0.006$), with a large

setting effect size ($R^2 = 0.56$). Post-hoc t-test comparisons indicate that exposure to the Nature setting reduced C/B in a statistically significant way, when compared to both the Urban ($p=0.007$, $d = 1.86$) and Indoor ($p=0.005$, $d = 2.45$) settings.

Other POMS subscales demonstrated similar trends. The Tension-Anxiety (T/A) and Fatigue/Inertia (F/I) POMS subscales demonstrated near-significance with large setting effect sizes (T/A: $F_{2,12} = 3.753$, $p = 0.054$, F/I: $R^2 = 0.38$; $F_{2,12} = 2.700$, $p = 0.108$, $R^2 = 0.31$). Post-hoc t-test comparisons of T/A indicate that the Nature setting had a large effect in reducing T/A, compared to increases experienced in the Urban ($p = 0.099$, $d = 1.03$), and Indoor ($p = 0.022$, $d = 1.86$) settings. F/I was more reduced after exposure to the Nature setting, compared to both the Urban ($p = 0.096$, $d = 1.04$) and Indoor ($p = 0.060$, $d = 1.47$) settings. It is plausible that a larger sample size would have provided sufficient statistical power to these analyses to achieve significance.

Informal qualitative content analysis of verbal responses also revealed distinct differences in environmental setting assessment. Participants overwhelmingly described the Nature setting in positive terms such as “comforting” and “inviting”, while primarily using words such as “busy”, “sterile”, “impersonal” and “depressing” for the other settings.

Discussion

The primary purpose of this pilot study was to test the feasibility of collecting biometric and psychometric data from participants after exposure to three environmental settings; this was accomplished with no negative events. The secondary purpose was to assess the data and determine if any place-based health effects were suggested. The overall trends of both the quantitative and qualitative responses do suggest that between-setting differences occurred. Specifically, the positive effect of exposure to the Nature setting suggests a restorative and stress-reducing experience, especially contrasted with the negatively experienced Indoor setting. The many limitations of this study (e.g. small sample size, homogenous population, multiple individual and situational variables) preclude any definitive conclusions from being made from these results. However, the results do support the hypotheses and findings of researchers^{3,8} and are congruent with general human experience. It is possible that future experimental studies could assess environmental settings to determine if natural spaces can be used as adjunctive components to established therapies, as has been suggested.⁹ In addition, environmental features’ ability to determine health status could be measured and included in the design of optimal clinical healthcare settings and community accessible public spaces. Preliminary support for this work exists,^{2,10} and continues to grow with the addition of new research. However, more evidence is needed demonstrating environments’ influence on holistic health and well-being before it will be considered as part of the standard models of healthcare and health determination.

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Figure 1.
Environments used in the study, including:
a) Nature, b) Urban and c) Indoor settings\

Table 1

Participant attendance

<u>Participant ID</u>	<u>Week 1</u>	<u>Week 2</u>	<u>Week 3</u>
E01	A	-	B
E02	C	B	-
E03	B	A	-
E04 *	A	B	C
E06	B	-	A
E07 *	C	A	B
E08	-	-	A
E09	B	A	-

Setting Key: A = Nature, B = Urban, C = Indoor

Note: * indicates participant attended all 3 study visits