Baker/Koob Final Report

Final reports will be published on the Cal Poly Digital Commons website (http://digitalcommons.calpoly.edu).

Title of Project:
Design and Test the Effectiveness of Interpretive Signs Using Eye Tracking and Biometric Data

Project Completion Date:
March 29th, 2024

Student Names and Majors:
Hadara Gordon, Natural Resources Management and Environmental Sciences
Wendy Miyazaki, Communication Studies

Faculty Advisor and Department:
Dr. Sandy Shen, Experience Industry Management Department

Cooperating Industry, Agency, Non-Profit, or University Organization(s):
• City of San Luis Obispo Parks and Recreation
• San Luis Obispo Botanical Garden
• University Graphic Systems

Executive Summary:
Recreational trails on forested lands should satisfy the needs of recreationists, safeguard important habitats, and maintain the natural environment (Kortenkamp et al., 2021). Appropriate management is critical because of the increasing number of visitors. Signs are a cost-effective method to reduce the negative impacts on visitors and enhance visitor experiences (Brown et al., 2010). This research aimed to investigate how visitors pay attention to signs, view the trail surrounded by trees and behave in a natural space. The approaches of messages conveyed on interpretive signs could significantly influence people’s behavioral compliance based on the stimulus-organism-response theory (Hameed et al., 2022). Previous studies used self-reported data to understand visitor behaviors in an urban nature park (Sever & Verbič, 2018), but self-reported data pose issues such as inaccurate recall and validity issues. How to use signs to attract attention and raise people’s awareness of protecting trails and forested lands was not tested using objective measurement. This research adopted a triangulated and mixed-method approach, including eye-tracking technology, skin conductance sensors, surveys, and interviews. During the experiment, each participant wore a Tobii Pro Glasses 3 eye tracker along with an E4 wristband to explore the trail for 5 minutes. The eye-tracking and biometric data revealed participants’ actual visual and emotional behaviors. The
survey questions were about participants' attitudes towards the signs, the knowledge they gained from reading the signs, and their visitor experiences. The interview probed participants' answers to the survey questions and their experiences.

Seventy participants in June and July of 2023 were recruited on-site to study the communicational efficacy of the hiking trail signs. Signs included those with relevant information on hiking etiquette, fire hazards, and oak trees. Each sign displayed a QR code containing more information, but only 3 out of 70 participants scanned any. The effectiveness of the QR codes was rated with a mean value of 3 (SD = 1.33), but many agree they were still a valuable additive to signs in natural areas. The more attractive elements of signs included pictures, subheadings, fun facts sections, bold text, and contrast in color (Figures 1 and 2). In an effectiveness comparison, half of the participants experienced the trail with an ethical-based messaging approach, and the other half with a humor-based one. The ethical-based sign reads “Keep our trails clean and healthy. Leave only footprints!”, and the humor-based sign reads “Please do not litter. Littering Stinks!” with a picture of a skunk. Many preferred the latter for its upbeat message, but the ethical sign viewers responded strongly to their knowledge about littering on the trail. In aligning the biometric data with the eye-tracking data, specific visual points triggering participants' interest and arousal were identified (Figure 3). The factors significantly influencing participants' emotional changes included humor signs, forest fire and squirrel pictures, fun facts, numbers, and questions. Many agreed that the signs taught them something new, as indicated by the participant, “They told me something I didn’t know. So, you know, knowledge is power.”

Figures 1 and 2: Heat map and gaze map of “Fire Hazard” sign.
Overall, participants agreed that the signs were educational regarding forest education, fire hazard prevention, and environmental protection. Although most participants did not scan QR codes, they acknowledged that QR codes remain a valuable addition to signs in natural areas for obtaining more information when needed. Humor signs were favored by many for their interesting and fun messaging, but ethical signs proved more effective in conveying hiking rules.

We also interviewed twenty-four participants in March 2024 to further explore the specific suggestions on the sign design. Future sign design can be improved by adding elements such as specific information, interactive elements, specific and relevant pictures, and more native plant and animal species facts. Based on the interviews, we found that the specificity of the information was a large suggestion amongst participants as some content on the signs could be described as “general” or “common knowledge” - hence why the statistical information and fun facts were so memorable. One participant mentioned expanding the hiking etiquette to include more socially aware principles: “You know, don’t take up the whole trail if you’re in a big group. If there’s people behind you, don’t walk right on somebody’s heels kind of thing.” Balance of sign content such as paragraphs, pictures, and text size and color was heavily emphasized to give each sign variation. Furthermore, much emphasis was placed on minimizing paragraph length on signs – bullet points were a much-preferred way of receiving written communication. There were several suggestions for interactive elements: “like show me a seed of an oak, show me the growth progression...even if it’s just in pictures,” which could include these progressions of images, historical elements of the trail, and elements such as flaps or
sensory objects to elicit a different style of learning. A participant described a sign element that has visitors lifting a flap to guess a specific animal or plant and thus “It’ll [stick] in your brain more... and it will appeal to children more too.” Other interactive elements could include before and after pictures of wildfires to better demonstrate their impact and the historical developments of the trail.

Overall, the findings provided insights into the sign design and park management. It extended the theory of selective attention, and the triangulated approach laid a foundation for future studies that wish to use this approach, especially in the context of outdoor recreation.

Major Accomplishments:

- We designed 5 new interpretive signs to introduce oak trees, hiking etiquette, fire hazards, and no littering rule for the Discovery Trail at the San Luis Obispo Botanical Garden. After we completed the study, we gave the printed signs and sign stands to the garden for their future use.
- Three conference presentations.
  - Hadara Gordon did a poster presentation at the Graduate Education & Graduate Student Research Conference in Hospitality & Tourism between January 6 and January 7, 2023.
  - Hadara Gordon did an oral presentation at the IMEX America conference in Las Vegas between October 18 and October 19, 2023.
  - Dr. Sandy Shen represented the team to do a poster presentation at the NALR & CPRS Conference in Palm Springs between February 26 and March 1, 2024.
- Suggestions on the design of the signs in hiking trails were shared with San Luis Obispo Botanical Garden and the City of San Luis Obispo Parks and Recreation for their future practices.
- We have drafted a journal manuscript, which will be submitted to a high-ranking academic journal soon.

Expenditure of Funds:
The Baker/Koob funds were used to support the research team in presenting at conferences, designing and printing signs, setting up experiments, collecting data, and storing data. For detailed items and costs please see the table below.
### Table 1. Items and Expenses

<table>
<thead>
<tr>
<th>Items</th>
<th>Expenses and Costs</th>
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<tbody>
<tr>
<td><strong>Travel: In-state</strong></td>
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<tr>
<td>Attending the NALR &amp; CPRS Conferences in Palm Spring</td>
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<td>Travel expenses for data collection in San Luis Obispo</td>
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<td><strong>Travel: Out-of-state</strong></td>
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<tr>
<td>Attending the IMEX America Conference in Las Vegas</td>
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<tr>
<td>Printing for conference</td>
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<td><strong>Supplies and Services</strong></td>
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<td>Incentive Amazon cards (94 participants, each received $10)</td>
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<td>Sign stands</td>
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<td>Sign printing at University Graphic Systems</td>
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<td>Folders to store hard-copy documents</td>
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<td>SanDisk 4TB Portable SSD to store digital files and data</td>
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<td>Battery Charger</td>
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<tr>
<td><strong>Total</strong></td>
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### Impact on Student Learning:

**Reflection from Hadara Gardon**

This project, in working closely with Dr. Shen has granted me the ability to exercise my practice as a research assistant in copious ways. I have learned so much from working with Dr. Shen directly, from working with the equipment in the field, and from being a part of this team. This project most certainly has served the “Learn by Doing” motto of Cal Poly, as I have received ample experience in working in the research field, recruiting research participants, and developing a soon-to-be-published manuscript.

Working in the research field has profoundly impacted my learning in expanding upon my problem-solving abilities, interpersonal communication, and hands-on technological experience. I was able to have access to incredible technology such as the eye-tracker and E4 wristband in the study, and I was able to exercise a leadership role over this past summer in calibrating and operating these instruments. I learned how to most effectively recruit and incentivise participants for the study, and serve as a reputable representative for the Cal Poly research community. Through this interdisciplinary experience, I was able to observe and further comprehend differentiated perspectives in addressing local environmental challenges. I believe this study has enabled me the opportunities to enact positive environmental change within the San Luis Obispo community, and the Baker/Koob grant has enabled me the ability to extend this knowledge and practice for the future.
I have gained valuable insight into environmental management through sign design, and I believe I now have a much greater understanding of the interconnectivity between environmental conservation, community engagement, and sustainable tourism. My personal growth throughout this year of research has enhanced my confidence in entering the professional field of environmental science. The Baker Koob grant has also given me the ability to attend several conferences in highlighting our research and to collaborate with other like-minded individuals in the field. It was incredible to learn of other research projects with similar goals, and the comparative processes exhibited by each research team was absolutely insightful. These conferences include The Graduate Education & Graduate Student Research Conference in Hospitality & Tourism and IMEX America.

Overall, this project has provided me with abundant tools for navigating both academic and professional endeavors. I am overwhelmed with gratitude for the opportunities I have accessed through the means of this grant.

**Reflection from Wendy Miyazaki**

this project impacted my learning and career aspirations by giving me more experience with research and with giving me more practice working on a team. It was a rewarding experience to be able to work together with others who were passionate about the project and to see how all of our efforts came together to complete the project. I have always been interested in doing research that gathers data and engages with the public, so this project was very interesting to be a part of. I look forward to doing more research in the future and getting to be a part of a team that works well together.