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Article

Eye Tracking as a Tool for Sustainable Food Consumption Research

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Abstract: This paper investigates the use of eye tracking technology as a tool for examining sustainable food consumption behaviors. Positioned within a broader ethnographic and sensory research framework, eye tracking operates as a biosensor method capable of capturing consumers' visual attention and emotional responses during purchasing scenarios. The study demonstrates how this technology uncovers unconscious consumer preferences, offering valuable insights into responsible consumption patterns. These findings contribute to the development of green knowledge strategies and foster innovation within agroecological systems.

Keywords: eye tracking, sustainable innovation, responsible consumption, green knowledge, agroecology

1. Introduction

1.1 Context and rationale

In the face of accelerating environmental degradation, climate change, and re-source depletion, sustainable consumption and production systems have emerged as central pillars of global development strategies. International frameworks such as the United Nations' Sustainable Development Goals (SDG 12) [1] emphasize the need to transition toward patterns of consumption that are not only environmentally viable but also socially just and culturally inclusive [2]. Within this paradigm, agroecology understood as both a scientific discipline and a socio-political movement offers a compelling model for food systems transformation [3]. It integrates ecological principles, traditional knowledge, and community empowerment into the fabric of agricultural and commercial practices.

Latin America, with its profound biodiversity and rich indigenous heritage, has be-come a key locus for agroecological experimentation and innovation [4]. The Ande-an-Amazon region of Peru, in particular, has witnessed the emergence of cooperative organizations that align ecological sustainability with local identity, autonomy, and intergenerational solidarity [5]. These cooperatives do more than trade products they mediate between global ethical

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markets and local cultural ecosystems, translating terms like "organic," "fair trade," and "green innovation" into everyday language, rituals, and behaviors [6]. However, dominant narratives around innovation often remain locked within a technocratic vocabulary, detached from how communities on the ground actually perceive, adopt, or resist these terms. It is within this cultural dis-sonance that new forms of learning, critique, and transformation emerge opening space for research grounded in critical ethnography and intercultural understanding.

1.2 Problem statement and research gap

While sustainable branding and fair-trade certifications have gained visibility in international markets, the real-world practices and meanings behind these labels often remain opaque, particularly in the context of the Global South [7]. A growing body of research in consumer studies points to the limitations of assuming a linear relation-ship between ethical awareness and purchasing behavior. In practice, consumer choices are shaped by a complex mix of social norms, emotional responses, symbolic associations, and domestic contexts, which vary significantly across cultural and socioeconomic backgrounds [8].

At the same time, many producer organizations especially rural cooperatives are celebrated for their capacity to generate "inclusive innovation." Yet this praise often ignores the internal cultural tensions, asymmetries in knowledge systems, and struggles over narrative authority within these organizations. Most academic and policy literature isolates either the producer side (with emphasis on market access and sustainability metrics) or the consumer side (focused on attitudes and behaviors), with-out bridging the two [9]. This siloed approach obscures the relational and cultural dynamics that co-produce meaning and value in agroecological markets. Thus, there is a pressing need for interdisciplinary, multi-sited research that can trace the flow of meaning, emotion, and design across the entire sustainability chain from farm to shelf to home.

This study addresses this research gap by examining how sustainability is culturally constructed and behaviorally embodied by both producers and consumers in the Peruvian organic coffee ecosystem. It argues that understanding these dynamics requires going beyond economic indicators and survey-based metrics, and instead engaging with the symbolic infrastructure of sustainability: rituals, aesthetics, trust, and storytelling.

1.3 Research objectives and approach

The central objective of this study is to explore how emerging cultures of innovation and sustainability manifest in the daily practices, preferences, and symbolic vocabularies of producers and consumers engaged in organic coffee systems in Peru [10]. The research is situated within a constructivist and interpretivist paradigm, privileging lived experience, meaning-making, and localized knowledge as key sources of insight. Specifically, the study examines:

- How do producers and consumers interpret and emotionally relate to sustainability symbols such as eco-labels, origin stories, and cooperative narratives?

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- What behavioral patterns and decision-making processes shape responsible consumption in urban middle-class households?

- How are innovation and sustainability embodied and performed in both production sites (e.g., cooperatives) and consumption contexts (e.g., homes, stores)?

To address these questions, the study adopts eye-tracking experiments. This method allows for a understanding of consumer-producer interaction [11].

The empirical anchor of the research is the Pangoa Coffee and Cocoa Cooperative, located in the Satipo province of the Junín region, which serves as a leading example of agroecological transition, gender-inclusive governance, and intercultural innovation in Peru. Through this case, the study contributes to global debates on inclusive innovation, ethical consumption, and sustainable branding, offering practical insights for policymakers, designers, educators, and cooperative leaders seeking to align environmental goals with cultural integrity and local agency.

2. Methodology

Eye tracking was used as part of a participatory ethnographic approach in the observation of middle-class Latin American consumers. This was situated within a larger sensory ethnography that employed a biosensor methodological framework, including facial coding and galvanic skin response (GSR), aimed at capturing multisensory interactions.

Participants were engaged in a guided purchase experiment set in a simulated grocery environment tailored to resemble a Latin American urban market. Eye tracking was conducted using Tobii Pro Glasses 2, enabling real-time recording of gaze metrics such as fixation duration, gaze sequence, and heat maps. These were interpreted in conjunction with participants' responses to ecological labels and storytelling elements found on product packaging. Environmental variables such as shelf lighting and soundscape were also standardized.

The technique was essential for identifying moments of cognitive dissonance, attention prioritization, and emotional shifts as consumers interacted with sustainably marketed items. The experiment was complemented with qualitative post-session interviews to ensure cross-validation of data.

The sample consists of purposively selected participants identified for their cultural and behavioral relevance. Two key consumer profiles were considered:

- (n =8) Young adult professionals (men and women), digitally active and sustainability-aware.
- (n =4) Young mothers in metropolitan Lima, representing current organic product consumers.

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This segmentation allowed for the analysis of generational, gendered, and domes-tic roles in shaping responsible consumption practices.
Structured observation using visual tracking technologies in the cooperative's distribution center to assess visual behavior and decision-making in product selection.

3. Results

3.1 User experience and emotion tracking: eye-tracking analysis

To understand the consumer's emotional and cognitive responses during organic coffee product selection, a structured observation protocol using eye-tracking technology was applied. The study focused on young adult mothers from socioeconomic segment B (NSE B) in Lima, identified as an emerging profile in responsible and sustainable consumption.

3.2 Facial emotion recognition in decision-making

Two complementary visualizations captured the emotional response during product interaction:

- A valence-arousal radial graph indicated that 28% of recorded responses fell in the "pleasant-active" quadrant, corresponding to the emotion of happiness.
- A donut chart confirmed that 43% of facial expressions registered as "happy", followed by neutral and other less frequent emotions such as surprise, sadness, and contempt, see figure 1.

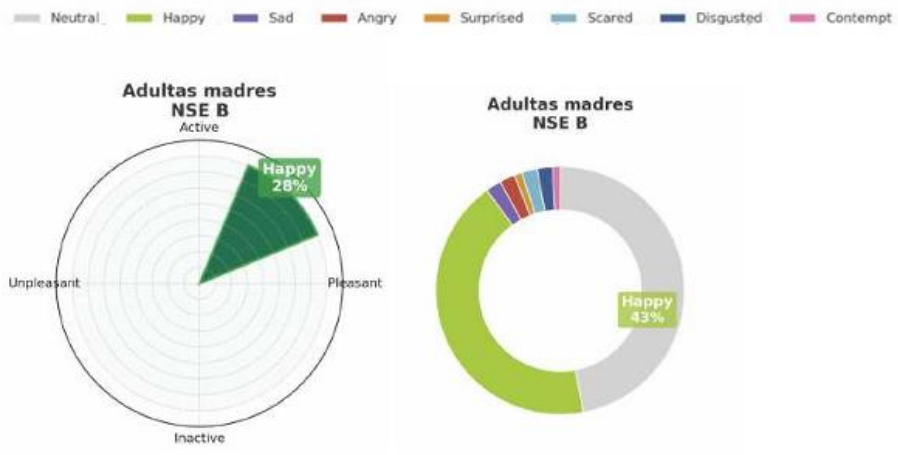

Figure 1. Eyetracker experiment plot

These metrics suggest a positive affective disposition toward the organic coffee category, with happiness as the dominant emotion during decision-making.

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3.3 Visual attention and behavioral fixations

The Tobii Pro experiment revealed heatmaps of consumer gaze patterns over product shelves, identifying Areas of Interest (AOIs).

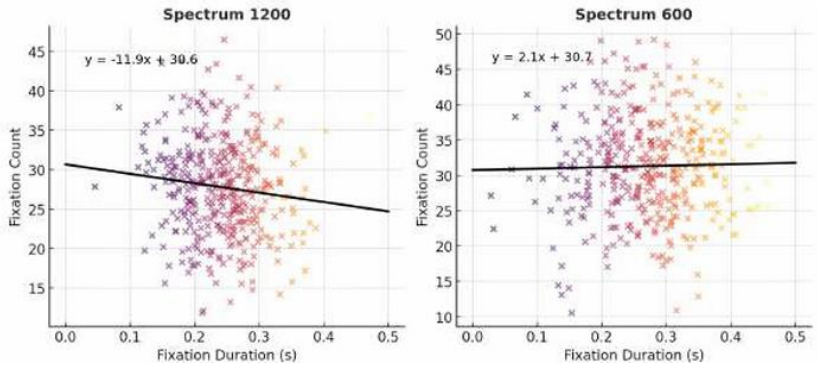

Figure 2. Behavioral fixations

Figure 2 shows the quantitative analysis of fixation metrics across four eye-tracking devices—Spectrum 1200, Spectrum 600, EyeLink F, and EyeLink U demonstrated consistent patterns in visual attention. Average fixation durations ranged from 0.22 to 0.27 seconds, with Spectrum 600 showing the highest mean duration (0.27 s), indicating slightly longer engagement with visual stimuli. Median fixation values closely mirrored the means, suggesting stable attentional responses. The number of fixations per session varied, with Spectrum 600 again leading with an average of 31.31 fixations, followed by EyeLink U (26.58), Spectrum 1200 (27.77), and EyeLink F (24.82).

3. Results

Preliminary results show distinct visual patterns and emotional responses when participants are exposed to ecological certifications, product origin, and packaging design. Eye tracking revealed hidden cognitive processes that traditional interviews may not uncover, providing deeper insights into the factors influencing green purchasing decisions.

Findings indicated that eco-labels received the most visual attention, suggesting they are a critical factor in guiding sustainable choices. Pupil dilation suggested increased emotional engagement when products were associated with local producers or social justice narratives. Participants displayed notable gaze shifts when visual storytelling elements were incorporated on labels, such as images of producers or ecological impact icons. However, high information density on packaging sometimes led to cognitive overload, decreasing attention duration.

The combination of gaze path and fixation data was particularly insightful in identifying purchase hesitation points, revealing a disconnect between intention and action in sustainability claims. Heat maps further illustrated areas of packaging that failed to attract attention, offering guidance for future design improvements.

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Table 1. Summary of average fixation duration on sustainable product features.

Feature	Average Fixation Duration (ms)
Eco-labels	750
Product Origin	620
Packaging Imagery	510
Price Tag	480
Nutritional Label	400

4. Conclusion

Eye tracking complements qualitative ethnographic methods by adding measurable physiological data. Its use enriches the understanding of sustainable consumer behavior and supports the design of communication strategies and product placement that foster green innovation and cultural acceptance. As a key tool within biosensor-based ethnography, eye tracking enables the decoding of consumer attention and emotional alignment with sustainability narratives. This methodological contribution strengthens the role of cultural analysis in the development of green knowledge and responsible innovation.

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