The Perceptual Experience Lab (PEL): In-Context Training and Product Experience Analysis.

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Introduction

Advancements and increased affordability of innovative user-testing environments and technologies have broadened the scope of consumer research approaches and novel testing methods to study food-allied topics[1].

The Perceptual Experience Lab (PEL) is an immersive, multi-sensory digital theatre, used to stage simulated task environments (STE) for user-testing praxis, food safety training and consumer behaviour research. In-house digital theatre designs are often employed by global companies whilst testing packaging design iterations; to observe consumer purchasing behaviours in context and ultimately increase brand growth above their competitors[2,3].

Extraneous variables can be easier to control within an STE compared to a real (field) environment, which can be too complex, thus increasing the researcher's ability to study behaviour[4] and the validity of study data[5]. In contrast to field research, when carrying out 'in-vitro' laboratory studies it is almost impossible to provide an equal level of realism. Crucially, 'in-sitro' STE scenarios that match as close as possible to the field environment are advantageous because they allow researchers to maintain a high level of experimental control[6].

Whilst conducting training, it is considered imperative to replicate psychological fidelity to such an extent that users engage in the same situational behaviours experienced in the field[7]. To aid this, multisensory cues and props are applied to increase context and presence[8]. Scenarios devoid of context can become abstract, whereas context provides familiarity, allowing individuals to ground themselves in arranged tasks[9].

The PEL provides an unhindered space to operate wearable eye-tracking technology, allowing an unbiased visual account of user engagement and product preference[10,11]. Fixation data within the context of the field environment removes search task uncertainty and provides robust visual attention insights[12,13]. Further behavioural analysis is possible through observation lab systems that allow discrete surveillance of participants. This method is seen in food safety research within domestic and industry settings[14,15].

The development of unique transdisciplinary STE research within existing cognitive and behavioural food-allied arenas may offer the most appropriate method for evolving an in-depth understanding of consumer behaviour and solutions to real-world food industry problems.

Research Purpose

The research presented here showcases the immersive capabilities of the PEL during commercial and academic eye-tracking projects which employ environments that are not readily or habitually accessible for research purposes.

- To explore the commercial viability of conducting in-context consumer packaging design research within a simulated setting.
- Investigate the feasibility of using a simulated environment to deliver interactive food safety and security training.

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Applied Technology

Our implementation of wearable eye-tracking technology within simulated food and drink settings has provided unique insights into shopper engagement with packaging to determine product preference. Further eye-tracking applications have seen it being used to deliver food safety and security training research to improve auditor consistency.

The PEL Facility

The PEL provides the benefits of controlled laboratory settings while simulating real contexts of use. It offers a robust user-testing environment for recording the visual attention and behaviour of participants.

- The digital theatre has been developed using rear projection and surface mapping technology to deliver 200° of seamless field-of-view content around the user (see Fig. 1).
- The floor-to-ceiling display system uses cylindrical media to appropriately convey situations that are not traditionally accessible for research purposes.
- A multi-speaker system and spatial panner technology are used to create an immersive soundscape that can also replicate feedback of real acoustic spaces.
- The staging area that participants occupy can be configured in terms of physical objects, air movement and the delivery of custom smells.
- An observation system allows the review and analysis of participant behaviour.

Figure 1. The PEL has been Configured to Simulate a Food Industry Setting to Deliver Food Safety Training

Figure 1. The PEL is an embryonic research project, with immersive, behavioural and physiological capabilities evolving out of the needs of academic and commercial research activities.

Eye-Tracking Overview

The main function of eye-tracking technology is to determine where a person is looking during an activity. The technology employs infrared light, sensors and gaze algorithms to provide eye movement data and behaviour analysis.

- Eye-tracking research classifies eye movements as fixations and saccades.
- Saccades are the movement between fixations and during this movement our eyes take in little visual information.
- A fixation is not really a movement, when our eyes are still, we are able to take in visual information.
- Eye-tracking data is initially observed using a still image (see Fig. 2) which is used to depict visual attention over a specified period.
- Detailed numerical analysis requires demarking Areas Of Interest (AOI) (see Fig. 3) so that fixation data (e.g., fixation hit, total duration of fixations) can be calculated across study recordings.

Figure 2. Heat Map Visualisation

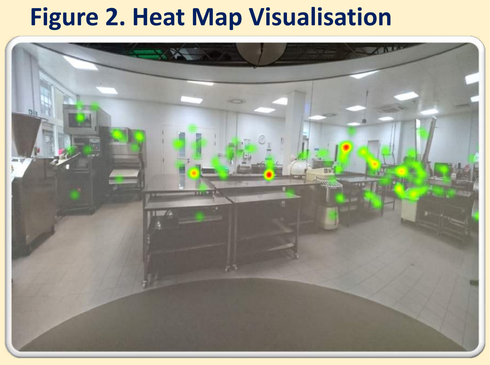

Figure 2. Visualised distribution of attention over a selected timeline. The warmer colours indicate a greater viewing time.

Figure 3. Area Of Interest (AOI)

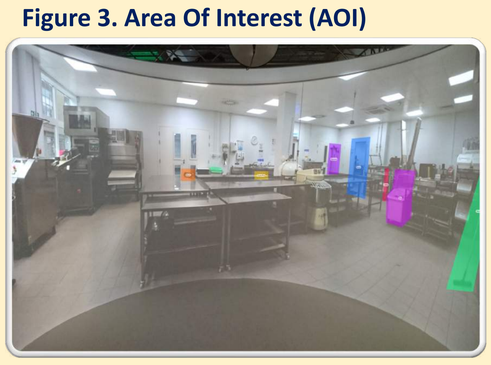

Figure 3. Demarked Areas Of Interest (AOI) allow the bespoke analysis of fixation data from participants' eye-tracking recordings. Logged visual attention provides a robust way to examine participant biases (e.g. honesty) during search tasks and conventional response data.

Examples of PEL Research

The completed experimental studies promote the PEL as a robust way to mitigate commercial protocols during the packaging design process and training. Consumer purchasing behaviour data from a simulated aisle observation study signalled key graphic elements to enhance in-store product merchandising, and the delivery of food safety training in a simulated bakery environment yielded similar observational results to its physical commercial setting.

Consumer Behaviour

The purpose of the study was to reveal key insights into consumer decision-making in response to a company's new packaging concept which they wanted to compare against their existing packaging and a retailer's own label.

- A consumer-testing method developed for the PEL was applied[16]. This involved participants (N=32) wearing eye-tracking glasses, to record their attention in a supermarket aisle experience whilst verbally responding to design (graphic elements) and marketing questions.
- Following the simulated shopping activity, participants discussed the rationale behind their responses.
- Analysis of consumer perception data revealed a preference for the new packaging design over their existing and supermarket's own label designs. This was reinforced through the analysis of fixation data (see Fig. 4).
- The consensus was that the new packaging design appealed to a wider demographic through its simpler layout and more tasteful imagery (see Fig. 5).

Figure 4. Eye-Tracking Analysis was Used to Reinforce Verbal Responses to Packaging Design Questions

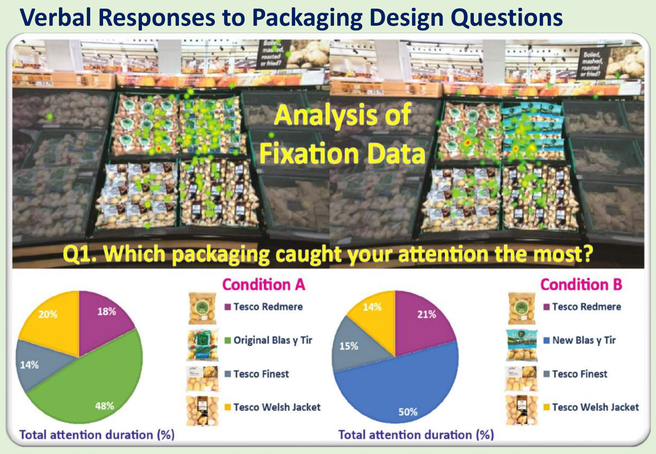

Figure 4. Consumer perception judgements in the PEL provided important design insights for the company and positive refashion evidence to circulate to retailers.

Figure 5. The *Blas y Tir* project

Figure 5. An example of the packaging that was released after the PEL driven design revisions were made.

In-Context Training

The purpose of the research was to explore the feasibility of using the PEL to deliver food safety training within a manufacturing environment. Primarily to inform the creation of effective food safety behaviour training packages.

- Food safety experts (N=16) dressed in personal protective equipment (PPE) and wearing eye-tracking glasses were asked to verbally identify staged hazards in a real and simulated commercial bakery.
- The staged hazards (N=19) were matched in both conditions and comprised microbial, allergen and OH&S types. Counterbalancing was used to deal with the order effects of this repeated measures design.
- Participant eye-tracking records were investigated using AOI and fixation hit data to confirm which hazards were observed in both conditions.
- No significant difference (P>.05) was found between the real bakery and the PEL bakery when completing the verbal hazard reporting task.
- Analysis of unreported hazards and observation (fixation hit) data pinpointed follow-up training as viewed hazards were not always reported (see Fig. 6).
- The study demonstrated the stability of the PEL over the commercial bakery as it could be controlled more effectively, improving training consistency.

Figure 6. Example Profile Plot Illustrating Hazards Missed During Observation and Reporting in Both Conditions

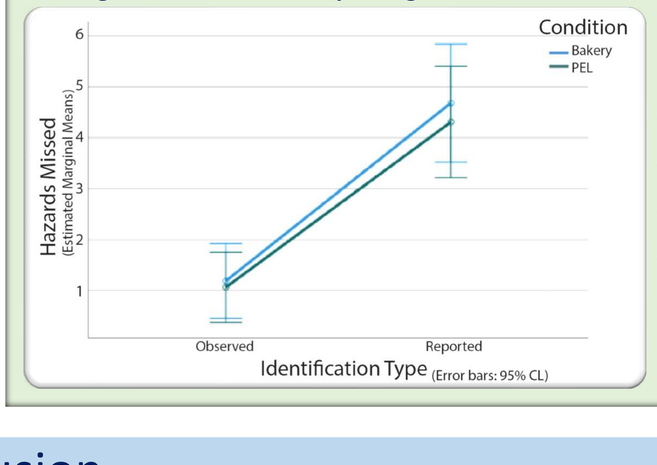

Figure 6. The comparable results between the PEL and the real bakery demonstrate the reliability of the PEL and that it could play an important role in delivering future training activities. In addition, analysis of eye-tracking data was able to expose if critical elements were observed but not reported by food safety experts.

Conclusion

- Importantly both studies demonstrate evidence in support of using STEs such as the PEL as a more appropriate and robust research method when field research is unavailable and laboratory research would be too contrived. Further large-scale commercial studies are required to validate this with academics of other disciplines.
- Anticipated PEL environments can be set up quickly, and with improved repeatability, over their real environments. For packaging, this was seen in shelf location counterbalancing and in the manufacturing training scenario, the arrangement of machinery and location of staged hazards could be matched across all sessions.
- The application of eye-tracking technology in the PEL was shown to be a robust method to determine food expert knowledge and a powerful marketing research tool that provides an important role in delivering a competitive edge to branding for new and existing products.
- Future eye-tracking, observation and physiological research capabilities of the PEL continue to be explored by food industry researchers to advance knowledge of consumer behaviours, food safety practices, and educational opportunities to provide meaningful training services within diverse settings.

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