






Hospitality in the Cyborg Age: The Power of Brain-Computer Interfaces in a Field-Experiment

Alexander Kiess¹  and Alexander Lennart Schmidt²  

¹ RWTH Aachen University, Kackertstr. 7, 52070 Aachen, Germany
kies@time.rwth-aachen.de

² Research Centre, Hotelschool The Hague, Jan Evertsenstraat 171, 1057 BW Amsterdam, Netherlands
a.schmidt@hotelschool.nl

Abstract. This paper explores the emerging role of Brain-Computer Interfaces (BCI) in the hospitality industry. BCI technology allows users to control devices with their thoughts, potentially transforming guest experiences. The study investigates how guests perceive BCI-enhanced experiences compared to traditional ones. Drawing from service and human-computer interaction literature, the paper conducts a quasi-field pre-study, where participants interact with a BCI-equipped waitress. Surprisingly, participants perceived the BCI-equipped waitress as superior and warmer, resulting in an improved service experience.

The research contributes in two ways: it advances understanding of how people perceive BCI-augmented interactions in hospitality and explores the use of BCIs in addressing service failures, improving efficiency in handling customer complaints. The paper outlines plans for larger-scale field studies and online experiments across different hospitality contexts. This research offers insights into the evolving landscape of human-computer interaction in hospitality, with practical implications for the industry's future.

Keywords: Brain-Computer Interfaces · Digital Experiences · Field Study · Hospitality · Human Enhancement Technology · Service Recovery

1 Introduction

There is an ongoing debate on how hospitality businesses are impacted by emerging digital technologies [1]. In this regard, scholars put the design of technology-enhanced, digital guest experiences on the research agenda for hospitality scholars [2]. Next to studies discussing the impact of digital technologies such as service robots, virtual realities, or cryptocurrencies, brain-computer interfaces (BCI) have entered the scholarly debate [2]: Picture the ability to command your computer or smartphone solely through your thoughts. What was once considered a futuristic idea, often found in science fiction literature and films, is now on the verge of becoming reality thanks to the rapid advancements

in consumer-grade BCI [3]. Recent advances in BCI technology have yielded remarkable results, one of which is the successful training of monkeys to play Pong wirelessly through mind control, a breakthrough achieved by Elon Musk's company Neuralink. Meanwhile, NextMind, a startup that was acquired by Snapchat's parent company Snap in 2022, has developed a BCI headset that allows users to interact with their smart home or control their TV [4]. Hence, by wearing a BCI device, humans turn into cyborgs, i.e., individuals whose physical abilities get enhanced by digital technology [5]. These consumer-grade devices hold tremendous potential to enhance the user experience by providing a more intuitive and seamless way of interacting with technology, both on a customer and service provider side. Based on forecasts, it is evident that BCI technology will play a significant role in shaping and transforming how users interact with technology, thereby redefining hospitality experiences [6]. For this study, BCI refers to an information technology that is placed on the outside of the brain that enables humans to interact with technology without any body movement, using only electrical signals generated in the brain to record activity [7]. BCIs have primarily been researched to provide communication abilities to disabled or "locked-in" patients [8]. Simultaneously, service researchers debate impacts of human-enhancement technologies, such as BCI, on customer experiences [5].

Clearly, the way guests perceive hospitality experiences, which are enhanced by BCI technology is relevant in determining BCI's future diffusion in the hospitality and tourism sector. However, despite the abundance of literature on the technical aspects of BCI, research on guests' perceptions is limited but much needed [5]. Recognizing this research gap, our study is directed towards addressing the research question: How do guests perceive BCI-enhanced experiences at the hospitality frontline compared to traditional, non-BCI-enhanced experiences?

By answering this research question, our study contributes to literature in both information systems and hospitality research, ultimately promoting interdisciplinary collaboration and knowledge exchange: (1) Our research is among the first to analyze the effects of BCI technology at the hospitality frontline. (2) We investigate the evaluative outcomes of BCI technology for service recovery through a real-life experiment.

2 Literature Review

We anchor our study in the ongoing debates surrounding the impact of digital technologies on the tourism and hospitality sector. Recent reviews underline the growing relevance of understanding the consequences of emerging technologies on guest experiences and guest-host interactions [9, 10]. Current advances in artificial intelligence have paved the way for precise and reliable Brain-Computer Interfaces (BCI) that will reimagine how Frontline-Employees (FLE) interact with customers. By just thinking about what a FLE wants to do, they can look up databases, transfer orders or make decisions using a BCI. These devices can be worn inconspicuously as headphones or glasses. Most existing research on BCI has primarily focused on extracting features from brain waves or developing medical applications to assist users with brain injuries or locked-in states to communicate or control robotic extensions [8]. Despite these efforts, there has been a lack of research on the acceptance of BCI and the impact on guest experience [2, 3, 11].

Limited studies have begun to investigate the implications of consumer-grade BCI for users in applications such as gaming, controlling Internet-of-Things (IoT) devices, and inferring user intentions from brain waves. In gaming, enabling consumers to interact with games through a BCI has been shown to enhance the experience by serving as both an active and passive controller, fostering higher engagement and introducing novel forms of interaction [3]. Improved signal detection and the ability to distinguish it from noise has shown to make it feasible to utilize BCI technology to control IoT devices, such as smart homes [4].

Moreover, research in the field of hospitality, tourism, and service marketing has begun to pay attention to human enhancement technologies (HET) and their implications for consumers and guests [5]. As part of HET, BCI are a central technology which could allow more advanced approaches to merge its users with artificial intelligence. This, in turn, could reshape the service experience, improving the well-being of guests and enhance their overall experience. However, there may also be drawbacks, such as financial inequality or ethical concerns related to the technology. Grewal et al. [5] have conceptualized the impact of HET on front-line employees, who may be perceived as robotic cyborgs, leading to potential dehumanization and negative perceptions of warmth and competence during service encounters. In this context, cyborgs are users who interact with BCI technology to augment their abilities.

3 Research Design and Methodology

This research suggests that implementing BCI technology in hospitality, specifically in dining contexts, can yield insights into service experience during service failure recovery. Our main goal is to explore BCI's practical application in real-world frontline scenarios and analyze the primary effects it produces in these interactions. We start our initial investigation with a pre-study where we showcase a genuine interaction between patrons and a frontline cyborg enhanced with BCI technology in a quasi-field setting. Following this, we'll briefly introduce study 1 (field experiment) and study 2 (online experiment), scheduled for late 2023 and early 2024.

The study design for the quasi-field pre-study utilized a 2 (waitress input type: BCI vs. Pen & Paper) x 1 between-subjects design. A total of 20 students at a major European hotel school participated in the study in exchange for a complimentary meal. Our dependent variable was the perceived service performance assessment and we additionally assessed warmth, responsibility for failure and employee superiority, among other measures. Participants received a paper briefing before the study, which outlined the study procedure and information about their waitress using either a BCI or pen & paper to aid in the service encounter and to provide a definition for the technology used. Additionally, they were asked to express their service expectations before the experiment.

Participants ordered food from a food truck, where they were intentionally served the wrong dish prepared in advance to create a service failure scenario. Next, participants were seated at assigned tables with instructions to alert the waitress if they had any problems. Because the food was served in a closed-lid container, individuals noticed the wrong dish only when they sat down. Once the employee was contacted by the individuals about their incorrect order, the guest was informed that handling the issue involves using

either BCI or pen and paper. With a pre-programmed mental command (vs. written down information), the kitchen staff was alerted about the incorrect dish, allowing them to immediately start preparing the correct one upon receiving the information. After voicing their complaints, participants received the correct dish, finished their meals, and were then asked to take a survey about their dining experience.

In the BCI condition, we employed an Emotiv EPOC X headset and a programmed Python script to record all orders. We trained the waitress on a pre-programmed mental command on the Emotiv BCI software to signal when a served dish was incorrect. This information was then relayed to the kitchen via the script, allowing the food truck staff to promptly prepare the correct food. In the pen and paper condition, the waitress physically walked to the food truck to convey that an order was incorrect. After this information was transmitted to the staff, they began preparing the correct dish.

The planned experiment in Study 1 closely resembles the pre-study but with a larger sample size. In Study 2, we will conduct a pre-registered online experiment on Prolific to assess the strength of our observed effects in a different hospitality context.

4 Results of Pre-study 1

In a first step, we tested participants' perception of enhanced employee capabilities through the application of technology, serving as our manipulation check. As we had anticipated, the cyborg waitress was perceived as significantly more superior than the waitress using pen and paper ($M_{\text{BCI}} = 4.59$, $SD = 0.72$; $M_{\text{Pen\&Paper}} = 3.8$, $SD = 0.86$, $p = 0.049$). Therefore, the manipulation proved to be successful.

The presence of a cyborg waitress resulted in a perception of improved service performance compared to the use of pen and paper. Our findings indicate that customers who interacted with a BCI-equipped waitress experienced a notably improved service encounter following a failure, compared to those assisted by a waitress using pen and paper ($M_{\text{BCI}} = 5.14$, $SD = 1.68$; $M_{\text{Pen\&Paper}} = 2.5$, $SD = 0.84$, $p = 0.005$). Moreover, participants perceived the BCI waitress as weakly significantly warmer compared to control ($M_{\text{BCI}} = 4.56$, $SD = 1.1$; $M_{\text{Pen\&Paper}} = 3.6$, $SD = 1.17$, $p = 0.096$). The attribution of the cyborg waitress's performance outcome to the restaurant was lower compared to the control group. Patrons attributed less responsibility for the service failure to the restaurant in the BCI condition ($M_{\text{BCI}} = 3.79$, $SD = 1.1$; $M_{\text{Pen\&Paper}} = 2.75$, $SD = 1.17$, $p = 0.069$).

5 Discussion, Expected Contributions and Outlook

The study shows that participants perceived the service recovery experience to be better with a cyborg waitress compared to the control group. Customers also blamed the restaurant less for service issues in this scenario. Surprisingly, the enhanced waitress was seen as warmer than the control group. We plan to investigate these findings and interaction effects further in Studies 1 and 2 with a larger sample size to understand the interactions within the data and investigate possible confounding effects.

We expect this study to offer two major contributions. First, this study will advance the limited research on frontline cyborgs in service marketing and hospitality literature.

By addressing a gap in the literature, which primarily investigated observing users, this research takes a pioneering step towards understanding how individuals perceive interacting with individuals who are augmented with a BCI. We thus contribute to the research in hospitality and provide an additional perspective exploring the utilization of BCI by FLE in a restaurant setting. Our second contribution involves the application of BCI in addressing service failures. We propose that the enhanced efficiency offered by BCIs in promptly handling customer complaints can lead to more favorable customer outcomes. Based on the evidence from our pre-study, we were able to confirm this benefit and as a result we will present a further investigation into this potential to enhance the service recovery process. After a successful pre-study, we are now preparing a large-scale field study and subsequent pre-registered online studies to expand our investigation into various aspects of the hospitality industry. This dual approach will provide a comprehensive understanding of our research area and offer valuable field insights.

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