

Consumer Attitudes toward Brain–Computer Interfaces in Marketing: A Grounded Theory of Control Anxiety and Neuro-Trust

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Abstract

Brain–computer interfaces (BCIs) promise neural-level insights for personalization, yet acceptance depends on how consumers understand risks and control. Drawing on 20 semi-structured interviews (10 digital natives; 10 digital immigrants) and a classic Grounded Theory approach, this study identifies six dimensions—control and manipulation, perceived protection, technological anxiety, human reduction, digital perspective, and orientation toward BCIs. From these, we develop a process model where **control anxiety** and **neuro-trust** mediate consumer acceptance, moderated by generational technology orientation. We situate our model within interactive marketing scholarship and recent ethics and public policy debates, emphasizing implications for managers, policymakers, and researchers. All raw materials (interview guide, excerpts, open-code lists, and coding tree) are provided in the Appendix.

1. Introduction

BCIs translate neural activity into signals that can be used to infer attention, affect, and preferences with greater immediacy than self-report, potentially enabling a new frontier of interactive personalization. Recent work on AI-driven marketing demonstrates that transparency, perceived control, and trust are decisive in shaping whether consumers experience personalization as empowering or manipulative (Weidig et al., 2024; Lambillotte et al., 2022; Talwar et al., 2020). Yet explanations alone can paradoxically heighten feelings of surveillance if not accompanied by meaningful affordances for refusal (Felzmann et al., 2019; Schilke & Helfat, 2025). Ethics and policy research has also stressed the sensitivity of neural data, highlighting risks of commodification of inner states and calling for enhanced protections (Tubig & McCusker, 2021; Gonçalves et al., 2024; Yang & Jiang, 2025;

Szoszkiewicz & Yuste, 2025). Within the Journal of Interactive Marketing tradition, interactive systems are most effective when they embed consumer agency at the heart of the design and cultivate trust throughout the experience (Bleier & Eisenbeiss, 2015; Weidig et al., 2024; Leszczynska & Baltag, 2024; Lambillotte et al., 2022). However, little is known about how ordinary consumers, rather than experts or clinical users, make sense of BCIs in marketing contexts. Given the novelty and ethical salience of neural data, an inductive Grounded Theory design is particularly appropriate, allowing us to identify emergent constructs rather than impose pre-existing schemas. We therefore explore what concerns, framings, and orientations consumers hold toward BCIs in marketing, and how generational orientations shape their acceptance.

2. Method

We recruited 20 participants through purposive and snowball sampling: ten digital natives (aged 20–26, mean 24.1) and ten digital immigrants (aged 46–76, mean 57.5). Natives were primarily students, while immigrants included homemakers, retirees, and other professions, with geographic spread across Italy. Interviews lasted on average 29 minutes (range 20–55), fourteen were conducted face-to-face and six online. To ensure comprehension, all participants received a short primer explaining non-medical BCIs. Written consent was obtained before each interview, and all transcripts were anonymized using pseudonyms. Audio recordings and transcripts were securely stored on encrypted drives and deleted after the completion of coding and analysis

The semi-structured interview guide invited reflection on familiarity, potential benefits and risks, privacy and consent, trust in regulation, distinctions between medical and marketing applications, and willingness to participate. Participants were encouraged to imagine concrete scenarios (e.g., a headset detecting attention to an advertisement) and to discuss likely reactions and desired safeguards.

All interviews were recorded, transcribed verbatim, and analyzed using constant comparison. During **open coding**, two coders independently performed line-by-line coding, generating 204 in vivo codes (e.g., *mind-reading fear*, *stop-button desire*, *rules as reassurance*, *being reduced to data*). Codes were iteratively collapsed into 17 first-order categories. In **axial coding**, we linked categories by specifying conditions, actions, and consequences, which yielded broader dimensions such as control and manipulation or perceived protection. In **selective coding**, we integrated these into a central storyline: **control anxiety** emerged as the core process, moderated by a **digital perspective** and buffered by **perceived protection**, leading to varying

orientations toward BCIs. Negative cases were examined to refine the model. Theoretical saturation was reached after the seventeenth interview, as no new first-order categories emerged in the remaining transcripts. Reliability was enhanced through double coding, memoing, deviant-case analysis, and maintaining an audit trail. A subset of interviews was independently double-coded by both researchers, and discrepancies were resolved through iterative discussion until full agreement was reached. The Appendix provides the full codebook, coding tree, and exemplar quotations.

3. Findings: Six Dimensions with Theoretical Integration

3.1 Control and Manipulation

Control and manipulation concerns dominated the corpus. Participants repeatedly articulated the fear that BCIs might expose private thoughts or enable marketers to steer decisions covertly: *“If they can read my brain, how do I refuse?”* (Native_03). Analytically, these statements clustered around perceived loss of agency and the absence of credible refusal. This pattern coheres with interactive marketing work showing that personalization without tangible control levers is interpreted as surveillance rather than service (Bleier & Eisenbeiss, 2015; Weidig et al., 2024). It also explains recent findings that disclosure and explanation can backfire when they illuminate the scope of inference but do not grant actionability, thereby heightening manipulation inferences (Felzmann et al., 2019; Schilke & Helfat, 2025). In our data, participants required *operational vetoes*—a pause or stop function—to reclassify BCI engagement from coercive to consensual. The move from fear of thought exposure to demand for refusal affordances illustrates how control anxiety precedes calculus about benefits, extending privacy-concern models beyond information risk to **existential autonomy**.

3.2 Perceived Protection

A second theme concerned reliance on external safeguards to temper anxiety. Interviewees referenced laws, audits, and penalties as conditions for legitimacy: *“It’s the future, but there must be laws to protect us.”* (Immigrant_01). These expectations mirror evidence that institutional trust moderates privacy concerns yet remains fragile when enforcement seems distant or symbolic (Martin & Murphy, 2017). In the BCI context, participants reasoned that neural signals should be treated as a special category, echoing current policy debates on mental-privacy rights and neuro-data protections (Yang & Jiang, 2025; Szoszkiewicz & Yuste, 2025). Our axial coding captured a directional proposition: when enforcement is credible and

redress visible (e.g., independent audits, deletion rights), **perceived protection** attenuates control anxiety; when safeguards are merely declarative, anxiety persists. This buffering mechanism helps reconcile why some transparency initiatives succeed while others do not: **assurance must be enforceable to carry trust.**

3.3 Technological Anxiety

Participants also expressed a diffuse unease about the trajectory of BCIs: *“It worries me, who knows where it will end up.”* (Native_06). Beyond concrete privacy harms, this future-oriented anxiety reflected worries about mission creep, secondary uses, and misuse by bad actors. Prior research documents that technology anxiety can suppress adoption even before users evaluate specific features (Lwin et al., 2007; Talwar et al., 2020). We observed technological anxiety amplifying control concerns by supplying imagined scenarios in which BCIs outpace regulation. This mechanism dovetails with interactive marketing findings that anticipatory fears heighten surveillance appraisals and reduce willingness to engage unless countervailed by either strong affordances (for younger users) or visible institutional guardrails (for older users). Thus, technological anxiety functions as a **multiplier** of control anxiety unless checked by the two mitigating routes described below.

3.4 Human Reduction

A fourth dimension captured apprehension that BCIs reduce human subjectivity to extractable signals: *“We lose part of our humanity.”* (Immigrant_07). Participants worried that neural readouts would over-interpret fleeting states, flattening creativity and interiority into marketable data points. These concerns align with business-ethics scholarship warning that treating inner mental life as a commodity risks dignity violations and misrecognition (Tubig & McCusker, 2021; Lu, 2024). Importantly, human-reduction talk surfaced even among otherwise tech-positive participants, indicating that ethical limits can be salient alongside perceived utility. In our selective model, human reduction feeds into control anxiety by reframing BCI engagement as a threat to **self-definition**, not merely data privacy. This deepens interactive marketing debates on personalization by specifying a boundary condition: when inference targets interiority rather than behavior, consumers’ tolerance for error and intrusiveness sharply declines.

3.5 Digital Perspective

Despite pervasive concerns, many digital natives framed BCIs as a logical extension of existing personalization ecosystems—*“If it helps me find what I need, why not?”*

(Native_05). This **digital perspective** reflects habituation to tracking and a pragmatic focus on utility, consistent with work on generational differences in how personalization and transparency cues are processed (Saha et al., 2024; Weidig et al., 2024). In our axial analysis, digital perspective moderated the weight of control anxiety: when credible refusal was available, natives accepted residual risks as the price of utility. By contrast, immigrants tended to discount utility unless institutional credibility was evident. The generational split maps onto dual routes to trust found in interactive contexts—**affordance-based empowerment** versus **assurance-based legitimacy**—and clarifies why the same disclosure can be read as empowering by one group and alarming by another (Leszczynska & Baltag, 2024; Lambillotte et al., 2022).

3.6 Orientation toward BCIs

Finally, participants formed overall evaluations ranging from rejection to conditional openness. Acceptance rose when BCIs were framed as high-benefit or beneficent (e.g., accessibility, health), consonant with evidence that perceived beneficence can legitimize sensitive data practices if coupled with control (Teepapal, 2025; Falk et al., 2012). In marketing contexts, however, many respondents insisted on stricter thresholds: refusal must be easy, inferences bounded, retention minimal, and oversight independent. Our selective coding thus positions **orientation toward BCIs** as the outcome of tensions among control anxiety, perceived protection, technological anxiety, human reduction, and generational digital perspective. The emergent process model specifies **two pathways to conditional acceptance**—a utility-with-exit route salient among natives and an institutional-credibility route salient among immigrants—which together illuminate heterogeneity in consumer responses to neural-level personalization.

4. Discussion

The proposed model centers **control anxiety** as the pivotal construct in lay evaluations of BCI-enabled marketing. By showing how perceived protection and digital perspective condition this anxiety—and how technological anxiety and human reduction intensify it—we extend interactive marketing theory on transparency, control, and trust. Our account clarifies why disclosures can backfire when they increase awareness of inference power without delivering *actionable* control (Felzmann et al., 2019; Schilke & Helfat, 2025), and why assurance must be **credible and enforceable** to attenuate surveillance appraisals (Martin & Murphy, 2017). Conceptually, we introduce **neuro-trust** as distinct from generic data trust: it

concerns the acceptability of reading and acting upon neural signals, a domain where dignity-based objections are salient (Tubig & McCusker, 2021; Lu, 2024) and where calls for mental-privacy rights are gaining force (Szozkiewicz & Yuste, 2025; Yang & Jiang, 2025). By grounding these insights in consumers' own narratives, the study contributes an empirically anchored framework for aligning neural-level personalization with autonomy and legitimacy.

For practice, the findings suggest a sequencing principle: design for **agency first, transparency second**. Real-time refusal (pause/stop), scope limitation (what signals, to what ends), and enforceable rights (deletion, contestation) should precede explanatory communications. Absent such architecture, explanations risk amplifying manipulation inferences among both cohorts. For policy, participants' expectations converge with contemporary proposals for special protection of neural data and independent audits. Recognizing the generational split can guide targeted governance: younger consumers may prioritize seamless, granular control affordances; older consumers may prioritize visible enforcement, penalties, and third-party certification.

5. Conclusion

Consumers approach BCIs with a blend of curiosity and caution. Acceptance hinges on whether control anxiety is substantively addressed—either through affordances that confer agency or through institutions that credibly protect rights. Our grounded model, visualized in Figure 1, articulates how six dimensions interlock to shape orientation toward BCIs and delineates dual generational pathways to conditional acceptance. Future research should develop measures for control anxiety and neuro-trust, test causal pathways experimentally, and compare regulatory contexts to assess how enforcement credibility and affordance richness interact over time.

6. Limitations

This study presents several limitations. Its exploratory qualitative design and small, non-representative sample—composed entirely of Italian participants - limits the generalizability of the findings. While generational orientation was operationalised through age and experiential criteria, the study did not account for other potentially meaningful moderators such as technological proficiency, prior privacy experiences, or psychological traits. Further, this study did not account for the potential relevance of a third category,

“naturalised digital natives” (Hoffmann, Lutz, & Meckel, 2014), whose hybrid technological trajectories may introduce further granularity to generational analysis. Since grounded theory is inherently interpretative and aimed at generating hypotheses and theoretical propositions rather than testing them; different samples or contexts may therefore yield alternative category structures. These limitations highlight opportunities for future research to refine and empirically validate the model in more diverse settings.

Conceptual Model of Consumer Acceptance of BCIs in Marketing

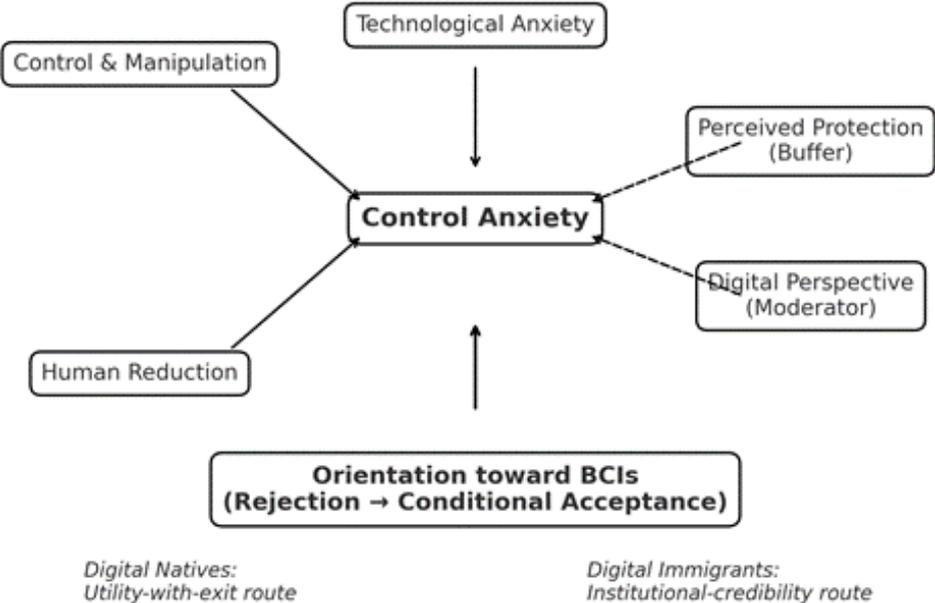


Table 1. Construct positioning and theoretical boundaries

Prior construct	Emergent construct	Boundary / difference	Indicative evidence	Implication for BCI acceptance
Privacy concern	Control anxiety	Extends beyond data privacy to fears of cognitive intrusion and loss of mental autonomy.	“If they can read my brain, how do I refuse?” (Native_03)	High anxiety without credible refusal mechanisms increases rejection likelihood.
Perceived control	Control anxiety	Not perceived control but anticipated lack of agency when BCIs infer mental states.	Requests for a “pause/stop” function; discomfort with involuntary inference	Requires agency-first architectures (real-time opt-out, bounded inference).
Institutional trust	Perceived protection	Focuses on enforceable safeguards (audits, penalties, deletion rights) rather than generalized institutional trust.	“There must be laws to protect us.” (Immigrant_01)	Acceptance depends on visible, credible, independent governance.
Technology anxiety	Technological anxiety	More future-oriented; reflects concerns about mission creep and long-term neural risks.	“Who knows where it will end up.” (Native_06)	Amplifies control anxiety unless mitigated by affordances (natives) or governance (immigrants).
Data trust / governance trust	Neuro-trust	Concerns the acceptability of reading neural signals , tied to dignity, interiority, and mental privacy.	“We lose part of our humanity.” (Immigrant_07)	Necessitates bounded inference, purpose limitation, and mental privacy safeguards.
Digital orientation	Digital perspective	Captures habituation to personalization and pragmatic trade-offs beyond age alone.	“If it helps me find what I need, why not?” (Native_05)	Moderates acceptance via two pathways: utility-with-exit (natives) vs. institutional-credibility (immigrants).

Note. This table positions key constructs proposed in this study against related constructs in prior literature to clarify theoretical boundaries and emphasize the novelty of the grounded theory model

Appendix

Qualitative data and participants details are provided in the appendix in the following link:
https://docs.google.com/document/d/1UyOhRy776IYWX-2_Dtzv5BQqVsgz2zBo/edit?usp=sharing&oid=101558578907126335780&rtpof=true&sd=true

Bibliographic References

- Bleier, A., & Eisenbeiss, M. (2015). The importance of trust for personalized online advertising. *Journal of Retailing*, 91(3), 390–409. <https://doi.org/10.1016/j.jretai.2015.04.001>
- Talwar, S., Talwar, M., Kaur, P., & Dhir, A. (2020). Consumers' Resistance to Digital Innovations: A Systematic Review and Framework Development. *Australasian Marketing Journal*, 28(4), 286-299. <https://doi.org/10.1016/j.ausmj.2020.06.014>
- Falk, E. B., Berkman, E. T., & Lieberman, M. D. (2012). From neural responses to population behavior: Neural focus group predicts population-level media effects. *Psychological Science*, 23(5), 439–445. <https://doi.org/10.1177/0956797611434964>.
- Gonçalves, M., Hu, Y., Aliagas, I., & Cerdá, L. M. (2024). Neuromarketing algorithms' consumer privacy and ethical considerations: Challenges and opportunities. *Cogent Business & Management*, 11(1), 2333063. <https://doi.org/10.1080/23311975.2024.2333063>
- Tubig, P., & McCusker, D. (2021). Fostering the trustworthiness of researchers: SPECS and the role of ethical reflexivity in novel neurotechnology research. *Research Ethics*, 17(2), 143-161. <https://doi.org/10.1177/1747016120952500>
- Felzmann, H., Villaronga, E. F., Lutz, C., & Tamò-Larrieux, A. (2019). Transparency you can trust: Transparency requirements for artificial intelligence between legal norms and contextual concerns. *Big Data & Society*, 6(1). <https://doi.org/10.1177/2053951719860542>
- Lu, W. (2024). Inevitable challenges of autonomy: Ethical concerns in personalized algorithmic decision-making. *Humanities and Social Sciences Communications*, 11, 38. <https://doi.org/10.1057/s41599-024-03864-y>
- Saha, P., Sengupta, A., & Gupta, P. (2024). Influence of personality traits on Generation Z consumers' click-through intentions towards personalized advertisements: A mixed-methods study. *Heliyon*, 10(15), e34559. <https://doi.org/10.1016/j.heliyon.2024.e34559>
- Lwin, M. O., Williams, J. D., & Wirtz, J. (2007). Consumer online privacy concerns and responses: A power–responsibility equilibrium perspective. *Journal of the Academy of Marketing Science*, 35(4), 572–585. <https://doi.org/10.1007/s11747-006-0003-3>
- Martin, K. D., & Murphy, P. E. (2017). The role of data privacy in marketing. *Journal of the Academy of Marketing Science*, 45(2), 135–155. <https://doi.org/10.1007/s11747-016-0495-4>

Leszczynska, M., & Baltag, D. (2024). “Can I have it non-personalised?” An empirical investigation of consumer willingness to share data for personalized services and ads. *Journal of Consumer Policy*, 47, 345–372. <https://doi.org/10.1007/s10603-024-09568-9>

Lambillotte, L., Bart, Y., & Poncin, I. (2022). When does information transparency reduce the downside of personalization? The role of need for cognition and perceived control. *Journal of Interactive Marketing*, 57(3), 285–301. <https://doi.org/10.1177/10949968221095557>

Teepapal, T. (2025). AI-driven personalization: Unraveling consumer perceptions in social media engagement. *Computers in Human Behavior*, 165, 108549. <https://doi.org/10.1016/j.chb.2024.108549>

Schilke, O., & Helfat, C. E. (2025). Unlocking dynamic capabilities: Pathways for empirical research. *Journal of Management Scientific Reports*, 3(2), 71–87. <https://doi.org/10.1177/27550311251318724>

Szoszkiewicz, Ł., & Yuste, R. (2025). Mental privacy: Navigating risks, rights and regulation. *EMBO Reports*, 26(7), 3469–3473. <https://doi.org/10.1038/s44319-025-00505-6>

Weidig, J., Weippert, M., & Kuehnl, C. (2024). Personalized touchpoints and customer experience: A conceptual synthesis. *Journal of Business Research*, 177, 114641. <https://doi.org/10.1016/j.jbusres.2024.114641>

Yang, H., & Jiang, L. (2025). Regulating neural data processing in the age of BCIs: Ethical concerns and legal approaches. *Digital Health*, 11, Article 20552076251326123. <https://doi.org/10.1177/20552076251326123>