

Would the Robot Cheapen Your Croissant? How Robots Impact Brand, Service and Quality Perception

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Abstract—Do robots cheapen our food experiences? While much of the automation used in mass production of food remains invisible to consumers, it is unclear whether having robots visibly handle food will diminish the value of an otherwise artisanal food product. To explore how robot interaction with customers influences perceptions of food quality, service, and brand, we conducted an in-the-wild experiment ($N = 324$) using a pop-up croissant bakery brand, Buttered Byte. We manipulated: who served the croissant (robot vs. human), whether the server worked alone or with a baker in the scene, and the quality of the croissant served (artisanal vs. mass-manufactured). We find that people are willing to pay significantly more (\$0.38 CAD) for the same croissant when both a baker and a server are present, even when the server is a robot. We found that perception of artisanal croissants is not negatively affected by having a robot serve them, whereas it does for mass-manufactured croissants. Overall, our findings suggest that visible framing of a robot server working with/for a person counters negative perceptions associated with robotic service and can support human craftsmanship and retain product perception in retail contexts.

Keywords: Social Robots, Service Robots, Human-Robot Interaction, In-the-wild Experiment, Automation in Retail

I. INTRODUCTION

Imagine walking into your favorite local bakery, the one where you remember the scent of freshly baked croissants that makes everything feel a bit slower, a bit cozier. Now imagine a robot, instead of a person, serving you the croissant from behind the bakery display case. Would it affect your perception of the bakery or the croissant?

Today, robots are making coffee [13], [15], [16], checking in hotel guests and coordinating deliveries [20], and appearing more frequently in food retail environments [2]. While more robots are streamlining various services, it is uncertain what brand/reputation risks small businesses take on when they incorporate robots into a customer-facing part of their operation.

We examine these questions through the lens of the *Experience Economy* [11], [22], a framework that emphasizes how value today comes not just from goods or services but from memorable, multisensory experiences. Using a bakery selling croissants as an example of such experience-centered



Fig. 1: The experiment setup shown here with *Robot* as serving agent and *Server-baker* condition.

spaces — shaped by ritual, sensory cues, and narratives of craftsmanship — we explore how the deployment of robots as service agents influences perception of product quality and brand experience. In the remainder of this paper, we first review related work (Sec. II) and outline our in-the-wild experiment involving a pop-up bakery (Sec. III). We then present our findings (Sec. IV), concluding with a discussion of the broader implications for robot governance and service design (Sec. V).

II. BACKGROUND

Service robots can delight customers, but they can also alienate them. This duality is central to the literature on robotic service in hospitality and retail [11]. As businesses turn to robotics to improve efficiency and consistency, they also risk altering the very experiences that make certain spaces feel meaningful to customers. From the perspective of the “Experience Economy” framework [1], [11], [22], the introduction of service robots into businesses must address whether robots can play a role in delivering and supporting rich, authentic, and artisanal customer experiences. In this study, we focus on the following three factors to explore the impact customer-facing robots can have on customer experiences.

A. Serving Agent (Human vs. Robot)

The first factor concerns the type of agent serving the product, which influences perceived service modality and social presence. Prior research shows that robotic service reshapes customer experience by amplifying certain aspects while weakening others. For instance, Hwang et al. [11]

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found that robot baristas increased *sensory* and *intellectual* engagement in cafés, but were less effective than human baristas at fostering *affective* experiences (e.g., warmth, personal involvement). Similarly, a robot concierge at a hotel enhanced guests' *sensory* and *intellectual* brand experiences (e.g., novelty and visual intrigue) but struggled to convey interpersonal care [4]. Hence, for businesses such as bakeries, which connote expectations of warmth and authenticity, the presence of robotic service may negatively affect the perceived quality of service. We hypothesize:

H1. Customers will perceive the quality of the service to be higher when a croissant is served by a human rather than a robot.

B. Team Composition (Solo vs. Collaborative Framing)

Prior research suggests that framing robots as assistants rather than replacements can help preserve trust and authenticity. For example, Reis [23] found that in a partially automated café, customer satisfaction was higher when robots handled preparation tasks while human staff remained involved in personalization and interaction with the customers. Similarly, Shrivastava [27] argues that visible human involvement helps maintain authenticity in craft-oriented service settings. In a bakery context, collaborative framing may therefore signal that human care and expertise remain central, even when automation is introduced. Based on this reasoning, we hypothesize:

H2a. Hybrid human-robot service will result in higher perceived service quality than robot-only service, but lower perceived service quality than human-only service.

H2b. When a robot is framed as the sole service provider, overall brand experience will be lower than when the service is framed as a collaborative human-robot effort, even if the robot performs the primary serving task.

C. Product Authenticity (Artisanal vs. Mass-manufactured)

Foods are valued not only for their sensory qualities, but also for the signals they convey about human labour, care, and tradition associated with their preparation [24], [28]. In a bakery setting, where authenticity is closely tied to notions of craftsmanship and warmth, these cues strongly shape perceptions of quality and value. At the same time, perceptions of food quality are influenced by how products are served. Research in service robotics suggests that both the identity of the service provider and the visibility of human involvement affect perceived fit and acceptance of robots [5], [31]. As a result, customers may be particularly sensitive to automation when product authenticity cues are weak, interpreting robotic service as further diminishing the experiential value of store-bought items. This can also influence how much they are actually willing to pay for a product. Based on this reasoning, we hypothesize:

H3a. Artisanal croissants will be perceived as being higher quality than mass-produced croissants.

H3b. Robot serving croissants will negatively affect how much people are willing to pay for a mass-manufactured croissant more so than its impact on artisanal croissants.

III. METHOD

We designed a between-subjects experiment involving three independent variables: 2 *Serving Agent* (robot vs. human) $\times$ 2 *Team Composition* (server only vs. server-baker team) $\times$ 2 *Product Authenticity* (artisanal vs. mass manufactured croissants), resulting in eight experimental conditions. We first describe the experimental procedure (Sec. III-A), followed by the three manipulated factors (Sec. III-B, III-C, III-D), the robot system design (Sec. III-E), participant recruitment (Sec. III-F), and data collection (Sec. III-G).

A. Experiment Procedure

We set up our 'pop-up bakery' at the entrance hallway of a university building and designed it to simulate a realistic bakery encounter using a display case, signage, and the bakery logo (See Fig. 1). Upon entering the building, participants were greeted by a confederate (greeter) who encouraged them to take a free croissant and informed them that there is an optional questionnaire for them after. Willing participants placed their order. Either the robot or a human server placed a croissant onto a bread basket lined with napkins. Participants grabbed the croissant and either left or moved to the questionnaire station to fill out the consent form and a questionnaire. The researchers playing the role of greeter and questionnaire administrator remained consistent throughout the experiment.

We conducted the experiment across seven business days from 9:30 AM to noon during a low-traffic season (summer semester) of the university in order to avoid possible safety hazards related to overcrowding. Each condition was mapped to different days. This ensured that the *Serving Agent*, *Team Composition* or *Croissant Type* remained the same throughout the day, and no changes take place in front of participants. An exception was the (Human Server) $\times$ (With Human Baker) conditions where the same experimenters could be stationed throughout the morning across both artisanal and mass-manufactured croissant types. The artisanal croissants were given away first, followed by a 30-minute break, and giving away of the mass-manufactured croissants.

B. Serving Agent (Human vs. Robot)

Croissants were always served in the same manner (grasped from a clear display case using kitchen tongs, then placed onto a basket lined with napkins. In the **human-server** condition, a human experimenter acted as the *Serving Agent*. In the **robot-server** condition, a Franka Emika Panda robotic arm performed the same serving task. The robot manipulated the croissant using kitchen tongs attached to its end-effector. The robot's base was mounted on a workbench at a fixed location behind the display case. A robot operator hid behind a nearby pillar and away from the participants' line of sight, and manually triggered the robot's movement upon receiving the participant's verbal order. The physical layout of the service area remained consistent in all conditions (as per Fig. 1).



Fig. 2: (a) Outer view and (b) cross-sectional cut of the croissants being served (left: mass manufactured, right: artisanal).

C. Team Composition (Solo vs. Collaborative Framing)

Team Composition was manipulated by varying whether the *Serving Agent* operated alone or as part of a visible team. In the **Server Only** condition, only the *Serving Agent* (human or robot) was present in the serving area behind the display case. In the **With Human Baker** condition, an additional researcher performed the role of a baker, manipulating dough and ostensibly performing baking activities. The baker was positioned visibly behind the server but did not directly interact with participants during the serving process. This manipulation was intended to frame the *Serving Agent* as working in collaboration with a human baker, rather than in isolation.

D. Product Authenticity (Artisanal vs. Mass-manufactured)

The culinary experience and perception of a food item can vary widely depending on the subjective preferences of individuals (e.g., some pizza lovers may prefer thin crust, while others may insist on thick-crust pizza). To manipulate the construct of *Product Authenticity* in food, we sought to find food that provides a clear delineation of artisanal craftsmanship from mass manufacturing despite subjective variation of individual preferences. This led us to croissants.

Croissants are beloved pastries, the quality evaluation and perception of which has been studied scientifically and within the culinary world [10], [17], [19]. The quality of a croissant can be evaluated by its shape, odour, colour, taste, consistency, crust, crumb and so on [10].

We operationalized two different levels of culinary experience as *Croissant Type* (artisanal vs. mass-manufactured) by sourcing croissants from two different vendors. The **artisanal croissant** was sourced from the second place winner of the city's annual croissant competition in 2024 [9]; the **mass-manufactured croissant** was sourced from a large international grocery brand. Both were comparable in size, but had a significant price difference: average weight (67, 64 g), width (8, 9 cm), length (16.5, 18.5 cm), price (\$3.60, \$0.67 CAD per croissant), for artisanal and mass-manufactured respectively (see Fig. 2(a) and 2(b)). All croissants used in our experiments were baked on the morning of the experiment, ensuring an equivalent degree of freshness.

E. Robot as Serving Agent

Fig. 3 presents a system overview of the robot used. We programmed the Panda robotic arm using ROS Noetic

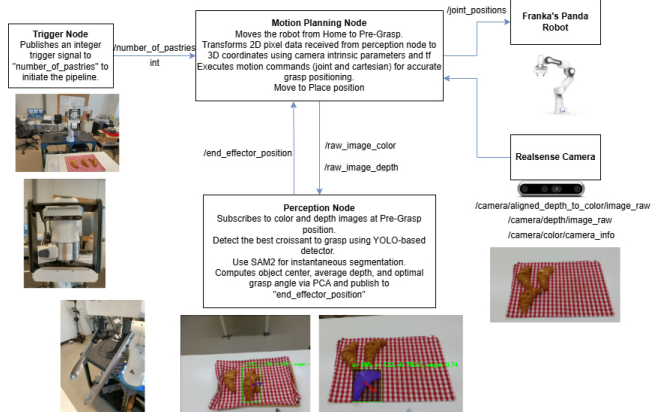


Fig. 3: Croissant serving robot system diagram.

to coordinate all functional modules and using MoveIt for motion planning [6]. The robot followed a fixed sequence of poses: starting from a fixed initial pose, moving to a predefined pre-grasp position near the tray, then executing a perception-informed croissant grasp, and finally transferring the croissant to a fixed basket location on the tabletop. A wrist-mounted RealSense camera provided visual input for the perception module. Croissants were detected using a fine-tuned YOLO-based object detection model trained on our custom croissant dataset. When multiple croissants were detected, a heuristic prioritized objects toward the bottom-right of the tray to reduce interference with adjacent items. After selecting the target croissant, the system estimated the optimal grasp orientation using Principal Component Analysis (PCA) applied to segmented object pixels. Segmentation was performed either with classical thresholding or the Segment Anything Model (SAM2), depending on visual conditions. The minor principal axis from PCA defined the grasp angle, aligning the tongs with the croissant's geometry to ensure stable contact.

F. Participant Recruitment

Our *a priori* power analysis using G*Power 3.1 ($f = 0.25$, $\alpha = 0.05$, power = 0.80) indicated a required sample size of 30 per group ($n = 240$). About a week before the start of the experiment, we started recruiting participants from local Facebook groups, Reddit, and mailing lists within the university. Once the experiment started, we naturally recruited participants who were walking by the experiment area, or heard about the experiment through word of mouth. We gave out 50 to 60 croissants per experiment session, and collected completed questionnaire responses from 324 participants (see Table II).

G. Measures

To test our hypotheses, we sought to measure dependent variables of brand perception, perceived croissant quality, and service quality perception. To measure **brand perception**, we used three well-established constructs from the literature: *Brand Attitude* — a gauge of either positive or negative sentiment toward a brand [25]; *Brand Authenticity* — how

<i>Brand Attitude</i> [25]
How would you describe Buttered Byte as a brand? (Bad/Good) (Negative/Positive)
<i>Brand Authenticity</i> [29]
This bakery wants to do its best in providing its product/service
This bakery has a true passion for its business
This bakery is devoted to what it does
<i>Repurchase Intention</i> [21]
I would like to get croissants from this bakery again
I would choose to come to this bakery over other bakeries in the future
This bakery would be my first choice compared to other bakeries in the future
<i>Perceived Croissant Quality</i> *
The croissant seemed to be high quality overall
I believe this croissant was artisanally crafted
I believe this croissant was mass-produced or factory-made
<i>Willingness to Pay</i>
If you were to pay for this croissant, what is the highest price you would be willing to pay?
<i>Service Excellence</i> [14]
The {robot} server has professional bakery service skills
The service at the bakery makes me feel more special and valued than service at general bakeries
When I think of the {robot} server, I think of excellence
<i>Service Authenticity</i> [7]
The service encounter in this bakery felt authentic
Services I received in this bakery DO NOT feel genuine
<i>Service Satisfaction</i> [15]
I would recommend this bakery to others based on this experience
I would like to be served this way again in the future

TABLE I: Questionnaire items (* = custom-made items).

a consumer perceives or judges a brand to be aligned with the values and norms of the brand [3], [8], [29], [30]; and *Repurchase Intention* — a customer’s willingness to return to the same business, indicative of brand satisfaction and loyalty [28]. Perception of croissant quality was measured using two constructs (*Perceived Croissant Quality*, *Willingness to Pay*). **Perception of service** was measured using *Service Excellence* [14], *Service Authenticity* — the degree to which a service feels real or genuine [7] —, and our custom-made questionnaire measuring *Service Satisfaction* (inspired by [15]) and the Net Promoter Score and Overall Satisfaction (CSAT) score often used by businesses to measure customer satisfaction.

We adapted existing measures to reflect our experiment context. Most of the constructs in this study were operationalized as 5-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree). The exceptions were the qualitative questions and *Willingness to Pay*, presented as open text fields. The full list of questions is presented in Table I.

We included demographic questions at the end of the questionnaire to account for potential individual differences in baseline attitudes toward automation. Age was measured as bins (18-24, 25-34, 35-44, 45-54, 55-64, 64+). Participants also rated their familiarity with robot arms on a 5-point scale.

To complement the quantitative findings, participants also responded to open-ended prompts: “What did you most like about the way you were served?” and “Do you have any feedback or suggestions to help us improve?” The qualitative responses were also supplemented by observational notes

Condition	Mass Manufactured	Artisanal	Total
Robot Server Only	34	46	80
Robot Server, Human Baker	44	22	66
Human Server Only	40	45	85
Human Server, Human Baker	44	49	93
Total (Server Only)	74	91	165
Total (Server+Baker)	88	71	159

TABLE II: Distribution of participants ($N = 324$).

taken by a researcher throughout the sessions.

IV. RESULTS

All of our measures demonstrated acceptable reliability (Cronbach’s $\alpha \geq 0.70$), with the exception of *Service Authenticity* ($\alpha = 0.67$). A total of $N = 324$ participants were included in the analysis. Participants were evenly distributed across *Croissant Type* (162 per condition). In terms of gender, 175 participants identified as male, 130 as female, 6 as non-binary, and 13 did not declare. Most participants were under 35 years old (18–24: $n = 215$; 25–34: $n = 72$), with only 28 aged 35 or older.

We conducted a $2 \times 2 \times 2$ MANOVA to test the effects of our three independent variables on the dependent measures. To examine potential demographic effects, we conducted a multivariate ANOVA for all dependent variables across all gender and age groups, while accounting for experimental conditions (i.e., controlling for *Serving Agent* and *Team Composition*). We found no significant effects of gender on any dependent variable. However, age group significantly impacted *Brand Attitude* ($F(4, 249) = 6.912, p < 0.05$). Specifically, the oldest age group (55–64; $n = 3$) exhibited substantially lower brand attitude across conditions ($M = 2.79, SE = 0.42$) compared to other age groups ($M = 4.21–4.77, SE = 0.13–0.30$). However, note that the number of participants in the age group is significantly smaller than other age groups, making the age effect inconclusive.

To complement our findings, we conducted a thematic analysis of responses to the open text fields in the questionnaire. Since the text responses to the questionnaire is self-reported, we treated it separately from the observational notes we took of participant behaviours. We articulate the former qualitative analysis alongside our quantitative findings below and reserve broader qualitative findings for Sect. IV-D.

A. Service Perception

While *Service Authenticity* did not meet internal reliability expectations, the results for *Service Excellence* and *Service Satisfaction* tell an interesting story. We find a significant *Team Composition* $\times$ *Serving Agent* interaction effect on *Service Excellence* ($F(1, 256) = 5.205, p < .05$; see Fig. 4(a)). Services delivered with a baker in the scene are perceived as having higher *Service Excellence* than services delivered by a single agent. This *team advantage* is stronger when the server is a human than when it is a robot, indicating that a baker’s presence boosts *Service Excellence* more for human service. Consistent with **H1**, service delivered by a human is perceived as better overall than service delivered by a robot.

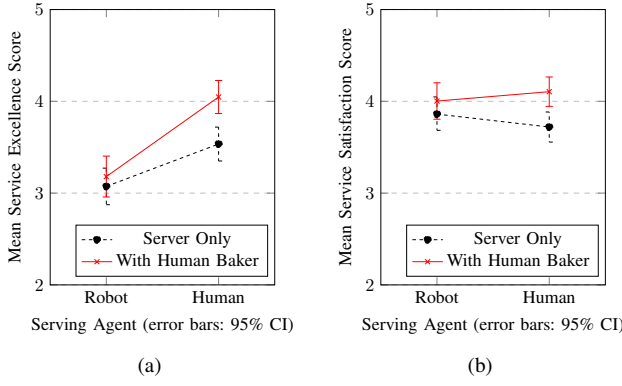


Fig. 4: (a) Comparison of *Service Excellence* scores. (b) Comparison of *Service Satisfaction* scores.

For *Service Satisfaction*, we observe a trend toward a *Team Composition* $\times$ *Serving Agent* interaction ($F(1, 256) = 3.094, p = .08$) alongside a significant main effect of *Team Composition* ($F(1, 256) = 9.24, p < .005$). Across the conditions, having a baker in the scene leads to higher *Service Satisfaction* than having a server only ($M = 3.78, SE = 0.07$ for Server Only, $M = 4.07, SE = 0.07$ for With Human Baker, $p < .005$), regardless of who served the croissant. However, this increase is attenuated when the server is a robot compared to when the server is a human (see Fig. 4(b)).

These results support **H1** and partially support **H2a**: adding a baker improves perceived service quality relative to the Server Only condition, but this benefit is smaller when the robot is the serving agent. Human service remains the most positively evaluated overall. This suggests that perceived service quality is shaped not only by the server's identity, but also by how human involvement is framed in the service encounter.

Participants' open-text responses also reveal qualitative differences across service agents. When a person was serving the croissant, participants uniquely related the experience to affective and relational terms, commenting on the server as being warm, welcoming, and friendly, in both Server Only (51 comments) and With Human Baker (25). In comparison, only six such comments were found when the server was a robot. In addition, participants tended to evaluate "good service" as being welcomed, cared for, and treated as a person (as opposed to being treated in a purely transactional manner).

On the other hand, participants judged the robot's service in more functional terms. Participants were more likely to focus on whether the robot succeeded or failed in the croissant grasping task (32 comments), and to evaluate it in terms of efficiency and convenience. Even when the robot successfully served the croissant, participants perceived it as involving extra steps, time, or effort. For instance, we did not have any instance of failure to understand participants' verbal orders — the robot operator manually listened for the order and triggered the robot. Yet, 49 participants commented on

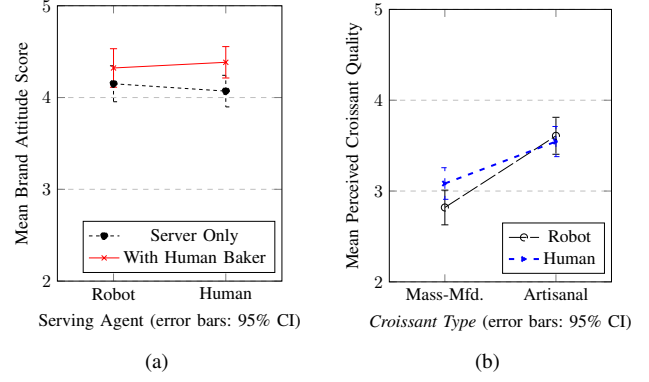


Fig. 5: (a) Customers' brand attitude perception. (b) Perceived croissant quality across *Croissant Type* (Mass Manufactured vs Artisanal) and *Serving Agent*.

communication with the robot as being unsuccessful, and 22 commented on the smoothness of the verbal ordering process. Unlike with a human server, participants' expressions of expectations focused more on whether the robot can interpret requests, respond correctly, and maintain a two-way interaction.

B. Brand Experience

We find that *Team Composition* is a significant main factor for *Brand Attitude* ($F(1, 256) = 6.50, p < 0.05$) as well as *Brand Authenticity* ($F(1, 256) = 13.40, p < 0.001$). Specifically, when a baker was present, participants reported a more positive attitude toward the brand (see Fig. 5(a)) and perceived it to be more authentic. In contrast, *Serving Agent* is not a significant factor for either *Brand Attitude* ($F(1, 256) = 0.017, p = .90$) or *Brand Authenticity* ($F(1, 256) = 1.23, p = .27$). These findings support **H2b**. Notably, the non-significant effect of *Serving Agent* suggests that the *collaborative framing* (With Human Baker) matters more for brand evaluations than whether the immediate serving agent is a human or a robot.

We see limited reference to the participants' brand perception in their text-based questionnaire responses. However, we find that participants commented more about hygiene/cleanliness when a robot was serving them (13 comments) compared to human server conditions (1 comment). The robot server was also perceived as being bias-reducing by some participants and projected inclusiveness/accessibility as part of their brand experience (10 comments). On the other hand, participants commented more about affordability (e.g., the croissant being free) in the human server condition (31 comments) compared to robot server conditions (8 comments).

C. Product Quality Perception

We find that when both a baker and a server are behind the counter, customers are willing to pay significantly more ($M = \$3.54, SE = 0.14$) than when only a server is present ($M = \$3.16, SE = 0.13$; *Willingness to Pay*, $F(1, 256) =$

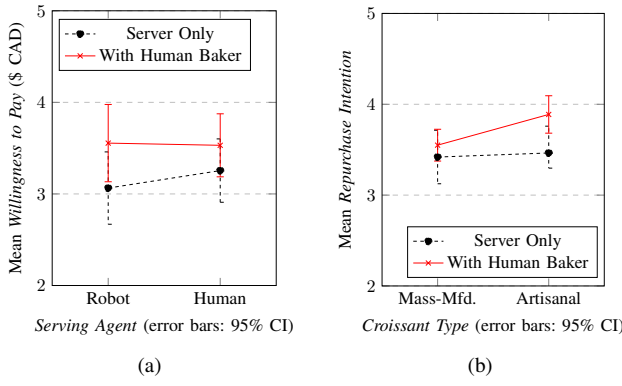


Fig. 6: (a) *Willingness to Pay*, i.e., maximum amount participants are willing to pay for the croissant. (b) *Repurchase Intention* across *Croissant Type* (Mass Manufactured vs Artisanal) and *Team Composition*.

3.98, $p < .05$; see Fig. 6(a)). This effect holds regardless of whether the server is a human or a robot, suggesting that visible human involvement in the production process increases perceived product value.

Beyond willingness to pay, product quality perception depends on a combination of factors. We observe a significant interaction between *Croissant Type* and *Team Composition* for *Repurchase Intention* ($F(1, 256) = 5.05$, $p < .05$). As shown in Fig. 6(b), when a mass-manufactured croissant is served, repurchase intention is not significantly affected by *Team Composition* ($M = 3.42$, $SE = 0.10$ for Server Only; $M = 3.55$, $SE = 0.09$ for With Human Baker). In contrast, when an artisanal croissant is served, participants report significantly higher repurchase intention when a baker is present ($M = 3.89$, $SE = 0.10$) compared to when no baker is present ($M = 3.46$, $SE = 0.09$, $p < .05$).

We also find a significant interaction between *Croissant Type* and *Serving Agent* for *Perceived Croissant Quality* ($F(1, 256) = 4.49$, $p < .05$; see Fig. 5(b)). Artisanal croissants are perceived as high quality regardless of whether they are served by a human or a robot. However, when a mass-manufactured croissant is served, robotic service leads to lower perceived quality ($M = 2.81$, $SE = 0.10$) compared to human service ($M = 3.08$, $SE = 0.09$), independent of whether a baker is also present in the scene. In analyzing the open-ended questionnaire responses from participants, we did not find any significant differences in comments about the croissant quality.

Taken together, these findings support **H3a** with respect to perceived quality and repurchase intention: artisanal croissants are consistently evaluated more positively than mass-manufactured croissants. Support for **H3b** is partial: robotic service disproportionately harms product perceptions when the croissant is mass-manufactured, but not when it is artisanal. Notably, *Willingness to Pay* is driven more by cues of human involvement in production (i.e., baker presence) than by whether the server is a robot.

In summary, while a human baker elevates customers'

Willingness to Pay across the board, the human server acts as a 'buffer' for lower-quality goods, whereas artisanal products maintain their perceived value even when delivered by a robot.

D. Qualitative Observations

Our participants frequently expressed fascination and enthusiasm toward the robot, often verbally acknowledging its actions. Many of them thanked the robot after successful interaction and, notably, continued to express appreciation even when the robot failed (e.g., dropping croissants). When the robot failed to operate smoothly, participants ceased to view the encounter as social and reframed it as a technical system breakdown. Participants' accounts centered on whether the system could correctly interpret instructions and execute sequences without requiring "extra steps" or manual intervention.

Participants generally adopted polite, socially normative language during interaction, frequently using phrases such as "please" and "may I." Despite occasional failures, users were typically patient, playful, and forgiving; several participants clapped or verbally celebrated when the robot succeeded after a failure.

Language use varied across participants. While English was the primary interaction language for most, some attempted to place orders in French (e.g., "Un croissant, s'il vous plaît") or test its functional boundaries by ordering in their native language, and using negative phrasing (e.g., "Do not give me a croissant"). Such negative phrasing did not elicit a response from the robot. Yet, participants held implicit expectations about command structure and system feedback. One participant explicitly noted the lack of proactive feedback or invitation to interact, commenting that the robot "just sits there" without signaling readiness.

Behavioural indicators of engagement were also observed. At least twenty participants recorded videos of the interaction with their phones, suggesting heightened interest and novelty. Several participants (at least four) returned, appearing more comfortable and confident when interacting with the robot compared to first-time users. Additionally, participants frequently asked personal or meta-level questions about the robot (e.g., whether it had a name). Participants with engineering backgrounds expressed interest in the robot's control pipeline and computer vision system, desiring to initiate technical discussions with the research team.

V. DISCUSSION

The impact a customer-facing robot can have in an artisanal retail context is much more interesting in reality than at first sight. Overall, the visible presence of a human engaged in production activity (i.e., baker) leads to a significantly more positive perception of service (*Service Excellence* and *Service Satisfaction*), brand experience, and *Willingness to Pay*. Notably, we find this effect to be true regardless of whether a croissant is served by a human or a robot — although the positive effect on service perception is more

pronounced for human service. Interestingly, the actual quality of croissant plays a role in how much a robot affects their product perception. People's intent to repurchase a croissant increases significantly when a baker is visible in the scene, but only if the croissant is high quality; artisanal croissants are perceived to be of high quality regardless of who is serving them, whereas a mass-manufactured croissant is perceived to be of worse quality if a robot is serving them. In addition to visible human labour acting as an important signal of craftsmanship associated with higher quality products, robot service alongside such a human labour can be readily accepted as a mechanism to support and enable the human craft. These findings support the broader intuition that robots are more welcomed in the context of assisting/enabling a person rather than deployed as full replacements for human workers.

Our qualitative findings support previous findings in HRI. The relatively low anthropomorphic feature of our robotic platform may have shaped participants' interpretations of service failures. Reduced humanlikeness can influence the degree of "forgiveness" extended to the robot during interaction [26], as users may attribute errors to technical limitations rather than social incompetence. Prior HRI research also suggests that robot errors do not necessarily undermine user evaluations and may even increase likability due to the "pratfall effect" [18].

Taken together, these findings offer several practical implications for service design and deployment strategies. For lower-quality or mass-manufactured goods, robotic service may amplify perceptions of inferiority, whereas human service can partially mitigate this effect. This distinction suggests that different deployment strategies are required across premium versus low-cost retail environments. Rather than positioning robots as full replacement for human workers, service robots may be more effective when deployed as supportive or assistive agents that complement human labour while preserving the experiential value associated with human craftsmanship.

VI. LIMITATIONS

Several limitations should be acknowledged. First, although the order of conditions was randomized, some participants took part in the study multiple times. Therefore, especially for robot server conditions, participants are likely to have interacted with the same robot only days before, subjecting them to an order effect that cannot be controlled in our current experiment set-up. Second, the current experimental setup made it challenging to isolate the effects of teamwork between human staff and the robot without increasing the number of visible personnel. The presence of researchers and staff may have influenced participants' interpretations of the robot's role. Future studies could adopt a robot-only experiment set-up, in which no researchers or additional staff are visible, to more clearly examine the effects of a robot acting as the sole server. Third, it is not clear whether our findings using an articulated robotic arm can generalize to robots of different morphology. For

example, humanoid platforms with obvious anthropomorphic features (e.g., Pepper or NAO) may foster stronger social interaction, potentially eliciting different user expectations and evaluations of service quality or perceived quality of the served goods. Fourth, because this human subject experiment was conducted on a university campus, the resulting participant pool consists primarily of younger adults. With 287 participants under the age of 35 and only 28 above, caution must be applied when generalizing these findings to other consumer segments. Prior research highlights that the perceived value of robot servers in the restaurant industry can differ among different genders, age groups, educational statuses, and monthly income levels [12]. Consequently, future work should recruit a more demographically balanced sample to fully understand how these effects translate across broader consumer segments. Finally, the study was conducted over short time periods. Longitudinal studies are necessary to truly understand the effect of customer-facing robots on customers long term.

VII. CONCLUSION

The findings from our study show that, regardless of whether a robot or a person is serving a customer, the visible presence of a human baker significantly and positively impacts the perceived quality of service, brand experience, and the maximum amount people would be willing to pay for the same product. Contrary to common assumptions, robot handling of products does not diminish perceptions of high-quality artisanal products, while robot service compounds negative perceptions for mass-manufactured goods. Overall, we find that visible demonstration of robots working alongside humans can counter negative perceptions associated with robotic service. With strategic deployment choices, particularly in masstige and luxury contexts — rather than budget-friendly ones — service robots may deliver more value to brands without undermining authenticity or craftsmanship.

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