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When Food Scanner Apps Outperform Front-of-Pack Nutrition Labels: A Conditional Process Model to Foster Healthier Food Choices in Times of Growing Distrust

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ABSTRACT

While consumers increasingly use food scanner apps as an alternative to front-of-pack labels, the effectiveness of these nutritional signals in promoting healthier food choices remains a topic of debate. This study examines when and under what conditions food scanner apps encourage healthier eating and outperform front-of-pack nutrition labels. It builds on four studies: a quantitative content analysis of over 16,000 online reviews and a survey of 86 respondents in an exploratory phase, along with two experiments that test the conceptual model. The findings identify three conditions where food scanner apps outperform front-of-pack labels: when the nutritional quality score of a product is poor, when consumers distrust the dominant players, and when mid-range brands have average brand equity. These findings suggest that food scanner apps and front-of-pack labels complement rather than oppose each other, thus providing key insights for policymakers and food brand managers.

1 | Introduction

In the ongoing effort to address the public health crisis of obesity and unhealthy eating, consumers are increasingly turning to food scanner applications as an alternative to front-of-pack (FOP) nutrition labels (de Kervenoael et al. 2024; Gauthier and Bally 2025; Werle et al. 2024). Food scanner apps possess two distinctive attributes. First, smartphone-based technology enables these apps to provide technical affordances, including personalized information and recommendations tailored to individual dietary needs (Guthrie et al. 2015; Hanras et al. 2024). Second, they primarily rely on collaborative, citizen-based, open, and independent governance, such as Open Food Facts, and are therefore perceived as more independent (Gauthier and Bally 2025). As a result, food scanner apps empower consumers (de Kervenoael et al. 2024; Nøjgaard et al. 2024).

While these alternatives to front-of-pack labels are gaining popularity, their impact on healthier food choices remains inconclusive. Some research finds that food scanner apps have a limited effect on healthier food choices (Schruff-Lim et al. 2023; Werle et al. 2024), whereas other studies demonstrate a positive impact on beliefs and attitudes toward healthy eating (de Kervenoael et al. 2024; Jansen et al. 2021; Samoggia and Riedel 2020; Seid et al. 2024).

To address these inconsistencies in the literature, this study examines when and under which conditions food scanner apps may promote healthier food choices and potentially even outperform front-of-pack labels. More specifically, we investigate the effects of the distinctive attributes of food scanner apps (perceived source and technological affordances) while also exploring the role of three moderating factors: (1) the valence of

the nutritional quality score, (2) consumer distrust, and (3) brand equity. To this end, we conducted four consecutive studies. In the initial phase, we analyze the perception and use of a reference food scanner app through two studies: a quantitative content analysis of over 16,000 online reviews and a survey of 86 respondents. We then proceed with two experiments to test our conceptual model. The results indicate that food scanner apps are more effective than front-of-pack labels in three specific conditions: (1) when the nutritional quality score is poor, (2) for distrustful consumers, and (3) for brands with lower equity (compared with high-range brands). This study contributes to the emerging research stream on food scanner apps by identifying the conditions under which they exert a stronger impact than front-of-pack labels on consumer's healthier food choices. Ultimately, this suggests food scanner apps and front-of-pack labels complement rather than oppose each other. The findings provide implications for public policymakers and food brand managers.

2 | Theoretical Background

2.1 | Effects of Nutritional Signals on Healthier Consumer Food Choices

2.1.1 | Debated Effects of Nutritional Signals

Consumers are increasingly aware of the relationship between their food consumption and their health or, more broadly, their well-being (Block et al. 2011; Bublitz et al. 2013). Most of the time, however, consumers cannot accurately assess the healthiness of the products they wish to buy due to a lack of necessary information. Consumers face asymmetric information (Akerlof 1970). To evaluate a product's healthiness, they rely on product information and other cues, such as perceived naturalness (André et al. 2019), esthetics (Hagen 2021), or package shape (Qian et al. 2023). However, the proliferation of such cues, combined with conflicting personal goals, complicates the selection of healthier food options (McCarthy et al. 2017).

Firms and public policymakers primarily use front-of-pack nutrition labels to inform consumers. These labels are symbols or tags placed on the front of food product packaging to provide information about a product's nutritional content (Feunekes et al. 2008; Van Der Bend and Lissner 2019). The efficacy of front-of-pack nutrition labels remains a topic of debate (Meng and Chan 2021). Several studies demonstrate their positive influence on healthier consumer choices (Defago et al. 2020; Mauri et al. 2021; Meng and Chan 2021; Zlatevska et al. 2024), whereas others show a limited effect (Cadario and Chandon 2018; Folkvord et al. 2021; Schruff-Lim et al. 2023). While front-of-pack nutrition labels effectively modify cognitive attitudes by helping consumers identify healthier products, they are less successful in influencing actual purchase and consumption behaviors (Ikonen et al. 2020).

Recently, alternative nutritional labeling initiatives have emerged, including food scanner apps. The use of smartphone applications is rising, particularly for facilitating access to information. Such applications exist across various fields, including health and nutrition (Galanakis 2024; Lowe et al. 2015; Samoggia and Riedel 2020). They influence consumer behavior by simplifying cognitively complex decisions, such as food choices, through heuristics that consumers can easily process (Guthrie et al. 2015; Hsieh et al. 2022; Seid et al. 2024; Verma et al. 2023). Specifically, food scanner apps provide access to a product's nutritional information and quality scores by scanning its barcode (de Kervenoael et al. 2024; Werle et al. 2024). However, some nutrition experts question the reliability of the information presented (see, e.g., Braz and Lopes 2019; Martinon et al. 2022; Samad et al. 2022; Schumer et al. 2018). Although some policymakers develop these apps (e.g., the NHS Food Scanner in the UK), private third parties create the majority of them. For example, the nonprofit George Institute for Global Health launched FoodSwitch in Australia before expanding internationally, while French and Italian start-ups developed Yuka and Edo, respectively. Private third-party food scanner apps often rely on consumer involvement and promise greater transparency in content and rating (Gauthier and Bally 2025).

The literature on the potential benefits of food scanner apps for promoting healthier food choices remains inconclusive. On the one hand, food scanner apps appear credible and guide consumers toward healthier food choices (Benthem de Grave et al. 2024; de Kervenoael et al. 2024; Samoggia and Riedel 2020; Seid et al. 2024). On the other hand, Werle et al. (2024) find that food scanner apps are, overall, less effective than front-of-pack labels. However, the use of a comparative methodology may obscure effects attributable to the distinctive characteristics of food scanner apps. Medical research highlights the potential benefits of food scanner apps in improving diets among the general population and high-risk groups while also emphasizing the need for further research to fully ascertain their effectiveness (see, e.g., Campbell and Porter 2015; DiFilippo et al. 2015; Fakih El Khoury et al. 2019; Flaherty et al. 2018). This is particularly critical given the widespread and increasing use of food scanner apps among consumers. A more detailed understanding of the conditions under which these food scanner apps might be effective is essential.

2.1.2 | Nutritional Quality Score: A Valence Effect

According to prospect theory (Kahneman and Tversky 1979), individuals tend to be more sensitive to losses than to gains. Numerous studies demonstrate this asymmetry by comparing the impact of negative versus positive information on consumer response. For example, the negative effect of poor corporate social responsibility ratings on consumer attitudes is more pronounced than the positive impact of good ratings (Mohr and Webb 2005; Parguel et al. 2011). This suggests that negative information has a greater adverse effect than positive information has a beneficial one.

A similar phenomenon is likely to occur in the field of nutrition. If consumers have no reason to perceive a product as unhealthy, a good nutritional quality score is unlikely to alter their response, as it merely validates their initial assessment. By contrast, a poor score creates dissonance (Hémar-Nicolas et al. 2024), thereby increasing its potential to influence

consumer behavior. Consequently, we expect that consumers will give greater weight to nutritional signals when a product receives a poor nutritional score, as this alters their perception of the product's healthiness and, in turn, their response.

2.2 | Distinctive Attributes of Food Scanner Apps and Their Potential Effects on Healthier Food Choices

We seek to investigate when and under what conditions food scanner apps influence healthier food choices. Therefore, we focus on two distinctive attributes compared with front-of-pack labels: technical affordances and the perceived source of the nutritional signal.

2.2.1 | Technical Affordances

Food scanner apps offer technical affordances that allow consumers to interact in several ways, including (1) scanning, (2) accessing in-depth information via funnel navigation, (3) receiving recommendations for alternative products, (4) utilizing personalization options, and (5) participating in crowdsourcing. According to affordance theory, actors perceive objects based on the possibilities they offer for action rather than their inherent features (Leonardi 2011; Volkoff and Strong 2017). For example, "a chair affords an adult human the possibility of sitting (if he or she wants to) and does not depend on that person consciously analyzing the chair's height, stability or solidity" (Volkoff and Strong 2017, p. 233). Affordances, whether consciously perceived or not, arise from the relationship between the user and the object (Leonardi 2011). Thus, the technical affordances of food scanner apps provide consumers with more possibilities to regain control over their food choices than front-of-pack labels.

Moreover, consumers tend to trust algorithmic-based recommendation apps more than human recommendations and perceive them as less biased and more objective (M. K. Lee 2018). They are likely to trust such apps for their accuracy and objectivity in automating extensive data analysis (Cabiddu et al. 2022).

For these reasons, food scanner apps may have a greater influence on healthier food choices, as they foster a sense of consumer empowerment (Klucarova and He 2022). Consumer empowerment manifests in an increased sense of control, a better understanding of one's environment, and an enhanced ability to play an active role. It also reflects consumers' confidence in their skills and abilities (Bachouche and Sabri 2019). In this sense, food scanner apps empower consumers (de Kervenoael et al. 2024; Gauthier and Bally 2025; Nøjgaard et al. 2024), which may, in turn, contribute to their effectiveness.

2.2.2 | Perceived Source of Nutritional Signal in Times of Growing Consumer Distrust

While public policymakers primarily promote front-of-pack labels that companies display on their packaging, food scanner apps tend to rely on a collaborative, citizen-based governance structure, as exemplified by the Open Food Fact initiative (Soutjis 2020). According to source credibility theory, the credibility of a communication source influences consumer trust in or distrust of the information provided (Cheung and Thadani 2012). Ohanian (1990) argues that a communication source has an impact on individuals if they perceive it as attractive, knowledgeable, and sincere.

Considering consumers' growing distrust of large corporations and public authorities, the perceived source of a nutritional signal is becoming increasingly important. Distrust distorts perceptions of the influence of advertisers and corporations (Darke and Ritchie 2007), further fueling the proliferation of business-related conspiracy theories (Alemany Oliver 2022; Visentin et al. 2021). Consumers often perceive large, visible companies as biblical Goliaths–despicable corporate adversaries insidiously manipulating public opinion (Kozinets and Handelman 2004) and engaging in unfair competition against local SMEs (Alemany Oliver 2022). By contrast, they view smaller companies engaged in this struggle as more trustworthy, intimate, and authentic (Napoli et al. 2014; Park et al. 2021; Thompson et al. 2006). For this reason, we predict that the perceived source of a nutritional signal influences consumer response. More specifically, food scanner apps may outperform front-of-pack nutrition labels among distrustful consumers, as these consumers are more likely to trust sources they perceive as independent from large corporations and public authorities.

2.3 | Possible Effect of Brand Equity

The relationship between consumers and producers involves an asymmetry of information. Owing to various constraints, including cognitive capacity, knowledge, information accessibility, and time, consumers often struggle to obtain comprehensive details about the products they purchase (Dawar and Parker 1994). This information asymmetry in product information makes it challenging to differentiate between high- and low-quality products. According to signaling theory, the sender employs signals to convey information to the audience (Spence 1974). A signal is "an action taken by the better-informed party in a setting of asymmetric information to communicate its true characteristics in a credible fashion to the less-informed party" (B.-C. Lee et al. 2005, p. 610). In this context, extrinsic cues such as brands serve as signals that communicate product quality and mitigate purchase risks, particularly in the prepurchase phase (Wells et al. 2011).

Among the various signals that the producers emit, brands function as effective and credible indicators of product quality and act as heuristics for consumer choice (Erdem and Swait 1998). Brands demonstrate their strength through brand equity, which encapsulates the additional value a brand name brings to a product (Kamakura and Russell 1993; Park and Srinivasan 1994). At the perceptual level, this added value translates into brand awareness, coupled with strong, unique, and positive brand associations (Aaker 1991; Keller 1993). At the behavioral level, it leads to consumer preference for branded products, even when the objective evaluation of the product's characteristics does not justify this preference (Erdem and Swait 1998; Yoo et al. 2000).

Brand equity is the primary influencing factor in consumers' purchasing decisions, taking precedence over other criteria such as price, quality, or promotions (Cobb-Walgren et al. 1995; Keller 1993). Thus, in line with previous research (Medina-Molina et al. 2021; Velasco Vizcaíno and Velasco 2019), we assume that when brand equity is strong, it serves as a dominant signal that overrides other available signals, including those conveyed by food scanner apps. Conversely, when brand equity is low, consumers are more likely to rely on alternative signals, such as information from food scanner apps.

3 | Exploratory Research on the Distinctive Attributes of Food Scanner Apps

We first conduct exploratory research to develop a fine-grained understanding of user perceptions of a food scanner app and to further investigate the perception of its source. To this end, we collect and analyze a data set of online reviews by using data mining procedures and then assess the statistical robustness of the results through a quantitative survey. The findings from this preliminary exploratory research complement and refine our theoretical background.

We select Yuka, a widely used food scanner app on the French market. France provides an interesting research context, as the country has experienced declining public confidence in health policy initiatives, illustrated by a decade-long drop in vaccination rates (Peretti-Watel et al. 2014). Three young French entrepreneurs launched Yuka in 2017, featuring a recognizable carrot-shaped logo. As its website states, Yuka claims to be entirely independent of the food industry. Its mission is to "[help] consumers make better choices for their health and [act] as a lever to drive the food industry to offer better products." The app scans barcodes of food and cosmetic products and assigns a nutritional score ranging from 0 to 100. The app categorizes products into four categories using a color-coded system: green (excellent), light green (good), orange (mediocre), and red (bad). If a scanned product receives a poor score, Yuka suggests healthier alternatives. These features are for free, while a premium version gives access to additional functionalities. Yuka has 34 million users worldwide, including 18 million in France. Localized versions are available in Spain, Belgium, Switzerland, Luxembourg, the United Kingdom, Canada, Ireland, and, more recently, the United States.

3.1 | Study 1: Quantitative Content Analysis of Online Reviews

We extracted 16,222 online reviews of Yuka from the Google Play Store by using web scraping. The reviews span from 08 December 2017 to 13 June 2023. We analyzed the data set using data mining procedures in a quantitative exploratory approach (Buzova et al. 2016; Pantano and Stylos 2020). More specifically, to identify topics, we used the Jaccard similarity coefficient (JCS) to assess the similarity and diversity of the data set. JSC is a term-based similarity measure that compares common and distinct words across documents (i.e., shared words *vs.* distinct words) by evaluating unique word sets within each document. Four topics emerged from the corpus (Table 1): *Eat better*, *Suggests an alternative product*, *Agri-food industry*, and *Yuka app*.

The analysis reveals strong associations between all four topics (Figure 1). For example, *Suggests an alternative* and *Agri-food industry* (JSC: 0.690) show a strong connection, with discussions on *Agri-food industry* often emphasizing the value of *Yuka app* (JSC: 0.532).

The topic analysis highlights relationships between *Yuka app*, *Eat better*, and *Suggests an alternative*, as exemplified by the following review: *"Honestly, since I installed this application, I've started eating and buying only good things for my health. I highly recommend it because it's very useful. Bravo to the Yuka team, all my encouragement!"* (08 September, 2019). Suggesting healthier alternatives also reinforces psychological empowerment, as reflected in this review: *"This application has changed the way I shop. The suggestion of alternative products is a marvel. Fast, simple, effective, detailed, monitored, and ad-free–at last, an application that benefits us"* (04 January, 2018). Other reviews further emphasize this idea, noting that Yuka reveals information previously hidden or inaccessible to consumers: *"It's a great app that's helped me see that some of the products I usually eat aren't as good as I thought! It also gives alternatives, so it's a great way of changing bad habits!"* (13 May, 2020). This result reinforces our claim that food scanner apps empower consumers.

The topic analysis also identifies relationships between *Yuka app* and *Agri-food industry* by highlighting the militant dimension attributed to Yuka, portrayed as a battle of the small against the big. This is particularly evident in reviews that emphasize the local French start-up versus multinational corporations: "*A fantastic idea […], just from the brain of three young lads, that helps me make healthier and militant food-related choices […] We remain in control of what we eat*" (08 January, 2023). Other reviews frame this local versus global opposition as support for local products over multinational food industry giants: "*It would be great to better account for the value of the company offering the products (locally produced vs produced with Monsanto, e.g.)*" (22 January, 2018). Some reviews even invoke the biblical figure of David against Goliath by explicitly positioning Yuka as the underdog challenging the industry: "*Once again, David is back against Goliath! I support Yuka against industry scams, overproduction, murder (slaughter with dignity, less barbaric), and junk food lobby corruption* 🥕🥕🥕 😾😾😾" (24 July, 21). These findings indicate that food scanner app users exhibit a certain level of distrust toward the food industry and public authorities. They also perceive Yuka as an independent and therefore more reliable source of information. This supports our argument regarding a potential perceived source effect.

The results of the exploratory study on Yuka further validate the conceptual proposals presented in the literature review. First, the findings confirm that consumers perceive Yuka as a useful tool for facilitating healthier food choices, which reinforces the role of food scanner apps as nutritional signals. Second, in addition to its functional benefits, consumers

TABLE 1 | Exploratory topic modeling.

Topic identified	Examples of words associated with this topic	Example of related online review	Occurrences
Eat better	Eating habits; change; food; consumption; allowed; changed; diet; change my habit; dietary habit; change one's habits; change our habit; consumption habit; etc.	"*This app enabled us to monitor what we eat and consume only good and healthy products*" (29 June 2023) "*Everybody should use this app. I scanned my fridge with it and realized I needed to change my purchasing habits*" (8 December 2018) "*It changed my buying and consumption habits*" (24 June 2022)	6436 cases (39.67%)
Suggests an alternative product/ proposes an alternative	cause; awareness; choice; help; choose; purchase; informed awareness; awareness of cause; allow to make a choice; help me; food choice; Yuka helps me	"*Very useful [...] For products that are considered less good, the app suggests better alternatives*" (4 June 2023) "*No more buying products polluted by manufacturers who disregard our health. A huge THANK YOU to you and to manufacturers committed to selling healthy products without pesticides, additives, etc."* (29 February 2020) "*Yuka [...] helps us become more independent and master our consumption [...] increases people's awareness, makes them responsible, and encourages healthier food choices*" (3 February 2019)	7046 cases (43.43%)
Agri-food industry	industry; agro; agri-food; industrial; lobby; poison; agri-food industry; agro food industry; etc.	"*We see that the app is independent, as it is unfortunately often attacked by lobbies. All the more reason to support it*" (15 September 2021) "*This app is a weapon against agri-food lobbies*" (26 October 2020) "*Thanks for bringing to our phones the power to see through what the lobbies want to sell us!*" (30 March 2019)	6859 cases (42.28%)
Yuka app	data; base; database; bar; code; search; scan a barcode; etc.	"*The best free, independent, and responsible app I know*" (10 November 2019) "*The best app I have ever installed [...] I will live longer thanks to this app! Thanks!*" (05 July 2023) "*In one click, you get an impartial review of what you eat*" (05 November 2018)	11,659 cases (71.87%)

also view Yuka as a means of regaining control over food consumption by (1) replacing unhealthy options with superior alternatives and (2) engaging in a form of confrontation with the food industry. The former enhances consumer empowerment, while the latter illustrates a "David versus Goliath" effect that fosters consumer distrust and embodies the idea of challenging dominant players and overturning established power structures.

FIGURE 1 | Network of co-occurrences and association of topics (JSC score).

3.2 | Study 2: Survey on the Perceived Source of Nutritional Signals

To deepen our exploration, we conducted a consumer survey to examine perceptions of the source of a food scanner app versus a front-of-pack label. We selected Yuka as the representative food scanner app and Nutri-Score as the front-of-pack label. Designed to encourage healthier food choices, Nutri-Score is a front-of-pack labeling system that summarizes a product's nutritional value using a graded scale from A (green/healthiest) to E (red/least healthy) (Merz et al. 2024). Although adoption remains voluntary, Nutri-Score is gaining widespread acceptance across Europe, with countries such as Belgium, Germany, and Switzerland incorporating it into their food labeling practices (Merz et al. 2024). Since its introduction, several studies have concluded that Nutri-Score influences consumer response, including brand trust and purchase intention (De Temmerman et al. 2021; Dubois et al. 2021; Nabec et al. 2022).

To investigate whether the perceived difference in source influences consumers' responses to various types of nutritional signals, we recruited 87 respondents from Panelabs, an online panel (51.7% women, $M_{age} = 44.2$ years, SD = 12.7) and asked them to identify which entity they primarily associate with front-of-pack nutritional scores (e.g., Nutri-Score) and scores displayed on food scanner apps (e.g., Yuka). The response options reflect a "David versus Goliath" dynamic, contrasting smaller entities (e.g., consumer associations, small companies, or start-ups) with dominant players (e.g., public authorities or major corporations). In addition, we measured respondents' trust in these two types of nutritional signals by using single-item scales, that is, "*I trust nutrition apps on my smartphone (like Yuka)*" and "*I trust the Nutri-Score displayed on the products I buy*."

After excluding respondents who were unsure about the source attribution, we obtained 86 attributions for front-of-pack signals and 81 for signals on food scanner apps. Our analysis reveals that 77.1% of respondents perceive that dominant players are the source of front-of-pack signals, whereas only 26.6% of respondents associate food scanner apps with dominant players ($\chi^2_{(1)} = 54.06$, $p < 0.001$). Moreover, while overall trust tends to be higher for front-of-pack signals than food scanner app signals ($M = 4.43$ vs. 4.01, $t = 1.41$, $p = 0.080$), trust is greater when the nutritional signal is attributed to small entities rather than large ones. This holds true for both front-of-pack signals ($M = 5.37$ vs. 4.26, $t = 2.48$, $p = 0.015$) and food scanner app signals ($M = 4.53$ vs. 2.71, $t = 3.37$, $p = 0.001$).

These results corroborate the findings of our quantitative content analysis and show a difference in the perceived source of nutritional signals. Consumers associate front-of-pack labels more with dominant players, whereas food scanner apps are more linked to smaller entities. Furthermore, the results highlight a trust gap that favors food scanner apps when consumers attribute their source to small entities. We conclude that distrustful consumers differentiate their level of trust in a nutritional signal according to how they perceive its source. Consequently, these consumers are more likely to trust a food scanner app than an front-of-pack label, leading to a trust gap between the two signals.

To test our conceptual model, we conducted two experimental studies after receiving ethical approval from the Ethics Committee of the research institute of one of the authors.

4 | Study 3: Experiment Investigating the Effects of Score Valence

Study 3 investigates the effect of two types of nutritional signals (front-of-pack vs. food scanner app) on perceived healthiness and consumer response, depending on the valence of the score displayed (good vs. poor).

4.1 | Hypotheses

H1: *Both types of nutritional signals (front-of-pack and food scanner app) help consumers make better choices when the score is poor, leading to a degraded consumer response (compared with the control condition) when the score is poor.*

H2: *Nutritional signals on food scanner apps are more effective than front-of-pack nutritional signals when the score is poor, such that a poor score on a food scanner app reduces perceived healthiness more than a poor front-of-pack score.*

H3: *Perceived healthiness mediates the influence of the type of nutritional signal (front-of-pack vs. food scanner app) on choice quality, such that a poor score on a food scanner app reduces perceived healthiness more than a poor front-of-pack score, which ultimately leads to a greater decline in consumer response.*

4.2 | Method

4.2.1 | Design

We conducted a 2 (nutritional signal: front-of-pack vs. food scanner app) × 2 (score valence: good score vs. poor score) between-subjects experiment, with a control condition that included only the product, without any nutritional information.

Following the approach of De Bauw et al. (2021), we placed respondents in a simulated consumption context to evaluate

orange juice. We selected orange juice because it fits our experimental design, as it can be credibly associated with both good and poor nutritional quality. To maintain ecological validity while minimizing potential bias from prior strong familiarity, we chose a mid-range, real brand for the experiment: Réa.

The front-of-pack condition involves adding the Nutri-Score to the product. The food scanner app condition involves simulating the use of the product within the Yuka application and replicating how users view a product's nutritional score on a smartphone screen. This approach aligns with prior research (Werle et al. 2024). Yuka displays nutritional information through a score ranging from 0 to 100, with 60% based on the Nutri-Score, making the two tools highly comparable in evaluating products.

To distinguish between a good and a poor score, we used a credible Nutri-Score for the orange juice and directly translated it into Yuka's equivalent scoring system. For the good score, we used a Nutri-Score of B, as we could not identify any examples of A-rated orange juices in the market. This corresponds to a Yuka score of 71/100. For the poor score, we used a Nutri-Score of E, which directly corresponds to a Yuka score of 11/100. Figure 2 displays our experimental stimuli.

4.2.2 | Procedure

At the start of the questionnaire, we obtained explicit consent from respondents and assured them of anonymity. On the first page, respondents answered a filter question to confirm that they purchase orange juice at least occasionally (response options ranged from "*never*" to "*very regularly*"). Using Qualtrics's randomizer tool, we randomly assigned respondents to one of five experimental conditions, in which they viewed an orange juice image, with or without a nutritional signal, for as long as they wished. Following exposure, we measured consumer response using three items ($\alpha = 0.916$): "*Réa is a good orange juice brand*," "*Next time I buy orange juice, I could buy a Réa orange juice*," and "*I could recommend Réa orange juice to people I know*." We measured perceived healthiness using three items from Hagen (2021) ($\alpha = 0.939$): "*The orange juice I was shown is healthy/nutritious/good for me*." Finally, we collected respondents' age, gender, health concern, and brand loyalty (nobody mentioned loyalty to Réa) to use as control variables in our analyses. We measure health concern using four items from Rozin et al. (1999) ($\alpha = 0.750$): "*I'm concerned about the health of people close to me (family, friends) who don't eat healthily*," "*I am concerned about the long-term effects of my diet on my health*," "*I pay attention to the quality of what I eat*," "*I am concerned about the effects of my diet on my physical appearance*." We used a seven-point Likert scale for all items and calculated the mean scores to measure the constructs. We included two attention checks in the questionnaire. As a manipulation check, we asked respondents to identify their experimental condition. To ensure they clearly viewed our stimuli, we restricted the study to desktop views. Respondents spent an average of 7 min completing the study.

4.2.3 | Respondents

Data collection involved 407 French respondents ($N_{\text{control}} = 81$, $N_{\text{FOPgood}} = 88$, $N_{\text{FOPpoor}} = 76$, $N_{\text{FSAgood}} = 80$, $N_{\text{FSApoor}} = 82$;

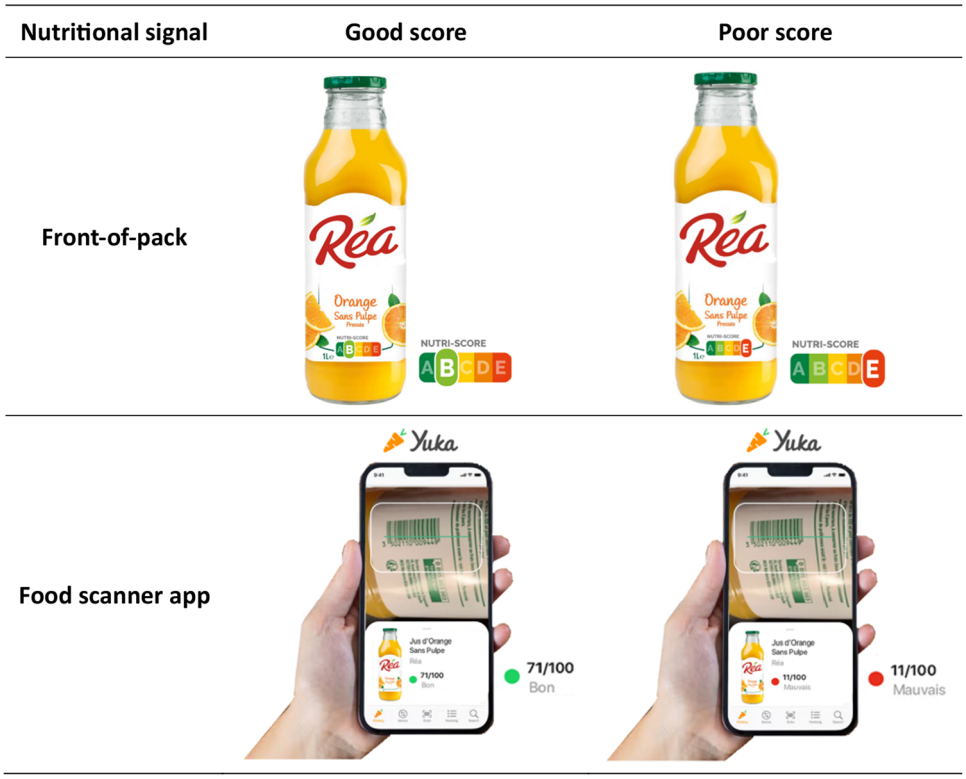

FIGURE 2 | Stimuli used for Study 3.

51.8% women, $M_{age} = 42.6$ years, SD = 13.2) recruited from Panelabs, an online panel institute. We excluded respondents who failed the attention or manipulation checks or completed the survey in an extreme timeframe. Regarding education level, 27% of respondents held an associate degree, while 35% had a bachelor's degree or higher. Their individual net monthly income distribution was as follows: 27% earned less than €1500, 30% earned between €1500 and €2000, 19% earned between €2,000 and €2500, and 24% earned over €2,500. The five groups of respondents did not differ significantly in terms of age ($F_{(4,402)} = 1.486$, $p = 0.206$), gender ($\chi^2_{(4)} = 0.900$, $p = 0.925$), or health concern ($F_{(4,402)} = 0.966$, $p = 0.426$).

4.3 | Results

To test H1, we conducted two ANOVAs. The first ANOVA examined consumer response based on the experimental manipulation (good front-of-pack score, poor front-of-pack score, control) and the covariates. The analysis revealed an effect of the manipulation ($F_{(2,250)} = 17.818$, $p < 0.001$). Planned contrast tests further explored this effect: When the score was good, consumer response was significantly stronger than when the score was poor ($M_{FOPgood}$-$M_{FOPpoor} = 1.24$, $F_{(1,250)} = 33.080$, $p < 0.001$). The control condition allowed us to determine whether a good score increased consumer response or whether a poor score decreased it. Consumer response was significantly lower for the poor score than in the control condition ($M_{FOPpoor}$−$M_{Control} = -0.939$, $F_{(1,250)} = 17.959$, $p < 0.001$). A separate contrast test found no significant difference in consumer response between the good score and the control condition ($M_{FOPgood}$−$M_{Control} = 0.30$, $F_{(1,250)} = 1.892$, $p = 0.170$). The second ANOVA examined consumer response based on the experimental manipulation (food scanner app good, food scanner app poor, control) and the covariates. The analysis revealed an effect of the manipulation ($F_{(2,247)} = 59.484$, $p < 0.001$). Planned contrast tests showed that when the score was good, consumer response was significantly stronger than when the score was poor ($M_{FSAgood}$−$M_{FSApoor}$ = 1.98, $F_{(1,247)} = 106.562$, $p < 0.001$). The control condition helps determine whether a good score increases consumer response or a poor score decreases it. We found that consumer response is significantly lower for the poor score than for the control condition ($M_{FSApoor}$−$M_{Control}$ = -1.63, $F_{(1,247)} = 67.912$, $p < 0.001$). Furthermore, a separate contrast test found no significant difference in consumer response between the good score and the control condition ($M_{FSAgood}$−$M_{Control} = 0.35$, $F_{(1,247)} = 3.255$, $p = 0.072$). The results of the two ANOVAs corroborate H1 by showing that nutritional signals help consumers make better choices, but only when the score is poor. This suggests that, in the absence of any nutritional signal, consumers evaluate products based on a positive baseline.

To test H2 and H3, we conducted a moderated mediation analysis using Model 7 of Hayes (2013) PROCESS macro, with 5000 bootstraps and the same covariates as in the previous analyses. We used the nutritional signal (front-of-pack vs. food scanner app) as the independent variable, perceived healthiness as the mediator, consumer response as the dependent variable, and score valence (good vs. poor) as the moderator of the relationship between the nutritional signal and consumer response. This analysis confirmed an interaction effect between the nutritional signal and score valence on perceived healthiness ($a = 0.95$, $t = 3.21$, $p < 0.01$), with a significant negative effect when the score was poor ($a = -0.95$, $t = -4.48$, $p < 0.001$) but not when it was good ($a = -0.01$, $t = -0.04$, $p = 0.970$). Controlling for the nutritional signal, the effect of perceived healthiness on consumer response was significant and positive ($b = 0.66$, $t = 18.90$, $p < 0.001$). In addition, the direct effect of the nutritional signal on consumer response was not significant ($c = 0.15$, $t = 1.17$, $p = 0.243$). Finally, the indirect effect of the nutritional signal on consumer response, through perceived healthiness, was significant and negative when the score was poor (indirect effect = −0.63, CI = [−0.9775 to −0.3047]) but not when the score was good (indirect effect = −0.01, CI = [−0.2197 to .2080]). The moderated mediation index was significant (index = 0.64, CI = [0.2501 to 1.0283]). Specifically, when the score was poor, consumer response was lower when exposed to the food scanner app than the front-of-pack label ($M = 3.33$ vs. 3.87, $t = 2.18$, $p = 0.030$). However, this effect did not appear when the score was good ($M = 5.25$ vs. 5.19, $t = -0.34$, $p = 0.738$). Figure 3 presents the results of the moderated mediation analysis, which support H2 and H3.

5 | Study 4: Experiment Investigating the Effects of Brand Equity and Consumer Distrust

Building on the findings of Study 3, Study 4 explores the boundary conditions for the superior efficacy of food scanner apps over front-of-pack signals when the score is poor.

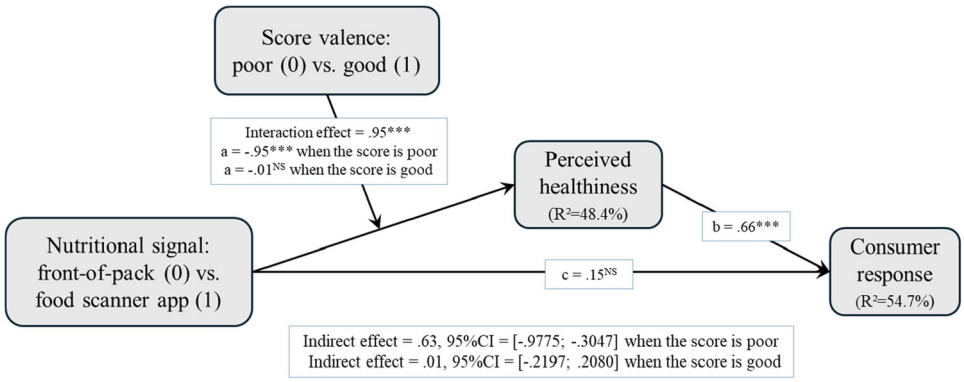

FIGURE 3 | Mediation results of Study 1 (*** $p < 0.01$).

Specifically, it investigates the moderating effects of brand equity and consumer distrust, operationalized as the trust gap between food scanner apps and front-of-pack signals.

5.1 | Hypotheses

H4: *The indirect effect of the type of poor nutritional signal (front-of-pack vs. food scanner app) on consumer response, with perceived healthiness as the mediator, is conditional on brand equity, such that the indirect effect is stronger when brand equity is lower.*

H5: *The indirect effect of the type of poor nutritional signal (front-of-pack vs. food scanner app) on consumer response, with perceived healthiness as the mediator, is conditional on the trust gap between food scanner apps and front-of-pack signals, such that the indirect effect is stronger when the trust gap increases.*

5.2 | Methods

5.2.1 | Design

We conducted a 2 (nutritional signal: front-of-pack vs food scanner app) × 2 (brand equity: good vs. average) between-subjects experiment, with one control condition per brand that included only the product without any nutritional information. Overall, Study 4 replicated Study 3. We placed respondents in a simulated consumption context before asking them to evaluate orange juice. Maintaining the same product category ensured consistency with Study 3 and avoided introducing a differentiating factor that could serve as an alternative explanation for the observed results. In addition, we manipulated the poor nutritional signal for the front-of-pack label and the food scanner app, following the same procedure as in Study 3.

We manipulated brand equity using two different brands: Réa, a mid-range real brand already tested in Study 3, and Tropicana, a market leader in the orange juice industry. Although a low-range real brand would increase experimental variance, we selected a mid-range brand to maintain consistency with Study 3 and minimize the risk of a floor effect (e.g., the stimulus being perceived as too negative). As a manipulation check, we measured brand equity for the two control conditions to make sure not to spoil them after our manipulations using three items from Yoo and Donthu (2001) ($\alpha = 0.941$): "*If I find a brand this good, I'd still rather buy Réa/Tropicana*," "*Between a Réa/Tropicana orange juice and an identical orange juice from another brand, I prefer to buy Réa/Tropicana*," and "*If I have to choose between Réa/Tropicana and another orange juice in the same style, I'd choose Réa/Tropicana.*". The test confirmed that Tropicana has higher brand equity than Réa ($M_{\text{Réa}} = 3.58$ vs. $M_{\text{Tropicana}} = 4.36$ out of 7, $t = 3.74$, $p < 0.001$). Figure 4 displays our experimental stimuli.

5.2.2 | Procedure

The procedure for Study 4 followed the same steps as Study 3, with one key difference. We introduced a measure for the trust gap, calculated as the difference between two items: "*I trust nutrition apps on my smartphone (like Yuka)*" and "*I trust the Nutri-Score displayed on the products I buy.*" Respondents spent an average of 6 min completing the study.

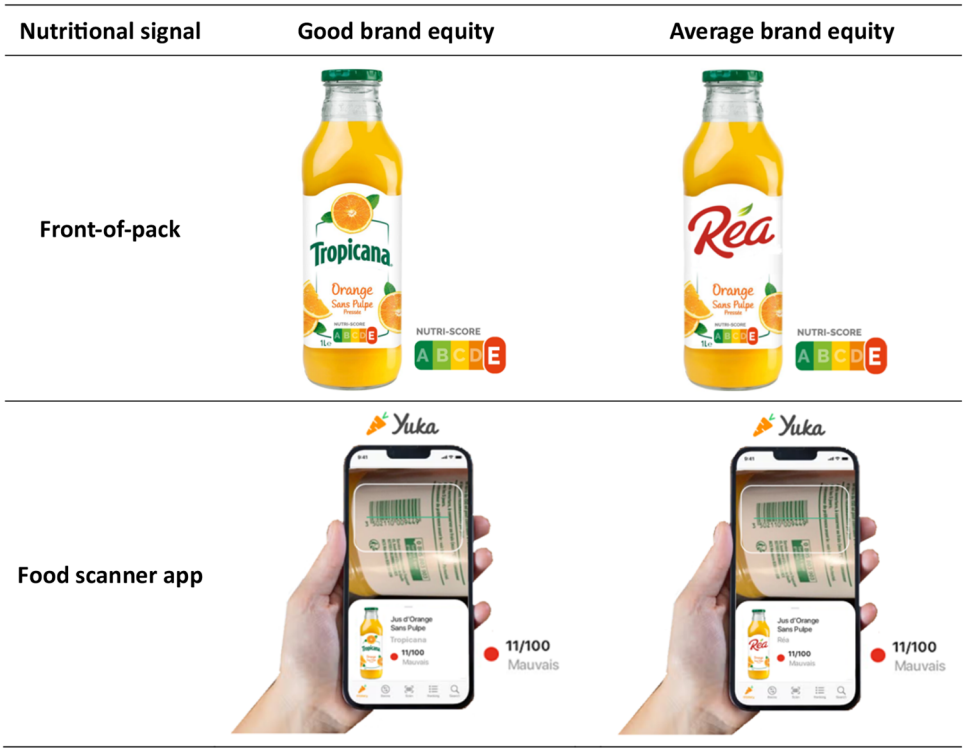

FIGURE 4 | Stimuli used for Study 4.

5.2.3 | Respondents

Data collection involved 604 respondents (for Réa: $N_{control} = 107$, $N_{FOPgood} = 106$, $N_{FOPpoor} = 102$/for Tropicana: $N_{control} = 103$, $N_{FSAgood} = 98$, $N_{FSApoor} = 98$; 52.4% women, $M_{age} = 43.1$ years, SD = 13.3), recruited from Panelabs, an online panel institute, after excluding those who had failed the attention or manipulation checks or answered in an extreme timeframe. Regarding education, 26% of the respondents hold an associate's degree, and 38% hold a bachelor's degree or higher. Their individual net monthly income distribution is as follows: 28% earn less than €1500, 26% between €1500 and €2000, 19% between €2000 and €2500, and 27% over €2500. The six groups of respondents do not differ significantly in terms of age ($F_{(5,608)} = 0.258$, $p = 0.936$), gender ($\chi^2_{(10)} = 8.336$, $p = 0.596$), health concern ($F_{(5,608)} = 0.807$, $p = 0.545$), or trust gap ($F_{(5,608)} = 0.710$, $p = 0.616$). Regarding the trust gap, which ranges from −6 to 6 ($M_{TrustGap} = -0.72$, SD = 2.02), 28.8% of respondents exhibited the same level of trust for both nutritional signals. Meanwhile, 49.5% reported greater trust in the poor front-of-pack score, while 21.7% expressed greater trust in the poor score displayed on the food scanner app.

5.3 | Results

We first examined whether Study 4 replicated the findings of Study 3 for the brand Réa. An ANOVA, incorporating planned contrasts and the same covariates as in Study 3, revealed that consumer response was significantly lower for both the poor front-of-pack score ($M_{FOP} - M_{Control} = -1.11$, $F_{(1,308)} = 30.200$, $p < 0.001$) and the poor score on the food scanner app (M_{FOP}-$M_{Control} = -1.67$, $F_{(1,308)} = 67.239$, $p < 0.001$) compared with the control condition. Using Model 4 of Hayes (2013) PROCESS macro with 5000 bootstraps, we also confirmed that perceived healthiness mediated the effect of the nutritional signal (front-of-pack vs. food scanner app) on consumer response. Specifically, when displaying poor nutritional quality, the food scanner app generated lower perceived healthiness scores than the front-of-pack label ($a = -0.84$, $t = -4.04$, $p < 0.001$), which in turn led to a decline in consumer response ($b = 0.66$, $t = 12.19$, $p < 0.001$). The indirect effect of the nutritional signal on consumer response, mediated by perceived healthiness, was significant and negative (indirect effect = −0.56, CI = [−0.8458 to −0.2929]).

To assess the potential compounding effects of the two hypothesized moderators, brand equity and trust gap, we tested H4 and H5 simultaneously using Model 11 of Hayes (2013) PROCESS macro with 5000 bootstraps. Table 2 presents the results, showing that for Tropicana, the high-range brand, perceived healthiness did not mediate the effect of the type of nutritional signal on consumer response. This mediation effect emerged only for the mid-range brand, Réa, and only when the trust gap between the food scanner app and the front-of-pack increased, supporting H4 and H5. A conditional analysis using the Johnson–Neyman technique identified the trust gap threshold at which significant mediation occurred. For individuals with a trust gap level below −0.35 ($\beta_{JN} = 0.35$, $p = 0.05$), the mediating effect was significant, but only for the brand Réa. Figure 5 presents the results of this moderated mediation analysis, which corroborate H4 and H5.

6 | General Discussion

6.1 | Contributions to Theory

Our findings offer insights into the boundary conditions under which food scanner apps are more effective than front-of-pack labels in promoting healthier food choices. Specifically, they indicate that food scanner apps outperform front-of-pack labels under the following conditions: (1) when the nutritional quality score is poor, (2) for consumers who are distrustful of dominant players, and (3) for brands with lower equity compared with high-range brands.

1. The moderating effect of score valence aligns with research showing that negative information has a greater impact than positive information (e.g., Mohr and Webb 2005; Parguel et al. 2011), consistent with prospect theory (Kahneman and Tversky 1979). Regardless of the nutritional signal, good scores do not affect consumer response, as consumers generally do not expect the product to be unhealthy. This finding likely depends on the overall perception of the product category in terms of healthiness. Since Wertenbroch (1998), several studies have categorized food products as either vice or virtue, showing that consumer response varies depending on whether they perceive the product category as beneficial to health (virtue) or detrimental (vice). In our experiments, we selected the juice category because it includes products of both good and poor nutritional quality, particularly depending on added sugars. If consumers perceive the category as virtuous, a poor nutritional score should generate dissonance and trigger a cognitive process of evaluation (Hémar-Nicolas et al. 2024), thereby amplifying their response.

   In addition, our findings show that food scanner apps are more effective than front-of-pack labels when the quality score is poor. We identify two possible explanations for this. First, food scanner apps foster consumer empowerment by providing affordances. Second, we envision a possible unit effect of the two nutritional scales tested. Nutri-Score utilizes a five-point letter scale (A to E), whereas the tested food scanner app in our study employs a 100-point numerical scale linked to a four-color code, ranging from green (75 to 100, "excellent") to red (below 25, "bad"). This difference in scale framing could influence consumer interpretation, as a score of 11/100 (theoretically equivalent to an E in Nutri-Score) may seem even lower due to framing and anchoring effects (Tversky and Kahneman 1974).

2. We explain the moderating effect of the trust gap between food scanner apps and front-of-pack labels through the "David versus Goliath" effect. This finding highlights the role of growing consumer distrust toward dominant players, including public authorities and large corporations. Conspiracy theories, rumors, and misinformation have become increasingly prevalent in contemporary social and political discourse and fulfill consumer needs for causal explanations of events (Douglas et al. 2017). These theories often suggest that major events result from covert schemes orchestrated by

TABLE 2 | Results for Study 4.

Dependent variable: Perceived healthiness ($R^2 = 14.6\%$)			
		Effect	***t***
Nutritional signal		−1.05	−4.41***
Brand equity		−0.70	−1.28
Nutritional signal * Brand equity		0.74	2.18**
Trust gap		0.43	2.54**
Nutritional signal * Trust gap		−0.29	−2.60**
Brand equity * Trust gap		−0.53	−2.18**
Nutritional signal * Brand equity * Trust gap		0.29	1.84*
Gender		0.03	0.16
Age		0.03	5.72***
Health concern		−0.03	−0.36
Brand loyalty		0.06	0.32
Conditional effects of nutritional signal on perceived healthiness at values of brand equity and trust gap		**Effect**	***t***
Moderate (Rea)	−3	−0.19	−0.54
Moderate (Rea)	0	−1.05	−4.41***
Moderate (Rea)	3	−1.34	−4.52***
High (Tropicana)	−3	−0.30	−0.90
High (Tropicana)	0	−0.31	−1.29
High (Tropicana)	3	−0.31	−1.06
Dependent variable: Consumer response ($R^2 = 41.3\%$)			
		Effect	***t***
Nutritional signal		−0.17	−1.32
Perceived healthiness		.62	15.57***
Gender		.15	1.19
Age		−0.01	−0.31
Health concern		−0.10	−1.79*
Brand loyalty		−0.36	−2.43**
Direct effect of nutritional signal on consumer response		**Effect**	***t***
		−0.17	−1.31
Indirect effects on values of brand equity and trust gap		**Effect**	**Confidence interval**
Moderate (Rea)	−3	−0.11	[−0.4768 to 0.2603]
Moderate (Rea)	0	−0.66	**[−0.9271 to −0.4009]**
Moderate (Rea)	3	−0.84	**[−1.1759 to −0.5343]**
High (Tropicana)	−3	−0.19	[−0.7165 to 0.3167]
High (Tropicana)	0	−0.19	[−0.4813 to 0.0985]
High (Tropicana)	3	−0.20	[−0.5376 to 0.1501]

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

influential corporations (Big Pharma, Big Tech, Big Food, Big Tobacco...). Conspiracy theories have been shown to negatively influence consumer trust in health policy initiatives (Zhang et al. 2022), ultimately contributing to public distrust (Islam et al. 2021). France serves as a particularly relevant context for these findings, as the country has been experiencing a decline in public confidence in health policies (Peretti-Watel et al. 2014; Richet et al. 2024;

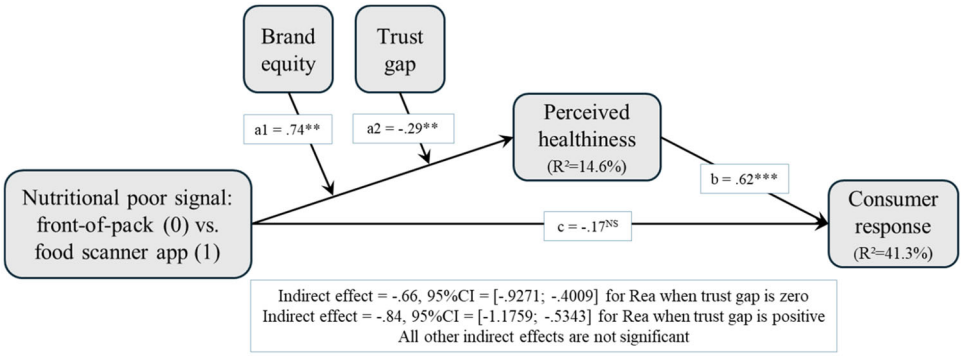

FIGURE 5 | Mediation results of Study 2 (*** $p < 0.01$, ** $p < 0.05$).

Rowe et al. 2020), leading to increased resistance from consumers against institutions. Large companies and public authorities should account for consumer distrust, as it undermines the efficacy of nutritional signals that public policies like Nutri-Score promote. Distrustful consumers, who represent more than a fifth of our sample, attribute front-of-pack nutritional signals to institutional mechanisms they no longer trust, whether established by the agri-food industry or by public authorities. By contrast, food scanner apps associated with smaller entities prove to be an effective tool for influencing these consumers toward healthier food choices. This finding is consistent with recent research on the political agency of food scanner apps, which redistribute power among food market actors (Gauthier and Bally 2025; Soutjis 2020). It also aligns with the work of Nøjgaard (2023), who examines the role of calculative and evaluative devices in driving market changes from a Callonian perspective (Callon and Muniesa 2005). From this viewpoint, food scanner apps like Yuka function as consumer watchdog organizations (CWOs), a form of activism that institutionalizes distrust toward market actors and advocates for consumers through monitoring and alerting mechanisms.

3. The moderating effect of brand equity indicates that nutritional signals are less effective for high-range brands. Food brands with high equity can often do without nutritional signals, as brand strength itself serves as a powerful choice heuristic (Erdem and Swait 1998). This finding aligns with Godden et al. (2023, p. 9), who demonstrated that brand-driven consumers "just want their brand" and disregard nutritional signals. Consequently, public policymakers should integrate the power of brands into the array of resources deployed for public health policies and appeal to brands' social responsibility (Grohmann and Bodur 2015). However, food scanner apps remain an effective counterweight for brands with average equity when the nutritional score is poor.

Overall, we identified when food scanner apps are effective. Our findings suggest they complement front-of-pack labels and sometimes even outperform them. They are particularly effective when the nutritional quality score is poor, for brands with average brand equity, and for consumers who distrust institutions and dominant market players. This is particularly relevant given the rising trend of consumer distrust.

6.2 | Managerial Implications

This study offers several recommendations for policymakers. Given the limited efficacy of institutional nutritional signals in a context of consumer distrust, policymakers should consider food scanner apps developed by start-ups or nongovernmental organizations as complementary tools. These apps are particularly relevant for promoting healthier food behaviors among distrustful consumers and for brands with average equity. In certain cases, food scanner apps may even substitute for public authorities, as demonstrated by a recent case in France, where the charcuterie industry opposed Yuka's decision to label certain nitrite-containing products, such as ham, as carcinogenic and to assign them a negative rating (red color). Yuka won the legal dispute, with the tribunal ruling that the issue constituted "a subject of general interest that affects public health." This prompted the charcuterie industry to remove nitrites from these products, including from well-known brands. In the context of growing consumer distrust toward firms and institutions, food scanner apps offer an effective complementary solution for guiding consumers toward healthier choices and can thus meaningfully contribute to public health prevention policies.

This study also offers several managerial contributions. First, the implications for marketing managers handling high-equity brands are primarily ethical. Since nutritional signals do not fully influence consumer behavior in these cases, managers must recognize the brand's social responsibility in promoting healthier food behavior. This aligns with previous research calling for a systematic assessment, management, and tracking of brand social responsibility (BSR). Indeed, "BSR fosters psychological connections between consumers and brands that translate into positive consumer responses to the product brand" (Grohmann and Bodur 2015, p. 395). Second, this study provides valuable insights for managers overseeing brands with lower levels of brand equity, such as local or small brands owned by SMEs or start-ups. For these brands, enhancing the nutritional quality of their products is strategically beneficial, as food scanner apps can effectively promote them as healthier alternatives to high-range brands when the latter receive poor nutritional scores.

6.3 | Limitations and Further Research

Some limitations of the research are inherent to online experiments. Although we carefully designed our studies with

real brands and familiar nutritional signals to ensure ecological validity, we did not test food scanner apps in real-world conditions. Instead, we conducted a visual and static application transcription experiment that allowed us to control for multiple variables and, thus, strengthen internal validity. Future studies could address this limitation by conducting lab-based experiments where respondents interact directly with food scanner apps on smartphones. Moreover, our study does not examine the combined effects of food scanner apps and front-of-pack labels, even though both operate simultaneously in real-world settings. Another limitation is the choice of product category. We focused on a high-glycemic index product commonly consumed at breakfast. Future replications could examine other product categories, including "vice" foods like ready meals, as well as different consumption contexts, like out-of-home dining.

This study opens new avenues for research on how food scanner apps influence consumer attitudes and behaviors. One promising direction is the investigation of the perceived source's characteristics, such as type (e.g., public authorities, big corporations, nongovernmental organizations, or small and medium-sized enterprises) and size (large vs. small organizations). Furthermore, our findings on consumer distrust highlight the need for further exploration of its antecedents. Future studies could examine how individual psychographic traits, such as consumer psychological empowerment or self-esteem, amplify or mitigate the effects of distrust. Past experiences may also shape consumer distrust, which suggests a need for longitudinal studies. Social contagion could provide an alternative explanation for distrust, particularly through the spread of conspiracy theories and social media filter bubbles. The objective of our research was not to assess the reliability of the nutritional information provided by food scanner apps, a topic that remains a subject of debate (Braz and Lopes 2019; Martinon et al. 2022; Schumer et al. 2018). However, further research in public health and nutrition is essential.

In conclusion, this study sheds light on the boundary conditions under which food scanner apps may outperform front-of-pack labels. In an era of growing consumer distrust and increasing reliance on smartphone-based devices, food scanner apps represent an effective complement to public policies aimed at promoting healthier eating habits.

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Conflicts of Interest

The authors declare no conflicts of interest.

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