Measuring Consumers' Acceptance in Food Labels: a Cross-Country Investigation on Usefulness, Ease of Use and Trust

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Abstract: Front-Of-Pack Labels (FOPLs) are being increasingly investigated as a tool to guide customers toward healthier food choices. Existing theoretical models focused on consumers understanding have not been able to provide clear evidences of which labels are more effective on food choices. Drawing on extant studies conducted on primary grocery shoppers from Italy, France and the UK we developed a new framework, the Front-Of-Pack Acceptance Model (FOPAM), to evaluate label effectiveness in terms of usefulness, ease of use, attitude, trust and behavioral intention. Our findings highlight significant relationships between perceived usefulness, ease of use of the labels and trust towards them, and the way consumers form their attitudes and intentions towards buying healthier products.

Introduction

As part of the worldwide effort to help citizens reduce disease connected to food habits, in recent years governments, authorities, and socially responsible businesses and organisations, have been involved in activities that support consumers in making healthier food choices (WHO, 2020).

In this perspective, Front-of Pack labels, or FOPLs, have been identified as a fundamental tool to promote a healthier diet. FOPLs are labels placed on the front of food packaging, that provide detailed and simplified information about food composition and nutritional values (van der Bend, 2019). The lack of a streamlined, shared regulation has led to the proliferation of multiple types of labels in various countries, with different designs and underlying categories (such as per the Taxonomy devised by the EU).

Table 1. Recent taxonomy of EU labels

Nutrient-Specific Labels	
Provide detailed information about certain nutrients with the quantities contained in the food.	• **Numerical Labels** (e.g., NutrInform Battery) • **Colour-Coded Labels** (e.g., Multiple Traffic Light)
Summary Labels	
Provide a synthetic assessment of the overall nutritional healthiness through an algorithm	• **Endorsement Logos** (e.g., Keyhole logo) • **Graded Indicators** (e.g., Nutri-Score)

While the approaches are different, an ongoing debate at EU level aims at ensuring better labelling information, and part of its goals is to identify which labels allow to pursue the best outcome in terms of customer education toward informed and healthier diets. In this context, one of the most discussed frameworks (Hersey et al., 2013; Ducrot et al., 2015, 2016, 2016a; Talati et al., 2017; Ares et al., 2018; Finkelstein et al., 2019, Egnell et al., 2019, 2020; Dreano-Trecant et al., 2020; Mazzù et al., 2021a) evaluate label efficacy is the model of Grunert&Wills (2007), which differentiates the phase of understanding the message brought forward by the labels between subjective and objective.

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Yet, focusing on “understanding” has not been able to provide evidence of the existence of a uniform trait of "superiority" (Mazzù et al., 2021b). Moreover, while the impact of FOPL in identifying healthy food in the context of purchase intention and choice has been widely evaluated, (Ducrot et al., 2016; Talati et al., 2017), effectiveness at the time of purchase still needs to be.

Our attempt to close a gap both in literature and in which is the best tool to actually help consumers make better choices for their health, is through an approach based on an alternative evaluation model that could provide a new perspective on the FOPL-driven decision-making process.

Our approach has thus concentrated on assessing whether switching the focus to attitude formation, purchase intention, and trust, could positively contribute to the issue. We have developed a sequence of studies, based on Technology Acceptance Model (Davis, 1989; 1993), to extend the evaluation of FOPLs.

The following paper is divided as follows: after an overview of the theoretical frameworks, we discuss our research methodology and showcase our model, together with the main implications of our studies.

Conceptual Framework and Extant Literature

As labels could be seen as a Decision Support System (DSS), their acceptance as a technology could be evaluated through the Technology Acceptance Model (Davis, 1989) which establishes “perceived usefulness” (PU) and “perceived ease of use” (PEOU), as antecedents to a customers’ attitude toward using the system and purchase/usage intention.

Over the years, the TAM has proven to be flexible in its applications, in sectors that go beyond technology, thanks to its parsimony and predictive power (Venkatesh, 2000). Examples are the acceptance of new policies (Pierce et al., 2014), food traceability (Kim & Woo, 2016), online food purchasing (Nguyen et al., 2019). It could thus be leveraged to understand whether FOPLs can be an easy-to-use system for consumers to make healthier choices when buying food.

Moreover, investigating further mediating variables could strengthen the effects produced in the relationship. Trust is a factor that majorly affects the decision process in terms of purchase (Hong and Cha, 2013) and repurchase (Trivedi and Yadav, 2019) intention, technology adoption (Van et al., 2020); it could thus increase the predictive power of the TAM (Gefen, 2004). When consumers feel trust, they are more likely to buy or use a product or service (Aydin et al., 2014), because of a perceived risk reduction (Handi et al., 2018). Conversely, a reduction in trust might happen when the amount of information consumers have access to is reduced (Hong and Cha, 2013), as they might perceive an increase in uncertainty.

It is thus possible that consumers may feel less trust in a label providing less information about the food content than in a detailed one. Considering that some labels, such as the Nutri-Score (NS), employ algorithms to provide a measure of food healthiness, there is also a need to understand the impact that these calculations, and the trust that consumers feel towards them, have on behavior in the context of FOPLs.

Figure 1. Adapted Technology Acceptance Model tested in studies 1 and 2

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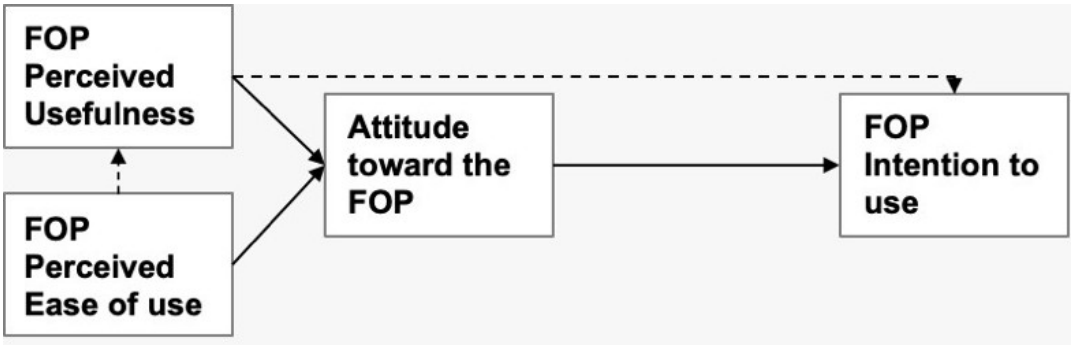

In study 1, we tested the acceptance of two different labels, the Multiple Traffic Light (MTL), a Nutrient-Specific Colour-coded Label and the Nutri-Score, a Graded-Indicator Summary Label, while assessing the effectiveness of PEOU, PU and attitude as explanatory variables of consumers' intentions. In study 2, we assessed the relationships among PU, PEOU, Attitude and Behavioral Intention in a sample of 940 Italian Primary Grocery Shopper divided into three subgroups: (1) one for the NutrInform Battery (n=319), (2) one for MTL (n=318), and (3) one for Nutri-Score (n=303). In Study 3 we assess whether trust is a relevant mediator of behavioral intention under conditions of exposure to a Nutrient-Specific Label and a Summary Label, also evolving the Front-of-Pack-Acceptance-Model (FOPAM); in Study 3.b, we evaluate trust dimensions, with focus on the perception of the presence of an algorithm behind FOPLs nutritional information, while explaining the computational details of the algorithm and preventing potential biases deriving from previous label exposure.

Research Hypotheses

Table 2. Research Hypotheses

Study	Description
Studies 1 and 2	• H1: Front-of-Pack Perceived Usefulness positively affects the attitude toward the usage • H2: Front-of-Pack Perceived Ease of Use positively affects the Front-of-PacPerceived Usefulness • H3: Front-of-Pack Perceived Ease positively affects the attitude toward the usage • H4: Front-of-Pack Perceived Usefulness positively affects the behavioral intention • H5: Attitude toward the usage positively affects the behavioral intention
Study 3	• H6: Trust mediates the relationship between attitude toward using the FOP and behavioral intention.
Study 3.b	• H7: The attitude toward the usage of NutrInform Battery is higher than the attitude toward the usage of the Nutri-Score also in contexts where the FOPL computational methods are made transparent • H8: Trust toward FOPL mediates the relationship between attitude toward using the FOPL and behavioral intention also in contexts where the FOPL computational methods are made transparent • H9: Behavioral intention enhanced by Nutri-Score is higher than the behavioral intention enhanced by the NutrInform Battery also in contexts where the FOPL computational methods are made transparent • H10: The trust toward NutrInform Battery is higher than the trust toward the Nutri-Score also in contexts where the FOPL computational methods are made transparent

Research Objectives: To establish the role of acceptance in the evaluation of the performance of FOPLs, we validate the "Front-of-Pack Acceptance Model" (FOPAM), a new theoretical model applied to food purchase and healthy diet decision making.

Our approach began by defining item scales and then testing the FOPAM on them. We decided to apply our model to three labels representative of the different blocks of the EU Taxonomy, and that follow a logical continuum.

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We thus selected two Nutrient-specific labels, the Multiple Traffic Light, a color coded label, and the NutrInform Battery, a numerical indicator, and one graded Summary Label, the Nutri-Score, as they reflect a continuum in the recent classification outlined by the EU Commission (2020).

We then assessed the robustness and goodness-of-fit of the model, by surveying 3001 purchase responsibles from three markets (UK, France, Italy) characterised by different situations in terms of obesity rates, introduction date of the market, exposure and awareness levels, (Talati et al, 2017). In particular, the UK has adopted the Multiple Traffic Light since 2013 while France has used the Nutri-Score since 2017 in France. Italy has also been selected for the lack of previous exposure to FOPL. We also focused on the role of trust in the model, to assess its relevance as a mediating factor.

Methods and Materials

Study Population: We worked on a cumulative sample of 3,001 purchase responsible on multiple studies. All surveys were performed in each respondent's language, and sample sizes were computed in accordance with Kline's (2015) optimal ratios of observation : parameter (20:1, with a lower limit of 10:1)

Table 3. Sample

Study	Population	Description
Preliminary Phase Early Stage	61 Italian MBA Students	• Assessment of main label associations with PU and PEOU • Could have been influenced by previous exposure • Awarded with extra points on the final grade
Preliminary Phase Confirmatory	288 (France + UK)	• Understanding of PU and PEOU associations with FoPL • Confirmation of the validity in two countries in which FoPL are already in use
Study 1	1523 (France + UK)	• Identification of construct relationships in FOPL-mediated contexts
Study 2	191 (Italy)	• Three subgroups: NutrInform, MTL, Nutri-Score
Study 3 and 3.b	189 (Italy)	• Manipulation check + analysis on mediation effect

Surveys were administered via Prolific, a web panel provider with high recruitment standards, a proper response rate and high reliability and replicability of studies (Palan & Schitter, 2018). We used SPSS Statistics for reliability tests, and SPSS AMOS for CFA and SEM.

Research design: In the preliminary phase, MBA students were tasked with composing a healthy meal by considering information derived from labels applied to different alternatives of specific products. They then performed prioritization, to rank items according to how well the meaning of each statement matched the given definition of PEOU and PU (Sherif & Sherif, 1967), and categorization, to allocate items into clusters according to their similarity (Davis, 1989; Sherif & Sherif, 1967), leveraging spontaneous associations.

In Study 1, we tested the French and UK samples, to verify whether the relationships among constructs were observable in Front-of-Pack labels mediated contexts (i.e., Nutri-Score and Multiple Traffic Light). We assessed the validity of PU, PEOU, Attitude Toward the Using (ATT) and Behavioral Intention (BI) items through a CFA. Subsequently, in study 2 we tested the validity of FOPAM in Italy, a country where no FoPL system has been adopted, on NutrInform Battery, on the Multiple Traffic Light, and on the Nutri-Score. Study 3 poised to understand, via a manipulation check, the degree to which consumers perceive the nutritional information of FOPLs as deriving from an algorithm, nutritional experts, consumers' associations, firms or institutions, as well as the mediating effect of trust.

Analysis: After a de-duplication process to reduce redundancies, a combined 33 items concerning PU and PEOU were selected using scales from studies regarding technology

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(Davis, 1989, 1993; Venkatesh et al., 2003) and food (Kim & Woo, 2016; Ma et al., 2017), plus items for "Attitude toward using the label" and "Behavioral Intention", adapted to the context of food shopping in FoP-mediated settings. Mirroring Davis's approach (1989), we obtained three main clusters for both scales. A combination of Python code, Gephi and R code was employed to represent the clusters as part of a weighted network graph. Modularity was employed to create communities (Langfelder et al., 2008) of clusters, prioritising items according to a scoring model which considered the times an item was ranked in a position. Items were then ranked based on their normalized score. The scales were confirmed by surveying French and UK grocery shoppers, already exposed to FoPLs, applying Cronbach's Alpha, Principal Component Analysis (PCA) and Confirmatory Factor Analysis (CFA) and resulting in 4 items for PU and 3 for PEOU.

Study 1 was employed to (1) validate the effectiveness of the scales tested in the preliminary phase in a larger sample to confirm that PU and PEOU function as prominent constructs in forming attitudes and behavioural intention in FOP-mediated contexts, and (2) develop and introduce FOPAM through a Structural Equation Model, adapting TAM to food contexts.

In study 2, a CFA was followed by the evaluation of the goodness of fit of the model. A multi-group analysis evaluated the invariance across the groups exposed to the three different labels.

Findings

Study 1: The CFA suggested a high model fit (UK: $\chi2$ = 229.651, p=0.000; GFI=0.953; CFI=0.981; NFI = 0.977; SRMR=0.028; RMSEA=0.069) (France: $\chi2$ = 130.197, p=0.000; GFI=0.969; CFI=0.989; NFI = 0.982; SRMR=0.0214; RMSEA=0.051). Also, for the SEM (UK: $\chi2$ = 308.673, p=0.000; GFI=0.937; CFI=0.973; NFI = 0.969; SRMR=0.0621; RMSEA=0.080) (France: $\chi2$ = 137.312, p=0.000; GFI=0.968; CFI=0.988; NFI = 0.981; SRMR=0.0623; RMSEA=0.023) all the relationships among latent constructs were significant, and PEOU significantly predicted PU (UK: β=0.689, p<0.001; France: β=0.522, p<0.001) and attitude toward usage (β=0.230, p<0.001; France: β=0.305, p<0.001). Specifically, in a FoPL context, PU significantly affects attitude toward usage (UK: β=0.746, p<0.001; France: β=0.653, p<0.001), which in turn affects BI (UK: β=0.386, p<0.001; France: β=0.564, p<0.001). Attitude significantly mediates the relationship between PU and BI (UK: β=0.287, p<0.001; France: β=0.259, p < 0.001). This study validates the FOPAM model, connecting PU and PEOU to Attitude Formation and BI.

Study 2: The CFA showed an acceptable fit of the sample data of Italian customers to the model (NS: $\chi2$ = 151.077, p=0.000; GFI=0.923 CFI=0.977; NFI = 0.966; SRMR=0.0220; RMSEA=0.084; MTL: $\chi2$ = 102.822, p=0.000; GFI=0.951; CFI=0.988; NFI = 0.977; SRMR=0.0210; RMSEA=0.060; NI: $\chi2$ = 109.207, p=0.000; GFI=0.945; CFI=0.985; NFI = 0.974 SRMR=0.0260; RMSEA=0.063), and a high reliability and validity of the constructs. It indicates that the measurements are discriminating properly among themselves and converge within the assumed construct. Convergent validity suggests that all loadings are measuring the construct properly whilst, as per the discriminant validity, are distinctive among them (λ>0.70 and SMC>0.50) . For all the three labels, PEOU significantly predicts PU (NI: β=0.723, p<0.00; MTL: β=0.697, p<0.001; NS: β=0.650, p<0.001) and Attitude (NI: β=0.287, p<0.001; MTL: β=0.324, p<0.001; NS: β=0.184, p<0.001) which in turn positively affects BI (NS: β=0.291, p<0.001; MTL: β=0.267, p<0.01; NI: β=0.547, p<0.001). BI is also predicted by PU (NI: β=0.363, p<0.001; MTL: β=0.267, p<0.001; NS: β=0.291, p<0.001). The invariance test showed that the configural invariance model across front-of-packs demonstrated an acceptable model fit. In the configural model all parameters are estimated for the calibration and validation groups simultaneously; that is, no parameter is constrained equally across

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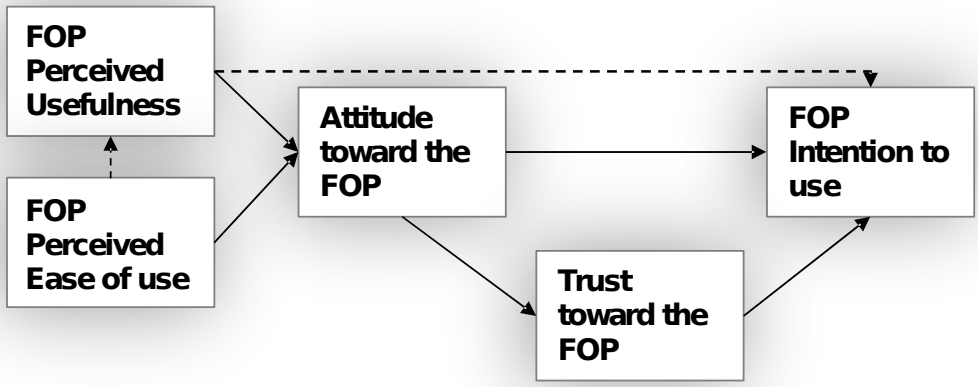
groups (Byrne, 2013). This multigroup model yielded a $\chi 2$ value of 474.073 with 210 degrees of freedom and served as the baseline referent against which all subsequent models were compared. In the second model tested (measurement weights), all factor loadings of the indicator variables were constrained equally across groups, hypothesizing no variance in the way constructs are formed. In the models (structural weights, covariances and residuals) all betas, covariances and residuals were constrained equally across groups, hypothesizing no variance in the way relationships between constructs were formed. Observing the fact that the ΔCFI across all models never exceeded the cutoff of 0.01, according to Cheung & Rensvold (2002), we concluded that the model is completely and totally invariant across the three groups. In summary, this conclusion advises that all factor loadings, structural paths, factor covariances, factor residual variances, and measurement error variances are operating equivalently across calibration and validation samples.

Study 3: Study 3 revealed that an increase of attitude toward using the FOPL led to a higher trust toward the label (b=0.73; t(189)=16.37; p<0.001); the trust, in turn, positively affected consumers' Behavioral Intention (b=0.36; t(189)=6.26; p<0.001). Whereas, since the algorithm aversion does not vary significantly across the sample, we found it to be not significant (b=0.25; t(189)=0.92; p=0.35). When considering attitude toward using FOPL in the regression model with Behavioral Intention (BI) as the dependent variable, the variable shows a positive significant effect on BI (b=0.53; t(189)=9.691; p<0.001). More importantly, the indirect effect of trust variable on BI was positive and significant (b=0.2607; 95% CI:0.1659 – 0.3675), thus confirming that trust partially mediates the effect of attitude toward using the label on Behavioral Intention.

Figure 2. Front-of-Pack Acceptance Model adopted in studies 3 and 3.b



Study 3.b: Subsequently, to assess whether the Front-of-Pack labels cued with computational details significantly vary the perception of the two Front-of-Pack labels, we ran a sequence of independent two-sample t-test. As regards the comparison between Nutri-Score and NutrInform Battery cued with computational information, the Nutrient-specific label showed higher means in terms of attitude (MNutri-Score=5.30; SD = 1.56 vs. MNutrInform=6.03; SD=0.84; t(1.189)=-3.778; p<0.001) and trust (MNutri-Score=4.94; SD=1.47 vs. MNutrInform=5.58; SD=0.90; t(1.189)=-3.410; p<0.001). Similarly, the behavioral intention varies significantly between the two labels (MNutri-Score=5.30; SD=1.47 vs. MNutrInform=5.89; SD=0,94; t(1189)=-3.134; p<0.001). Hence, NutrInform Battery showed

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significant and positive mean differences in terms of Trust, Attitude and Behavioral Intention also when the two labels are cued with details referring to the computational information. By focusing on trust, we offered a possible analysis of the extent to which the presence, even if indirect, of algorithmic elements can bring changes to decision-making. In addition, looking at the results on the individual variables, there was evidence that the Nutri-Score was less effective than the NutrInform Battery on Attitude, Behavioral Intention, and Trust. Furthermore, the results indicated that respondents do not vary their Attitude toward the label, Trust and BI if the Front-of-Pack labels are combined with computational details.

Table 4. Summary of results

Study	Description
Studies 1 and 2	• H1: not rejected • H2: not rejected • H3: not rejected • H4: not rejected • H5: not rejected
Study 3	• H6: not rejected
Study 3.b	• H7: not rejected • H8: not rejected • H9: not rejected • H10: not rejected

General Discussion

The aim of our studies was to contribute to the FOPL debate with a new approach, oriented at understanding the role of consumer acceptance of labelling systems and their usefulness and ease of use in directing towards informed and healthier choices, as mediated by trust.

We thus expanded the TAM, a very flexible and tested model, to measure the efficacy of labelling schemes. As labels play a prominent role in informing the consumer decision-making process at the point of sale, it is important to understand not only which kind is more informative, but also which ones overthrow acceptance barriers and guide consumers towards healthier behaviours.

The FOPAM contributes to the current debate by proposing an alternative and complementary framework that provides additional information about acceptance and efficacy: this can be of significant advantage to policymaking, and to citizens as well. Building on the fact that when consumers feel trust, their purchase intention increases (Aydin et al., 2014), consumers may feel less trust towards a less detailed food label. Considering that some labels, as the Nutri-Score, are the result of algorithmic calculations, this study shows statistically significant differences in the effects of algorithms on consumer behavior and investigates the effectiveness of the mediating role of trust towards the label in these contexts.

Thus, the upgraded FOPAM allows for an alternative theoretical model to move forward in the EU debate to assess the relative superiority of different FOPLs and by preventing the possible introduction labels that are less trusted, and then less effective, from a customer acceptance point of view.

Our model suggests that the effectiveness of labels in affecting attitudes and Behavioral Intentions towards food purchase is predicted by their usefulness and ease of use: labelling systems support buying decisions and contribute to the definition of healthier choices when they are perceived as useful and easy to use. We have shown trust to be a significant factor in the BI of consumers towards food labels, and we have built on it a model capable of measuring the different performances of two divergent labels - the NutrInform Battery and the

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Nutri-Score - leading to clear and incontrovertible results on the superiority of the NutrInform Battery across all dimensions of the FOPAM.

Conclusion

Our research aims at contributing to the European Debate on Front-of-Pack labelling by introducing acceptance and trust as metrics to evaluate label efficacy on improving people's decision toward healthier food choices, through a systematic model that can provide actionable insights to multiple stakeholders and to policymakers in particular

Yet, our study is not exempt from limitations. As it was decided to study Italian, French and English respondents, future research should try to target individuals from other countries in order to understand whether the results are generalizable in a broader way. Furthermore, our research has given relevance to trust, but the model could be further integrated by considering other variables, such as actual use versus perceptual use, user experience level or type of users and type of use (King & He, 2006; Venkatesh, 2000). In addition to that, our work was performed as a survey-based experiment: implementing a field test could provide a real-world validation of the results and behavioral values.

We believe study such as ours should have the chance to encourage policy makers to promote nutrition education among consumers, and can help identify the right way to do so to benefit citizens.

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