The Interaction of Front-of-Package Food Processing Claims and Disclosures for Ultra-Processed Products

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In recent years, ultra-processed food consumption has been linked to many critical negative health outcomes including obesity, type-2 diabetes, cardiovascular disease, and cancer (e.g., Juul et al. 2021; Monteiro et al. 2019; Collins 2020; Piore 2021; Hall et al. 2019). Food product processing relates to how the foods have been manufactured through industrial techniques that often include processes such as hydrogenation, extrusion, and the addition of colorants, emulsifiers, and preservatives (Matos et al. 2021; Piore 2021). Ultra-processed foods (UPFs) account for more than 50% of U.S. consumers caloric intake, and include foods such as frozen food dinners, breakfast cereals, hot dogs, and carbonated soft drinks. Many countries including Brazil, Uruguay, Ecuador, Peru, and France are now explicitly recommending that consumers reduce intake of UPFs to decrease various negative health effects and diseases.

This research is the first to examine the use of ultra-processing package disclosures in conjunction with favorable food processing claims (e.g., "natural," "organic"), and nutrient content (e.g., sugar, sodium) warnings on perceived product processing level, disease risk evaluations, and purchase intentions. Using a pilot test and three studies, we add to the marketing discipline's existing knowledge on front-of-package (FOP) labeling in three important ways. First, the effects of processing related FOP claims and disclosures have not been studied as extensively as nutrient content claims. Understanding how these positive claims and disclosures jointly affect consumer perceptions of the processing level of food products enhances our understanding of what consumers consider when determining the healthfulness of food products and making purchase decisions. Second, *nutrient content* stop sign disclosures on packaging have recently been studied (Andrews et al. 2021) and are currently being implemented in many countries including Chile, Argentina, and Brazil (Monteiro et al. 2019). However, food *processing* stop sign disclosures have not been studied and thus offer a novel and important role in fulfilling the requirements proposed in the U.S. Food Labeling Modernization Act

(FLMA) to aid consumers in healthier food choices. Lastly, directly comparing processing claims and disclosures to our knowledge has yet to be studied and answers a recent call to explore the interactions between different types of FOP labeling (Ikonen et al. 2020). Thus, research examining how processing stop sign disclosures attenuate the positive inferences created by unregulated processing claims is essential for public policy, CPG marketers, and consumer well-being.

Background, Theory and Predictions

Marketers use various claims and promotions on the FOP to communicate favorable benefits to consumers. Conversely, global health, NGOs, and policy makers attempt to ensure claims are not deceptive and that consumers are presented with information that aids in making informed (and hopefully more healthful) decisions. Because they are generally not regulated and communicate positive information, processing claims (e.g., "natural") made by the manufacturer should be perceived favorably and affect the perceived processing level of the product. In contrast, stop signs communicate only negative information that warns consumers of high and problematic levels of an attribute.

There is a vast literature that demonstrates the relative strength of negative information such as that indicated by stop signs that relate to unfavorable nutrition or product processing levels (e.g., contains artificial ingredients, preservatives, etc.). For example, the psychology and marketing literatures both show that negative information is weighted more heavily than positive information in consumer evaluations and decisions (Baumeister et al. 2001; Tversky and Kahneman 1981). This negative information can dominate the effects of other favorable information on evaluations, and thus we anticipate that UPF and processing attribute package disclosures should attenuate effects of favorable processing related claims, such as those indicating the product is "natural" (Berry et al. 2017; FLMA 2021) or organic (Bauer, Heinrich, and Schafer 2013). In Studies 1 and 2, we examine both an UPF stop sign disclosure and processing attribute disclosures (contains GMOs. artificial ingredients, preservatives). We anticipate that relative to a no disclosure control, both will affect processing level perceptions and

perceived product healthfulness (H1 and H2) and attenuate the favorable effects of a favorable processing claim (i.e., all-natural, organic) on the FOP (H4).

Given the many recent studies showing the unfavorable effects of UPF consumption on consumers' health, understanding how perceived processing level is related to downstream consequences is of substantial interest. While the recent medical research *objectively* shows the negative effects of UPFs on health outcomes and disease risk, it is less clear how links to disease are *perceived* by consumers. We anticipate that product processing level is a mediator that is likely to be directly influenced by stop sign disclosures (H3). Consistent with prior research indicating the *positive* indirect effects of favorable package claims about *natural* and *minimal processing* on health-related outcomes and purchase intention (e.g., Rybak et al. 2021), we predict that unfavorable evaluations about perceived processing level will mediate effects of processing claims (e.g., natural, organic) (H5). Further, extending the moderation proposed in H4, we predict mediation for the interaction of these positive processing claims and stop sign disclosures (i.e., moderated mediation predicted in H6).

Overview of Methods and Results

In a pilot study and three randomized between-subjects online experiments (total n=1740), we examine the H1 to H6 predictions. Effects of the following independent variables on food package stimuli are examined: an ultra-processed warning, both regulated (e.g., USDA Organic) and unregulated processing claims (e.g., "natural") on the package, and nutrient content stop signs (e.g., high in sugar; high in sodium), such as those now used in Chile, Brazil, and Mexico (Popkin et al. 2021). Study 1 is a 2 x 2 and Studies 2 and 3 are a 2 x 2 x 2 between-subjects experiments. Stimuli examples are available upon request. We assess predictions for main effects, interactions, and mediation of effects through perceived processing level for multi-item dependent variable measures of perceived product healthfulness, disease risk perception, and purchase intentions (all α's > 0.90) using measures from prior studies (e.g., Berry et al. 2017).

The pilot study shows that most consumers have a general understanding of what "ultra-processed" means in a food context and are able to identify UPF categories (e.g., hot dogs, frozen food dinners, breakfast cereals, soft drinks). Study 1 ANOVA results show that ultra-processed stop sign disclosure (UPF_{disc}) and processing attribute disclosures (PA_{disc}) affect processing level, perceived healthfulness, disease risk, and purchase intentions for the frozen food dinner. Mediation results from PROCESS model 4 (Hayes 2022) show perceived processing level mediates effects of each of the disclosures on healthfulness, disease risk, and purchase intentions, and results support H1-H3.

Study 2 examines the effects of three factors, the UPF and PA disclosures in Study 1 and a "natural" claim for the product. All main effects are significant for processing level perception, but are qualified by two-way and three-way interactions ($F(1,598) = 4.26$, $p < 0.05$). The effects of the all-natural claim are significant when there are no disclosures on the package, but when the UPF_{disc}, PA_{disc}, or both are displayed, the effects of the all-natural claim are *not* significant. Results for moderated mediation using PROCESS model 12 (Hayes 2022) support mediation effects on purchase intentions through perceived processing level. A figure for the three way interaction and the mediation results are shown in Table 1. Study 3 extends these results to a different product category (an energy bar instead of a frozen dinner) and use of an USDA organic claim (rather than the natural claim in Study 2). Moderated mediation results are replicated for the different category and organic claim. In general, the pattern of results provide support for H1-H6.

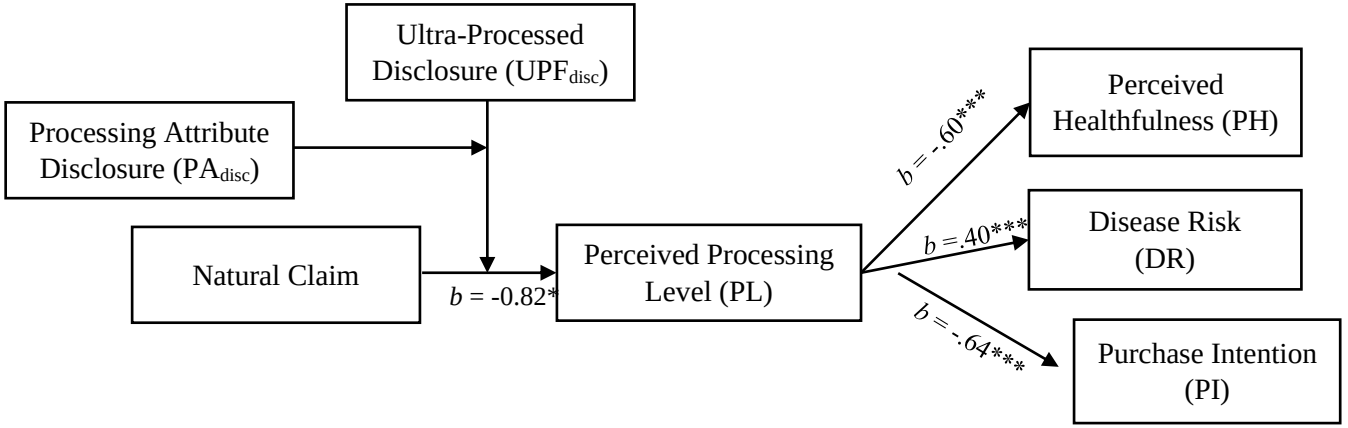
Conclusions and Implications

Through a pretest and three studies, we show consistent results suggesting the importance of using processing-related stop-sign disclosures on food packaging. Both studies highlight the direct positive effects on perceived processing level and the negative effects on healthfulness and purchase

intentions. Furthermore, processing level was shown to mediate the relationship between these disclosure types and disease risk, and results differ from controls with no processing disclosure information. This is important because even though prior research suggests *objective* disease links from consumption of UPFs, our studies show consumers *perceive* increased levels of processing lead to increased risk of disease. Further, Studies 2 and 3 revealed the importance of stop-sign disclosures in attenuating the positive inferences created from unregulated FOP claims (e.g., natural) on perceived processing level which extended to perceptions of disease risk, healthfulness, and purchase intentions. As a result, this research is particularly meaningful for both CPG food managers marketing healthy foods to consumers as well as policy makers seeking to implement food labeling systems based on the recent FLMA (2021). In addition, the U.S. FDA is currently evaluating use of a Healthy icon on product packaging, but how "healthy" will be operationally defined is currently being debated (FDA 2022). Our results show the importance of healthfulness of products for consumers clearly includes how the product is processed, and there are downstream effects on disease risk and purchase intentions.

Table 1
Study 2: Conditional Mediation Effects of Disclosures and Natural Claim on Healthfulness, Disease Risk, and Purchase Intentions

Panel A: Mediation Model Tested (PROCESS Model 12)



Panel B: Conditional Indirect Effects (IEs) of Stop Sign Disclosures on Natural Claim

	Index of Moderated Mediation		No Disclosure		Ultra-Processed Disclosure		Processing Attribute Disclosure		Both Disclosures	
	Index	95% CI	IE	95% CI	IE	95% CI	IE	95% CI	IE	95% CI
Mediation Paths										
Nat. Claim → PL → PH	0.49*	[0.02, 1.00]	0.46†	[0.19, 0.74]	-0.07	[-0.30, 0.14]	0.19	[-0.03, 0.41]	0.16	[-0.07, 0.40]
Nat. Claim → PL → DR	-0.33*	[-0.67, -0.01]	-0.30†	[-0.51, -0.13]	0.05	[-0.10, 0.20]	-0.13	[-0.27, 0.02]	-0.10	[-0.26, 0.05]
Nat. Claim → PL → PI	0.52*	[0.02, 1.07]	0.49†	[0.21, 0.81]	-0.07	[-0.32, 0.15]	0.21	[-0.03, 0.44]	0.17	[-0.08, 0.42]

Notes: The table shows results of Model 12 (Hayes 2018) assessing if the positive effect of the natural claim is moderated by the two stop sign disclosure types and is mediated by the perception of processing level. There are three outcomes assessed, perceived healthfulness, disease risk perceptions, and purchase intentions. The index of moderated mediation is the test of moderated (or conditional) mediation for each of the separate mediation paths (Hayes 2018). The IEs are the indirect effects for the natural claim across the four information disclosure conditions. The CIs are the bias-corrected 95% confidence intervals. Natural Claim (Nat. Claim) indicates whether the natural claim was present (0.5 if present, -0.5 if absent) on the package, while the disclosure conditions indicate if the ultra-processed stop sign disclosure (UPD) (0.5 if present, -0.5 if absent) or the processing attributes stop sign disclosure (PAD) (0.5 if present, -0.5 if absent) were shown on the front of the package. The three-way interaction between UPD, PAD, and NC is negative and significant (b = -0.82, $t(597)$ = -2.06, $p < 05$). Processing level, in turn, negatively affects all outcomes.

* Statistically significant index of moderated mediation. † Statistically significant indirect effect.

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