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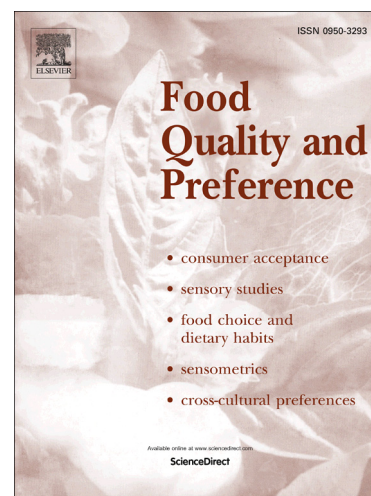
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**The relative ability of different front-of-pack labels to assist consumers discriminate  
between healthy, moderately healthy, and unhealthy foods**

RUNNING TITLE: Effectiveness of the health star rating

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## 1. Introduction

The provision of front-of-pack labels (FoPLs) on prepackaged foods is a common public health intervention aimed at reducing diet-related chronic disease (Cecchini et al., 2010; Hawkes, 2010). Different FoPLs vary in how effectively they assist consumers to make healthy choices, which is likely to be related to the degree to which they provide an interpretation of the nutrient profiles of foods (Hamlin, McNeill, & Moore, 2015). The Daily Intake Guide (DIG), which states the level of selected negative and positive nutrients (e.g., fat, sugar, protein) within a product in grams per serve and as a percent of an average adult's recommended daily intake, is known as a reductive FoPL because it provides little interpretation of nutrition information. The Multiple Traffic Lights (MTL) FoPL, which use the colors red, amber and green to indicate whether negative nutrients are high, medium or low respectively, is known as an evaluative FoPL because it provides more interpretation of the nutrition information. Evidence suggests that evaluative FoPLs are more likely to lead to greater accuracy in determining relative healthiness and greater intentions to purchase healthier products than reductive FoPLs (Hawley et al., 2013; Hersey, Wohlgenant, Arsenault, Kosa, & Muth, 2013).

The Health Star Rating (HSR) has recently been introduced as a voluntary evaluative FoPL in Australia and New Zealand (Australian Government Department of Health, 2013).

Manufacturers can choose to specify the amount of key nutrients per 100g or per portion and include text to indicate whether nutrient levels are high or low. The key differentiating aspect of the HSR is a summary indicator (that is always present) that rates overall product healthiness from half a star to five stars. Focus group research suggests that consumers find the summary indicator in the HSR easier to interpret than nutrient-level information (both in the HSR and other FoPLs; Talati et al., 2016) However, quantitative evidence to support this suggestion is lacking. Another study recently found that across healthy and unhealthy foods, respondents were less likely to select a product if the HSR was present rather than absent (Hamlin & McNeill, 2016), although this may have been because the HSR was colored red in that study and red has been shown to create avoidance reactions to foods regardless of actual healthiness (Rohr, Kamm, Koenigstorfer, Groeppel-Klein, & Wentura, 2015). Importantly, the main effect of package design was far greater than the main effect of the HSR, suggesting that consumers were basing their choice more on other elements of the package design than the FoPL.

The aim of this study was to quantitatively measure consumers' perceptions of product healthiness resulting from exposure to FoPLs characterized by varying levels of interpretive content. Listed from least to most interpretive content, the three tested FoPLs were the DIG that provides only reductive nutrient-level information, the MTL with its color-coded nutrient-level interpretations and the HSR with its summary indicator and text-based nutrient-level interpretations. It was hypothesized that ratings of perceived healthiness would be more aligned with a product's nutritional profile when the HSR or MTL was present, but not when

the DIG or no FoPL was present. The interaction of these variables with demographic factors such as age, gender and socioeconomic status (SES) was also explored.

## 2. Methods

This study was part of a larger research project investigating Australian consumers' attitudes towards packaged foods (Trial ID: ACTRN12616000626460, see <https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=370675> for further details on all of the variables manipulated and assessed). Ethics clearance was obtained from a University Human Research Ethics Committee. The study design and variables relevant to the present analysis are described below.

### 2.1 Sample

A sample of Australian children and adults was recruited from a national online panel using radio and internet advertising, publicity and referrals. Quotas were set according to age, gender and SES (Australian Bureau of Statistics, 2011). Of the 2,058 respondents, 50% were female, 25% were children (10 – 17 years of age) and 49% were from low SES neighborhoods (see Table 1 for a breakdown of the demographics). Participants received a small nominal payment for their time in completing this survey.

**Table 1.** Age, gender and socioeconomic status of survey respondents ( $n= 2,058$ )

Age (years)	Socio Economic Status		BMI (Body Mass Index)		
	Low	Medium-High	Underweight	Normal weight	Overweight/obese
<i>Males (n=1,028)</i>					
10-18	132	139	32	81	63
19-35	118	117	6	78	93
36-55	126	133	0	63	145
56+	128	135	2	50	182
Total	504	524	40	272	483
<i>Females (n=1,030)</i>					

10-18	126	135	34	101	46
19-35	122	119	20	76	68
36-55	131	130	12	73	110
56+	132	134	6	74	135
Total	511	518	72	324	359

Note: BMI calculated according to categorization outlined by the World Health Organization

(World Health Organisation, 2004)

## 2.2 Stimuli

The design of the fictional mock packs and their corresponding nutritional profiles were created based on real products currently found in Australian supermarkets. The product attributes relevant to the present study were FoPL type (none, DIG, MTL and HSR) and nutritional profile (healthy, moderately healthy and unhealthy). Food type was also varied to ensure that FoPL effectiveness was generalizable across a diverse range of foods (i.e., cookies, cornflakes, pizza and yoghurt). The unhealthy, moderately healthy and healthy variants of the pizzas and cookies received a star rating of 1, 2 and 3 stars respectively, while the cornflakes and yoghurt (which tend to be healthier products) received a star rating of 1.5, 3 and 4.5 stars, respectively. All levels of each variable (FoPL, nutritional profile, food type) were fully crossed resulting in a full factorial design. Figure 1 shows the FoPLs used for the different nutritional profiles for one of the food types (cornflakes) and Figure 2 shows an example cornflakes mock pack.

## 2.3 Procedure

Respondents were recruited through an ISO accredited web panel provider (PureProfile) to take part in the online study via a computer or laptop. They completed demographic questions assessing their age, gender, SES and BMI before viewing and individually rating eight mock packs. Each participant saw 2 packs from each FoPL condition (with the first 2 coming from the no FoPL condition) and 2 mock packs from each food product category

(with no 2 products from the same food category occurring in a row). Scores on two 5-point semantic differential scales (Unhealthy – Healthy, Non-Nutritious – Nutritious) were averaged to create one measure of perceived healthiness ( $r = .82$ ,  $\alpha = .90$ ). Two items were used to increase the reliability of this outcome measure (rather than using a one-item scale). Throughout the task, respondents could view the Nutrition Facts Panel (NIP) by clicking a link below the mock pack image. For each rating task, data was collected on whether the NIP was viewed or not. Over the entire study, the NIP was viewed 17% of the time.

## 2.4 Analyses

Nutritional profile, FoPL, NIP views, the nutritional profile x FoPL, nutritional profile x NIP views and nutritional profile x FoPL x NIP views interactions were entered as fixed effects, respondent ID was entered as a random effect and age, gender, SES and BMI were entered as covariates into a linear mixed model with perceived healthiness as the dependent variable. Where significant main effects or interactions of the experimental manipulation were found, post hoc tests (adjusted using a Sidak correction) were conducted to determine where the differences occurred. Finally, a linear mixed model was run to test for interactions between FoPL and nutritional profile with food type, age, gender and SES.

## 3. Results

Nutritional profile influenced respondents' perceptions of product healthiness ( $F(2, 11374.28) = 26.02$ ,  $p < .001$ ), with unhealthy foods being accurately perceived as less healthy (all  $ps < .05$ ). There was no significant main effect of FoPL on perceived healthiness ( $F(3, 10997.28) = .6231.28$ ,  $p = .60$ ), but FoPL condition and nutritional profile interacted to influence perceived healthiness ( $F(6, 11372.30) = 2.57$ ,  $p < .017$ ). As shown in Figure 3, respondents perceived products with different nutritional profiles to be comparably healthy

when they featured no FoPL ( $M_{\text{healthy}}=3.05$ ,  $M_{\text{unhealthy}}=2.96$ ) or the DIG ( $M_{\text{healthy}}=3.01$ ,  $M_{\text{unhealthy}}=3.02$ ). However, when food products were labelled with the HSR, respondents were better able to discriminate between healthy/moderately healthy ( $M_{\text{healthy}}=3.13$ ,  $M_{\text{moderate}}=3.04$ ) and unhealthy products ( $M_{\text{unhealthy}}=2.91$ ). A marginally significant trend ( $p=.052$ ) indicated that the MTL provided weak assistance to consumers when distinguishing between healthy and unhealthy products, but did not improve discrimination of moderately healthy products from unhealthy and healthy comparators.

There was a significant interaction between NIP and healthiness. Participants who did not check the NIP were only able to distinguish healthy and unhealthy products ( $M_{\text{healthy}}=3.08$ ,  $M_{\text{unhealthy}}=3.02$ ,  $p=.013$ ) while those who did check the NIP could distinguish between all levels of healthiness ( $M_{\text{healthy}}=2.96$ ,  $M_{\text{moderate}}=2.82$ ,  $M_{\text{unhealthy}}=2.62$ , all  $p<.010$ ).

No significant interaction was found between FoPL and nutritional profile by NIP views, food type, age, gender or SES.

#### 4. Discussion

The aim of this study was to examine whether certain FoPLs are more effective in helping consumers discriminate between healthy, moderately healthy and unhealthy foods in terms of their perceived healthiness. Results revealed that the HSR out-performed two other FoPL schemes in enabling consumers to distinguish between healthy and unhealthy foods. Thus the hypothesis that evaluative FoPLs are more effective than reductive FoPLs in helping consumers discriminate between products of varying nutritional profiles was upheld for the HSR, with weak evidence suggesting that the MTL also facilitates product evaluation. The finding that an evaluative FoPL provided most utility for consumers is consistent with previous studies (Hawley et al., 2013; Hersey et al., 2013) and contributes new knowledge by



demonstrating that the HSR was more effective than the MTL. The NIP also helped respondents discriminate between products with different nutritional profiles. Accuracy was highest in instances where respondents chose to check the NIP, which in this study was less than a quarter of the time. There was no interaction between viewing the NIP, the presence of a particular FoPL and product healthiness on perceived healthiness.

The observed efficacy of the HSR is contrary to the results of one other quantitative study examining the HSR (Hamlin & McNeill, 2016). This may be due to the other study applying red coloring to the HSR and only studying muesli products, while the present study used a black and white HSR across multiple food products. Furthermore, the other study was conducted in New Zealand in October/November 2014, which was only a few months after the HSR had begun appear on select products and before the education campaign was launched. Thus familiarity with the star rating in the context of food would have been lower than in the current Australian study where the HSR has been in use since 2014 and supporting public education had been disseminated (Australian Government Department of Health, 2015). Given that so few studies have empirically examined the HSR, further testing is warranted.

In the present study, the HSR outperformed the MTL by facilitating discrimination between products with different nutritional profiles. Focus group research suggests that consumers find it difficult to reconcile all the information provided in individual nutrient indicators, such as that presented in the MTL and DIG formats, a problem that is ameliorated by the HSR's summary indicator (Talati et al., 2016). The ease with which people can identify healthy and unhealthy products using the HSR could lead to the unintended consequence of this FoPL being used to select unhealthy discretionary foods, based on the assumption that taste and

healthiness are negatively correlated (Raghunathan, Naylor, & Hoyer, 2006; Talati et al., 2016).

#### *Limitations, strengths and future research*

This study was limited by its focus on perceived product healthiness and not purchase or consumption behaviors. These behaviors are influenced by many other factors (especially price and taste; Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Sanlier & Karakus, 2010), and addressing consumers' perceptions of product healthiness constitutes just one aspect of the broader public health challenge of changing dietary patterns at the population level.

Caution must be used when attempting to generalize the findings from the specific FoPLs in this paper to other similar FoPLs. There are multiple differences between different types of FoPLs (e.g. colour, method of depicting summary evaluation), and without systematically varying all elements of a FoPL it is not possible to know how each element impacts product assessments. While many past studies have concluded that evaluative FoPLs are more effective than reductive FoPLs (Hawley et al., 2013; Hersey et al., 2013), a relative strength of this study is in its examination of whether different aspects of evaluative FoPLs (i.e., global versus nutrient-level information) can lead to more accurate judgements of product healthiness. This study provides an important starting point for future research on how different FoPLs (particularly the HSR) may influence food choice and consumption behaviors.

#### *Implications for policy and practice*

This study sought to determine which FoPL system best helps consumers distinguish between healthy and unhealthy products. Although many marketplaces contain products with different FoPLs (as well as products with no FoPLs), this study tested outcomes under ideal

circumstances (i.e., when one FoPL is uniformly applied across all products from the same category). The findings are important as they show potential benefits of implementing specific systems. The results have implications for food labelling policy around the world, and particularly for Australia and New Zealand where the HSR has begun to appear on packaged foods. The HSR facilitated more accurate identification of healthy and unhealthy foods compared to the DIG and no FoPL conditions. These results were observed in a diverse sample of consumers (i.e., males and females, those aged 10 to 85 years and people from high and low SES backgrounds), supporting the usefulness of the HSR as a population-level public health intervention.

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**Conflict of interest:** The authors declare no conflict of interest.

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**Figure 1.** FoPLs used on the cornflakes mock packs.

**Figure 2.** Example cornflakes mock pack

**Figure 3.** Discrimination between nutritional profiles according to FoPL

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Front-of-pack label condition	Healthiness		
	Unhealthy	Moderate	Healthy
No label			
Daily Intake Guide	<p>PER 30g SERVE</p>	<p>PER 30g SERVE</p>	<p>PER 30g SERVE</p>
Multiple Traffic Lights	<p>1 cup of cereal (30g) contains</p>	<p>1 cup of cereal (30g) contains</p>	<p>1 cup of cereal (30g) contains</p>
Health Star Rating	<p>PER 100g</p>	<p>PER 100g</p>	<p>PER 100g</p>

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Product healthiness comparison	FoPL condition	Mean difference	95% confidence intervals	Difference in perceived healthiness	<i>p</i>
Healthy - Unhealthy	No FoPL	0.09	-0.02 - 0.2		.133
	DIG	-0.01	-0.12 - 0.1		.996
	MTL	0.11	0.00 - 0.23		.052
	HSR	0.22	0.11 - 0.33		<b>.000</b>
Healthy - Moderate	No FoPL	0.08	-0.04 - 0.19		.281
	DIG	-0.03	-0.14 - 0.08		.865
	MTL	0.04	-0.08 - 0.15		.833
	HSR	0.09	-0.02 - 0.2		.124
Moderate - Unhealthy	No FoPL	0.02	-0.09 - 0.13		.975
	DIG	0.02	-0.09 - 0.13		.943
	MTL	0.08	-0.04 - 0.19		.280
	HSR	0.13	0.02 - 0.24		<b>.015</b>

-0.10      0.10      0.30

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**Highlights**

- Health Star Ratings aided discrimination between foods of all levels of healthiness
- Multiple traffic lights were only effective for larger discrepancies in healthiness
- The Daily Intake Guide did not facilitate discrimination of foods by healthiness
- Without front-of-pack labels, respondents could not differentiate by healthiness

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