BEHAVE 2020
6th European Conference on Behaviour and Energy Efficiency
Copenhagen, 21-23 April 2021

Cognition, energy literacy and the class valuation effect for energy labels

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Keywords: Energy efficiency, Energy label, Household decision-making, Information processing, Heuristics, Cognitive style, Energy literacy

1. Introduction

Categorical energy labels with grade-like efficiency ratings are widely used. However, representing energy efficiency information with limited categories has been found to induce heuristic decision-making, i.e. consumers value the efficiency class *per se* while ignoring the more precise difference in energy use, which is also known as the "class valuation effect" [1-3]. This effect has been found to be especially pronounced among those with a low level of cognitive reflection [3]. Alternatively, energy labels with continuous rating-scales include more detailed information and are more suggestive for comparison, thus could stimulate more conscious and rational energy-related decisions [1,4]. However, the effectiveness of the continuous-scale label has not been formally examined yet.

For an energy label to be effective, it is essential that consumers understand and process the information well. The continuous and categorical visualisation of the energy-efficiency rating on energy labels is intrinsically related to the concepts of holistic versus analytic cognitive style. This study therefore accounts for interpersonal and cross-country differences in holistic cognitive tendency [5-9] when studying the processing of information on energy labels, which adds to the understanding of the role of cognition in energy-related choices [3,10]. Besides, the effectiveness of an energy label also depends on whether individuals have the knowledge to understand

and utilise information and if they hold values and norms towards energy-saving [11]. Therefore, this study systematically measures and examines the influence of energy literacy on decision-making by following the multifaceted energy literacy concept [12-13].

Overall, this study addresses the following issues (1) whether the continuous-scale label, as opposed to the categorical label, can support rational decision-making and decrease the use of heuristics, (2) the role of cognitive styles and energy literacy for the processing of information on energy labels, and (3) the differences in the effectiveness of the labels across countries.

2. Methodology

Our analysis is based on a household survey including a decision task with randomized information treatments (between subjects-design). In the decision task, participants were randomly assigned to either a categorical label treatment or a continuous-scale label treatment (Figure 1). Respondents were asked to identify the refrigerator that minimises lifetime cost, among two otherwise identical models, based on the energy-related information communicated on the energy label and the cost information. Each participant was asked to make decisions in three different situations (Table 1). In situation B, where energy efficiency levels of the two models were close but belonged into different classes, we expected the categorical label to trigger decision-making heuristics, whereas the continuous-scale label could support a more rational decision. The decision task was embedded in a survey questionnaire eliciting individual-level characteristics such as socio-demographic information, energy literacy (including knowledge, attitude, behaviour), holistic cognitive tendency, and reasons of making the decision.

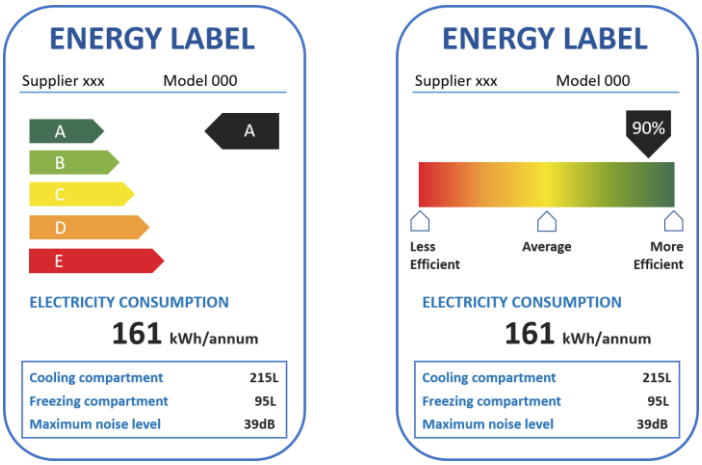

Figure 1. Examples of categorical and continuous-scale label

Table 1: Specification of the three decision situations

		Situation A		Situation B		Situation C	
	Unit	A1	A2	B1	B2	C1	C2
Annual energy consumption	kWh	160	220	205	215	155	210
Energy efficiency class (categorical label)	/	A	B	A	B	A	A
Energy efficiency level (continuous-scale label)	/	90%	79%	80%	79%	90%	80%
Purchase cost	Euro	550	400	500	400	600	500
	RMB	2,475	1,800	2,250	1,800	2,700	2,250

Data are collected in the Netherlands and China, two countries representing the analytical-focal Western and the holistic-contextual Asian cognitive style. The survey questionnaires were administered via Qualtrics with the sampling being done by two professional survey companies. 994 and 1041 valid questionnaires were collected from the Dutch and Chinese respondents, respectively. Both samples are representative for the general urban population in terms of gender and age, yet less representative with respect to education and income, where we observe a slight tendency towards higher education and higher income groups.

3. Results

Probit models are used to analyse the data. Below we present the average partial effects of the independent variables separately for the Chinese and Dutch samples. Overall, indicating energy efficiency with a continuous scale increase the likelihood of correct identification by 3 and 2.4 percentage points among the Chinese and the Dutch sample, respectively, both significant at 10% level. We include an interaction between continuous-scale label treatment and situation B to test whether the effectiveness of the continuous scale is dependent on the type of decision situation (Figure 2). We do not observe a significant interaction effect in the Chinese sample. However, for the Dutch sample, a continuous-scale label significantly increases the probability to identify the cost-minimising refrigerator by 11.3 percentage points - in situation B, while not showing a significant impact in situations A and C.

Based on the theory about analytic vs. holistic cognitive style [5-9], we expected that people with a holistic rather than analytical cognitive style process the information provided on a continuous-scale label more effectively. Results for the Dutch sample suggest that, as an individual's holistic cognitive tendency increases from 0.65 to 1, the continuous-scale label increases the probability of correct identification by 3.1 to 9.4 percentage points. However, in the Chinese sample, this interaction effect is only significant at 10% level when holistic cognitive tendency is around 0.7 (Figure 3). Additionally, possessing energy-related knowledge related to daily life increases the

probability of rational decisions in both countries. However, especially for the Chinese sample, having positive attitudes toward energy-saving and having installed energy-saving devices at home decrease the correct identification.

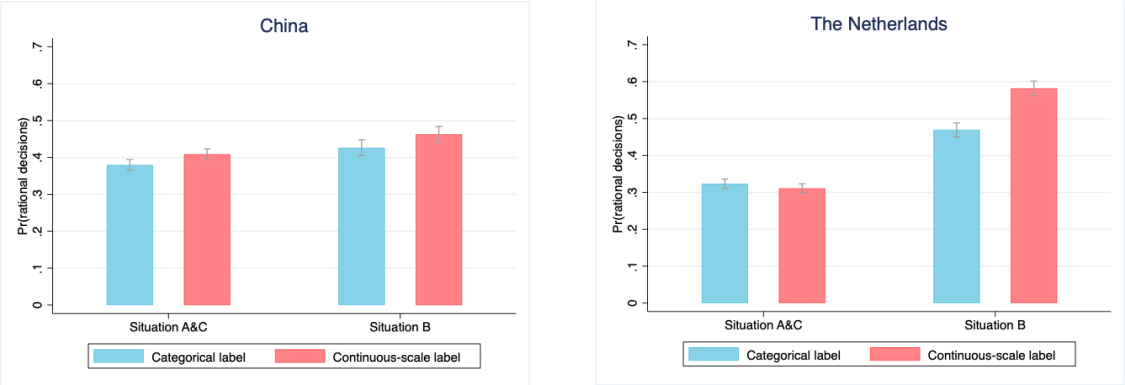

Figure 2. Interaction effect between label treatment and situations

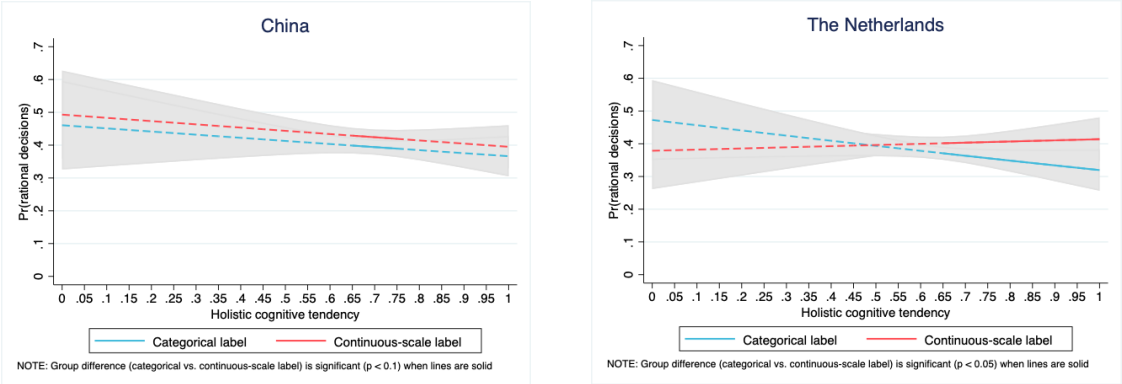

Figure 3. Interaction effect between label treatment and holistic cognitive tendency

4. Conclusions

This study critically evaluated the use of categorical rating-scales on energy labels in the EU and China. Our findings suggest that energy labels indicating the efficiency level of an appliance in efficiency categories, on average, tend to undermine rational decision-making of consumers. In certain situations, a continuous-scale label can correct for the "class valuation effect" [2-3]. Further, our study demonstrates that a holistic cognitive style can influence the effectiveness of visual information, which is a valuable insight to consider for the design of energy labels across countries dominated by different cognitive styles.

References

[1] R. Schubert and M. Stadelmann, "Energy-using durables - why consumers refrain from econom-ically optimal choices", *Frontiers in Energy Researc*h, 3, (2015).

[2] M. A. Andor, A. Gerster and S. Sommer, "Consumer Inattention, Heuristic Thinking and the Role of Energy Labels", *The Energy Journal*, vol. 41, no. 1, pp.83-112, (2020).

[3] M. A. Andor, M. Frondel, A. Gerster, & S. Sommer, "Cognitive reflection and the valuation of energy efficiency", *Energy Economics*, vol. 84, no. 104527, (2019).

[4] C. Egan (2000), "An evaluation of the Federal Trade Commission's EnergyGuide appliance label: Aninterim summary of findings", Available at: https://www.aceee.org/research-report/a003, (2000).

[5] L. Chiu, "A Cross-Cultural Comparison of Cognitive Styles in Chinese and American Children", *International Journal of Psychology*, vol. 7, no. 4, pp. 235-242, (1972).

[6] I. Choi, R. Dalal, C. Kim-Prieto and H. Park, "Culture and Judgment of Causal Relevance", *Journal of Personality and Social Psychology*, vol. 84, no. 1, pp. 46-59, (2003).

[7] L. Ji, K. Peng and R. Nisbett, "Cluture, Control, and Perception of Relationships in the Environment", *Journal of Personality and Social Psychology*, vol. 78, no. 5, pp. 943-955, (2000).

[8] T. Masuda and R. Nisbett, "Attending Holistically Versus Analytically: Comparing the Context Sensitivity of Japanese and Americans", *Journal of Personality and Social Psychology*, vol. 81, no. 5, pp. 922-934, (2001).

[9] A. Norenzayan and E. Smith, "Cultural Preferences for Formal versus Intuitive Reasoning", *Cognitive Science*, vol. 26, pp. 653-684, (2002).

[10] J. Blasch, M. Filippini and N. Kumar, "Boundedly Rational Consumers, Energy and Investment Literacy, and the Display of Information on Household Appliances", *Resource and Energy Economics*, vol. 56, pp. 39-58, (2019).

[11] J. Thøgersen, "Psychological determinants of paying attention to eco-labels in purchase decisions: Model development and multinational validation", *Journal of consumer policy*, 23(3), 285-313, (2000).

[12] J. DeWaters and S. Powers, "Energy Literacy of Secondary Students in New York State (USA): A Measure of Knowledge, Affect, and Behavior", *Energy Policy,* vol.39, no. 3, pp. 1699-1710, (2011).

[13] K. L. van den Broek, "Household energy literacy: A critical review and a conceptual typology". *Energy Research & Social Science*, 57, 101256, (2019).