Transportation Research Part D 63 (2018) 718–732

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

CO_2 valence framing: Is it really any different from just giving the amounts?

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ARTICLE INFO

Keywords:
Valence framing
CO_2 emissions
Influence
Motivation
Information
International comparison

ABSTRACT

Previous experiments have shown that negative valence framing in comparison to positive framing augments the perceived differences between CO_2 emission amounts. This means that, in order to increase the chance that an individual will perceive a difference between two CO_2 amounts, it is better to highlight the amount by which the other choice is larger. However, a number of questions remain with respect to such findings. First, those experiments did not test whether such framing results in differences as compared to just presenting the amounts. Choice experiments and travel behavior change programs often simply use the attribute values (e.g. 300 g/km versus 250 g/km), thus it is important to know whether valence framing would result in differences as compared to this valence-free or "neutral" framing. Second, some research suggests that loss-framing may be less effective in Asian as opposed to Western contexts. Further, as CO_2 emissions information is relatively new, and an individual will not always be presented with a second value (i.e. no context), how might that affect responses? Thus, in this research we describe the results of an experiment with four treatments and four key measures. The four treatments being: "no context", "neutral", "positive-framing", and "negative-framing". Lastly, when attempting to motivate support or change from the general population, aggregate information rather than individual information is often used. Is it possible that such general information would influence an individual?

1. Background

Information about CO_2 is increasingly being used in transportation, but it is typically presented in its scientific form of mass rather than as prescriptive information that would guide behavior (e.g. red-avoid, yellow-caution, green-acceptable). Previous work has demonstrated that the provision of greenhouse gas (GHG) information as a mass can influence perceptions and choices of travel alternatives. For example, research has found that individuals are influenced by the CO_2 emissions information presented as grams/km (or grams/mile) when making transportation choices such as car purchase or route choice (e.g. Daziano et al., 2017; Daziano and Achtnicht, 2014; Gaker and Walker, 2013).

CO_2 emissions information for cars is commonly presented in grams/km and individuals can estimate their CO_2 outputs for other modes through Internet tools such as carbon calculators or travel/journey planners which all use mass and only a few give additional information to help with interpretation (Avineri and Waygood, 2010). Travel programs such as the Travel Blending in Australia (Rose

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https://doi.org/10.1016/j.trd.2018.07.011

Available online 17 July 2018
1361-9209/

and Ampt, 2001) and the Travel Feedback Program in Japan (Taniguchi et al., 2003) give information feedback to users about various aspects of their travel including the mass of CO_2 emissions produced. Recent experiments involving CO_2 emissions information in route choice and car purchase also used mass (Daziano and Achtnicht, 2014; Gaker et al., 2010, 2011; Gaker and Walker, 2013). In all cases, the increased information is presumed to lead to more informed decisions, and to reduce CO_2 outputs, thus helping combat climate change.

Information plays an important role in understanding sustainable behaviour and has been incorporated into behavioural change measures. For example, a lack of clear information about the environmental impacts of products through labelling might constrain sustainable consumption behaviours (Borin et al., 2011). A specific challenge that transportation professionals (such as travel planners) are faced with is how to present the environmental costs of journeys in a way that will influence more sustainable travel choices. It has been demonstrated that how we present CO_2 emissions information can influence choice (Daziano et al., 2017; Waygood and Avineri, 2011, 2016; Avineri and Waygood, 2013).

One of the key observations of behavioural economics called loss aversion (or gain–loss asymmetry) refers to the fact that people tend to be more sensitive to negative impacts, or losses, than to positive impacts, or gains. This effect is captured by the cognitive modelling approach, prospect theory, developed by Kahneman and Tversky (1979) and its further extension, known as cumulative prospect theory (Tversky and Kahneman, 1992). Recent experimental studies in behavioural sciences, such as Abeler et al. (2011) and Gill and Prowse (2012) suggest that anticipated future disappointment or losses affect consumer decisions. Also, evidence of loss aversion in the context of travel behaviour is reported in several studies; travellers exhibit aversion to loss and have a strong tendency to avoid choices associated with losses (see examples in Avineri and Prashker, 2004; Hjorth and Fosgerau, 2012; Rose and Masiero, 2010; Stathopoulos and Hess, 2012; van de Kaa, 2010); and for a recent review see Avineri and Ben-Elia, 2015).

Valence framing and its application in the specific context of information design to encourage low-carbon sustainable travel behaviors can be seen as a sort of 'nudge' (Thaler and Sunstein, 2008). It can be generally argued that nudges, choice architecture and other insights emerging from behavioral economics can inform the design of soft measures, which would be particularly relevant to liberal democracies (see Avineri, 2012).

Previously it was demonstrated that valence framing affected perceptions of differences between CO_2 emission amounts (Avineri and Waygood, 2013). However, in that study, all participants were from Western countries and some research has found that in some Asian countries Prospect Theory did not have the same results as in Western culture countries (Brumagim and Xianhua, 2005; Marshall et al., 2011). Thus, it is unknown whether the framing of CO_2 emissions information works equally in both Western and Asian cultures.

How information is presented can be referred to as framing. Studies of so-called '*framing effects*' have demonstrated that alternative frames (or formats) influence how individuals respond to equivalent descriptions of the same critical information. Information can be put in a positive or negative light, emphasising choice outcomes that can be perceived as either 'gains' or 'losses'. This *valence framing* focuses attention either on the positive or the negative aspects of the differences (see for example Thaler et al., 1997). Across many contexts, the impact of negatively framed information has consistently been found to be stronger than the impact of the same information framed in positive terms of the same magnitude (Edwards et al., 2001; Kühberger, 1998). It can be therefore hypothesized that loss framing can be incorporated in the design of a variety of information-based measures to promote sustainable transportation behaviours.

In this study, four different types of valence framing (no framing, neutral framing, positive framing, and negative framing) will be tested with a convenience sample from three different cultures: English, French, and Japanese. Participants completed surveys in their own language and were randomly assigned to one of four surveys which varied by framing type. The analysis takes into consideration numerous hypotheses related to perception of sustainability, motivation to make personal changes, and motivation to support local government efforts to reduce GHG emissions.

2. Literature review

Levin et al. (1998) found that there are three distinct types of framing effects: attribute-framing, goal-framing, and risky choice-framing effects. Attribute-framing is when an attribute is highlighted in either a positive or negative light (e.g. 80% lean versus 20% fat). Goal-framing relates to the goal of the behavior (e.g. positive effects of taking a testicular cancer exam versus the negative consequences of not taking the exam). Risky choice-framing relate to the willingness to take a risk if the risks are framed positively or negatively (e.g. rate of survival versus rate of death). In this study, the focus is on attribute-framing effects.

Goal-framing theory (Lindenberg and Steg, 2007) suggests that people are motivated by hedonic, gain, and normative goals. Hedonic goals relate to emotional goals such as fun, thrilling, or happy. Gain goals relate to protecting one's resources such as money, time, or health. Normative goals relate to what is perceived to be right or wrong behavior; what is appropriate behavior. As such, aggregated information on transport CO_2 emissions would be providing information that relates to normative goals. This information could motivate individual changes that contribute to reducing the problem of climate change.

Previously, presenting individual-level transport CO_2 emission information motivated people to indicate they would make changes to reduce their transport emissions (Waygood and Avineri, 2016). However, research on intervention studies aimed at energy reduction in households found that individualized information is more effective (Abrahamse et al., 2005), but CO_2 emissions information can often be found with respect to aggregate averages (e.g. Waygood et al., 2013). From a practitioner's perspective, it would be important to know whether aggregate CO_2 emissions information would motivate support for city-level interventions. Such aggregate information may be used to help inform a voting population with respect to proposed interventions in their city to reduce emissions. Further, the amount of CO_2 emissions may be given with no reference to any other amount.