Tailoring energy-saving advice using a unidimensional Rasch scale of conservation measures

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Long Abstract for SPUDM '15

Aim:

Initiatives that promote energy conservation, such as mass-media campaigns, often fail to effectively persuade individuals to change their energy-saving behavior (Abrahamse et al., 2005; Midden et al., 2007; Steg, 2008). A main cause for this is that such initiatives do not tailor their content to individual consumers but are rather general instead (McKenzie-Mohr, 2000). In addition, such initiatives also leave recipients of conservation information unaware of all possible conservation measures (Benders et al., 2006; Darby, 2006; Gardner & Stern, 2008).

Recommender systems can overcome these issues by tailoring advice to users based on their choices, preferences, and behavior (Burke, 2002). Energy recommender system research has pointed out the effectiveness of tailoring choice interfaces towards users' knowledge levels (Knijnenburg et al., 2014). Using a recommender system to tailor conservation advice itself to individual characteristics though, such as one's conservation attitude, is unexplored in scientific literature.

In order to tailor conservation measures to individuals, we set out an energy recommender system that draws upon the probabilistic attitude-behavior relation described by the Rasch model (Kaiser et al., 2010). Rasch attributes execution difficulty levels to different behaviors, measures, or response items (such as 'Installing solar PV') based on the (self-reported) behavior of individuals (in this case, for instance, whether a user has installed solar PV or not). This way, Rasch can sort conservation measures according to their respective difficulty levels, creating a unidimensional scale that can estimate the energy-saving ability of individuals using the scale (cf. Bond & Fox, 2006).

Central to this paper are two questions. First, is it possible to create such a unidimensional scale of energy-saving measures? This is important as conservation literature discusses different types of measures (e.g. curtailment versus efficiency; Gardner & Stern, 2008), suggesting that energy-saving measures are multidimensional in nature. Second, if so, which energy-saving measures do users of a recommender system perceive as more appropriate: those with a difficulty level above or below one's ability?

Method:

To test the dimensionality of conservation measures, as well as developing a suitable set of conservation measures to recommend, we performed a pre-study using an online energy-saving tool, containing 88 different energy-saving measures. In total, 263 participants were presented a selection of 13 conservation measures and indicated whether they already executed each of them by either responding 'yes', 'no', or 'does not apply'. A Rasch analysis performed on the responses yielded a unidimensional scale of 79 measures, varying in execution difficulty levels. Curtailment and efficiency measures are mapped onto a single scale, although on average curtailment behaviors are easier than efficiency measures.

We used this scale in the main experiment, i.e. an online energy recommender system that estimated the user's ability and recommended tailored conservation measures accordingly. The difficulty levels of these recommendations were either above, equal to, or below the user's estimated energy-saving ability. To test which relative difficulty level is perceived as the most appropriate, users had to rank-order two lists of nine conservation measures in preference order.

Results:

196 users used our online energy recommender system. To test the effect of relative ability-difficulty differences on a measure's perceived appropriateness, we performed multiple rank-ordered logistic regression analyses on the ranked recommendation lists. The analyses indicated that the relative difficulty level of a conservation measure had a significant effect on a measure's ranked position in the recommendation list, with relatively easy measures topping the list. In others words, users perceived conservation measures with a difficulty level below their own ability as more appropriate than those with a difficulty level above it.

Conclusions:

We demonstrated two points: A diverse set of conservation measures can be mapped on a unidimensional scale according to the respective difficulty levels, allowing users to receive tailored conservation advice within a few clicks. In addition, users perceive easy conservation measures as the most appropriate, demonstrating how an energy recommender system should tailor its measures.