



Deriving attribute utilities from mental representations of complex decisions



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ABSTRACT

We propose a new approach to determine the utilities that consumers attach to different attributes in complex decisions. The approach builds on a recently developed model that posits that cognitive links between alternatives and attributes and between attributes and benefits are more likely to be activated in a consumer's mental representation of a decision if the expected gains of taking into account these links in terms of achieving better choice outcomes are higher. In this paper we derive how this model can be used to determine the utility of attributes directly from mental representations and extend the model to complex decisions with multiple decision dimensions. We illustrate the approach using data on 594 individuals' means-end chain responses for a hypothetical combined shopping location, shopping timing, and transportation decision problem.

1. Introduction

In this paper we propose a new approach that allows for a direct theoretical and empirical connection between consumers' mental representations of decisions and their attribute decision utility. In particular, we formalize how consumers' attribute utilities can be derived from a model of mental representations of decisions that was recently proposed by [Arentze et al. \(2015\)](#). At the basis of their model lies the observation that consumers' face inherent cognitive constraints that restrict the size of their mental representations of complex decision problems ([Beach and Mitchell, 1987](#); [Johnson-Laird, 2001](#)). Therefore, akin to information search theory, additional decision components are taken into account in a consumer's mental representation only if the expected gain of evaluating alternatives on these components outweighs the cognitive costs of doing so ([Hauser et al., 1993](#); [Moorthy et al., 1997](#); [Weitzman, 1979](#)). This insight is also reflected in recent work in choice modeling that has modelled how preferences can be derived from observations of the information that individuals look for in their information search ([Chorus and Timmermans, 2008](#)) and of which attributes they pay attention to when making their choices ([Cameron and DeShazo, 2010](#)). Furthermore, research on the neurological foundations of mental fatigue and decision processes also highlights the inherent trade-off between the cognitive costs of complex mental processes and their likely return in terms of decision outcomes ([Boksem and Tops, 2008](#); [Gershman et al., 2015](#); [Kurzban et al., 2013](#)).

The model by [Arentze et al. \(2015\)](#) formalizes the cognitive activation of different links in consumers' mental representations of

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decisions. In essence, the consumer's utility function drives the cognitive activation of decision components in the mental representation depending on whether variations in the level of the component have a strong enough impact on the decision utility outcome to warrant its inclusion in the consumer's mental representation of reality.

In this paper, we extend this model in two important ways. First, we derive how attribute utility values can be determined on the basis of the modeling approach. This is an important extension, because in the earlier model the parameter estimates expressed the probability of links occurring in a causal network structure, but no connection was made between the activation of attribute linkages in the mental representation and an attribute's decision utility. Second, we extend the model to derive attribute utilities for complex consumer choices that involve more than one decision dimension (e.g., a combined shopping destination and transportation mode decision). This second contribution is especially relevant because obtaining a better understanding of the main drivers of decisions is most strongly needed in the context of complex choices (such as shopping center choices, financial portfolio choices, or holiday package choices), where cognitive simplification in mental representations of decisions is most likely to occur. We illustrate the proposed approach using data from 594 individuals who provided means-end chain responses on their mental representations of a complex hypothetical shopping decision problem, involving a combined choice of shopping location, shopping time and transportation mode.

2. Mental representations of complex decision problems

We conceptualize a consumer's mental representation for a given complex decision problem as a network with links that connect decision alternatives to a set of more abstract benefits that consumers look for (Arentze, et al., 2015; Dellaert, Arentze, & Timmermans 2008). Within the network, attributes and benefits are distinguished, where the attributes describe the decision alternatives (“what is chosen”) and benefits reflect how the alternatives’ attributes connect to consumers’ underlying personal needs (“why it is chosen”) (Gutman, 1982; Griffin and Hauser, 1993; Liberman et al., 2007). This structure captures the fact that consumers derive utility from achieving the benefits that they look for when selecting a certain alternative.

Formally, the network structure defines three cognitive mappings that connect the decision alternatives in the different choices that can be made to the consumer's latent decision utility. The first mapping describes the consequences of selecting a *decision alternative* (D) of a given choice set in terms of the *attributes* (A) that the alternative provides. In this first mapping (D is mapped on A) it is not yet evident how choosing an alternative affects the fulfillment of the benefits that the consumer looks for. Therefore the second mapping connects the attributes to the set of underlying *benefits* (B) (A is mapped on B). A third mapping finally connects the (potentially) realized benefit outcomes (that can be positive or negative) to the consumer's *utility* function for decision alternatives (B is mapped on utility). The utility of each benefit depends on how highly each benefit outcome is evaluated by the consumer.

When extending the model to complex decisions such as shopping center choices, holiday choices, or financial investment decisions, typically the benefits that consumers look for are influenced by multiple attributes that can come from more than one decision domain (e.g., location and transportation for shopping centers, multiple tourism activities for holiday choices, or multiple types of financial products for investments). This structure implies that decision domains, attributes, and benefits, need not be strictly nested and may follow a structure in which cross-over connections exist between the components of the different decision domains (i.e., an attribute or benefit can depend on a combination of alternatives from multiple decision domains). Fig. 1 graphically illustrates how, in a complex choice involving two decision domains, the attributes and benefits could be connected in a consumer's mental representation. In particular, at the benefit level the value of Benefit 2 is jointly determined by Attributes 2, 3, and 5. These attributes in turn depend on the consumer's choice of an alternative in decision domain A (Attributes 2 and 3) and decision domain B (Attribute 5). This structure clearly illustrates that the cognitive activation of each attribute and benefit in a mental representation depends on how these components jointly affect consumer utility through the overall network structure. Importantly, this structure also implies that cognitive activation of an attribute is not a one-to-one indicator of the utility of the attribute, since the latter also depends on how the attributes connect with decision alternatives and benefits.

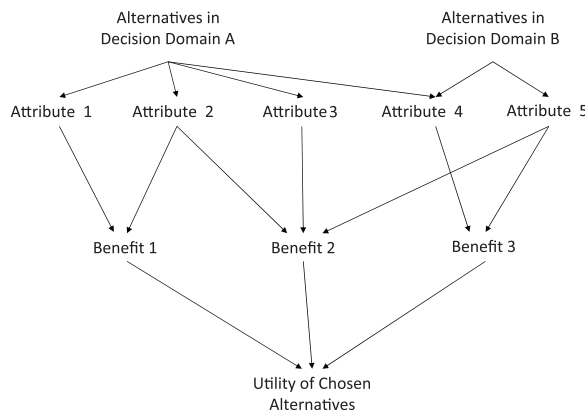


Fig. 1. Schematic illustration of a mental representation of a complex consumer decision spanning two decision domains.

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