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Taboo trade-off aversion in choice behaviors: A discrete choice model and application to health-related decisions

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ABSTRACT

Objectives: Taboo trade-offs can explain some of the (moral) difficulties in healthcare decision-making. The moral psychology literature suggests that individuals are averse to making trade-offs between attributes belonging to different values, such as (sacred) human lives versus (secular) money. We demonstrate and empirically test a discrete choice model designed to capture Taboo Trade-off Aversion (TTOA) behaviors in the healthcare domain.
Methods: The linear-additive Random Utility Maximization (RUM) model is extended to capture TTOA behaviors by including penalties for taboo trade-offs. Using two Discrete Choice Experiments (DCEs) focusing on taboo trade-offs in public health policies, we empirically compare conventional linear-additive RUM models with TTOA models to explore differences in model and behavioral results.
Results: We observe TTOA in both DCEs. In one DCE, the TTOA model separates TTOA effects from attribute-related parameters, showing inflated parameters in conventional RUM models when TTOA behavior is present. This discrepancy affected Willingness-To-Pay (WTP) estimates, with WTP to save an incremental patient life approximately 3.5 times higher in conventional RUM models compared to the TTOA models. The presence and magnitude of TTOA varied considerably across respondents. Latent Class (LC) models reveal that some respondent groups perceive trade-offs as taboo significantly, while others do not.
Conclusions: Accounting for TTOA in RUM models may lead to more accurate behavioral information when choice behaviors are affected by taboo trade-offs. Researchers and policymakers can use TTOA models to obtain a more nuanced understanding of public acceptability in morally salient policy decisions – ultimately helping to navigate, rather than avoid, taboo trade-offs.

1. Introduction

Due to rising healthcare costs and an ageing population (Brouwer et al., 2019; Pammolli et al., 2012; Stadhouders et al., 2016), physicians, policymakers, and other healthcare practitioners progressively experience moral difficulties in their everyday decision-making, particularly when allocating scarce resources (Prentice et al., 2016; Miljeteig et al., 2021; Antiel et al., 2013). Taboo trade-offs can explain some of the moral problems in these decisions. A trade-off is considered *taboo* when it involves trading between attributes linked to sacred (e.g., number of patient deaths) and secular values (e.g., money)(Fiske and Tetlock, 1997; Tetlock, 2003; Walzer, 2010; Tetlock et al., 2000)–(Fiske and Tetlock, 1997; Tetlock, 2003; Walzer, 2010; Tetlock et al., 2000). Attributes associated with *sacred* values are absolute, inviolable and protected to the individual, such as human lives, freedom or democracy, while those linked to *secular* values are relative, violable and unprotected. Secular attributes are more likely to have an exchange value than sacred attributes (e.g., trading money to gain access to a service) (Tetlock, 2003).

When these value domains collide, trade-offs are often perceived as morally problematic and constitute what is known as *taboo trade-off aversion* (TTOA)(Fiske and Tetlock, 1997; Tetlock, 2003; Tetlock et al.,

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2000). According to Fiske and Tetlock's theory of taboo trade-offs (Fiske and Tetlock, 1997), such trade-offs violate deeply held social norms and symbolic boundaries, as they appear to commodify sacred values. Consequently, individuals may strongly resist taboo trade-offs, even when they are economically or utilitarianly optimal.

TTOA likely varies among individuals, shaped by one's cultural values (e.g., religion (Adamczyk et al., 2021; Chandrasekaran et al., 2023)) (Fiske and Tetlock, 1997; Tetlock et al., 1996) and stigmatization (Yang et al., 2007; Billings et al., 2021; Figueroa et al., 2024; Major et al., 2017). For example, public funding for abortion may be acceptable in one culture where maternal life is prioritized but taboo in another where both fetal and maternal lives are equally protected (abortion is viewed as the killing of humans). Therefore, the varying degrees of indignation depend on how individuals view the trade-off between sacred and secular attributes as morally impermissible (Fiske and Tetlock, 1997). In this light, *taboo trade-offs* are defined as "any explicit mental comparison or social transaction that violates deeply held normative intuitions about the integrity, even sanctity, of certain forms of relationships and the values that derive from those relations" (Fiske and Tetlock, 1997).

To illustrate the concept of *taboo trade-offs* and *taboo trade-off aversion*, we present an example. Consider a scenario in which individuals are asked to choose between two healthcare policies. The first allocates substantial public funds to provide an expensive, life-saving treatment to a small group of terminally ill patients. The second directs those same funds toward preventive care programs that benefit a larger, healthier population, but excludes those who are terminally ill. At first glance, this may seem like a standard trade-off between cost-effectiveness and health outcomes. However, the decision implicitly involves placing a lower monetary value on the lives of terminally ill patients in favor of maximizing population-level outcomes. Such decisions may be perceived as morally impermissible or taboo, even if they result in better aggregate outcomes.

To make effective and well-accepted decisions, physicians and policymakers strive to include patient and societal preferences in their decision-making on drug development, reimbursement, and treatment (de Bekker-Grob et al., 2012; Soekhai et al., 2019). Discrete choice models (DCMs) are used to understand choices and inform health-related decision-making (Whitty et al., 2014; Gadjradj et al., 2022; Mott, 2018). DCMs assume that individuals evaluate alternatives by trading off all attributes in a full-compensatory manner, consistent with random utility maximization (RUM) theory (McFadden, 1974, 1981; Lancaster, 1966). This framework allows estimation of attribute importance, willingness-to-pay, and prediction of choice behaviors under various scenarios.

However, when decisions involve taboo trade-offs, the standard RUM models may fail to capture the inherent moral conflict in choice behaviors. Although individuals may engage with taboo trade-offs, the moral content of the trade-off can provoke emotional distress (Tetlock, 2003) or cognitive dissonance (Loewenstein and Ubel, 2008), resulting in moral disutility not captured by standard utility functions. While RUM models are based on the premise that losses in one attribute can be offset by gains in another, individuals may penalize taboo alternatives, leading to misleading insights into choice behaviors (Hensher et al., 2010; Gigerenzer, 2010; Leong and Hensher, 2012; Smeele et al., 2023; Chorus et al., 2008; Chorus, 2010).

For example, empirical evidence shows that offering monetary incentives to potential organ donors reduces their willingness to donate (Howard et al., 2015). From a rationalist perspective, such incentives should increase donation rates. Yet, because monetizing organ donation is perceived as a taboo trade-off (i.e., 'selling' organs for money), individuals may respond with aversion (Gigerenzer, 2010; Gigerenzer and Selten, 2001). This suggests that the standard RUM model may not adequately capture decision-making in morally sensitive contexts.

Recently, an alternative utility specification for RUM models has been developed in the transport domain based on the notion of TTOA (Chorus et al., 2018). The TTOA model retains the full-compensatory utility structure and adheres to the principle of RUM. This approach does not, by definition, reject taboo trade-offs outright but leads to a disutility to reflect moral discomfort, thus better modeling choice behaviors in morally sensitive contexts.

This paper demonstrates and empirically tests the TTOA model in the context of healthcare-related decisions, where moral considerations frequently arise. We present two discrete choice experiments (DCEs) to evaluate its merits empirically. One DCE focused on taboo trade-offs in health insurance policies, and the other on organ transplantation policies. We compare the TTOA model against its conventional RUM counterpart, examining both model and behavioral results.

Beyond empirical validation, we make several important contributions to the development of TTOA modeling. We extend the original specification proposed by Chorus et al. (2018) by applying it to morally sensitive health decisions, introducing theoretical distinctions between types of taboo trade-offs, and capturing heterogeneity in moral choice behaviors through latent class modeling. In doing so, we contribute to a deeper understanding of how morally problematic trade-offs influence healthcare choices and how these can be integrated into discrete choice modeling frameworks.

2. Methods

2.1. Taboo trade-off aversion in discrete choice models

The Random Utility Theory (RUT) serves as the basis for the DCM paradigm, which posits that choices are noisy signals of the weights the individual attaches to the alternative's attributes (Lancaster, 1966; Samuelson, 1948; Luce, 1959). Within the RUT, the RUM framework combines a noisy (random) element with the concept of utility maximization (McFadden, 1974, 1981). Consider an individual n who faces a set of choice tasks S where each choice task s contains a set of J alternatives. Each alternative i is defined by a set of attributes K and the set of levels of each attribute x_{sik}. In a RUM model, the utility U_{in} is decomposed into a deterministic and random component as follows:

$$U_{sin} = V_{sin} + \varepsilon_{sin} \quad (1)$$

Here, the random component ε_{sin} is unexplainable and stochastic, assuming independent and identically distributed (i.i.d.) and captures all unobserved factors, such as behavioral idiosyncrasies and measurement errors. The deterministic component V_{sin} is explainable and specified as a linear-additive function, which can be written as:

$$V_{sin} = \sum_{K} \beta_k \cdot x_{sik} \quad (2)$$

Where β_k is the estimable preference parameter for the attribute k and x_{sik} denotes the level for attribute k of alternative i in choice task s. Given the distribution of ε_{sin} and assuming a choice task s with a set of J alternatives where an individual n chooses an alternative i if and only if their utility is maximized, the probability P_{sin} that an individual n chooses an alternative i over any other alternative j in the choice task s is given by:

$$P_{sin} = Pr\left(V_{sin} > V_{sjn}\right) \quad \text{for all } i \neq j \,\epsilon\, s \quad (3)$$

The RUM model assumes full-compensatory behavior, where a deterioration in one attribute can be compensated by an improvement in another. However, this assumption may be too strict for choices involving taboo trade-offs. Consider a set of ordered pairs (a, b) with sacred attribute a (e.g., human lives) and secular attribute b (e.g., costs). An individual may exhibit non-compensatory or non-trading behavior, where they either assign infinite utility weight to sacred attribute a (saving as many human lives as possible) or ignore certain attributes entirely. For instance, an individual may consistently prioritize saving lives over cost considerations, effectively implying a zero or near-zero utility weight for the cost attribute. These patterns suggest that standard marginal rates of substitution are not meaningful, and the underlying preferences cannot be (fully) captured by a traditional utility function (Gigerenzer and Goldstein, 1999; Fishburn, 1975; Tversky, 1969; Scott, 2002). Such behavior can be an artefact of perceiving the taboo trade-off as highly severe in the choice situation.

Despite the apparent unease that taboo trade-offs induce, not all individuals reject taboo trade-offs outright. Some attend to all attributes but experience cognitive dissonance when facing such trade-offs (Fiske and Tetlock, 1997; Tetlock, 2003; Loewenstein and Ubel, 2008; Ubel et al., 2005; Riis et al., 2005; Brickman et al., 1978; Gilbert et al., 1998, 2002; Loewenstein and Schkade, 1999; Frederick and Loewenstein, 1999). This dissonance creates an anticipated discomfort, for which one has an aversion to taboo trade-offs as they reflect on the moral conflict inherent in the trade-off, thereby affecting their decision utility rather than their hedonic utility. Rather than employing non-trading behavior, these individuals consider all relevant information but react with a lower degree of indignation (leading to disutility) to the act of making a taboo trade-off. They do not, by definition, reject taboo trade-offs(Fiske and Tetlock, 1997; Tetlock, 2003; Tetlock et al., 2000). This reflects TTOA behavior: a behavioral response rooted not in inattention or heuristic simplification, but in anticipated moral discomfort when making trade-offs between the sacred and secular attributes.

To account for this behavior, we incorporate TTOA directly into the RUM framework. This allows us to retain meaningful marginal rates of substitution while capturing the disutility associated with taboo trade-offs. Unlike non-compensatory models such as attribute non-attendance, which infer zero utility weights from ignored attributes, the TTOA specification assumes that all attributes are attended while the penalty term captures the aversive reaction to a priori hypothesized attribute combinations perceived as morally problematic or taboo.

To capture TTOA behavior in the RUM model, the deterministic component V_{sin} of the utility of alternative i in choice task s is extended as follows:

$$V_{sin}^{TTOA} = \sum_K \beta_k \cdot x_{sik} + \sum_{(a,b)\in T} \tau_{a\to b} \cdot I_{x_{sia}\to x_{sib} \mid x_{sja},\, x_{sjb}} \tag{4}$$

Where $\tau_{a\to b}$ denotes the estimable taboo penalty, T is a set of ordered pairs (a, b) with sacred attribute a (e.g., human lives) and secular attribute b (e.g., costs), and j denotes the alternative that is being compared against alternative i in the choice task s. In Eqn. (4), one penalty is estimated for different kinds of taboo trade-offs, allowing distinctions between them. The indicator function $I_{x_{sia}\to x_{sib} \mid x_{sja},\, x_{sjb}}$ equals one if the value of sacred attribute x_{sia} deteriorates for an improvement in the value of secular attribute x_{sib} compared to their counterparts (x_{sja}, x_{sjb}) in alternative j of choice task s.

In essence, the extended component of the deterministic utility in Eqn. (4) accounts for how the relative comparison between the sacred attribute a and secular attribute b across alternatives i and j influences the utility and choice behavior. This extension captures more than a general cross-effect; it specifically reflects an aversion to trade-offs between attributes that are perceived as taboo. The penalty term $\tau_{a\to b}$ quantifies the degree of aversion to taboo trade-offs.

A special case of Eqn. (4) occurs when we estimate one generic taboo penalty. This model does not make a distinction between different kinds of taboo trade-offs. The Generic-TTOA (TTOA-G) utility specification can be written as:

$$V_{sin}^{TTOA-G} = \sum_K \beta_k \cdot x_{sik} + \tau_G \cdot \max_{(a,b)\in T, j\in J-i} I_{x_{sia}\to x_{sib} \mid x_{sja},\, x_{sjb}} \tag{5}$$

Where, τ_G denotes the estimable generic-taboo penalty. Compared to Eqn. 4, the TTOA-G specification contains a maximum operator indicating whether at least one taboo trade-off occurs in alternative i compared to any other alternative j in the choice task s.

By incorporating taboo penalties in the RUM model, we do not presume that taboo trade-offs are, by definition, rejected by individuals employing TTOA behavior. Instead, looking at our definition of taboo trade-offs from the RUM perspective, we hypothesize the following.

Hypothesis. Individuals who face trade-offs between attributes that are considered taboo do not inherently reject such trade-offs; instead, they have an aversion to taboo trade-offs, resulting in a (decision) disutility.

The behavioral interpretation of the TTOA behavior in the RUM model, as defined in Eqn. (4) and Eqn. (5), is: choosing alternative i over any other alternative j in the choice task s may involve taboo trade-offs. Taboo trade-offs come at the cost of a penalty representing the (decision) disutility associated with trading off sacred attribute a against secular attribute b. Another intuitive way to capture TTOA in the RUM model is presented in Appendix A.

Moreover, the TTOA utility specifications as defined in Eqns. (4) and (5) can be incorporated into any model class (e.g., Multinomial Logit, Mixed Logit, Latent Class Logit). The TTOA specifications introduce a theoretically motivated taboo penalty parameter, guided by a priori hypotheses, to estimate the aversion to taboo trade-offs.

It is important to emphasize that taboo trade-offs are directional (i.e., $a\to b$). Trade-offs that involve, for example, sacrificing human lives to save money are taboo. In contrast, sacrificing money to save human lives is not taboo. More formally, if attribute a represents a sacred value and attribute b represents a secular value, then trading off a against b is considered taboo, while the other way around is not. This directionality is captured in the indicator function as follows:

$$I_{x_{sia}\to x_{sib} \mid x_{sja},\, x_{sjb}} = \begin{cases} 1 \;\; if \; [\beta_a(x_{sia} - x_{sja}) < 0 \;\; and \;\; \beta_b(x_{sib} - x_{sjb}) > 0] \\ \quad 0 \quad otherwise \end{cases} \tag{6}$$

From an econometric perspective, the step-function may be problematic, as it prevents differentiation around the points where $\beta_a \cdot (x_{sia} - x_{sja})$ or $\beta_b \cdot (x_{sib} - x_{sjb})$ are zero. Appendix A describes a smooth-step function to avoid this issue, as Chorus et al. (2018) suggested.

2.2. Data collection for two discrete choice experiments

We designed two DCEs to demonstrate and empirically test the TTOA models. Both DCEs focus on taboo trade-offs embodied in public health policies in The Netherlands. Our first DCE studies societal preferences for health insurance policies involving taboo trade-offs. The government regularly decides on whether to include new (often expensive) medicines in insurance packages. Because the decision changes the average health premiums while affecting patients' lives who depend on the new medicines, it involves a taboo trade-off when patient lives are sacrificed for lower health premiums. Note that sacrificing money (accepting higher health premiums) to save patient lives is not taboo.

Although the choice situation involves, by definition, one taboo trade-off, we disentangled the taboo and hypothesized that there are two types of taboo trade-offs. First, the taboo trade-off in the *negative* domain of valuing patient lives, where the taboo alternative increases patient deaths while having a lower health premium than the status quo and the other alternative in the choice task. Second, the taboo trade-off in the *positive* domain of valuing patient lives, where the taboo alternative simultaneously increases patient deaths and health premiums compared to the status quo, while the change in health premiums remains lower than the other alternative in the choice task. Fig. 1 shows two examples of a choice task with taboo trade-offs in the negative domain (left-hand side) and one in the positive domain (right-hand side). Choosing the taboo alternative in the positive domain can be justified, as it implies assigning a higher monetary value to patient lives than the status quo, whereas choosing the taboo alternative in the negative domain can undermine one's (moral) self-image (Shiell et al., 2009). To model the

I: Which policy option do you choose?

		Policy A	Policy B
Change in the number of patient deaths due to insufficient healthcare coverage		↑ 15.000 more patient deaths	↓ 10.000 less patient deaths
Your health insurance premium per month	€138	↓ €5 less	↑ €10 more
YOUR CHOICE		☐	☐

Taboo trade-off in the negative domain

II: Which policy option do you choose?

		Policy A	Policy B
Change in the number of patient deaths due to insufficient healthcare coverage		↓ 5.000 more patient deaths	↓ 10.000 less patient deaths
Your health insurance premium per month	€138	↑ €5 more	↑ €20 more
YOUR CHOICE		☐	☐

Taboo trade-off in the positive domain

Fig. 1. Example choice tasks for the health insurance policy DCE.

distinction between the two taboo trade-offs, the TTOA specification in Eqn. (4) is used in our analysis.

We used unlabeled choice tasks with two policy options. These alternatives are characterized by one sacred attribute (patient deaths due to inadequate healthcare coverage) and one secular attribute (change in health premiums). Appendix B presents the attributes and levels.

Our second DCE studies public preferences for raising funds by health premiums to 'refurbish' lower-quality organs to an acceptable level for transplantation, ultimately saving and improving patient lives. The choice situation involves, by definition, two types of taboo trade-offs separating different states of human existence ("being alive" versus "having a life"). One taboo trade-off involves assigning a monetary value (paying more or less for health premiums) to determine whether patients stay alive or die while being on the waiting list. In contrast, the other taboo trade-off assigns a monetary value to patients' quality of life. Note again that sacrificing money (accepting higher health premiums) to save patient lives or increase their quality of life is not taboo.

Given the aim of our paper, we do not make distinctions between the taboo trade-offs but assume one generic taboo trade-off to demonstrate the TTOA-G specification in Eqn. (5). We hypothesized that the taboo alternative increases patient deaths and/or reduces patients' quality of life while reducing health premiums compared to the other alternatives in the choice task. In this context, both the 'patient deaths' and 'patient quality of life' attributes are defined as sacred attributes, as they affect the worth of patient lives. Respondents would assign a monetary value to patient lives based on the changes in health premiums. Fig. 2 shows an example choice task from choice stage 1 involving a taboo trade-off.

We used a two-stage design. Respondents first choose between two unlabeled policy options, followed by a choice between the previously chosen policy and the status quo. The latter considers the possibility that respondents are unwilling to make trade-offs as an artefact of taboo trade-offs (Fiske and Tetlock, 1997; Tetlock, 2003). Each policy option is characterized by three attributes: two sacred attributes (patient deaths on the waiting list and changes in patients' quality of life after transplantation) and a secular one (change in health premiums). Appendix B presents the attributes and levels.

The attribute levels for both DCEs were determined through a three-step process. First, we conducted a literature review to identify relevant attributes and ensure that level ranges aligned with real-world health policies. Second, we held unstructured interviews with health experts to validate the realism of the selected attributes and levels. Third, we conducted pre-tests and pilot studies with members of the public to evaluate the comprehensibility, cognitive burden, and plausibility of the choice tasks.

This iterative process not only ensured the face validity of the DCEs but also provided initial insights into whether TTOA behavior could plausibly emerge. During pre-testing, several participants expressed moral discomfort when facing certain trade-offs, particularly those involving patient lives versus monetary costs. Some respondents reported drawing on moral principles such as "doing the greatest good", "minimizing harm", or ensuring "equal access", while others struggled with the perceived incommensurability of trading off human lives and cost. These reactions suggest that at least a subset of participants

Which policy option would you choose, considering the different consequences?

	Current policy	Policy A	Policy B
Number of patients on the waiting list who die prematurely	1,200	600	800
Improvement in quality of life of patients after organ transplantation	Good	Moderate	Good
Your health insurance premium per month	€138	↑ €10 more	↑ €5 more
YOUR CHOICE		☐	☐

Fig. 2. Example choice task from choice stage 1 in the organ transplantation policy DCE.

perceived the tasks as involving morally problematic trade-offs, consistent with the theoretical premise of TTOA behaviors.

Since both DCEs contain choice tasks with two unlabeled alternatives, the attribute-level combinations result in 2401 ($(7^2)^2$) and 1600 ($(2^1*4^1*5^1)^2$) potential choice tasks. We generated D-efficient experimental designs based on the Multinomial Logit (MNL) model using the respective TTOA utility specifications (i.e., Eqn. (4) for the HI-DCE and Eqn. (5) for the OT-DCE)(Rose and Bliemer, 2009). These utility specifications were incorporated into the design to reflect realistic behavioral assumptions and improve parameter estimation efficiency. For example, in the health insurance DCE (HI-DCE), the priors assumed negative preferences for increases in patient deaths and health premiums. In the organ transplantation DCE (OT-DCE), we assumed positive for higher quality of life and negative preferences for patient deaths and health premiums. We have made the full design syntax publicly available on GitHub at https://github.com/nvrsmeele/ttoamodel.

The HI-DCE included 42 choice tasks divided across three blocks of 14 tasks, while the OT-DCE had 40 choice tasks split across four blocks of 10 tasks for the first experiment stage. Respondents were randomly assigned to a block. Besides the stated choices, we also collected respondent characteristics such as sociodemographic, EQ-5D health states, and risk perception levels using three statements (see Appendix C for all covariates).

A sample size of 519 and 256 respondents was required for the HI-DCE and OT-DCE, respectively, following the framework proposed by de Bekker-Grob et al. (de Bekker-Grob et al., 2015). These sample sizes ensure that the statistical power in our analyses is maintained. Given our research budget, we targeted complete data collection from 770 respondents per study. Respondents were recruited through market research panels accessed via the SurveyEngine platform. SurveyEngine facilitated survey distribution, while the respondents were drawn from established panel providers targeting the Dutch population. Quota sample ensured representativeness by gender and age. Data collection for both DCEs took place in July 2023. Approval for the DCE studies is obtained from the Research Ethics Review Committee, Erasmus School of Health Policy & Management (ETH2223-0324).

2.3. Statistical analyses

We estimated Multinomial Logit (MNL) and Latent Class (LC) models to analyze preferences in each DCE, incorporating the TTOA specifications presented in Eqn. (4) (HI-DCE) and Eqn. (5) (OT-DCE). Models were estimated using Apollo software (Hess and Palma, 2019), with attributes such as health premium and number of deaths treated as continuous variables with linear effects. This specification was tested empirically and yielded statistically significant and theoretically consistent coefficients. Alternative categorical codings were also tested, but linear models offered comparable or superior fit while enhancing parsimony and interpretability.

It is important to note that for the OT-DCE, which employed a dual response format, we modeled each respondent's answer as a single observed choice among three available alternatives (Policy A, Policy B, and the Current Policy), effectively combining the forced and unforced responses into one choice outcome.

2.3.1. Multinomial Logit (MNL) models

We first estimated MNL models for each DCE to identify population-level mean preferences. The MNL assumes that preferences are homogeneous across individuals (McFadden, 1974, 1981). For both DCEs, we estimated a conventional benchmark model and TTOA model to evaluate the effects of TTOA on preference parameters and overall model fit. Model fit was assessed using the log-likelihood values and the Likelihood Ratio Statistic (LRS)(Train, 2003; Hauser, 1978), as the benchmark and TTOA models are nested and do not account for the panel structure of the data.

2.3.2. Latent Class (LC) models

To account for preference heterogeneity and explore the empirical validity of TTOA behaviors, we estimated LC models. These models assume that respondents can be clustered into a finite number of latent classes, each reflecting a distinct preference structure (Yamaguchi, 2000).

We followed a two-step modeling procedure. First, we estimated benchmark LC models assuming standard RUM behavior using two to five classes. Model selection was guided by the Bayesian Information Criterion (BIC), class interpretability, and class sizes (Hensher et al., 2015; Roeder et al., 1999). Based on the optimal number of classes, we then estimated TTOA-LC models with the same number of classes and tested their relative fit using the LRS.

In line with theoretical assumptions, we constrained the taboo penalty to zero in any class of the TTOA-LC models where the estimated penalty was positive and statistically significant, as such findings contradict the premise that taboo trade-offs are perceived as aversive. A positive taboo penalty would imply a preference for lower premiums even when this leads to greater loss of life – an outcome that conflicts with the conceptual foundation of TTOA behavior. Such results may instead reflect decision noise, inattentive responses, or low perceived moral relevance of the trade-off for some individuals.

Second, to further examine the existence of TTOA behavior, we incorporated attitudinal and sociodemographic covariates into the class membership component of the TTOA-LC models. These include age, religiosity, and responses to moral belief items as listed in Appendix C. This allowed us to test whether class membership corresponded with theoretically expected drivers of taboo sensitivity.

2.3.3. Willingness-to-pay (WTP) analyses

To assess the policy implications of TTOA, we estimated WTP values across models. WTP was calculated as the marginal rate of substitution between sacred (e.g., deaths) and secular (e.g., health premium) attributes, reflecting the monetary change to offset a one-unit change in the sacred attribute (Hensher et al., 2015).

We also derived the WTP to avoid taboo trade-offs, calculated from the taboo penalty relative to the health premium parameter. In the TTOA models, the disutility associated with taboo trade-offs is captured explicitly via the taboo penalty. As discussed in Section 2.1, this penalty reflects the aversion toward certain morally sensitive trade-offs. Its marginal rate of substitution with respect to the health premium provides an estimate of the amount individuals are willing to pay to avoid such trade-offs. Failing to account for TTOA conflates these effects with attribute-related parameters, which may bias WTP estimates.

Standard errors of the WTP estimates are calculated using the Delta method (Daly et al., 2023). The source code is publicly available on GitHub at https://github.com/nvrsmeele/ttoamodel.

3. Results

3.1. Description of the study samples

The survey in the HI-DCE and OT-DCE was accessed by 3521 and 3411 respondents, respectively. Of these, 2742 and 2641 respondents either dropped out, were screened out due to lack of consent or being under the minimum age of 18, or were excluded due to quota limits to maintain sample representativeness in both DCEs. This resulted in 774 and 770 respondents who completed the survey in the HI-DCE and OT-DCE, respectively.

As part of the data cleaning process, we excluded respondents who stated 'other' gender because the parameter could not be identified empirically due to insufficient variation (HI-DCE: $n = 4$; OT-DCE: $n = 3$). We also excluded respondents who stated 'I do not want to answer' for monthly household income (HI-DCE: $n = 62$; OT-DCE: $n = 76$), since income was one of the key covariates in the latent class analyses and a substantial proportion of missing responses would limit interpretability and reduce model robustness. The final datasets contain 708 and 691 respondents (9912 and 13,820 choice observations) for HI-DCE and OT-DCE, respectively. Table 1 shows the demographic composition of the two samples, roughly representative of the Dutch general population (Centraal Bureau et al.a; Centraal Bureau et al.b; Centraal Bureau et al. c).

3.2. Health insurance DCE: comparison of discrete choice models

Tables 2 and 3 report the results from the benchmark MNL model, the TTOA-MNL model, and the TTOA-LC model with class membership covariates, based on the HI-DCE. Corresponding WTP estimates are also presented. Additionally, the results of the benchmark LC and TTOA-LC models without class membership covariates are provided in Appendix D.

The TTOA-MNL model significantly improves model fit over the benchmark MNL as supported by the LRS ($p < 0.01$). All attribute-related parameters are highly significant ($p < 0.01$) and have expected negative signs, confirming theoretical validity. For example, in the TTOA-MNL model, an increase of 1000 patient deaths reduces utility by 0.0268 utils.

In the TTOA-MNL model, we also observe significant taboo penalties ($p < 0.01$), with disutilities exceeding those of patient deaths by factors of ~35 (negative domain) and ~16 (positive domain). Compared to the benchmark model, the TTOA-MNL model yields a 33 % lower patient death coefficient and a 131 % higher health premium coefficient. This reflects its ability to separate attribute-related parameters from penalties, assigning a negative weight to an increase in patient deaths and adding a negative penalty when patient deaths coincide with a decrease in health premiums. In contrast, the benchmark model combines all effects into one attribute-related parameter, inflating the patient deaths parameter. The opposite holds for the effects of the health premium attribute.

The parameter differences between the two models affect WTP estimates. In the benchmark model, the WTP to save 1000 lives is 1.98 Euros per month, compared to 0.57 Euros per month in the TTOA-MNL model. Additionally, individuals are willing to pay 20.26 and 9.23 Euros per month to avoid taboo trade-offs in the negative and positive domains, respectively.

To illustrate the interpretation of TTOA behavior, consider two hypothetical health policies. Policy A reduces health premiums by 5 Euros but results in 5000 additional patient deaths. Policy B increases health premiums by 15 Euros, leading to 10,000 fewer patient deaths. In this scenario, Policy A entails a taboo trade-off – monetary gain at the cost of patient lives, triggering a taboo trade-off in the negative domain of valuing patient lives. As a result, individuals experience moral discomfort when such trade-offs are presented and are willing to pay to avoid them. In the context of the HI-DCE, this translates into an average WTP of 20.26 Euros per month to avoid making such morally problematic decisions.

To examine preference heterogeneity and assess the empirical validity of TTOA behaviors, we estimated TTOA-LC models both with and without class membership covariates. Table 3 reports the results for the TTOA-LC model with covariates, while the corresponding model without covariates, along with the benchmark LC model, is presented in Appendix D.

The TTOA-LC model demonstrated a significantly better fit to the data than the benchmark LC model, as indicated by the lower BIC ($11{,}103 < 11{,}254$) and LRS ($p < 0.01$). This supports the added value of incorporating TTOA behaviors in explaining respondent choices.

The TTOA-LC model with covariates identified three distinct classes, each characterized by different sensitivities to both standard attributes

Table 1
Demographic composition of the samples compared to the Dutch general population.

	HI-DCE sample		OT-DCE sample		Gen pop.
	#	%	#	%	% [a]
Total	708	100.00	691	100.00	100.00
Gender					
Male	319	45.06	299	43.27	49.40
Female	389	54.94	392	56.73	50.60
Age					
18-19	74	10.45	87	12.59	21.00
20-39	261	36.86	264	38.21	26.00
40-64	263	37.15	239	34.59	33.00
65-79	100	14.13	97	14.04	15.00
80 and older	10	1.41	4	0.57	5.00
Income					
Low	272	38.42	237	34.30	50.50
Medium	270	38.13	270	39.07	39.50
High	166	23.45	184	26.63	10.00
Education					
Low	165	23.31	164	23.73	29.20
Medium	294	41.53	279	40.38	36.30
High	249	35.16	248	35.89	34.50
Household composition					
Single	173	24.44	177	25.62	36.30
With partner	188	26.55	175	25.33	26.90
With partner and child(ren)	187	26.41	196	28.36	30.00
With partner, child(ren, and others	39	5.51	25	3.62	30.00
With partner and others	10	1.41	7	1.00	26.90
Single parent with child(ren)	52	7.34	33	4.78	6.80
Single parent with child(ren) and others	10	1.41	12	1.74	6.80
Others	49	6.93	66	9.55	–
Religion					
Atheism	349	49.29	390	56.44	–
Catholicism	164	23.16	129	18.67	–
Buddhism	2	0.28	3	0.43	–
Protestantism	80	11.30	58	8.39	–
Islam	56	7.91	58	8.39	–
Judaism	4	0.56	4	0.58	–
Hinduism	5	0.71	3	0.43	–
Other	48	6.79	46	6.67	–

Gen pop. General population, *HI-DCE* Health insurance discrete choice experiment, *OT-DCE* Organ transplantation discrete choice experiment.
[a] Categories with equal percentages are combined by the Statistics Netherlands.

Table 2
Results from the benchmark MNL and TTOA-MNL models for the HI-DCE.

	Benchmark MNL		TTOA-MNL	
Attribute	Param.	S.e.	Param.	S.e.
Change in the number of patient deaths caused by insufficient health coverage (x 1000 deaths)	−0.0399***	0.0020	−0.0268***	0.0025
Change in basic health premium per month (x 1 Euro)	−0.0202***	0.0020	−0.0467***	0.0030
Taboo (negative domain)	–	–	−0.9458***	0.0804
Taboo (positive domain)	–	–	−0.4308***	0.0460
Implied values	**Estimate**	**S.e.**	**Estimate**	**S.e.**
$WTP_{savelives}$	1.98***	0.0118	0.57***	0.0032
$WTP_{taboo\ (negative\ domain)}$	–	–	20.26***	0.0651
$WTP_{taboo\ (positive\ domain)}$	–	–	9.23***	0.0524
Log-likelihood	−6647.38		−6574.69	
Adj. Rho Sq.	0.0322		0.0425	
BIC	13,313.17		13,186.19	
LRS p-value (vs. Benchmark MNL)	–		≤0.0001	
Number of observations	9912		9912	
Number of parameters	2		4	

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.
Param. Parameters, *S.e.* Standard error, *Adj. Rho Sq.* Adjusted Rho Square, *BIC* Bayesian Information Criterion, *WTP* Willingness-to-pay.

Table 3
Results from the TTOA-LC model for the HI-DCE.

	Class 1		Class 2		Class 3	
Attribute	Param.	S.e.	Param.	S.e.	Param.	S.e.
Change in the number of patient deaths caused by insufficient health coverage (x 1000 deaths)	−0.0641***	0.0097	−0.1568***	0.0210	−0.0227***	0.0038
Change in basic health premium per month (x 1 Euro)	−0.3810***	0.0358	−0.0527***	0.0085	−0.0530***	0.0049
Taboo (negative domain)	−2.6069***	0.3154	−2.0159***	0.2888	−0.8955***	0.1182
Taboo (positive domain)	–	–	−1.3231***	0.1881	−0.3231***	0.0671
Implied values	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**
$WTP_{savelives}$	0.17***	0.0280	2.98***	0.7654	0.43***	0.0980
$WTP_{taboo\ (negative\ domain)}$	6.84***	0.5721	38.29***	6.9941	16.91***	1.8510
$WTP_{taboo\ (positive\ domain)}$	–	–	25.13***	4.8786	6.10***	1.3972
Class membership functions	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**
Constant	−3.6345***	0.7642	−6.0858***	0.7756	0	(fixed)
Religious - No	0	(fixed)	0	(fixed)	0	(fixed)
Religious - Yes	−0.0925	0.2657	−0.4767**	0.2179	0	(fixed)
Age - Low	0	(fixed)	0	(fixed)	0	(fixed)
Age - Medium	1.5015***	0.2897	0.5039**	0.2452	0	(fixed)
Age - High	1.2858***	0.3894	0.9441***	0.3020	0	(fixed)
Equality & Justice - Equal treatment for all patients	−0.1192	0.1584	−0.1981	0.1407	0	(fixed)
Equality & Justice - Equal importance of patient rights	0.0920	0.1764	0.2092	0.1643	0	(fixed)
Compassion & Harm - Decisions should consider patient suffering	0.7377***	0.1736	0.4944***	0.1514	0	(fixed)
Care & Protection - Obligation to care for the vulnerable	0.0009	0.1695	0.6471***	0.1807	0	(fixed)
Loyalty & Obligation - Obligation to help family and friends	0.0891	0.1575	0.0895	0.1425	0	(fixed)
Loyalty & Obligation - Obligation to help community members	−0.4448***	0.1493	0.0608	0.1333	0	(fixed)
Average class shares	**0.172**		**0.313**		**0.515**	
Log-likelihood			−5403.62			
Adj. Rho Sq.			0.209			
BIC			11,092.48			
Number of observations			9912			
Number of parameters			31			

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.
Param. Parameters, *S.e.* Standard error, *Adj. Rho Sq.* Adjusted Rho Square, *BIC* Bayesian Information Criterion, *WTP* Willingness-to-pay.

(patient deaths and health premium) and taboo trade-offs. All attribute-related parameters were statistically significant ($p < 0.01$) with the expected sign. For instance, in Class 2, an increase of 1000 patient deaths and a 1 Euro increase in monthly health premiums were associated with utility decreases of 0.1568 and 0.0527 utils, respectively. TTOA effects were statistically significant ($p < 0.01$) with the expected negative sign in Classes 2 and 3 for taboos in the negative and positive domains, while in Class 1, only aversion to taboos in the negative domain was observed ($p < 0.01$).

Differences in attribute-related parameters across the classes can explain the presence and variations in taboo penalties. For instance, the patient deaths parameter is about seven times larger in Class 2 compared to Class 3, indicating that policy options with increases in patient deaths lead to larger disutilities in Class 2. With more negative weight allocated to patient deaths, the taboo penalties impose a larger (negative) impact on policies with taboo trade-offs in either the negative or positive domain of valuing patient lives.

Class 1 shows strong cost sensitivity, with the health premium parameter (per 1 Euro) approximately six times larger than that for patient deaths (per 1000 deaths). This suggests that increases in health premiums generate more disutility than patient deaths. The higher cost sensitivity likely explains the absence of TTOA effects in the positive domain of valuing patient lives. As hypothesized in the HI-DCE, the domain involves taboo alternatives that raise both patient deaths and premiums relative to the status quo, though premiums remain lower than the non-taboo alternative in the choice task. For Class 1, the dominant influence of cost likely overrides moral discomfort, reducing the perceived salience of the taboo and thus suppressing measurable TTOA effects.

These differences in sensitivities are reflected in the WTP estimates. Class 1, characterized by strong cost sensitivity, exhibits the lowest WTP to save lives (0.17 Euros to save 1000 lives) and a modest WTP to avoid taboo trade-offs in the negative domain (6.84 Euros). In contrast, Class 2, which is more sensitive to patient deaths, shows the highest WTP to save lives (2.98 Euros per 1000 patient lives saved) and to avoid taboo trade-offs in both the negative (38.29 Euros) and positive (25.13 Euros) domains. Class 3 falls in between, with a WTP of 0.43 Euros per 1000 lives saved, and 16.91 and 6.10 Euros to avoid taboos in the negative and positive domains, respectively. These results suggest that TTOAs are most pronounced when moral discomfort associated with taboo trade-offs dominates cost considerations.

Class membership covariates provide further insight into the existence and variation in TTOA behaviors. Respondents in Class 2, who showed the strongest TTOA and highest WTP to avoid taboo trade-offs, were significantly more likely to be non-religious and to endorse care- and compassion-based moral values, relative to Class 3. This suggests that TTOA may stem not only from sacred or deontological beliefs but also from secular moral concerns rooted in harm and care. Compared to Class 3, respondents in Class 1, characterized by high-cost sensitivity and the absence of TTOA in the positive domain, were less morally oriented toward community obligations, reflecting a more economically rational or utilitarian orientation.

3.3. Organ transplantation DCE: comparison of discrete choice models

Next, we turn to the OT-DCE results. Tables 4 and 5 present the results for the benchmark MNL, TTOA-MNL, and TTOA-LC model with class membership covariates. It also reports the WTP estimates. The benchmark LC and TTOA-LC models without class membership covariates are reported in Appendix D.

We first compare the benchmark MNL and TTOA-MNL models. While the TTOA-MNL slightly improves model fit, the difference is not statistically significant based on the LRS ($p > 0.1$). All attribute-related parameters are significant ($p < 0.01$) and have the expected signs. However, the taboo penalty in the TTOA-MNL model is not significant ($p > 0.1$), suggesting that, at the population level, taboo trade-offs do

Table 4
Results from the benchmark MNL and TTOA-MNL models for the OT-DCE.

	Benchmark MNL		TTOA-MNL	
Attribute	Param.	S.e.	Param.	S.e.
Constant	−1.4255***	0.0730	−1.4182***	0.1000
Number of deaths on the waiting list (x 100 deaths)	−0.1227***	0.0068	−0.1230***	0.0068
Change in patients' quality of life after transplantation to *Moderate* condition	0	(fixed)	0	(fixed)
Change in patients' quality of life after transplantation to *Good* condition	0.8855***	0.0347	0.8863***	0.0347
Change in basic health premium per month (x 1 Euro)	−0.0434***	0.0037	−0.0420***	0.0054
Taboo	–	–	0.0173	0.0481
Implied values	**Estimate**	**S.e.**	**Estimate**	**S.e.**
$WTP_{savelives}$	2.83***	0.3432	2.93***	0.4175
WTP_{taboo}	–	–	0.41	1.1123
Log-likelihood	−7089.51		−7089.45	
Adj. Rho Sq.	0.0656		0.0655	
BIC	14,214.38		14,223.10	
LRT p-value (vs. Benchmark MNL)	–		0.729	
Number of observations	6910		6910	
Number of parameters	4		5	

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.
Param. Parameters, *S.e.* Standard error, *Adj. Rho Sq.* Adjusted Rho Square, *BIC* Bayesian Information Criterion, *WTP* Willingness-to-pay.

not systematically reduce utility.

Still, the absence of a significant taboo effect does not imply these trade-offs are inconsequential or preferred. The negative parameter sign suggests that, if present, TTOA may be obscured by unobserved heterogeneity. To explore this further, we estimated TTOA-LC models both with and without class membership covariates. Table 5 reports the results for the TTOA-LC model with covariates. The corresponding model without covariates and the benchmark LC model are presented in Appendix D.

Several observations can be made. The TTOA-LC model showed a significantly better fit than the benchmark LC model ($p < 0.1$), supporting the added value of incorporating TTOA in explaining choice behaviors.

In the TTOA-LC model with covariates, all attribute-related parameters are statistically significant ($p < 0.1$ or $p < 0.01$) in classes 1, 2, and 3, and show the expected signs. For instance, in Class 1, an increase of 100 deaths and a 1 Euro increase in monthly health premiums reduce utility by 0.0459 and 0.0746, respectively, while improving quality of life from "moderate" to "good" increases utility by 0.4317. Respondents in classes 1 and 2 are significantly more likely to prefer one of the policy options over the status quo ($p < 0.01$), whereas respondents in Class 3 show no significant preference ($p > 0.1$).

TTOA effects are statistically significant only in Class 4 ($p < 0.1$), and not in the other three classes ($p > 0.1$). The distinct sensitivity to taboo trade-offs appears linked to Class 4's preference structure. Only the deaths parameter significantly affects choice behaviors in this class ($p < 0.01$), indicating insensitivity to both cost and quality-of-life improvements.

This pattern may also reflect underlying moral profiles. Compared to Class 4, respondents in Classes 1–3 were significantly less likely to be older ($p < 0.01$), suggesting TTOA sensitivity in Class 4 may be more

Table 5
Results from the TTOA-LC model for the OT-DCE.

	Class 1		Class 2		Class 3		Class 4	
Attribute	Param.	S.e.	Param.	S.e.	Param.	S.e.	Param.	S.e.
Constant	−0.7280***	0.1998	−5.0605***	0.3583	0.3712	0.7664	−3.9347***	0.4515
Number of deaths on the waiting list (x 100 deaths)	−0.0459***	0.0137	−0.2564***	0.0191	−0.1071*	0.0569	−0.2790***	0.0239
Change in patients' quality of life after transplantation to *Moderate* condition	0	(fixed)	0	(fixed)	0	(fixed)	0	(fixed)
Change in patients' quality of life after transplantation to *Good* condition	0.4317***	0.0800	2.5186***	0.1430	1.5550***	0.3735	0.1022	0.1138
Change in basic health premium per month (x 1 Euro)	−0.0746***	0.0110	−0.1034***	0.0161	−0.1869***	0.0400	0.0395	0.0243
Taboo	0.1216	0.0876	−0.0073	0.1385	0.4828	0.3747	−0.3229*	0.1654
Implied values	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**
$WTP_{savelives}$	0.62***	0.2252	2.48***	0.4163	0.57	0.3999	−7.07	4.8059
WTP_{taboo}	−1.63	1.5167	0.07	1.4665	−2.58	2.9764	−8.18	7.7271
Class membership functions	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**	**Estimate**	**S.e.**
Constant	3.0905***	0.6712	−1.0545	0.8424	1.5668**	0.7471	0	(fixed)
Religious - No	0	(fixed)	0	(fixed)	0	(fixed)	0	(fixed)
Religious - Yes	−0.0784	0.2666	−0.4567*	0.2742	−0.2627	0.2893	0	(fixed)
Age - Low	0	(fixed)	0	(fixed)	0	(fixed)	0	(fixed)
Age - Medium	−0.8449***	0.3067	−0.4299	0.3318	−0.1522	0.3389	0	(fixed)
Age - High	−1.5416***	0.3887	−0.5678	0.3568	−0.7846**	0.3981	0	(fixed)
Equality & Justice - Equal treatment for all patients	−0.2130	0.15671	−0.3820**	0.16284	−0.2889*	0.1704	0	(fixed)
Equality & Justice - Equal importance of patient rights	0.0307	0.1817	0.2366	0.1950	0.1041	0.1960	0	(fixed)
Compassion & Harm - Decisions should consider patient suffering	−0.0412	0.15314	0.3886**	0.17599	0.1807	0.1678	0	(fixed)
Care & Protection - Obligation to care for the vulnerable	−0.0292	0.1633	0.4347**	0.1966	0.0651	0.1873	0	(fixed)
Loyalty & Obligation - Obligation to help family and friends	−0.1633	0.1737	−0.0438	0.1850	0.0355	0.1864	0	(fixed)
Loyalty & Obligation - Obligation to help community members	−0.0358	0.1776	−0.1786	0.1854	−0.4303**	0.1845	0	(fixed)
Average class shares	**0.360**		**0.297**		**0.188**		**0.156**	
Log-likelihood	−5578.84							
Adj. Rho Sq.	0.2585							
BIC	11,599.71							
Number of observations	6910							
Number of parameters	50							

* significant at 10 %, ** significant at 5 %, *** significant at 1 %.
Param. Parameters, *S.e.* Standard error, *Adj. Rho Sq.* Adjusted Rho Square, *BIC* Bayesian Information Criterion, *WTP* Willingness-to-pay.

prevalent among older individuals. Additionally, respondents in Class 2 were more likely to endorse compassion-based and care-oriented moral beliefs ($p < 0.05$), while Class 3 respondents placed less emphasis on community obligations ($p < 0.05$). These findings suggest that respondents in Class 4, who exhibited a significant taboo penalty and insensitivity to cost and quality-of-life, may hold stronger deontological or sacred-value commitments - potentially influenced by age-related moral intuitions.

WTP estimates further highlight preference heterogeneity. Only Class 1 and Class 2 show statistically significant WTP to save lives – 0.62 and 2.48 Euros per 100 lives saved, respectively – reflecting their differing sensitivities to mortality and cost. WTP estimates in Classes 3 and 4 are not statistically significant. This suggests that for some respondents, particularly in Class 4, trade-offs involving life and death are guided more by moral commitments than by monetary considerations.

4. Discussion

This paper demonstrates and empirically tests the TTOA utility specification within the RUM framework, capturing the disutility from taboo trade-offs – moral discomfort arising when sacred and secular attributes must be traded - even when such trade-offs are not outright rejected. We hypothesized that TTOA manifests as a negative taboo penalty, which is supported across all models in the HI-DCE and the LC model in the OT-DCE. Unlike standard RUM models, which conflate TTOA into attribute parameters and thereby inflate WTP estimates, the TTOA model isolates these effects – leading, for example, to a two-thirds reduction in WTP to save lives in the HI-DCE.

The TTOA-LC models in both DCEs provided evidence for the presence and variation of TTOA behaviors. In the HI-DCE, TTOA effects varied across latent classes. Respondents in Class 2, who were highly sensitive to patient deaths, showed strong taboo aversion, while the cost-sensitive respondents in Class 1 exhibited no such effect in the positive domain, suggesting financial considerations may attenuate TTOA. Interestingly, Class 2 respondents endorsed care-based moral values despite being non-religious, indicating that secular moral intuitions may also drive TTOA behavior.

In the OT-DCE, TTOA emerged only in Class 4, characterized by strong mortality sensitivity and low concern for cost or quality-of-life improvements. This group was significantly older, consistent with the notion that sacred-value commitments intensify with age. At the aggregate level, TTOA effects were not significant, suggesting that contextually moralized policy domains like organ transplantation may elicit widespread moral engagement, thereby diminishing the distinctiveness of TTOA (Fiske and Tetlock, 1997; Tetlock, 2003; Tetlock et al., 1996, 2000).

These findings highlight the importance of context in shaping moral sensitivity to policy trade-offs. Differences between the two DCEs suggest that the salience of taboo trade-offs depends on the domain, the framing of moral consequences, and the emotional proximity to affected groups. Future research should examine how contextual cues and narrative framing influence the emergence of TTOA behavior.

One potential challenge in DCEs in modeling TTOA is hypothetical bias (Lancsar and Swait, 2014). In hypothetical settings, individuals may find it easier to make "rational" choices that would be more difficult when their choices have actual consequences. While some may feel compassion for patients, others may feel a lack of agency as patients are not directly identifiable, reducing the psychological immediacy of moral concern (Daniels, 2012; Jenni and Loewenstein, 1997). Considering hypothetical bias when using DCEs to study TTOA is crucial, as it may result in under- or overestimated model results.

To mitigate these concerns, we developed D-efficient experimental designs based on the TTOA specifications, carefully avoiding dominant alternatives and attribute overlap to enhance realism and respondent engagement. The choice tasks were framed in realistic health policy contexts involving patient lives, quality of life, and monetary costs. In the OT-DCE, we also employed a dual response format to better capture respondents' potential moral objections to taboo trade-offs.

Nonetheless, future research should more explicitly investigate how specific design elements, such as framing, response formats, and contextual cues, influence respondents' recognition and processing of taboo trade-offs. Understanding these influences is crucial to improving the validity of TTOA measurement in stated preference studies and ensuring that model results accurately reflect underlying moral considerations rather than artefacts of design.

Another important consideration is how the TTOA model compares to alternative decision rules. While TTOA remains embedded within the RUM framework and assumes compensatory behavior, this may be restrictive in morally sensitive contexts. Individuals may instead adopt non-compensatory decision strategies, prioritizing sacred attributes (e.g., human life) over secular ones (e.g., cost). In such cases, trade-offs may be rejected outright or processed using threshold rules, rendering marginal utilities and WTP estimates conceptually inappropriate.

Although stochastic components in RUM models can partially accommodate non-compensatory tendencies, they are limited in capturing structured, rule-based decision strategies (Hess, 2012; Johnson et al., 1989; Hess et al., 2018). Models based on lexicographic preferences, attribute cutoffs, satisficing principles, or attribute non-attendance offer alternative approaches, but they often rely on strong assumptions and are prone to misspecification when attribute interactions are complex (Swait, 2001; Mela and Lehmann, 1995; Hensher et al., 2005; González-Valdés and Ortúzar, 2018). Recent work (e.g., Cazor et al. (2024)) shows that RUM models are fundamentally constrained in approximating non-compensatory decision rules, especially when attributes are negatively correlated or lexicographic strategies are employed.

The TTOA model retains the tractability of RUM models while explicitly accounting for moral discomfort in taboo trade-offs. Rather than assuming complete rejection of trade-offs, TTOA captures systematic deviations from compensatory behaviors through penalty terms that reflect latent aversion toward taboo trade-offs. Future research could empirically compare TTOA with non-compensatory models to assess which better captures moral choice behaviors across contexts. Moreover, integrating TTOA with non-compensatory decision rules in a hybrid LC model may enhance the behavioral realism of discrete choice models in moral choice contexts.

Our study has some limitations that should be carefully considered. First, we only focused on testing the TTOA model in the context of social (individual-to-society) preferences. Therefore, replicating our results in other health-related contexts is necessary, for example, in situations involving individual-to-individual relationships like doctor-patient relationships. We evaluated the model fit but did not assess whether the TTOA model outperforms the RUM model in generating choice predictions. Future research should explore this direction to confirm the merits of the TTOA model. Second, in the OT-DCE, we modeled the dual response format as a single multinomial choice to facilitate comparability across choice tasks and respondents. While this approach simplified the underlying behavioral process, it allows us to focus on the overall effect of TTOA in the presence of a status quo alternative. Future work may explore two-stage or sequential modelling frameworks to capture the distinct decision processes that may occur in forced versus unforced choices.

Third, the results may lack external validity due to the hypothetical nature of our DCEs, a limitation we raised earlier. Further research is needed to explore the presence and magnitude of hypothetical bias when studying TTOA and, if present, how it should be addressed to improve the model's external validity. Fourth, we did not incorporate qualitative methods, which could enrich understanding of respondents' cognitive and moral considerations.

Fifth, the standard errors of the WTP estimates in the LC models are likely to be underestimated in both DCEs, as the Delta method does not account for the panel structure of the data. Future research should explore using Bootstrap or Jackknife methods to calculate standard errors of the WTP estimates, mainly when using LC models, which are prone to getting stuck at local optima. Finally, the study was exploratory and did not follow a pre-registered protocol.

5. Conclusions

In conclusion, this paper demonstrates the value of the TTOA model within the RUM framework. By capturing compensatory behavior under moral tension, TTOA models disentangle standard preferences from disutility associated with taboo trade-offs. Our results show that TTOA behavior represents a distinct choice process, empirically supported by class-specific moral orientation and improved model fit.

In policy contexts where trade-offs involved sacred and secular values – such as health outcomes versus costs – TTOA models allow for the derivation of meaningful marginal rates of substitution, providing richer insights into the WTP to avoid taboo trade-offs in new policies. However, preference heterogeneity and potential hypothetical bias must be carefully considered, especially as cultural and moral values influence whether individuals perceive trade-offs as taboo.

Altogether, the TTOA model enhances the preference elicitation toolkit by revealing how moral discomfort shapes decision-making. It provides researchers and policymakers with a more nuanced understanding of public acceptability in morally salient policy decisions – ultimately helping to navigate, rather than avoid, taboo trade-offs.

CRediT authorship contribution statement

Nicholas V.R. Smeele: Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Sander van Cranenburgh:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Bas Donkers:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Maartje H.N. Schermer:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Esther W. de Bekker-Grob:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Role of the funders/sponsors

The funder has no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data, preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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Conflict of interest disclosures

The authors have no conflicts to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2025.118606.

Data availability

Data will be made available on request.

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