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Willingness to pay for safety improvements in passenger air travel

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ABSTRACT

The risk of being involved in an airplane accident is largely ignored in air passengers' choice models. The reason presumably is that it is hard to operationalize, because objective safety indicators often involve extremely low probabilities that are hard to grasp and interpret by passengers. In this paper, we propose an operationalization that is based on the perception of safety, which is easy to understand and resonates that perceptions often influence decisions stronger than objective variables. We conceptualize that passengers form a safety perception score of a particular flight based on their perception of airline and route attributes and that this score in turn is traded-off against other flight attributes, such as ticket costs, to arrive at a flight choice. In line with this conceptualization, two stated preference experiments are conducted. In a first experiment, combinations of airline and route attributes are evaluated in terms of safety that is captured on a rating scale. In a second experiment, safety perception is treated as an attribute and traded-off against other flight attributes to arrive at a flight choice. The paper presents the results of a regression and a Panel Mixed Logit model estimated from responses obtained from a convenience sample of 161 air passengers recruited in the Netherlands. The results of both models are then combined to calculate the willingness to pay values for improvements made to a range of airline and route attributes, taking into account socio-demographic variables and psychological traits. As expected, the results indicate that the willingness to pay for improving safety decreases with higher initial safety levels.

1. Introduction

The risk of being involved in an airplane accident plays an important role in the public discourse surrounding air travel. Such safety risks, however, have been largely ignored in air passengers' flight choice models (Fleischer et al., 2015; Koo et al., 2015; Koo et al., 2016). These models are typically estimated from stated choice experiments that usually only include attributes that can be directly observed, such as ticket price, flight time, access time, number of connections, aircraft-type, and on-time performance (e.g., Hess et al., 2007; Wen and Lai, 2010; Bliemer and Rose, 2011; Brey and Walker, 2011; Collins et al., 2012). To examine to what extent safety is traded-off against those attributes, the inclusion of safety attributes in such an experiment is required. This allows calculating the willingness to pay for improvements in air transport safety, which may be used in managerial decisions and cost-benefit analysis of safety improvements in passenger air transport. Two notable exceptions to ignoring safety related attributes are the studies by Fleischer et al. (2015), who included a safety star rating that essentially represents the risk of being involved in an accident, and by Koo et al. (2015, 2016), who included an attribute describing the number of incidents the aircraft type was involved in the last three years.

A reason why safety is typically not included in stated choice experiments of flight choice is presumably that it is difficult to operationalize. In safety studies, objective risk indicators are usually formulated in terms of mortality, deaths per number of flights or deaths per distance or unit of time. These indicators, however, often involve extremely rare events that are hard to grasp and interpret by passengers. Moreover, there seems to be a mismatch between such objective risk indicators and how passengers perceive risks (e.g., Kasperson et al., 1988; Savage, 2011). Although air travel is considered one of the safest modes of transport (e.g.

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IATA, 2016; Squalli and Saad, 2006), Fleischer et al. (2015) found that about a quarter of their respondents suffers moderate to high flying anxiety. This is probably due to passengers' perceived lack of control while traveling by plane and the extensive coverage of airplane accidents by the media who tend to give this more attention than other prominent life threatening events (Rose, 1992; Hall, 2002). However, since it is the risk or safety *perception* of travelers that determine travelers' choices (Boksberger et al., 2007), preferably the operationalization of attributes should be based on passengers' safety perceptions.

That travelers base their choices on their perception of reality instead of on the objectively measurable reality itself, is widely acknowledged in the travel behavior literature (e.g. Koppelman and Pas, 1980; Ben-Akiva et al., 1998; Golledge, 2002; Bonsall et al., 2004). This seem to be even more pertinent with respect to safety, since in contrast to price, travel time, number of transfers etc., information about safety is generally not readily available when booking a flight (Rhoades and Waguespack, 1999, 2000; Fleischer et al., 2015). Hence, to form a perception of the safety of a particular flight, passengers have to rely partly on incomplete information and what they believe to be the characteristics of the specific flight. Nevertheless, we assume that they are able to form such safety perception and that this perception can be captured on a rating scale. A safety perception attribute expressed on such a scale can thus be included as an attribute in a choice experiment to examine its trade-off with other flight attributes such as ticket price or flight time, which allows calculating the willingness to pay for improvements in safety perception.

However, such a choice experiment does not reveal any insight into how passengers arrive at their safety perception score, hence, the extent to which various factors influence safety perception. To examine this, we propose to construct a supplementary experiment, a safety perception experiment. In this experiment, flight profiles that describe a particular flight in terms of attributes that are presumed to influence passengers' safety perception, such as airline and route attributes, are constructed. Respondents are then asked to rate these flight profiles on the same safety perception scale discussed above, which in this experiment is used as the response scale. Hence, the results of this experiment provide insight into which concrete safety measures airlines or flight authorities could employ to improve the perception of safety of passengers. Our proposed approach is inspired by the Hierarchical Information Integration (HII) approach originally proposed by Louviere (1984), which is discussed in the next section.

In sum, this paper contributes to the literature by being the first to simultaneously model (and analyze) the determinants of safety risk perception and the influence of this perception on flight choice behavior. First, the influence of airline and route attributes on perceived safety is examined. Next, the influence of safety perception on flight choice is examined. Unlike previous studies, the proposed modeling approach allows including a potentially large number of safety related attributes and calculate the willingness to pay for improvements made in those attributes, which is an advantage compared to previous modeling approaches that typically included only a single safety related attribute (e.g., Fleischer et al., 2015; Koo et al., 2015; 2016). This approach is demonstrated by reporting the modeling results obtained from a convenience sample of 161 air passengers recruited in the Netherlands.

The remainder of this paper is organized as follows. First, the applied methodology is explained in more detail. Then the modeling results are presented and discussed. First, the results of a regression model estimated from the safety perception rating experiment are discussed. Next, the results of a Panel Mixed Logit model estimated from the stated choice experiment are discussed. For both models, interactions with socio-demographic variables and psychological traits are explored. Then the willingness to pay values for improvements made in route and airline attributes are presented. Finally, conclusions are drawn and relevance for practice is discussed followed by a reflection on the modeling approach.

2. Methodology

As already discussed in the Introduction, we assume that passengers form a safety perception of a particular flight based on their perception of airline and route attributes and that this safety perception in turn is traded-off against objective flight characteristics such as travel costs and time to arrive a flight choice. This assumption implies that a safety related attribute only will affect flight choice if it changes safety perception. This conceptualization is inspired by the Hierarchical Information Integration approach, which is therefore discussed next.

2.1. The hierarchical information integration approach

The Hierarchical Information Integration (HII) approach was originally proposed by Louviere (1984), as a modeling approach for studying complex decisions that involve many attributes (for a review of HII, see Molin and Timmermans, 2009). HII assumes that if faced with a complex decision, decision makers first classify the attributes into a set of higher order decision constructs. Examples of these decision constructs in the transportation context include ‘service quality’, ‘safety’ and ‘comfort’. In fact, every attribute which is not described in physical terms can be regarded as a decision construct, because an additional experiment is needed to examine how the construct is composed of the physical terms. It is further assumed that decision makers first form impressions for each of the decision constructs separately, and then integrate these impressions into overall preference values for the decision alternatives or to make a choice.

Consistent with these theoretical assumptions, the implementation of conventional HII models requires the construction of two different experiments. First, a sub-experiment for each construct is required to examine how the attributes defining that construct are traded-off to evaluate the construct. Next, a bridging experiment is required to examine how the decision construct evaluations are traded-off to arrive at an overall evaluation or choice. As an alternative to the rather abstract bridging experiment, Oppewal et al. (1994) prosed to construct integrated HII experiments, which involve constructing a series of experiments where each experiment varies attributes of one decision construct, while describing the other decision constructs in summarizing values. This approach avoids constructing a bridging experiment and offers opportunities for validation.

Yet another variant is applied in Bos et al. (2004) and Molin and van Gelder (2008). In these studies, sub-experiments are constructed to evaluate how physical attributes determine the score of the decision construct. In addition, a decision construct evaluation is included as an attribute in a choice experiment together with physical attributes such as travel costs and travel time. By expressing the levels of the decision construct evaluation on the same scale that is used as the response scale in the sub-experiments, the results of the model estimated from the sub-experiment and the choice experiment can be linked. This modeling approach is also applied in this paper, though in this paper we assume only a single decision construct, namely, safety perception.

Our modeling approach assumes that passengers consider airline and route characteristics to arrive at their perception of safety of a particular flight, which is then traded-off against other