# Does it Pay to Reveal Safety Information?

# The Effect of Safety Information on Flight Choice

By

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**Abstract:** The case of flights safety lends itself as a natural case study for choice under of information asymmetry that involves dread risk and emotional factors. Specifically it allows one to experiment how the releasing of information will affect consumer choice. Previous studies, which followed the deregulation of commercial aviation, raised concerns about the corresponding potential for a marked deterioration in airline safety. Measures to prevent that decline were subsequently proposed. Specifically, it was argued that the public sector should establish and release flight safety indicators in addition to accidents' statistics, which are currently available. It was argued that such safety indicators will also enable airlines to diversify their safety offerings. Underlying this argument are the assumptions that consumers' flight safety preferences vary and that, provided with safety information, consumers will use it when making decisions. The present work, however, refutes the first assumption and sheds light on the second. It further investigates whether and how consumers react to and interpret safety information when choosing a flight, while accounting explicitly for a psychological trait. Employing an advanced experimental design and econometric approach, we find that: 1. when formal flight safety ratings are supplied, individuals abandoned their priors and rely on the information provided 2. when it comes to "bad death" probabilities, people are not sensitive to the different shades of safety, and instead, they simply discern flights as either safe or unsafe. 3. under a certain conditions disclosed information can alleviated fear and change the decision making of airline passengers.

**Keywords:** fear of flying, perceived risk, airline safety, information asymmetry, experimental design

## 1. Introduction

Commonly, information on flight risk is not easily obtainable to those booking flights. This is due to multiple factors. First, publication of safety records is still a taboo in the aviation sector. In fact, airlines do not even allude to their safety records in their advertising and press statements (Savage 2011). Second, private safety certification schemes are problematic. They suffer from methodological drawbacks that cast doubt on their reliability. Numerous web sites provide a variety of safety indicators. But, these are not consistent with each other and therefore add to the confusion in the public. Third, public sector bodies (in the EU and USA) limit themselves to periodical publication of black lists of unsafe airlines. Fourth, while statistics on fatal crashes are released by public and private agencies, accident frequency per se cannot be considered as a meaningful indicator of airline safety (Knorr 1977) nor can it be used to compare the safety levels of flights (Czerwinski & Barnett 2006; Liou, Tzeng, & Chang 2007). As result, although research has indicated that passengers are concerned about the safety levels of flights, currently, no meaningful indication of these is available to them (Rhoades and Waguespack, 1999). This situation differs significantly from other sectors, such as the automotive industry, in which standardized safety rating methods (e.g., NCAP and EuroNCAP) are used. Their results are published by public agencies and accepted by both manufacturers and the public. Car makers today consider these ratings as important features of their products and often refer to them in their marketing campaigns (NHTSA 2007).

In light of this informational asymmetry and concerns regarding a possible deterioration in airline safety following the deregulation of the aviation industry, the resultant intensive competition, and the introduction of low-cost carriers, there has been an ongoing debate over whether safety indicators should be disclosed by the public sector. In this study, using a stated preference experiment, we analyze the effect of safety information on flight choice.

Many of the economic analyses of airline safety in the 1980s and early 1990s focused on the potential safety effects of deregulation and liberalization and the comparative safety performance of various industry segments (Borenstein & Zimmerman 1988; Savage 1999). Later studies pointed out the problems of data availability and interpretability and thus were mainly concerned with the proper methodology for measuring air travel safety (Czerwinski & Barnett 2006; Liou, Tzeng, & Chang 2007). Savage (2011) examined the safety issue as a differentiating attribute and suggested that airlines can compete on the basis of safety characteristics. He showed that several safety levels may exist on the same route, hence profit-maximizing firms should seek to diversify their safety offerings. The underlying assumption in the aforementioned studies is that individuals can distinguish between different levels on a range of safety indicators. We attempt here to assess this assumption.

Despite the relatively large number of flight choice studies (e.g. Bliemer & Rose,2011; Brey & Walker 2011; Wen & Lai 2010), the role of safety information and perception in the choice process has been largely overlooked, probably due to the fact that the airline industry suffers from safety information asymmetry. The issue of information asymmetry has been discussed generally in the literature. According to Akerlof's (1970) "lemons" model, airlines with high safety levels may not be able to extract profit from this advantage, since uninformed passengers cannot distinguish between airlines based on their safety levels. Therefore, airlines lack incentive to invest in measures that will improve their safety beyond the minimal requirements. In the extreme scenario, a "lemon" market will evolve in which all airlines provide the lowest safety level which is allowed by regulations. Disclosure of airline safety levels can mitigate information asymmetry by allowing passengers to identify safety differences among airlines and incentivize airlines to provide higher safety levels. Assuming that airline safety is a desired attribute, we expect that demand for airlines that provide high safety levels may then increase at the expense of airlines with low safety levels. This might eventually cause airlines to increase their investment in safety as long as the cost of raising safety levels is sufficiently valued by the market. In this study, we attempt to assess the change in demand for flights when information asymmetry is mitigated.

Flying involves emotional factors that can hinder rational decision-making. Dying in an airplane crash is considered a "bad death", i.e.  a death preceded by unusual pain and suffering (Sunstein 1997). Thus, individuals might estimate the risk associated with flying as being higher than the risk involved in other modes of transportation, despite the fact that aircraft accidents are extremely rare (Squalli and Saad 2006). Another related emotional factor involved in air travel is fear of flying (FOF). Van Gerwen, Diekstra, Arondeus & ,Wolfger, (2004) asserted that FOF is a problem affecting approximately 30% of the adult population in developed countries.

It is well established in the literature that individuals' choices are not based solely on rational considerations of the likelihood and consequences of different events, but also influenced by emotional factors (Kahneman & Tversky 2000). McFadden (1986) and Ben-Akiva et al. (2002) proposed a framework that incorporates emotional and psychological factors in choice models using latent variables, which can lead to a more behaviorally realistic representation of the choice process and consequently has better explanatory power. Using this approach, Fleischer, Tchetchik, & Toledo (2012) found that passengers with high FOF levels differ in their choice of flights from passengers with low FOF levels, thus confirming that emotional factors should be considered when analyzing choice of flights. This previous study was based in the prevailing settings in which safety information is not explicitly presented to passengers. The current study uses similar questionnaires and factors to account for the effects of FOF, which were shown to be substantial. However, the focus in this paper is on the effect of safety information on the itinerary choice.

Another issue involved in air travel decision-making is the use of subjective risk perceptions and objective risk related indicators. The literature suggests that in the presence of information asymmetry, passengers draw on their subjective perceptions of the airlines' safety. The subjective perceptions on the safety of a specific airline may be formed as a result of the number and severity of injuries in past accidents involving this airline, the size of the airline, and time proximity to the most recent accident (Borenstein & Zimmerman 1988; Squalli 2010). These perceptions may also depend on the financial condition of the airline (Rose 1990) or on characteristics connected with being a flag carrier (Fleischer et al. 2012). In a different context, it was shown (Heiman & Lowengart 2011) that when information about the health risks in meat consumption is not available, consumer decision-making regarding meat purchase depends on the perception of health risks. Nevertheless, when objective information was introduced, the participants in the experiment altered both their decisions and the decision-making process itself (i.e. their reliance on their subjective perceptions). We expect to obtain similar results in this study, since it also addresses the consumption of goods that involve physical risks.

Taking into account the information asymmetry, emotional factors and risk perception, the adoption and interpretation of safety indicators by individuals is not straightforward and should be further examined. Although each of these factors has been discussed in the literature (Kunreuther et al. 2001; Kunreuther 2002), their combined effect and the interaction between them is not clear. For example, a person with high level of FOF can react differently to safety information than a person not suffering from FOF. Thus, prior to a disclosure of safety information in air travel, it is imperative to understand how this information affects choice, since misinterpretation of it could lead to sub-optimal individual behavior and insufficient government regulations (Sunstein & Zeckhauser 2011). In this paper, we aim to evaluate how air passengers interpret and use information on air travel safety in their choice of flights while taking into consideration all three factors. To this end, we conducted a choice experiment.

Participants were asked to choose among different flights. In some of the scenarios, participants received (allegedly) objective information about the safety indicators of the flights. An itinerary choice model was estimated using this data and accounting for FOF as a latent variable. The FOF factor was estimated via established indicators, simultaneously with the choice model. The results show that when safety information was not available, the participants used their own safety perceptions of the airlines when choosing a flight. However, when supposedly objective flight safety information was provided, they discounted their own perceptions and relied more on this information in their decision-making. The safety information was presented to the participants at three levels: high, medium, and low. We show that participants treated the flights with high safety ratings as superior alternatives, but did not distinguish between the medium and low safety levels, and treated both as inferior. We also show that information disclosure affects demand, i.e., the participants were less (more) likely to choose a flight that received inferior (superior) safety ratings compared to a similar flight for which safety information was not available at all. The inclination to avoid flights with low safety levels is stronger in individuals who suffer from high levels of FOF. However, there was no difference in preferences regarding flights with high safety levels between individuals with various levels of FOF.

## 2. Methods

The data collection was conducted through a questionnaire that consisted of four parts: (i) a stated preference (SP) choice experiment in which respondents were asked to choose flight itineraries from eight menus of available alternatives; (ii) a set of questions regarding the perceptions of the respondents of the alternative airlines; (iii) a psychological scale that captured the respondent's level of FOF; and (iv) a set of background questions that solicited information on membership in the frequent flyer clubs of the carriers included in the experiment, and socioeconomic and demographic characteristics of the respondent.

### 2.1 Choice experiment

In order to evaluate the impact of safety information on flight itinerary choice while accounting for FOF, a stated preference (SP) experiment was conducted. Participants were asked to choose a flight itinerary from London to Zurich from a menu of three different flights. The London-Zurich route was chosen because it represents a distance (1,010 km) for which flight is a reasonable alternative, but can also be served by another transportation mode, i.e., train. Each itinerary was characterized by the attributes that consumers commonly observe when searching for a flight in online travel agencies, such as Expedia and Travelocity. These include the airline brand, flight duration, number of stops, and price. In addition, half of the respondents received information on the safety level of the flight in the scenarios presented to them.

The respondents were asked to choose flight itineraries from among sets of alternatives. Table 1 lists the attributes and their levels used to describe each itinerary in the survey.

**Table 1:** Summary of attributes and associated levels for London-Zurich itineraries

| **Attribute** | **Levels** |
|---|---|
| Price | 6 levels: \$91, \$117, \$143, \$169, \$196, \$222, \$248, \$274 |
| Airline | 4 levels: EL AL, Lufthansa, easyJet, Aeroflot |
| Connections | 2 levels: non-stop, connecting flight |
| Total Trip Duration<br>(including layover duration) | 6 levels:<br>3 levels for connecting flights: 2h 20m, 2h 40m, 3h,<br>3 levels for non-stop flight: 1h 20m, 1h 40m, 2h. |
| Safety Rating | 4 levels: high, medium, low, None |

The prices used were based on actual one-way prices for this route that were offered at the time of the survey. Within all choice experiments, an opt-out alternative, i.e. to travel by train, was also available. This alternative was described only by price and travel time. The airlines used in the experiments were El Al (Israel's flag carrier), Lufthansa (a flag Western European carrier), easyJet (a low- cost carrier), and Aeroflot (an Eastern European flag carrier). These carriers are all active in the Israeli market.

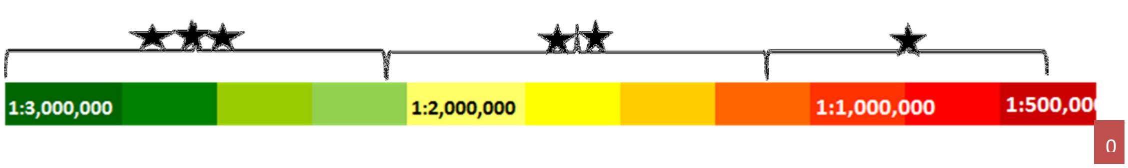
The choice menus used in the experiment were designed using a D-efficient Bayesian approach (Sándor and Wedel 2001), which aims to yield data that would support parameter estimation with minimum standard errors. Our design employs uniform distributions $\tilde{\beta} \sim U(u, v)$, which are widely used in the literature. For computing the Bayesian efficiency, we employed Halton draw simulation procedure (Halton, 1960). The design was programmed and created with the Ngene software (Ngene, 2007) and yielded a D error=0.298, which is considered sufficiently low. The prior values for the parameters were obtained from two sources: parameter estimates obtained from the literature (Fleischer et al. 2012) and from a pilot study.

The design resulted in 144 menus with three alternative flight itineraries and the train option in each. The menus were grouped into 9 blocks of 8 menus with safety information and 9 blocks of 8 menus without safety information. Each respondent was randomly assigned to a particular block, and had to choose one alternative in each of eight menus. Figure 1 shows two sample menus: one with and one without safety information.

**Figure 1:** An example of two menus – Menu 1 without safety information, Menu 2 with safety information

| **Menu 1** | **Flight 1** | **Flight 2** | **Flight 3** | **Train** |
|---|---|---|---|---|
| Price for one-way trip | $ 169 | $ 274 | $ 196 | $ 290 |
| Carrier | easyJet | EL AL | Lufthansa | |
| Flight type | connecting flight | non-stop | connecting flight | 7h 50m |
| Total trip duration | 2h 20m | 2h | 3h | |
| Choose your best option | | | | |
| **Menu 2** | **Flight 1** | **Flight 2** | **Flight 3** | **Train** |
| Price in US $ for one-way trip | $ 91 | $ 248 | $ 196 | $ 290 |
| Carrier (1) | easyJet | AEROFLOT Russian Airlines | easyJet | |
| Flight safety rating | * | * * | * * | 7h 50m |
| Flight type | connecting flight | non-stop | non-stop | |
| Total trip duration | 2h 20m | 1h 40m | 1h 20m | |
| Choose your best option | | | | |

**(1) Note that the different safety ratings for easyJet are due to different aircraft types operated.**



### 2.2 Fight safety attribute

Each alternative flight was given a safety rating in one of three categories: “Low”, “Medium” and “High”. The rating values were derived from the experimental design. They are not based on the actual characteristics of the airlines. However, in each case, the rating was presented to the respondents as an objective value that has been calculated by aviation experts of the National Flight Safety Authority according to a model based on the history of accidents, near-accidents, and pilot errors, the quality of aircrew training and expenditures on aircraft maintenance. The safety levels were depicted using a star rating system. The flight menus included only the star ratings themselves. Yet each menu was followed by a scale explaining the rating system (see an example at the bottom of Figure 1).

A similar presentation was employed by Bateman, Islam, Louviere, Satchell, & Thorp (2011), and was supported by Vlaev et al. (2009), who found that range presentation resulted in more stable risk preferences in comparison to other methods described in the literature. Another justification for using this framing is that consumers are used to such representations in automobile marketing communications. A pilot study preceding the survey supported the use of this framing type, in the sense that participants were able to understand it correctly.

### 2.3 Airline perceptions

In the second part of the questionnaire, the participants were asked to rate each of the four participating airlines on a scale of 1 to 7 according to safety, flight comfort, service, and on time performance. They also indicated their experience traveling with each of these airlines. The answers to these questions reflect the participants’ perception of the airline, and thus were used in the model to explain the flight choice. We expected that airlines with higher ratings on these dimensions would be more likely to be chosen.

**2.4 Fear of flying**

To assess respondents' FOF, we relied on Gerwen, Spinhoven, and Van Dyck's (1999) validated self-report questionnaire. Specifically, we employed a combination of factor 2 and factor 3 (anticipatory flight anxiety and in-flight anxiety). The respondents were asked to rate their agreement with 12 statements indicating fear on a scale of 1 to 7.

The responses demonstrated high reliability of the scale, with a Cronbach-α value of 0.94. Confirmatory factor analysis of the responses found a single underlying FOF factor (with eigenvalue 7.63, explaining 63.6% of the variance). However, it should be noted that the factor analysis loadings were not used in developing the model in the next section; instead, they were estimated jointly with the other parameters of the model.

Within the experiment, the fear of flying indicators appeared after the choice task. But, the mean fear of flying level did not differ significantly between participants who received safety information and those who did not, thus excluding the possibility of any labelling effect due to the mention of phrases such as "accident risk" and "airplane crash" in scenarios with information.

**3. The sample and summary statistics**

Participants were sampled from a pre-recruited online panel representative of the adult Israeli population. A screening process was used in which only panelists who were 18 years or older, spoke Hebrew, and had travelled abroad at least once in the last five years were allowed to participate. 30 respondents were sampled for each block, for a total of 540 participants. Respondents were allocated randomly to one of the blocks. A total of 518 completed questionnaires that yielded 16,576 choice observations was collected. Of the respondents 47% were males; 6% were below their 20s, 21% were between 20-30 years old, 17% were between 30-40 years old, 17% were between 40-50 years old and 39% were above their 50s; 12% had much below average income, 18% had below average income, 30% had average income and 30% had above average income, and 10% had much above average income.

### 3.1 Airline perceptions

Table 2 summarizes the means and standard deviations of respondents' experience and perceptions towards the four airlines participating in scenarios with and without safety information.

**Table 2:** Experiences with and attitudes towards the airlines included in the survey

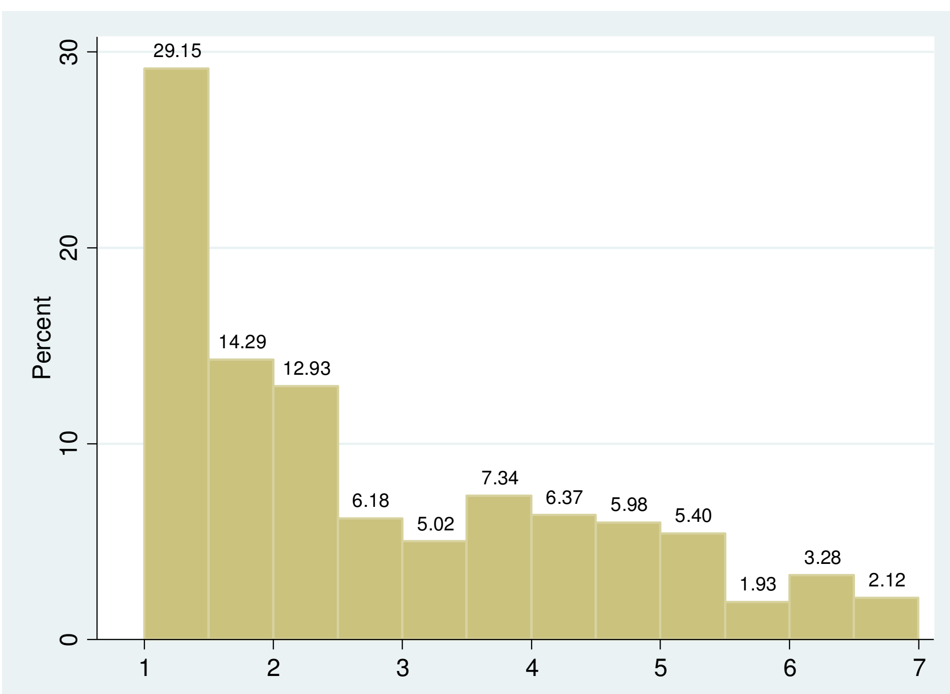
| | El Al | | Lufthansa | | easyJet | | Aeroflot | |
|---|---|---|---|---|---|---|---|---|
| **No safety info** | **No safety info** | **With safety info** | | **With safety info** | **No safety info** | **With safety info** | **No safety info** | **With safety info** |
| Never flown | 16.7% | 11.0% | 59.7% | 59.2% | 82.5% | 85.5% | 87.1% | 85.9% |
| Flown 1 to 5 times | 68.4% | 74.1% | 38.4% | 39.2% | 15.2% | 14.1% | 11.4% | 13.7% |
| Flown 6 to 10 times | 8.7% | 10.2% | 1.1% | 0.8% | 1.1% | 0.4% | 1.1% | 0.0% |
| Flown more than 10 times | 6.1% | 4.7% | 0.8% | 0.8% | 1.1 | 0.0% | 0.4% | 0.4% |
| Safety | 6.14 (0.79) | 6.00 (0.86) | 5.40 (1.24) | 5.42 (1.09) | 4.25 (1.27) | 4.23 (1.17) | 3.95 (1.38) | 4.05 (1.21) |
| Comfort | 4.79 (1.27) | 4.75 (1.33) | 5.23 (1.10) | 5.18 (1.09) | 3.99 (1.22) | 4.06 (1.12) | 4.06 (1.16) | 4.08 (1.06) |
| Service | 5.31 (1.16) | 5.32 (1.21) | 5.39 (1.20) | 5.46 (1.02) | 4.15 (1.26) | 4.08 (1.21) | 4.11 (1.14 | 4.16 (1.07) |
| On time | 5.37 (0.93) | 5.27 (1.10) | 5.47 (1.08) | 5.41 (1.04) | 4.18 (1.16) | 4.24 (1.11) | 4.17 (1.17) | 4.21 (1.04) |

* All attitudinal variables are on a 1-7 scale, where 7 refers to the best (highest) and 1 to the lowest rating.
**Numbers in parentheses indicate standard deviations.

### 3.2 Fear of flying

As noted, the responses to the validated self-report questionnaire were analyzed using factor analysis which indicated a single FOF factor. For ease of presentation and as the loadings of the factor's items where roughly similar, we calculated the average score of these items. The distribution of this average score is presented in Figure 2. Based on the scale interpretation of Gerwen et al. (1999), Figure 2 reveals that 26% of our sample suffer moderate to considerable flying anxiety.

**Figure 2:** The distribution on FOF factor among the sample participants



**4. The Model**

We present a model of flight itinerary choice based on the framework of consumers' discrete choice behavior. This model incorporates FOF as a latent psychological variable that explains the choice. The model also incorporates variables that capture the effects of the safety information and the respondents' own perception of safety regarding the various alternatives.

The likelihood function formulation presented below is adopted from Fleischer et al. (2012). It allows joint estimation of all of the model parameters, including those in the utility functions of the alternative itineraries, the FOF indicators, and the latent fear variables.

The choice of travel itinerary is modeled using a mixed logit random utility model. The utility of an alternative is given by:

$$U_{ikn} = \beta X_{ikn} + \beta^* X_n^* + \alpha_i \upsilon_n + \varepsilon_{ikn} \qquad (1)$$

$U_{ikn}$ is the utility of alternative *i* in choice experiment *k* to individual *n*. $X_{ikn}$ and $\beta$ are vectors of explanatory variables and the corresponding parameters, respectively. $\upsilon_n \sim N(0,1)$ is an individual-specific error term that captures unobserved characteristics of the decision-maker, and $\alpha_i$ is the corresponding parameter for a specific alternative. $X_n^*$ is a latent variable related to FOF. $\beta^*$ is the parameter that capture the effect of the FOF latent variable on the itinerary choices. $\varepsilon_{ikn}$ is an i.i.d. random error term, specific to the individual and the alterative, which is assumed to follow a Gumbel distribution.

The latent variable $X_n^*$ is assumed to depend on explanatory variables:

$$X_n^* = \gamma Z_n + \alpha \upsilon_n + \eta_n \qquad (2)$$

$Z_n$ is a vector of explanatory variables for the FOF latent variable and individual *n*. $\gamma$ and $\alpha$ are the parameters of the model. $\eta_n$ is a normally distributed random error term.

The responses to the statements in the psychological scale, $I_{rn}$, are discrete random variables. It is assumed that they derive from underlying continuous variables $I_{rn}^*$ through a mapping given by:

$$I_{rn} = \begin{cases} 1 & -\infty \le I_{rn}^* \le 0 \\ 2 & 0 \le I_{rn}^* \le \tau_{12} \\ \vdots & \vdots \\ J & \tau_{J-1,J} \le I_{rn}^* \le \infty \end{cases} \qquad (3)$$

$I_{rn}$ and $I_{rn}^*$ are the discrete responses and the continuous variables, respectively, underlying the responses of individual *n* to statement *r* in the scale respectively. $\tau_{j-1,j}$ is the threshold parameter between choosing response levels *j-1* and *j*. *J* is the total number of response levels in the scale (7 in our case).

These continuous variables that underlie the responses to the fear scale are affected by FOF and used as indicators of it:

$$I_{rn}^* = \lambda_r X_n^* + \alpha_r \upsilon_n + \zeta_{rn} \qquad (4)$$

$\lambda_r$ and $\alpha_r$ are parameter, $\xi_{rn}$ is a normally distributed random error term.

The data used to estimate the parameters of this model include the responses $Y_{kn}$ to the choice experiments and the FOF indicators $I_{rn}$. With the model specified above, the conditional itinerary choice probabilities are given by:

$$p\left(Y_{kn} \mid X_{kn}, X_n^*, \upsilon_n\right) = \frac{\sum_i \exp\left(\beta_{ik} X_{ikn} + \alpha_{ik}\upsilon_n + \beta_{ik}^* X_n^*\right) Y_{ikn}}{\sum_i \exp\left(\beta_{ik} X_{ikn} + \alpha_{ik}\upsilon_n + \beta_{ik}^* X_n^*\right)} \qquad (5)$$

$Y_{kn}$ and $X_{kn}$ are matrices of the choice indicators and explanatory variables respectively. The choice indicators $Y_{ikn}$ equal 1 for the chosen alternative and 0 otherwise.

The probability density of the latent fear variables is given by:

$$f\left(X_n^* \mid Z_n, \upsilon_n\right) = \frac{1}{\sigma}\phi\left(\frac{X_n^* - \gamma Z_n + \alpha\upsilon_n}{\sigma}\right) \qquad (6)$$

$\sigma$ is the standard deviation of the error term $\eta$.

The probability of a response to a specific indicator is given by:

$$p\left(I_{rn} = j \mid X_{mn}^*, \upsilon_n\right) = \Phi\left(\frac{\tau_{j,j+1} - \lambda_r X_n^* - \alpha_r\upsilon_n}{\sigma_r}\right) - \Phi\left(\frac{\tau_{j-1,j} - \lambda_r X_n^* - \alpha_r\upsilon_n}{\sigma_r}\right) \qquad (7)$$

The conditional joint probability of the observed outcomes and the latent variables is given by:

$$f\left(Y_n, I_n, X_n^* \mid X_n, Z_n, \upsilon_n\right) = \prod_k p\left(Y_{kn} \mid X_{kn}, X_n^*, \upsilon_n\right) \prod_r p\left(I_{rn} \mid X_n^*, \upsilon_n\right) f\left(X_n^* \mid Z_n, \upsilon_n\right) \qquad (8)$$

The joint probability of the observed outcomes for individual *n* is given by:

$$p\left(Y_n, I_n\right) = \int_{\upsilon}\int_{X^*} f\left(Y_n, I_n, X^* \mid X_n, \upsilon\right) f\left(X^*\right) f\left(\upsilon\right) dX^* d\upsilon \qquad (9)$$

Finally, the log-likelihood function is given by:

$$LL = \sum_n \ln\left[p\left(Y_n, I_n\right)\right] \qquad (10)$$

## 5. Empirical Results

In this section we provide the estimation results of the simultaneous choice and FOF model followed by three illustrations of the estimated results.

### 5.1 Model estimation results

The model parameters were estimated using GAUSS 8 by maximizing a function that implemented the likelihood function defined above. Table 3 presents the results of two models: one that includes only the flight attributes and takes into consideration the 'opt-out' alternative of a train (Model 1), and a second one that also incorporates the effects of FOF through its interaction with the key variables in the model (Model 2).

Comparison of the estimated coefficients in the two models reveals that they are similar in terms of signs, magnitudes, and statistical significance. Thus, we describe here the results for these variables in Model 2 only.

**Table 4: Choice Model Estimation Results**

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| **Parameter** | **Estimate** | **SE** | **Estimate** | **SE** |
| Lufthansa dummy | -0.331** | 0.069 | -0.310** | 0.070 |
| easyJet dummy | -0.441** | 0.094 | -0.376** | 0.094 |
| Aeroflot dummy | -0.611** | 0.114 | -0.472** | 0.107 |

| | | | | |
|---|---|---|---|---|
| Price | -1.392** | 0.057 | -1.466** | 0.061 |
| Direct flight dummy | 0.248** | 0.068 | 0.242** | 0.071 |
| Flight duration | -0.124** | 0.009 | -0.127** | 0.010 |
| Comfort | 0.054 | 0.036 | 0.054 | 0.035 |
| Service | 0.120** | 0.038 | 0.121** | 0.037 |
| On-time performance | 0.074* | 0.039 | 0.066** | 0.038 |
| Airline frequent flier | 0.199* | 0.106 | 0.220* | 0.104 |
| Train dummy | -8.799** | 0.565 | -8.468** | 0.346 |
| Safety information – High[3] | 0.301** | 0.089 | 0.281** | 0.093 |
| Safety information – Medium[3] | -0.291** | 0.088 | -0.257** | 0.091 |
| Safety information – Low[3] | -0.326** | 0.061 | -0.284** | 0.064 |
| Safety perception – with info.[1] | 0.051 | 0.039 | 0.060 | 0.038 |
| Safety perception – no info.[2] | 0.116** | 0.036 | 0.106** | 0.033 |
| El Al – FOF interaction | | | -1.429** | 0.271 |
| Lufthansa – FOF interaction | | | -1.471** | 0.267 |
| easyJet – FOF interaction | | | -1.611** | 0.261 |
| Aeroflot – FOF interaction | | | -1.724** | 0.263 |
| Price – FOF interaction | | | 0.239** | 0.058 |
| Direct flight – fear of flying interaction | | | 0.075 | 0.067 |
| Flight time – fear of flying interaction | | | 0.010 | 0.009 |
| High safety info.– FOF interaction | | | 0.015 | 0.087 |
| Medium safety info. – FOF interaction | | | -0.110 | 0.087 |
| Low safety info. – FOF interaction | | | -0.119* | 0.059 |

**, * significant at 1% and 5% respectively.
[1] The coefficient is relevant to participants who received safety information.
[2] The coefficient is relevant to participants who did not receive safety information.
[3] The reference of the safety level coefficients is the option of "None".

As expected, the price and duration variables are negative and significant, and the coefficient of a direct flight is positive and significant. The coefficients of ‘service’ and ‘on time' indicate that individuals prefer airlines that they perceive to have good service and whose flights are on time. Being a member of an airline’s frequent flyer program increases the probability of a traveler choosing this airline. The coefficients of Lufthansa, easyJet, and Aeroflot are all negative and significant. They reflect attributes of the airlines that are not explicitly included in the model. They are also specific to the Israeli population represented in the sample used in the study. Their values indicate that after controlling for being a member in the relevant frequent flier program and the perceptions of quality of service, on time performance and comfort, travelers in the Israeli market that the sample is drown from prefer El Al (which is the reference airline) to Lufthansa, EasyJet, and Aeroflot, in this order. Interestingly, the frequency of flying in the past, which was included in the model using a set of dummy variables, was not found to affect the itinerary choices and was omitted from the model. This may be partly explained by the fact that the data shows significant correlations between the past experience with a specific airline and the safety perception of the same airline, which is explicitly included in the model.

The opt-out alternative to travel by train is considered vastly inferior to the flights, with its constant utility being large, negative, and highly significant

The results indicate that participants who did not receive safety information used their own perceptions of safety. The coefficient of own safety perception is positive and highly significant. However, participants who received safety information for the flights discounted their own safety perceptions (their coefficient of safety perception is much smaller and not significant) and used the safety information they received instead. Participants' preference for flights for which the received high safety ratings increased over the situation that they did not receive information (the coefficient of this variable is positive and significant). In contrast, the participants showed a strong tendency to avoid flights that received medium or low safety ratings. The coefficients of the two lower ratings are similar and significantly negative. A t-test for the difference between the two coefficient showed that they are not significant (p-value=0.74). Thus, the participants treat flights with high safety ratings as superior, whereas flights with medium and low safety ratings are considered identically inferior.

Model 2 also accounts for the effects of fear of flying on preferences for flight attributes. The reference variable for the interaction variables with airlines is the train option. As expected, the coefficients of the interactions with all the airlines are negative and significant, indicating that participants with high levels of FOF tend to avoid flying and are more likely to choose the train compared to individuals with low levels of FOF. Travelers with higher levels of FOF are also less sensitive to price, which implies that they are willing to pay more for their preferred attributes. This result is in accordance with Fleischer et al. (2012), who found that price elasticity decreases as level of FOF increases.

A priori, we also expected that individuals with high levels of FOF would show significantly higher preference for flights with high safety ratings and dis-preference for flights with medium and low safety ratings compared to individuals with lower FOF levels. However, the results show that there is little difference among individual with different FOF levels with respect to the high level of safety. In spite of this, the negative effect of medium or low safety ratings on the itinerary choice was greater for individuals with higher FOF levels.

### 5.2 Illustrations of the estimated results

In order to better understand the role of the safety indicators in choice of flight with relation to safety perception and FOF, we illustrated the model's results in Figure 3 through 5. The first illustration presented in Figure 3 was created by fixing all flight attribute variables except for safety level at their average values. We then calculated willingness-to-pay (WTP) in order to move from lower to higher safety level flights as a function of FOF.

The WTP for a change from low to medium safety level flights is very close to zero and almost flat. This means that low and medium safety level flights are perceived as indistinguishable by the participants regardless of their level of FOF. However, the WTP for a move from a low or medium level flight to a high level flight is much higher and increases with the level of FOF.

An individual at the lowest 15th percentile of FOF is willing to pay a little over 20 USD more in order to buy a ticket for a flight with a high safety level rather than a flight with a low or medium safety level. A more fearful individual located at the 85th percentile of FOF is willing to pay about 60 USD for the same exchange of tickets.

**Figure 3: Willingness to pay for different safety levels as a function of FOF**

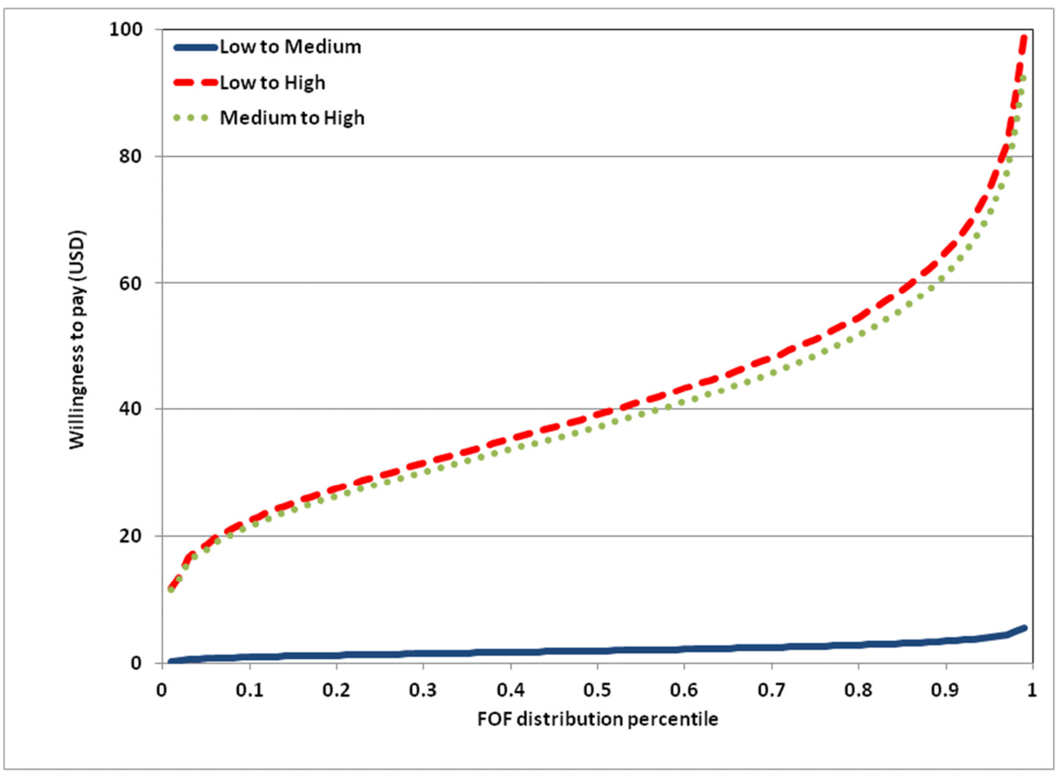



Figure 4 demonstrates the role of an individual's own perception of safety in choice of flights with and without the objective safety information. We calculated the probability of choosing flight 1over flight 2. The two alternatives are identical, except for the decision-maker's own safety perception level and safety information, which vary in flight 2. In this scenario, when no information on the safety level of the flight is provided, the choice probability for flight 1 is almost 70 percent when flight 2 is perceived as unsafe, but only about 40 percent when flight 2 is perceived as very safe. The other curves in Figure 4 demonstrate the probability of choosing flight 1 when information is provided. The three curves are for the three different levels of safety for flight 2. The safety rating of flight 1 is fixed to the high level.  The probability of choosing flight 1 is higher by about 15 percent when flight 2 is rated as low or medium compared to when it is rated high. The individual's own safety perception played a much smaller role here than it did when no information was provided. This is reflected in the fact that the curves are flatter than when information was not available.

**Figure 4: The probability of choosing flight1 as a function of the safety perception of flight2**

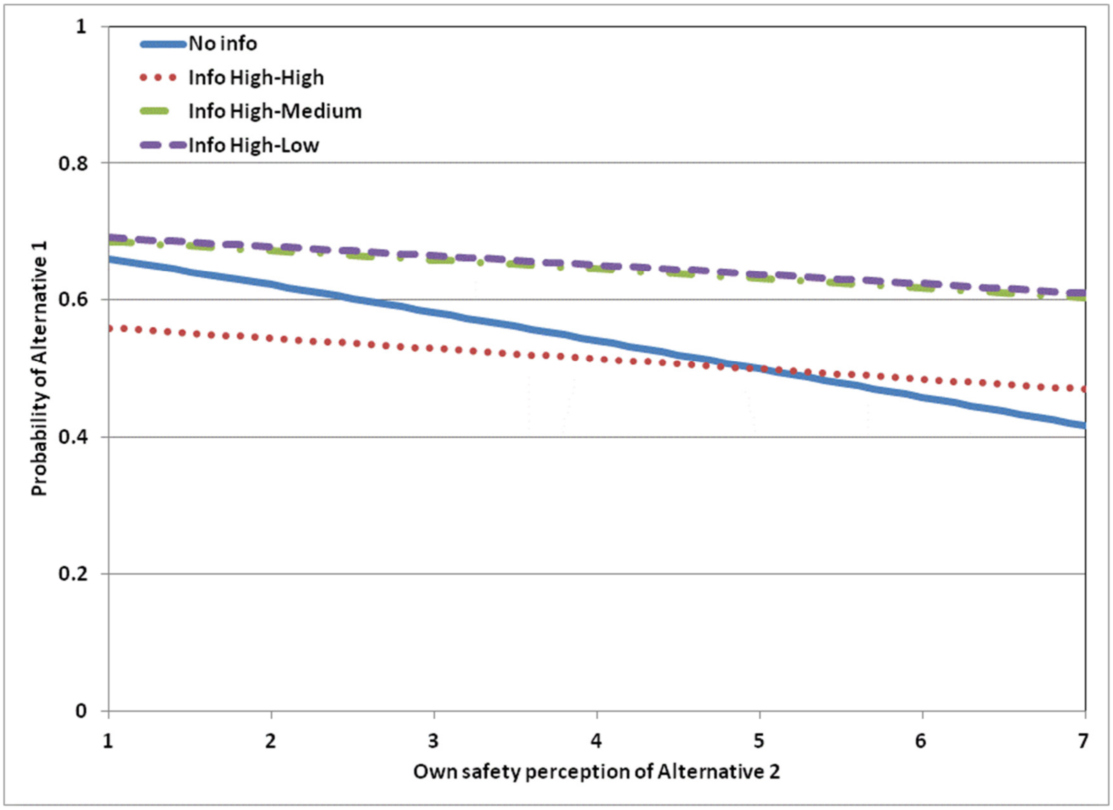
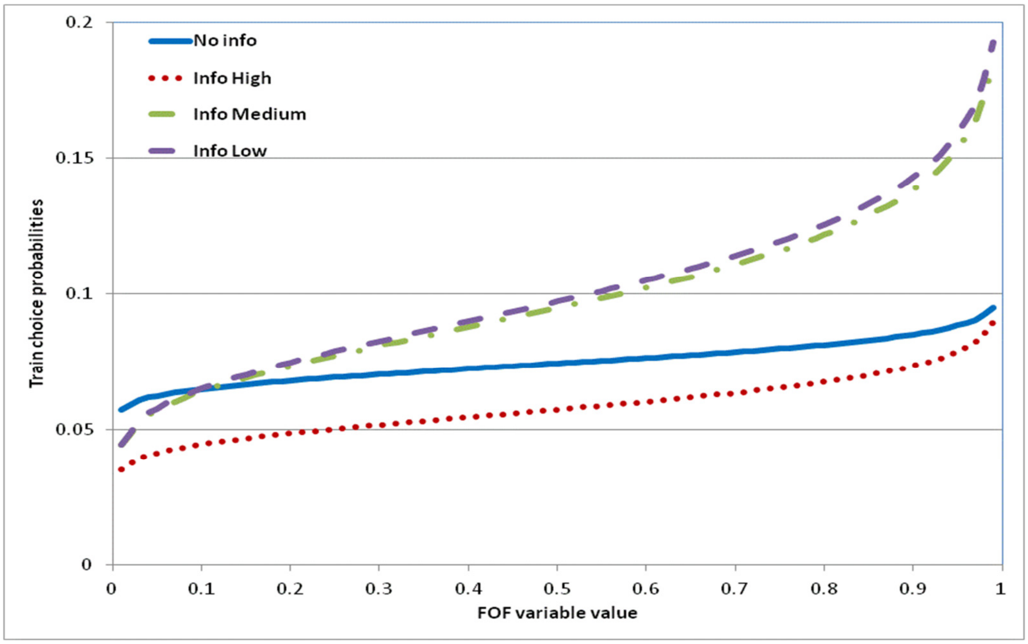



Figure 5 presents the results of a scenario in which there are two alternatives: a flight and the opt-out option to travel by train.

The figure shows the choice probabilities for the train as a function of the FOF level and information provided about the flight alternative. The provision of information about the flight safety affects the choice probabilities. When the flight is rated high, the train choice probabilities are lower than when information is not provided. When the flight is rated low or medium, the train choice probabilities are higher than when information is not provided. Furthermore, FOF level has little effect on the probability of choosing the train when high rating information or no information at all is provided (especially for the FOF values in mid-range values of FOF).

However, when low or medium ratings are provided, the effect of FOF on the choice probabilities is much more pronounced.

**Figure 5: The probability of choosing travel via train as a function of FOF**




## 6. Discussion

Based on the experiment conducted in this study, wherein half of the participants did not receive any safety information on the flights and half received safety information framed by range presentation and aided with visual representation to communicate the risk probabilities, we can infer the following:

As expected, when safety information is not available, individuals use their own safety perceptions of the airlines when choosing a flight. However, when (allegedly) objective flight safety ratings are supplied, they abandoned their perceptions and rely on the information provided in choosing flights. This finding is in accordance with other studies in different industries, such the meat industry, as shown in Heiman & Lowengart (2011).

We also demonstrate that individuals do not perceive the full ordinal scale of ratings, but only distinguish between the high safety ratings, which they perceive as superior,  and the other two (medium and low) ratings, which they perceive as equally inferior despite the fact that the medium safety is as 1.7 times safer than the low level.  That is, in our experiments, individuals perceive the safety ranking as dichotomous – high as superior and everything else as inferior.

This finding demonstrates that even when statistically robust safety measures that better represent airline safety performance are presented, as suggested by Czerwinski & Barnett (2006), individuals do not interpret them as a range. Despite the fact that we ranked the flights according to three risk levels and all the involved risks were extremely low, participants were not sensitive to the different levels. Our results, then, imply that Savage's (2011) suggestion that airlines can compete on the basis of safety performance and offer different levels of safety on the same route is not valid.  Air passengers cannot or do not wish to distinguish between the different safety levels, regardless of the fact that they receive information on the different risk probabilities. Our findings suggest that when it comes to life threatening and "bad death" situations, people are not sensitive to the different shades of safety and discern flights only as safe or unsafe. The implication of this finding for the industry and policy makers is that positioning safety measures along a scale may be meaningless to air passengers. Rather, airlines with high safety rankings will benefit from disclosing them, while airlines ranked below high, regardless of whether they are ranked medium or low, could face decreased demand. Thus, in accordance with Akerlof (1970), we expect safety information disclosure to motivate airlines to improve their safety levels and cause an increase in the average safety level of the airline industry, a desirable outcome if concerns about commercial aviation safety emerge.

Our findings suggest that for airlines that would not be rated at the highest level of safety, a state of information asymmetry is preferable to a state of safety information disclosure. This is due to the fact that individuals seem to avoid flying more when a flight receives an inferior safety ranking (low or medium) than when there is no information at all about the safety of the flight. Under conditions of safety information disclosure, individuals can not only take alternative flights, they can be encouraged to choose other modes of transportation than flying.

We also show here, in accordance with Fleischer et al. (2012), that the emotional factor of FOF plays an important role in flight choice. When flights are rated high, FOF does not play an important role in flight choice. However, this is not the case when the flights are rated lower on the safety scale; individuals with FOF demonstrate much stronger avoidance of flying than individuals without it. That is, we show that people with high FOF make different choices than their less fearful counterparts. They treat the different attributes (for example, carrier identity and price) differently, weighing them in ways that help them feel more secure. However this is not the case when a flight is ranked high on the safety scale. In this case, we could not find a difference between individuals with or without FOF. We believe that high safety level information provides fearful passengers some level of assurance by reflecting accurate safety measures and allowing them to abandon their reliance on heuristics and make decisions similar to those of fearless passengers.

**7. Concluding Remarks**

We show here that the debate over publishing airline safety information concerns not only the issue of accuracy of measurement, but also that of preferences and perceptions. In our experiment, we illustrated that while the information is important and the respondents make use of it, they may not interpret it as it is presented to them. It appears that the form in which the information is delivered needs to be studied thoroughly, since if accurate information is delivered in a non-effective form to passengers, specifically passengers who suffer from FOF, which is a growing phenomenon, they might choose other forms of transportation over flying, despite the fact that flying is the safest mode of travel, because they have misinterpreted the safety information.

Our results depends in the risk framing provide. While we chose to utilize a form of information presentation similar to that used in the automotive industry, it is possible that different presentation forms would have a different effect on travelers' decision-making. This issue should be explored further.

Another point that merits further study is the opt-out option. This alternative was not very attractive compared to flight for the route we used in this experiment, due to the long trip duration and high price. It is plausible that airlines with lower safety ratings may suffer even more on routes with better non-flight transportation alternatives.

Finally, we intentionally choose a trip that is not the local market for the respondents and that they do not follow closely. Maybe in situations where the respondents are familiar with the specific flights better, they would have stronger perceptions and therefore the information effect may be lower. This remains for future studies.

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