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Impact of Traumatic Life Events on Risk Behavior

Master Thesis - Behavioral Economics
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Abstract

Using data from the Dutch Longitudinal Internet Studies for the Social Sciences (LISS) panel, this paper analyzes whether traumatic events that are individually experienced in daily life such as sickness, violence, loss of a loved one have an effect on risk attitude. It also includes mediating factors of trauma to analyze the relationship, i.e. recency, severity and frequency. In agreement with previous studies, exposure to trauma induces higher levels of risk aversion. Two individual-specific events are associated with higher risk aversion: having experienced life-threatening illness and death of a loved one. The first one has a bigger tendency (7.7%) to become more risk averse than the second one (5.2%). The separating and/or divorcing parents only have an effect on risk aversion if this trauma is frequently experienced, and also the more often this trauma is experienced, the higher the levels of risk aversion. Other than this significant association, the impacts of other mediating factors seem to be ambiguous. This paper provides support to similar studies, which suggests that idiosyncratic negative life events should be considered as important as large-scaled traumatic events (e.g. financial crises), since the impact of those traumas on risk-taking behavior is comparable in terms of magnitude.

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1. Introduction

According to traditional economics, and from a theoretical perspective, all decision makers are rational and make decisions that maximize their self-interest. The expected utility theory (EUT) is a theory about individual decision-making under uncertainty (Starmer, 2000). Unlike the expected value theory, EUT also takes into account that each individual has different risk preferences, and thus have different utility functions. Bernoulli has introduced risk aversion in 1938 as the key player in examining decision-making under uncertainty and since then, a lot of research has been done on risk behavior to explain individual differences in risk-taking behavior. If there is a set of various risky options to choose from, a decision maker would always - according to EUT - choose the same optimal one that gives the highest expected utility. All deviations from that optimal option are considered as "irrational", and in real life settings, this appears to be the case: even when there exist options with higher expected utilities, individuals choose the irrational one seen from a traditional economic perspective. Their choices deviate from the predictions made by the EUT. Researchers not only realized that individuals in the real world are not rational as theorized, but consequently, also a lot of traditional finance theories such as the well-known efficient market hypothesis cannot be applied in practice. A reason that individuals do not make "optimal" choices is that the assumption of EUT - that decision makers have stable risk preferences – is not true. External factors alter their risk preferences across time.

Only the past few decades show a growing body of literature questioning the stability of risk preferences and aiming to find explanations how risk attitude is formed and the reasons behind the choices of individuals. Traditional economics focuses on how to elicit the choices or predict the behavior of the individuals, assuming that the risk preferences are constant over time, rather than understanding the reasons behind their choices or actions. On the contrary, psychologists and sociologists have done many studies on how characteristics such as personality, attitudes and beliefs of individuals are formed and why they are different for all individuals (Hoffman, 1977). Combining these two fields led to a new strand of literature in the past years, introducing behavioral economics, which studies economic behavior of individuals in real life settings. Behavioral economists believe that people are – contrary to the traditional economy theory - not rational and do not have stable risk preferences, leading to the so-called irrational financial decision-making. The systematic changes in risk preferences can ultimately lead to crucial real-world consequences, since an individual's willingness to take risks can predict aspects of labor market and health outcomes, addictive behaviors, investments and migration decisions (Schildberg-Horisch, 2018). Risk aversion can lead to, for example, diminishing optimal levels of consumption, less self-employment and individuals investing less in stocks and risky assets. Some countries have a lower total factor productivity, and do not invest in business opportunities, capital or human capital, which can be explained by their higher aggregate risk aversion (Shaw, 1996; Hartog and Diaz-Serrano, 2007; Yesuf and Bluffstone, 2009). Therefore, it is essential to learn about risk-taking

behavior in decision-making under uncertainty by investigating how actions and preferences of decision-makers are formed.

Research in psychology and economics found abundant empirical evidence that rejects the assumption that individuals have predetermined and exogenous risk preferences, which prior economics research are often based on. Some of the factors that have an impact on risk attitudes are background variables such as gender, age, education, income and parental background (Eckel and Grossman, 2002; Bucciol and Zarri, 2015). Furthermore, several studies discovered the significant roles of individual factors such as personality (Zeleskiewicz, 2001; Trimpop et al., 1999), cognitive abilities (Benjamin et al., 2005), genetics (Zhong et al., 2009) and emotions (Kuhnen & Knutson, 2005; Loewenstein et al., 2000). Studies in social psychology suggest that risk aversion is not a stable and exogenous preference, but varies according to different emotional states (Moya, 2018). Emotions are an important component in risky financial decision-making (Kuhnen & Knutson, 2005). Since traumas can induce strong emotions, it is not surprising that recent papers find evidence that experiencing major traumatic events such as natural disasters or wars have a significant impact on risk behavior of individuals. These events can significantly alter risk attitudes and decrease their ability to make efficient economics decisions.

As mentioned before, understanding risk behavior is fundamental in many economic models regarding decision-making under uncertainty. Despite the above mentioned important findings, predicting risk attitude still remains to be an unsolved area. Extensive research in economics has been done on what impact risk attitude has on economics decisions or how to quantify risk preference, but not on how risk attitudes are shaped. Research outside economics already showed abundant evidence that traumatic events can have major consequences on an individual's mental well-being. This study aims to contribute to prior work outside economics and the small but growing body of research within economics on the role of emotions on risk behavior. More specifically, this paper investigates the role of trauma experiences on risk attitudes. But unlike prior related studies in economics, the focus of this paper is on personal adverse life events, which are more common than the drastic disaster events, and even inevitable in daily life. Not all people directly experience a large-scaled disaster, but direct exposure to negative life events is inevitable and can trigger strong negative emotions, which in turn can shape the individual's risk behavior. Second of all, existing empirical literature on the effects of traumatic events on risk attitude of people are often case-based on one specific major disaster (such as a nature disaster, civil war and the 9/11 incident) that is collectively experienced. It is interesting to see whether these found effects also apply to individual-specific traumatic events. For instance, Bucciol and Zarri (2015) found that experiencing adverse individual-specific life events have the same impact in terms of intensity as experiencing a collectively experienced event such as the financial crisis in 2008 on financial risk taking. This suggests that in terms of impact on risk attitude, exposure to individual-specific trauma events might be comparable to exposure to a large-scaled disaster that is collectively experienced. To the best of my knowledge, this paper includes a list with the biggest variety of different types of traumatic events to explore their linkages with risk behavior.

1.1 Research questions

By conducting an empirical analysis on a representative sample of the Dutch population with hypothetical lottery questions from a national survey, this paper examines how prior life experiences alter individuals' risk behavior. This topic is relevant for economists since we can gain better understanding of how people make certain choices and improve (traditional) economic models. It can provide us new insights on the determinants of risk behavior and contribute to both the scientific and social literature. This paper provides support to empirical research in the psychology literature, which contributes to a more comprehensive theory of individual decision-making under uncertainty than the rational choice model. Risk attitudes are not a stable and exogenous preference but influenced by numerous factors. Not only are factors associated with cognitive ability important determinants of risk behavior, but also traumatic experiences - through the emotional mechanism - can shape the willingness to take risks. This could have important implications for calibrating macroeconomic models, forecasting investments in the financial market or estimating demand functions for insurance or retirement saving (Kim and Lee, 2012). This study contributes to a better understanding of systematic changes in risk preferences over time, of individual decision-making and also macroeconomic outcomes. Therefore, this study might also be relevant for policymakers and companies that try to understand and manage the effects of human factors in financial decisions. As an extension to the related articles, this study addresses the research question as following:

$$\text{"Are individuals who have experienced traumatic life events more risk averse in financial decision} - \text{making?" (1)}$$

Based on the outcomes of previous related studies, I hypothesize that individuals who went through a life trauma become more risk averse. Furthermore, this paper examines the effect of eleven different types of trauma, but I expect that not every type of traumatic events has an impact on risk aversion. Some events may have a higher impact than others, which is proven by Bucciol and Zarri (2015) and therefore, the impact of the different traumatic events will also be examined.

On top of this main research question, it is interesting to explore through what factors traumatic events have effects on the risk attitude of individuals. Moya (2018) found that two factors mediate the effects of trauma, i.e. the number of violent events experienced and temporal proximity. Following a dose-response relationship, more severe and recent traumas would increase risk aversion more. Following these findings, the following sub-hypotheses are derived and will be tested for all categories of trauma in the dataset:

H2: More recent traumatic events increases risk aversion.

H3: The severity of traumatic events increases risk aversion.

H4: A higher number of experiencing traumatic events increases risk aversion.

The second sub-hypothesis is derived by results of similar studies. Some studies find that the behavioral effects caused by traumatic events are not permanent and diminish or even vanish over time (Moya, 2018; Bucciol & Zarri, 2015). This suggests that traumatic events experienced a long time ago have diminishing or no behavioral effect on current decision-making. Moreover, as mentioned above, Moya (2018) finds that more recent violent events play a role in bringing higher levels of risk aversion. Bucciol and Zarri (2015) also evaluate the importance of the timing of the event on risk taking. They find that physical attacks only have an effect on risk taking if they are recently experienced.

According to Moya (2018), severity is one of the relevant factors that explain the relationship between violence and risk aversion. Using the frequency of experiencing violent events as a proxy for severity, he concludes that the more severe the trauma was, the more it increases the level of risk aversion. Cameron and Shah (2015) also elicit the importance of severity, discovering that the behavioral effects last longer with severity for natural disasters. Although Bucciol and Zarri (2015) do not include severity in their analysis, their findings are interesting for this study, specifically for this sub-question. Losing a child has a rather strong and long lasting effect on risk taking, while experiencing physical attacks has rather a small effect and only for a short term. It is plausible to believe that different types of traumatic events rank differently in scales of intensity. Although the authors do not analyze the effect of severity on risk attitude, one can expect that losing a child is more drastic than experiencing physical attacks. Moreover, they claimed that intensity of the experience plays a key role in influencing future (financial) decision-making. Based on these outcomes, it is likely that more drastic experienced events will have a bigger impact on the individual's well-being, and in turn a bigger impact on the risk behavior. As the measure for severity of traumatic events, this study uses the actual intensity levels filled in by the subjects. This has a few benefits compared to aforementioned studies. First of all, it is a more accurate measure than the frequency of being exposed to traumatic events, proxied by Moya (2018). Second of all, it solves the problem that it is difficult to rank the types of events accordingly by severity. Lastly, it is true to person as the impact of exposure to events is perceived differently for each person since this is subjective, and therefore is a better measure than a general ranking of the events, if this exists.

Lastly, the fourth sub-hypothesis is about the frequency of experiencing negative life events. Bucciol and Zarri (2015) found an indication (i.e. in their preliminary analysis) that people who have experienced more events are less likely to make risky investments. Moya (2018) measures frequency by counting the number of times the victims have experienced violent events and found that victims who have experienced multiple violent events display severe symptoms of psychological trauma. Prior studies support this finding as they have found that exposure to multiple traumatic events leads to higher levels of psychiatric distress (Williams et al., 2007; Suliman, 2009). Based on these results, a positive relationship is expected between the frequency of experiencing negative life events and risk aversion.

1.2 Traumatic events in the Netherlands

Despite the fact that the Netherlands is an interesting research population for topics concerning trauma due to its unique characteristics and rich literature on life traumas, only limited research similar to this paper's topic on the Dutch population has been done. The reasons why the Netherlands has an interesting research population for this paper will be clarified for a better understanding of the sample population. This subsection elaborates on the culture of the Netherlands, which is indispensable for understanding the interest in and prevalence of life traumas in this country, and the history on trauma.

The lifetime prevalence rate of exposure to life trauma in The Netherlands is relatively high (80.7%), which is comparable to that in the United States (De Vries and Olff, 2009). The most prevalent traumatic events in the Netherlands are comparable to those in many other countries, among which, the death of a loved one and motor vehicle accidents. The high prevalence rate might be the result of the unique characteristics of the country. Compared to other parts of Europe, the Netherlands is a country that has modern and liberal policies towards subjects that are normally viewed as taboo, such as drugs, prostitution, homosexuality, and euthanasia. Almost half of the population is nonreligious (42%). These characteristics embody their liberal and open culture and might be the reasons that fewer stigmas are attached to traumatic events. People tend to be more comfortable about opening up and revealing details of their personal and emotional lives, and thus resulting into less reporting bias in trauma surveys. At the same time, other socio-cultural aspects of the country may have increased the prevalence of traumatic events. The Netherlands ranks in the top six among the largest population size in the European Union (EU), with one of the lowest proportions of the elderly. The country has a relatively high multicultural population due to its history: there are citizens originating from Indonesia and Surinam, which used to be colonies of the Netherlands, and from Southern Europe and Morocco due to labor migration. Also a considerable proportion of refugees are present. These aspects, i.e. the degree of urbanization, age distribution, ethnic and cultural diversity are considered to contribute to a higher level of exposure to traumas (De Vries and Olff, 2009).

The Dutch literature on traumatic events is quite rich, as the first article goes back to over a century ago and the relatively big interest in psycho-trauma since then. Yet, some traumas only gained attention in the past decades. Sexual abuse, for example, slowly gained attention since the 1980s and this was shown in the form of conducting research and publishing books. The growing expertise in this field led to recognition of the impact of early life trauma, and this started to increase the attention for traumas in children around the 1990s. Because children was a long neglected research population, the research in traumas during childhood and clinic care for this group lagged behind in comparison to the study of adults. Awareness for other traumas related to violence, war and refugees also rose during these years. During the last three decades, the scientific interest in psycho-trauma in the Netherlands and the number of health care facilities grew exponentially. Dutch and European institutions focusing on trauma (e.g. International Society on Traumatic Stress Studies) were also initiated.

The growth in attention to psychological trauma in the Netherlands is also caused by the changes in the perception of trauma, including the popularization of intrusive images on TV and the emancipation of emotions. Partly due to the spread of mass media and this emancipation of emotions, the general population started to manifest itself. Besides the general population, victims, professionals and the government also had a change in attitude towards trauma. A proportion of the victims started to organize themselves, while the government became more involved in the acknowledgement of the suffering and managing of the consequences (Vermetten and Olff, 2013).

The remainder of the paper is organized as follows. The next section provides a brief and selected review of related studies in economics as well as psychology. In section 3, data and methodology will be discussed, where the data sample and the measures will be described. Section 4 presents the estimation results and main findings. The paper ends with the conclusion in section 5. This section also discusses the limitations of the paper and ideas for future research.

2. Literature Review

Outside economics literature, a wide range of studies has been done on the consequences of traumatic events. A number of studies investigate the impact of life traumatic experiences on socioeconomics and economic consequences such as health, schooling, investment and labor income. Aside from these consequences, abundant studies in medicine and psychiatry reveal that experiencing trauma can also lead to lasting consequences on mental and physical health, for example post-traumatic stress disorders (Yehuda, 2002) or that survivors of the Holocaust differ significantly in political attitudes, religious beliefs and future orientation (Carmil & Breznitz, 1991).

Within the economics literature, empirical research on the impact of traumatic experiences on individuals' preferences, beliefs and other economically relevant variables is relatively new. Only a small body of literature examines the effects of collectively experienced traumatic events such as natural disasters, wars and economic crises on risk preferences of individuals (Cassar et al,. 2017; Eckel et al., 2009; Li et al., 2011). However, even though significant effects are found, there is no coherent consensus about the direction in which traumatic experiences affect risk aversion since some studies show contradicting conclusions.

Some authors find results suggesting that traumatic events have significant increasing effects on risk aversion. Cassar et al. (2017) show that individuals who experienced the 2004 tsunami in Thailand exhibit higher risk aversion. Callen et al. (2014) find that subjects in Afghanistan exposed to violence have a stronger preference for certainty, suggesting higher levels of risk aversion. Li et al. (2011) find that individuals who experienced natural disasters are more risk averse in a loss domain but less risk averse in a gain domain. Malmendier and Nagel (2011) examine the effect of a big macroeconomic shock on the risk behavior of Depression babies and find that households who experienced low stock market returns are less willing to take risks.

Next to finding a positive effect of adverse life events on risk aversion, the following studies have analyzed the persistence of the behavioral effect caused by trauma on risk aversion. Moya (2018) find that more severe violence brings about higher levels of risk aversion in the gain domain and even a bigger shift in risk attitude under the ambiguity domain in which the first order probability distribution of payoffs was unknown, suggesting victims of violence dislike ambiguity more than risk. This behavioral effect is not permanent but vanishes with time. Complementing this study, Cameron and Shah (2015) recognize higher risk aversion of people in Indonesia who recently lived through natural disasters. This effect persists for years, especially if the disaster was severe. Also Kim and Lee (2014) find a significant effect of early childhood exposure to Korean War on risk behavior. Although the effect is not permanent but diminishes over time, it persists up to five decades. Aside from the finding that the victims are more risk averse than others, their study interestingly discovers that there exists a sensitive period for risk preference formation. Bucciol and Zarri (2015) find that experiencing life-history negative events has a

negative impact on financial risk taking. Specifically, two individual-specific events - having been victim of a serious physical attack and especially the loss of a child - are associated with lower and less frequent investments in risky assets. While the effect of the first event vanishes over time, the effect of the latter one is long-lasting. Comparing the impact of the personal events to the impact of the financial crisis, they find a similar effect in terms of intensity. Examining individual-specific traumatic events as well, this is the most closely related study to this paper. The key differences are the different measure of risk behavior, as Bucciol and Zarri (2015) use observed portfolio decisions as a proxy, and the list of traumatic events, as this paper contains a wider variety of trauma categories. In addition, their sample consists of only elderly people either already retired or at the end of their working lives, with an average age of 66. The sample is not representative of the whole population, and thus results in biased results.

Contrary to the aforementioned studies, a few articles observe a negative relationship between risk aversion and traumatic events. Eckel et al. (2009) find that individuals who were exposed to the disaster Hurricane Katrina display an increasing short-term effect in risk-seeking behavior, indicating that mental stress is the influencer. Hanaoka et al. (2015) find that men who experienced greater intensity levels of the earthquake in Japan become more risk seeking and this effect persists for five years. Voors et al. (2012) suggest that individuals in Burundi who have experienced violence are less risk averse. However, this finding might differ from the expected outcome due to the sample that includes residents who may or may not have been victimized.

Studies in neuroscience and social psychology could explain the underlying mechanism for the relationship between the exposure to traumatic events and risk behavior. Emotions are an important component in risky financial decision-making (Kuhnen & Knutson, 2005). When individuals experience negative life events, this will trigger negative emotions. These emotions, together with the sense of uncertainty and the lack of control associated to it, can lead to individuals' changing willingness to take risks. This impact can be long-lasting, gaining support from empirical evidence (Kim & Lee, 2014; Cameron & Shah, 2015; Bucciol & Zarri, 2015). They also suggest that the effects of traumatic events on risk attitude depend on the type of emotions: fear and anxiety induce higher levels of risk aversion, while anger has the opposite effect (Lerner and Keltner, 2001). This could provide an explanation for the difference in signs between the relationship of negative experienced events and risk behavior of the above mentioned studies. Nonetheless, the majority of the studies in this growing stream of literature suggest that people who experience adverse life events become more risk averse and are less willing to take risks.

3. Data and the Construction of Variables

In order to analyze the correlation between traumatic life events and risk attitude, this study makes use of the data from the Longitudinal Internet Studies for the Social sciences (LISS) panel administered by CentERdata (Tilburg University, The Netherlands). This data panel is a representative longitudinal survey of around 4,500 households comprising 7,000 individuals and it is based on the true probability sample of households drawn from the Dutch population registered by Statistics Netherlands. The panel covers a large variety of domains including work, education, income, housing, time use, political views, values and personality. Participants complete online questionnaires of about 15 to 30 minutes in total monthly and are paid for each completed questionnaire. For a representative sample of the Dutch population, those that do not have the tools to participate are provided with a computer and Internet connection. One member in the household provides the household data and updates this information at regular time intervals (LISS data, 2018).

From the LISS panel, three datasets, i.e. "Measuring higher order risk attitudes of the general population" (2009), the first wave of "Tonic immobility in response trauma: Prevalence and consequences" (2011) and "Background variables" (2009) are used. By matching individuals based on their household identification numbers, the three datasets can be merged for a complete dataset of interest. For a correct analysis of the data, unmatched variables, respondents with missing relevant variables and who have answered "I do not know" will be removed from the analysis. The final sample consists of 1,585 individuals aged 16 years and older after deleting participants of whom we do not have complete data.

The next subsections will describe and discuss the dependent, independent, and control variables that are used throughout the study. Table 1b provides an overview of all variables used for the analysis and their definitions. It also shows which variables are (transformed into) dummy variables. The descriptive statistics for these variables can be found in Table 3.

Table 1 Variables used in the analysis

(a) Questions on traumatic events
(Q1) *"Below is a list of experiences that people may have in their life. Will you please indicate whether you have **personally** had one or more of these experiences? "*
Possible answers: Yes, No

For each type of trauma the participant has answered yes, further questions are asked and repeated five times:
(Q2) *"Please indicate how old you were when this occurred."*
(Q3) *"How drastic was this for you?"*
Possible answer: 0 - 100

(b) Variables' definition

Variable	Dummy	Definition
Socio-demographic variables		
Age	No	Age at survey year (2009)
Female	Yes	Female
Married	Yes	Married
High school	Yes	Graduates from vmbo, havo/vwo
College	Yes	Graduates from mbo, hbo
University	Yes	University graduates (wo)
Income	No	Personal gross monthly income in Euros, imputed
Personal events		
(I) Trauma on its own		
Trauma	Yes	Answered "Yes" in (Q1) for any type of trauma
(II) Categories of trauma		
1. A life-threatening illness	Yes	
2. Parents that separated or divorced	Yes	
3. Abuse as a child	Yes	Incest/sexual, physical or psychological (emotional) abuse (3)
4. War	Yes	
5. Serious accident	Yes	
6. Sexual violence	Yes	By known or unknown person, also includes rape (4)
7. Physical violence	Yes	By known or unknown person (2)
8. Death of a loved one	Yes	Death of a close friend, partner, sibling or parent (4)
9. Death of a child	Yes	Includes miscarriage/stillbirth (2)
10. Life-threatening illness of a loved one	Yes	Of a parent, sibling or partner
11. Destruction of home by fire/disaster	Yes	
Recency	No	The most recent personal event (elapsed years)
Intensity	No	The most intense traumatic event on a scale from 0-100
Frequency	No	Number of experiences
Variable of interest		
Risk aversion	No	Total number of safe options chosen in the lottery experiment

3.1 Risk attitude

3.1.1 Lottery experiment

To elicit the risk attitudes of the participants, the dataset "Measuring Higher Order Risk Attitudes of the General Population" with paired lottery choices will be used. Risk behavior of subjects can be estimated using lottery-choice data from field experiments, as studies have shown that majority of individuals' decisions are consistent with their risk attitude (Noussair et. al, 2013). Several papers have used lottery-choice data to measure risk aversion, e.g., Binswanger (1980), who studies the relationship between the degree of risk aversion and the degree of payoff levels. The survey about the decisional behavior of participants was completed and collected in December 2009. The sample is randomly selected from the members of the LISS panel which is representative of the Dutch adult population, aged 16 and older. A total of 3,425 participants have completed this survey.

The dataset consists of 25 tasks, divided into four parts. For each task, subjects are required to choose between two games: the risky one or the safe one. The game involves a virtual throw of the dice, and the results of the throw determine subjects' payoff. Each part is a different lottery choice experiment. This study only includes data of the first part that contains five tasks, and is the most simple lottery choice experiment. The lottery design of this part is most easy to understand for subjects and therefore, the data for this part is relatively more complete, and probably contains less measurement error as subjects are less prone to choosing randomly due to complexity of the experiment. Furthermore, it is easier to elicit risk attitudes from the data collected from this kind of lottery design. The subjects are in advance randomly distributed across four conditions: two "Real conditions" and two "Hypothetical conditions", in the following proportions:

	RealNorm	RealLow	HypoNorm	HypoHigh
N	30%	10%	30%	30%

In the lottery experiment, subjects are first explained how the experiment works, and the rules for payment for those who will get paid. Some studies find that individuals tend to think more careful and are more motivated to choose according to their true preferences if real payments are involved (Holt and Laury, 2002; Binswanger, 1980). For incentive compatible decision-making, some of the subjects will get paid after the experiment according to their choices made in the tasks. Besides, Holt and Laury (2002) and Binswanger (1980) have shown that payoff levels influence risk aversion. Low laboratory incentives may be unrealistic as it is not useful in measuring risk attitude toward "real-world" risks. Subjects who participated in the high-payoff treatment become significantly more risk averse than in the low-payoff treatment. This experiment takes this into account and subjects get randomly assigned to questionnaires with one of the conditions. Real payments are involved under the Real Conditions and the amounts were low (RealLow) to normal (RealNorm). Under the Hypothetical Conditions, there are no real payments and the amounts were normal (HypoNorm) to high (HypoHigh).

After the explanation, subjects are asked to choose between the "risky" lottery options L or the different "safe" options R for five different tasks. For the first task under RealNorm and HypoNorm, they could choose to play the lottery and win either €65 or €5 with option L, each with 50% probability, or choose the safe option and win €20 for sure with option R. In all tasks option L is exactly the same, but option R increases with €5 in each task (see Table 2a). The payoffs of the tasks under RealLow are ordered in the opposite way. The tasks under HypoHigh condition involve the same order as RealNorm but all values are multiplied by 150. Notice that the expected values for the high payoff condition are multiplies of the expected values under the normal payoff condition, meaning that a rational person who is risk neutral should make the exact same choices for either version.

The expected payoff difference for the first task is quite large (€15), so only an extreme risk averse subject would prefer option R. The more risk averse the individual is, the sooner and the more frequent

he would choose the safe payment over the lottery. A risk neutral person would choose the lottery for the top three tasks, since the expected payoff differences are positive, and then switch to the safe option R for the last two tasks. For the forth decision the expected payoffs for both options are the same, however since there is an option that can be obtained with certainty winning €35 or the risky lottery, a risk neutral person would rather choose the safe option. Only risk loving subjects would in this case prefer the uncertain option L. If subjects have monotonic preferences, they should only have one or no switching point in the tasks and choose the same option in all subsequent decisions after the switching point.

Table 2 The lottery experiment

(a) Hypothetical Lottery Questions

Task number	Risky choice (lottery) (Option L)	Safe choice (Option R)	Expected payoff difference
1	½ of €65, ½ of €5	100% of €20	€15
2	½ of €65, ½ of €5	100% of €25	€10
3	½ of €65, ½ of €5	100% of €30	€5
4	½ of €65, ½ of €5	100% of €35	€0
5	½ of €65, ½ of €5	100% of €40	-€5

(b) Levels of risk aversion

| Count of safe choices	Likert scale for risk attitude
0	Very risk seeking to extreme risk seeking
1	Moderately risk seeking
2	Risk neutral
3	Moderately risk averse
4	Very risk averse
5	Extremely risk averse

3.1.2 Elicitation of risk attitudes

The dataset for measuring risk attitude of subjects is structured by a choice-list of five binary tasks. The binary variables indicate whether the subject chose a risky lottery option or a safe option. Holt and Laury (2002) used the total number of safe lottery options subjects have made as the measure for risk attitude, while Dohmen (2010) used the switching row in the lottery experiment. By eliciting the switching point from the choice-list, the subjects' willingness to take risks is revealed. However, there is a shortcoming for this approach of using switching points: subjects who are either extreme risk averse or extreme risk loving are not included since their switching points are not present and so their risk behavior cannot be elicited. Thus, following the approach of the former authors, this paper rather uses the count of safe options as a proxy for risk aversion. Risk preferences are measured on a 0-5 scale, with higher values corresponding to less willing to take risks. Table 2b shows the different levels of risk attitude corresponding to the scale of the risk aversion measure. For instance, a risk attitude of 2 would

mean risk neutrality. According to the expected payoffs, a risk averse person would have a count of two or more safe choices. The mean of risk aversion is 2.604 (Table 3a), which suggests that subjects on average are moderately risk averse.

However, it is still interesting to look at the switching points since switching rows show when the subject crosses over in the tasks, while the count of safe choices do not. According to EUT and the non-satiation assumption, rational subjects should not switch more than once in the choice-list. Observations that include two or more switching points will therefore be deleted from the analysis. Furthermore, assuming EUT and monotonicity, it would make no sense that subjects who choose the safe payment of €20 first, cross over to the risky lottery afterwards while the amount of safe payments increases in all other tasks. Therefore subjects who switch from the increasing safe payment to the non-changing lottery will also be removed, and this leaves 1,585 subjects for the analysis. A big proportion of the values (79.29%) concentrates on the boundaries of the 0-5 range, meaning that the majority of the subjects do not switch at all in the choice-list and since they are either extremely risk averse (safe count = 5) or risk seeking (safe count = 0).

Figure 2 Distributions of the switching points
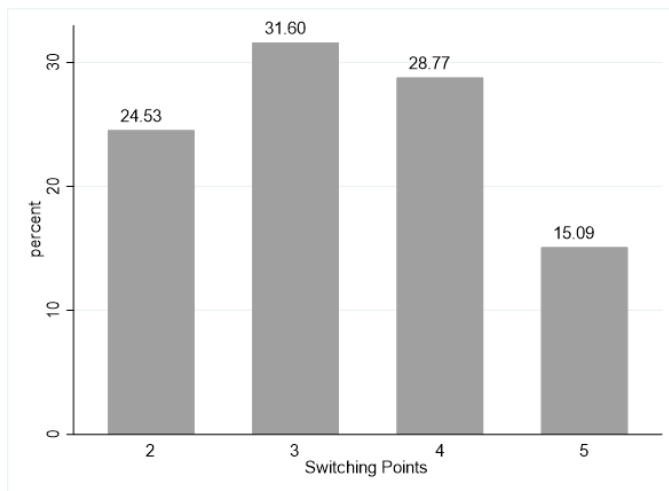
The graph in figure 2 shows the distribution when the subjects switch from options in the choice-list and excludes those who do not switch at all. The biggest proportion of subjects who switch in the choice list cross over in the third task (31.60%), which is sooner than the risk neutral choice of switching in the fourth task. The modal certainty equivalent is €30, which is below the expected value of the lottery €35. More than half of the subjects (56.13%) exhibit risk aversion, crossing over sooner in the choice-list than a risk neutral person would. They prefer the safe option, even though this has a smaller value than the expected value of playing the lottery. Merely 15.09% is risk loving, preferring the lottery with lower expected value than the sure amount of the safe option.

3.2 Traumatic experiences

3.2.1 Household survey

To determine the different types of traumatic events the subjects have experienced, dataset "Tonic immobility in response trauma: Prevalence and consequences" will be used. The dataset includes 26 types of traumatic events. Aside from this specified list they could also fill in what traumatic event they have experienced that is not on this list. There are two parts of the surveys: the first part examines what traumas subjects have experienced, at what age, and how drastic it was, and the second part focuses on the consequential behaviors caused by these traumas. For how drastic the trauma was, subjects could answer by means of a number between 0 and 100, where 0 means 'not at all drastic' and 100 means that it was 'extreme drastic'. This data will be used as the measure eliciting the severity of the event. For this study, only the first part is relevant, so further explanation will only be about the first part of dataset.

The LISS questionnaire involves two waves which are conducted in April 2011 and April 2012, respectively. Since 2011 contains a more detailed set of information, and the lottery dataset is only available until 2009, this study only includes Wave 1 of the trauma dataset. Regarding the first wave, after the participants have indicated which types of experiences they have had, a series of 26 blocks asked them repeated questions about the experiences. Each block would repeat its questions (i.e. age when the event occurred and intensity of the event) up to five times, so subjects could provide information for a maximum of five traumatic events per type experienced. Table 1a presents the key questions from which the answers form the measures for traumatic events.

3.2.2 Exposure to traumatic events

To make sure that the risk behavior of participants might only be effected by traumatic events that happened before participation on the lottery dataset, traumatic events that occurred after December 2009 will be deleted from the study group. Frequency can be obtained from the number of times the subject has answered age or intensity. As some subjects have experienced several incidents from the same trauma category, these subjects have entered multiple answers for intensity level and their ages when the events occurred. Assuming that events that happened a long time ago or events that were not that severe might have no or only small consequences for current decision-making, more intense and more recent events are expected to have an impact on risk aversion. Hence, if the subject experienced more than one incident in the trauma category, the most recent and the most intense event will be used as proxies for *Recency* and *Intensity* in the analysis, respectively. Recency can be obtained by calculating how many years have elapsed since the most recent event arose until the date of the survey, using participant's current age and his/her age when the event occurred.

The focus of the analysis is on idiosyncratic traumatic events that are out of individuals' control. Traumatic events that are (partly) under individuals' control may to some extent reflect specific

individual attitudes and personality traits, inducing self-selection in the sample (Buccoli & Zarri, 2015). To avoid endogeneity problems, these events are excluded for this study, leaving 21 types of traumatic events to analyze.[1] Since the list of trauma categories is very specified, some categories will be combined into groups to shorten the list and make it more general and simple. Moreover, this increases the sample size for each group. An example is *Abuse as a child*, which is a combined group of *Incest/sexual abuse as a child*, *Physical abuse as a child* and *Psychological (emotional) abuse as a child*. The 11 groups - or categories - of trauma for the analysis and their definitions are displayed in Table 1b. Those that are grouped together are specified by the number of categories combined in brackets in the *Definition* section. Looking at the summary statistics of the survey data for these groups, a few error answers are detected. For the group *Death of a child*, there are some observations (i.e. five observations) displaying that the subjects have experienced this type of trauma when they were at the age of 0 or 3 years old. This does not make sense as it is impossible. Most probably the question was misunderstood by these subjects and thus, these observations are removed from the analysis.

Table 3 Summary statistics

(a) Variables in general

Variables	Mean	Std. Dev.	Min	Max
Socio-demographic variables				
Age	50.718	16.662	16	89
Female	0.525	0.500	0	1
Married	0.615	0.487	0	1
High school	0.392	0.488	0	1
College	0.442	0.497	0	1
University	0.076	0.266	0	1
Income	2187.556	6189.945	0	239662
Personal events				
Trauma	0.788	0.409	0	1
Recency	9.434	19.062	0	69
Intensity	83.691	25.826	0	100
Frequency	2.850	3.125	0	37
Variable of interest				
Risk aversion	2.584	2.203	0	5

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[1] Five types of traumatic events from the dataset on LISS panel are excluded from the analysis: abortion, dismissal from work, break up from a long lasting relationship / divorce, bankruptcy, charged with criminal offense. Subjects could also choose "Other" and fill in what else they have experienced that is not in the choice list. This variable will also not be included for two reasons. The variable may have events that have the same statistic endogeneity problem mentioned in the context. And most importantly, the sample size of each specific event they have filled in, is very small.

(b) Variables based on Categories of traumatic events

Variables	Number of individuals	Trauma (%)	Recency	Intensity	Number of experiences	Frequency
	[1]	[2]	[3]	[4]	[5]	[6]
1. A life-threatening illness	137	0.086 (0.281)	12.504 (13.803)	78.898 (22.777)	184	1.343 (0.835)
2. Parents that separated or divorced	158	0.100 (0.300)	26.424 (17.410)	56.684 (30.780)	180	1.139 (0.592)
3. Abuse as a child	134	0.085 (0.278)	35 (16.630)	79.836 (23.678)	455	3.396 (2.403)
4. War	167	0.105 (0.307)	57.629 (19.053)	60.353 (31.164)	286	1.713 (1.125)
5. Serious accident	103	0.065 (0.247)	22.146 (17.069)	70.165 (25.065)	118	1.146 (0.567)
6. Sexual violence	46	0.029 (0.168)	28.717 (17.316)	75.717 (29.138)	70	1.521 (1.629)
7. Physical violence	72	0.045 (0.208)	20.208 (16.581)	70.25 (28.524)	121	1.681 (1.185)
8. Death of a loved one	1,018	0.642 (0.479)	10.197 (10.842)	82.787 (20.172)	2,362	2.320 (1.427)
9. Death of a child	207	0.131 (0.337)	20.614 (14.513)	74.401 (27.366)	283	1.367 (0.737)
10. Life-threatening illness of a loved one	339	0.214 (0.410)	12.056 (12.409)	79.357 (21.970)	436	1.281 (0.658)
11. Destruction of home by fire/disaster	21	0.013 (0.114)	21.952 (19.919)	72.381 (32.001)	22	1.048 (0.218)
Total	2,402				4,517	

Notes: Standard deviations are reported in brackets. Column 1 displays the number of individuals that have experienced a certain type of trauma and column 5 the total number of incidents individuals have experienced for that trauma category. Column 2 reports sample statistics on exposure to the different types of traumatic events, while column 3-4 report statistics on the most recent and the most intense incidents to the trauma categories, respectively. Column 6 lists the statistics on frequency, i.e. the number of incidents an individual have experienced from that trauma category.

Under the section *Personal events* in Table 3a, there are some summary statistics listed to get a general overview of trauma on overall. A big proportion of the sample has experienced trauma in the past (78.2%). This number is similar to the percentage (80.7%) reported by the survey on the lifetime prevalence of traumatic events (De Vries and Olff, 2009)[2]. On average, the most recent traumatic event happened around 9 years ago. The most intense traumatic event is on average around 83 on a scale ranging from 0 till 100. A person has been exposed to an average of 2.8 traumatic events in the past. If we exclude those who do not have experienced trauma, and look only at those that have, people have experienced on average 3.6 traumatic events in the past.

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[2] The demographic statistics of traumatic events are in general in line with the survey done by De Vries and Olff (2009) on the Dutch population. The lifetime exposure to any traumatic events is 80.7%, with a mean of 2.6 traumatic events. The most prevalent traumatic event is also the death of a loved one (53.9%). More male subjects experienced physical violence and serious accidents than female subjects, while for female subjects, sexual violence and loss of a child is more prevalent.

Looking more into detail, Table 3b reports the summary statistics on the variables grouped by different categories of trauma. Column 1 and 2 show that the most prevalent traumatic event is the death of a loved one (64.2% of the sample), followed by life-threatening illness of a loved one (21.4% of the sample) and death of a child (13.1% of the sample). Columns 3-6 display statistics on only those that have experienced trauma in the trauma categories. The most recent experience is death of a loved one, which is around 10 years ago, followed by a life-threatening illness and life-threatening illness of a loved one, both around 12 years ago. Not surprisingly, the most distant experienced event is war with an average of almost 58 years ago, referring to the end of the Second World War. In terms of intensity, death of a loved one is experienced as the most intense (83), while the event of parents separating or divorcing is the least intense (56). The most frequent event is abuse as a child (3.4), followed by death of a loved one (2.3).

3.3 Control variables

Kim and Lee (2012) found that there exists substantial heterogeneity across demographic groups in terms of their risk aversion. Female, older, more educated, married and poorer respondents tend to be more risk averse. To make sure that these covariates will not influence the outcomes of the analysis, these demographic characteristics are included in the analysis as control variables (see Table 1b). One can find this data from the LISS panel, which monthly updates the most important general characteristics of households since November 2007. Before joining the panel and participating in other questionnaires, the contact person of the household needs to complete the questionnaire for this dataset, known as the household box. Thereafter, LISS panel monthly presents the household box to households to enter any changes that may have occurred. This study use the "Background variables" dataset (December 2009).

Table 3 presents the summary statistics of variables used for the analysis. Table 3a includes the statistics for the socio-demographic variables. The average age of the sample is 51 and about 53% are female. Around 61.5% are married, 39.2% are high school graduates, 44.3% are college graduates and 7.6% are university graduates. The average monthly gross income is around €2,188.

4. Results

4.1 Nonparametric analysis

Using data from the LISS panel, this paper tests whether individuals who have experienced trauma in the past display higher risk aversion. This chapter aims to shed light on this relationship. As a preliminary analysis, this section first gives a peek at how the relationship between the occurrence of an adverse life event and risk attitude look like. Figure 3 shows the cumulative distributions of different risk attitudes, conditional on trauma. The horizontal axis represents the risk attitude (from extremely risk averse to very risk seeking). This can also be seen as the count of safe choices (5-0), which corresponds to the task number in the ascending order (1-5) with 0 as the outcome if the subject(s) chose no safe options at all for all tasks. The dashed line indicates the predicted behavior under risk neutrality: three risky options and then two safe options, corresponding to a risk attitude of 2. The shapes of the lines of the two groups are quite similar, with a steep increase in the beginning and end of the graph (5 and 0) while everything in the middle increases gradually. Looking at the risk attitude of 5, which also means choosing safe options for all tasks, the proportion of the group who experienced trauma (38.75%) is higher than the proportion of the group who experienced no trauma (32.74%). For a risk attitude of at least 1, i.e. choosing at least one safe option, the proportions for the trauma group and no trauma group are 65.17% and 60.71%, respectively. In overall, the group that has experienced trauma displays higher cumulative proportions of choosing the safe option in each task.

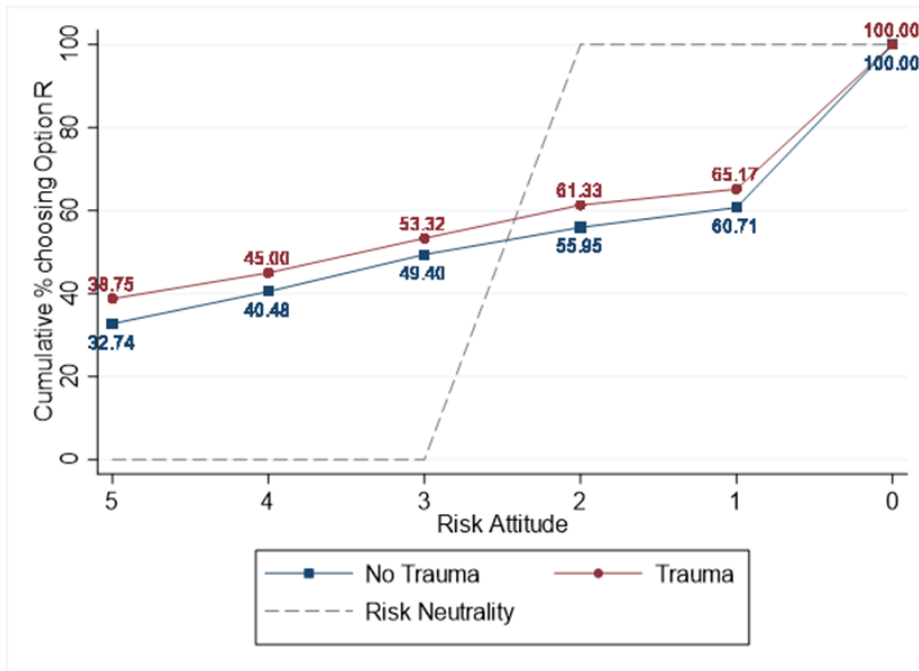**Figure 3** Cumulative Proportions of Safe choices

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Figure 3 gives a hint that experiencing trauma lead to higher risk aversion. Not surprising, the trauma group has a higher mean of risk aversion (2.64) compared to the one of the no trauma group (2.39). Performing the Mann-Whitney U-test to compare whether there is a difference in risk aversion for the two groups shows a weak significant difference (p-value of 0.059).

The figure and the nonparametric test suggest there is some correlation between experiencing trauma and risk behavior. Next, it is interesting to take this more into depth to see whether some categories of trauma are more significant than others. Besides, compared to this preliminary analysis, using regression models is a much better method for a more accurate analysis. The regression model also takes care of the socio-demographic background information on subjects as these will be included as control variables.

4.2 Regression analysis

This section is using regression models to explore the predictive power of different life-time individual-specific events on lottery decisions. All the specifications include the socio-demographic variables summarized in Table 1b as covariates, unless otherwise stated.

Considering the proxy for risk aversion is a ranking of groups based on the number of times safe options are chosen, no specific form of utility function will be assumed for measuring risk attitude. The effects of traumatic events on risk behavior will rather be estimated by an ordered probit regression model, which ranks the number of safe counts from the riskiest (0) to the safest (5). For every trauma category, a regression defined by Model 1 is run. This method is also used by Bucciol and Zarri (2015), and Moya (2018). A positive coefficient would mean that subjects that have experienced an adverse life event is more likely to choose safer options and therefore more likely to be more risk averse.

Model 1:

$$(1) \quad y_{ic}^* = \beta_0 + \beta_1 Trauma_{ic} + \beta_2 Control\ variables_i + \varepsilon_{ic}$$

where subscripts stand for individual i and trauma category c. The latent continuous variable y_{ic}^* itself is unobservable, but instead we can observe the six categories that the variable forms: from extremely risk seeking (0) to extremely risk averse (5). Regressing y_{ic}^* – the ordered outcome of the categories for the risk attitude of individual i – on the dummy variable $Trauma_{ic}$, a positive coefficient for β_1 is expected. This first regression model aims to analyze what kind of trauma has an effect on risk behavior.

Going more into depth by looking at what factors mediate the effect between trauma and risk behavior, the following regression is estimated:

Model 2:

$$(2) \quad y_{ic}^* = \beta_0 + \beta_1 Recency_{ic} + \beta_2 Intensity_{ic} + \beta_3 Frequency_{ic} + \beta_4 Control\ variables_i + \varepsilon_{ic}$$

The independent variables of interest here are: $Recency_i$, the number of years elapsed since the most recent traumatic event took place, $Intensity_i$, the level of intensity experienced for the most intense traumatic event, and $Frequency_i$, the number of traumatic events individual i was exposed to.

The first subsection discusses the results of Model 1, exploring which types of events will have an influence on risk behavior. The second subsection discusses the results of Model 2, examining what factors mediate these associations. For this section, the sample sizes vary since the analyses will be done on only those who have experienced the specified trauma.

4.3 Different types of trauma on risk attitude

The mean predicted probabilities of risk aversion categories are presented in Table 4. Holding all explanatory variables at their means, the table indicates that individuals are very likely to be either risk seeking or extremely risk averse. The predicted probability of being extremely risk averse is 37.4%, which is slightly higher than the predicted probability for being risk seeking (35.6%). As mentioned before, the analyses will be performed by ordered probit models to estimate the impact of different explanatory variables on the proxy of risk aversion that ranks the safe counts of choices from the riskiest to the safest. The interpretation of the marginal effects results will focus on the effects of the category with the highest count of safe choices (5), i.e. the extremely risk averse category, and the risk loving category that has zero counts of safe choices.

Table 4 Mean predicted probabilities of risk aversion categories

0	1	2	3	4	5
0.356	0.041	0.078	0.085	0.066	0.374

Notes: Given that all explanatory variables are set at their mean values, these are the mean predicted probabilities of the different risk aversion categories. The risk aversion categories ranges from 0-5, with 0 being the very risk seeking category and 5 the extremely risk averse category.

The results of Model 1 (Table 5) indicate that all of the socio-demographic variables are insignificant, while past literature has found some associations with risk attitude. This could be due to the correlation between personal traumas and the socio-demographic variables, unlike traumas on a big scale (nature, violent or financial disasters). Looking at the trauma categories, which are the variables of interest, significant positive correlations are found between some categories and risk aversion: the *Life-threatening illness* is statistical significant at a 5% level, while *Death of a loved one* and *Destruction of home by fire/disaster* is significant at a 10% level. Individuals experiencing any of these kinds of events lead to higher levels of risk aversion. In addition of these found effects, the magnitudes of these associations are captured by the average marginal effects in the next six columns. If the subject has experienced Life-threatening illness in the past, the probability that the subject falls in the extremely risk averse category increases by 7.7% and decreases the probability that the subject falls in the risk seeking category by 7.6%. Experiencing death of a loved one is associated with being 5.2% more likely to be in

the extremely risk averse category and 5.1% less likely to be in the risk loving category. Destruction of home by fire/disaster increases the probability of falling in the extremely risk averse group by 18.4% and reduces the probability of falling in the risk loving group by 18.1%. The results suggest that experiencing any of these three types of events, will increase the probability of being more risk averse in decision-making.

Table 5 Coefficients and marginal effects of ordered probit estimation of the trauma categories

Variables	(1) Probit	Marginal effects					
		0	1	2	3	4	5
Age	-0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Female	0.035	-0.013	-0.000	-0.000	0.000	0.001	0.013
	(0.062)	(0.023)	(0.001)	(0.001)	(0.000)	(0.001)	(0.023)
Married	-0.098	0.036	0.001	0.001	-0.000	-0.001	-0.037
	(0.064)	(0.023)	(0.001)	(0.001)	(0.000)	(0.001)	(0.024)
High school	-0.023	0.009	0.000	0.000	-0.000	-0.000	-0.009
	(0.107)	(0.040)	(0.001)	(0.001)	(0.000)	(0.002)	(0.040)
College	0.031	-0.011	-0.000	-0.000	0.000	0.000	0.012
	(0.107)	(0.040)	(0.001)	(0.001)	(0.000)	(0.002)	(0.040)
University	0.183	-0.068	-0.002	-0.002	0.001	0.003	0.069
	(0.145)	(0.054)	(0.002)	(0.002)	(0.001)	(0.002)	(0.054)
Income	-0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
traumatype1	0.205**	-0.076**	-0.003*	-0.003*	0.001	0.003*	0.077**
	(0.105)	(0.039)	(0.001)	(0.001)	(0.001)	(0.002)	(0.039)
traumatype2	-0.033	0.012	0.000	0.000	-0.000	-0.000	-0.012
	(0.098)	(0.036)	(0.001)	(0.001)	(0.000)	(0.001)	(0.037)
traumatype3	-0.047	0.017	0.001	0.001	-0.000	-0.001	-0.018
	(0.111)	(0.041)	(0.001)	(0.001)	(0.000)	(0.002)	(0.042)
traumatype4	-0.066	0.024	0.001	0.001	-0.000	-0.001	-0.025
	(0.106)	(0.039)	(0.001)	(0.001)	(0.000)	(0.002)	(0.040)
traumatype5	0.110	-0.041	-0.001	-0.001	0.000	0.002	0.041
	(0.118)	(0.043)	(0.001)	(0.001)	(0.001)	(0.002)	(0.044)
traumatype6	0.147	-0.054	-0.002	-0.002	0.001	0.002	0.055
	(0.182)	(0.067)	(0.002)	(0.002)	(0.001)	(0.003)	(0.068)
traumatype7	-0.091	0.034	0.001	0.001	-0.000	-0.001	-0.034
	(0.142)	(0.053)	(0.002)	(0.002)	(0.001)	(0.002)	(0.053)
traumatype8	0.139*	-0.051*	-0.002*	-0.002*	0.000	0.002*	0.052*
	(0.073)	(0.027)	(0.001)	(0.001)	(0.000)	(0.001)	(0.027)
traumatype9	0.103	-0.038	-0.001	-0.001	0.000	0.002	0.039
	(0.087)	(0.032)	(0.001)	(0.001)	(0.000)	(0.001)	(0.033)
traumatype10	-0.051	0.019	0.001	0.001	-0.000	-0.001	-0.019
	(0.073)	(0.027)	(0.001)	(0.001)	(0.000)	(0.001)	(0.027)
traumatype11	0.490*	-0.181*	-0.006*	-0.006*	0.002	0.007*	0.184*
	(0.260)	(0.096)	(0.003)	(0.003)	(0.002)	(0.004)	(0.098)
/cut1	-0.319**						
	(0.149)						
/cut2	-0.212						
	(0.149)						

Table 5 *(continued)*

Variables	(1) Probit	Marginal effects					
		0	1	2	3	4	5
/cut3	-0.015						
	(0.149)						
/cut4	0.200						
	(0.149)						
/cut5	0.371**						
	(0.149)						
Observations	1,585	1,585	1,585	1,585	1,585	1,585	1,585

Note: Column 1 reports the statistics of an ordered regression model on risk aversion. The next six columns reports the average marginal effects.

Standard errors in parentheses
*** p≤0.01, ** p≤0.05, * p≤0.1

4.4 Mediating factors of life events

Table 6 reports the statistics for regression Model 2, excluding specifications of trauma categories. The first column does not control for socio-demographic variables. It shows that recency is significant at a 10% level. This would mean that the more recent the subject suffered from a traumatic event, the more likely the subject is risk averse. However, if control variables are added, none of the variables have any significant influence on risk aversion (second column).

Table 6 Mediating factors of trauma

Variables	(1)	(2)
Age		0.001
		(0.002)
Female		0.059
		(0.069)
Married		-0.094
		(0.070)
High school		-0.039
		(0.123)
College		-0.025
		(0.124)
University		0.210
		(0.166)
Income		-0.000
		(0.000)
Recency	-0.005*	-0.005
	(0.003)	(0.003)
Intensity	0.001	0.001
	(0.002)	(0.002)
Frequency	0.004	0.002
	(0.011)	(0.012)

Table 6 *(continued)*

Variables	(1)	(2)
/cut1	-0.368***	-0.362*
	(0.142)	(0.214)
/cut2	-0.266*	-0.259
	(0.142)	(0.214)
/cut3	-0.061	-0.054
	(0.142)	(0.214)
/cut4	0.149	0.157
	(0.142)	(0.214)
/cut5	0.309**	0.318
	(0.142)	(0.214)
Observations	1,249	1,249

Standard errors in parentheses
*** p≤0.01, ** p≤0.05, * p≤0.1

Table 7 exhibits the results of the regressions of Model 2 for each trauma category. Destruction of home by fire/disaster (Trauma 11) is not included in this table, since there are too few observations for this category and the regression shows no relevant results, i.e. none of the variables are significant. Only for some traumatic events do the mediating factors have a role on the risk attitudes. Thus, only those that show significant results will be discussed.

For subjects who experienced their parents separating or divorcing (Trauma 2), some of the socio-demographic variables are significant. Married subjects experiencing this event, unexpectedly, are more likely to be more risk seeking, while those who graduated from high school, college or university are more likely to be more risk averse. From the mediating factors only frequency seems to be significant: the more frequent the subject has suffered from this event, the higher the probability he/she will be more risk averse. This is an interesting outcome, since previous regression model showed that experiencing this event does not have an effect on risk attitude. The combination of these outputs implies that experiencing this event only has an influence on risk attitude if this event occurs more often.

For those that have experienced sexual violence (Trauma 6), now age and intensity seems to be somewhat correlated with risk attitude. Age has the expected positive sign on risk aversion, but intensity has a negative sign, unexpectedly. The older the subject is, the more likely he/she has a higher level of risk aversion. Furthermore, the more intense the event was, the more risk seeking the subject is.

Only recency seems to influence risk aversion for those that experienced death of a loved one (Trauma 8) or death of a child (Trauma 9). Both coefficients show a negative correlation as expected, meaning the more recent the event was, the more likely the subjects are more risk averse.

Table 7 Mediating factors on different categories of trauma

| Variables	Trauma 1	Trauma 2	Trauma 3	Trauma 4	Trauma 5	Trauma 6	Trauma 7	Trauma 8	Trauma 9	Trauma 10
Age	0.009	0.009	0.013	-0.009	0.001	0.036*	0.016	-0.000	0.009	-0.001
	(0.009)	(0.011)	(0.017)	(0.013)	(0.010)	(0.020)	(0.011)	(0.003)	(0.010)	(0.005)
Female	0.267	-0.134	-0.269	0.344	-0.041	-0.390	-0.389	0.081	-0.058	-0.037
	(0.218)	(0.225)	(0.229)	(0.214)	(0.261)	(0.614)	(0.317)	(0.075)	(0.226)	(0.145)
Married	-0.150	-0.435**	-0.223	0.095	-0.123	-0.067	0.027	-0.038	-0.115	-0.116
	(0.231)	(0.197)	(0.213)	(0.212)	(0.258)	(0.418)	(0.290)	(0.078)	(0.196)	(0.135)
High school	-0.153	0.775**	0.105	0.222	0.076	1.078	-0.016	-0.104	-0.344	-0.084
	(0.361)	(0.374)	(0.406)	(0.259)	(0.485)	(0.816)	(0.544)	(0.138)	(0.355)	(0.249)
College	0.055	0.754**	0.147	0.128	-0.253	1.052	0.291	-0.083	-0.078	-0.053
	(0.369)	(0.381)	(0.400)	(0.281)	(0.482)	(0.786)	(0.562)	(0.139)	(0.372)	(0.253)
University	0.836	0.771*	0.606	0.286	-0.213	1.109	0.123	0.056	-0.370	-0.045
	(0.546)	(0.451)	(0.597)	(0.461)	(0.680)	(0.937)	(0.766)	(0.184)	(0.492)	(0.333)
Income	-0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Recency	-0.004	-0.001	0.001	-0.008	0.004	-0.031	-0.006	-0.006*	-0.020**	-0.005
	(0.008)	(0.010)	(0.016)	(0.007)	(0.008)	(0.020)	(0.011)	(0.004)	(0.009)	(0.005)
Intensity	0.004	0.000	0.004	-0.001	0.007	-0.014*	-0.001	0.000	-0.002	0.000
	(0.005)	(0.003)	(0.004)	(0.003)	(0.005)	(0.008)	(0.005)	(0.002)	(0.003)	(0.003)
Frequency	-0.038	0.372**	0.017	0.035	-0.101	0.135	0.206	-0.027	0.139	-0.027
	(0.118)	(0.185)	(0.046)	(0.099)	(0.203)	(0.147)	(0.130)	(0.030)	(0.119)	(0.094)
/cut1	-0.007	0.842	0.200	-0.782	-0.257	-0.193	0.358	-0.565**	-0.826	-0.737
	(0.770)	(0.587)	(0.629)	(0.940)	(0.688)	(1.170)	(0.566)	(0.284)	(0.652)	(0.479)
/cut2	0.079	0.912	0.346	-0.732	-0.173	-0.124	0.558	-0.466	-0.691	-0.674
	(0.770)	(0.587)	(0.629)	(0.940)	(0.688)	(1.169)	(0.567)	(0.284)	(0.651)	(0.479)
/cut3	0.223	1.179**	0.681	-0.480	0.166	0.146	0.860	-0.276	-0.484	-0.447
	(0.769)	(0.588)	(0.632)	(0.939)	(0.689)	(1.167)	(0.569)	(0.284)	(0.651)	(0.478)
/cut4	0.574	1.326**	0.820	-0.357	0.345	0.487	1.160**	-0.073	-0.344	-0.199
	(0.769)	(0.588)	(0.635)	(0.939)	(0.690)	(1.166)	(0.574)	(0.283)	(0.651)	(0.477)
/cut5	0.672	1.581***	1.088*	-0.216	0.473	0.758	1.355**	0.081	-0.166	-0.076
	(0.770)	(0.590)	(0.638)	(0.940)	(0.691)	(1.169)	(0.578)	(0.284)	(0.651)	(0.477)
Observations	137	158	134	167	103	46	72	1,018	207	339

Standard errors in parentheses
*** p≤0.01, ** p≤0.05, * p≤0.1

Figure 5 illustrates the average marginal effects of only the significant mediating factors for the found results in Table 7. For people who experience the separating and/or divorcing parents more often, the probability of being risk seeking reduces by 13.456% and the probability of being extremely risk seeking increases by 13.203%

Unlike previous findings, people who suffer from sexual violence more intensely, are 0.409% more likely to be risk seeking and 0.451% less likely to be extremely risk averse.

The average marginal effect of recency for death of a loved one is relatively very small. For people experiencing this event more recent, the probability of being risk seeking decreases by 0.233% , while the probability of being extremely risk seeking increases by 0.243%. Recency on death of a child seems to have relatively a bigger effect as the probability for becoming more risk averse is higher. The more recent this event is experienced, the less likely the subjects fall in the risk seeking category by 0.689% and more likely to fall in the extremely risk seeking category by 0.748%.

Figure 5 Average marginal effects of mediating factor on trauma
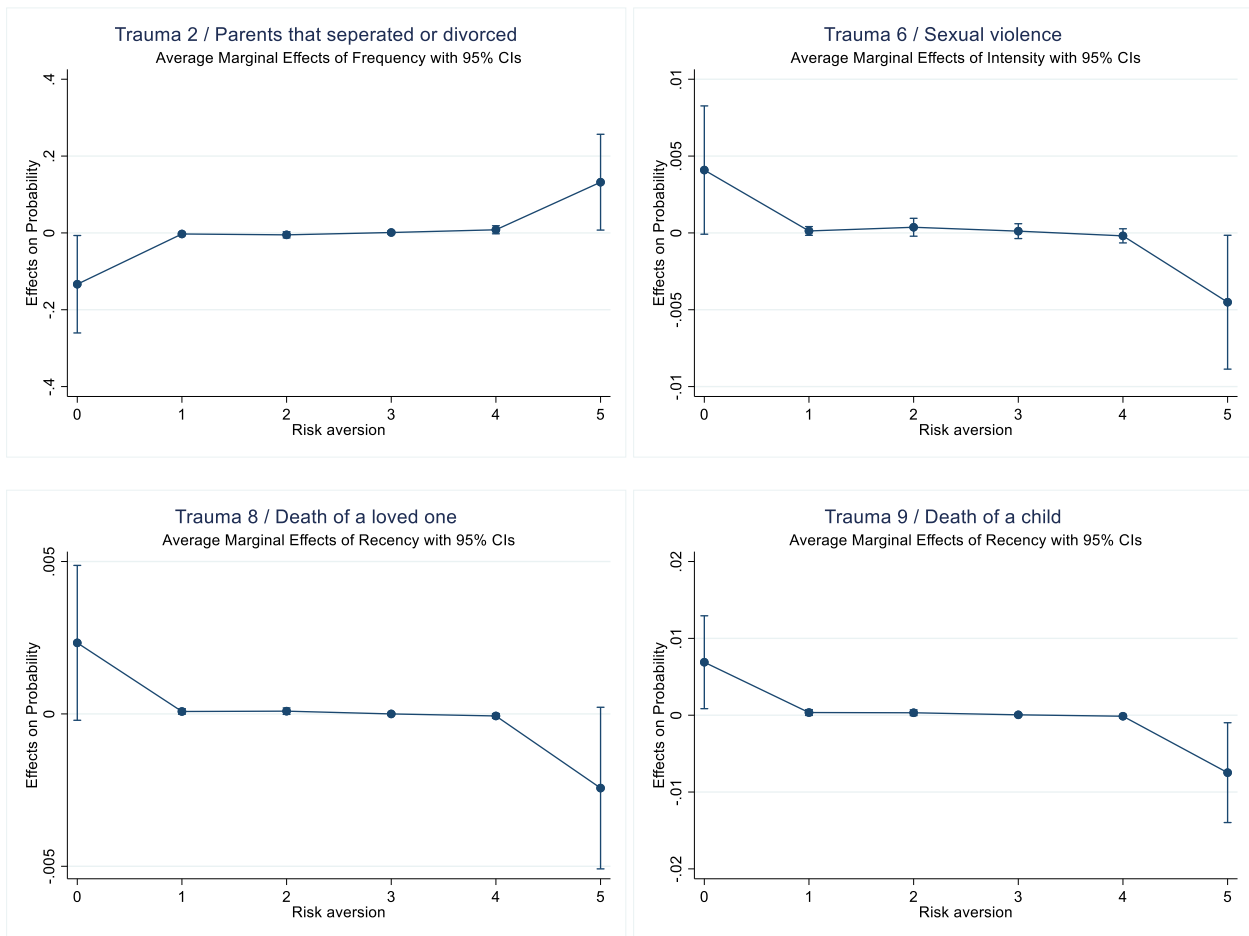
5. Conclusion

Since the introduction of risk attitude, risk attitude has been of big importance for economic decision-making. However, predicting risk attitude still remains to be a big puzzle as there is limited knowledge about how risk attitudes are shaped. This paper aims to contribute to this field by investigating how idiosyncratic trauma experience(s) in the past that are out of an individual's control can alter current decision-making under uncertainty for Dutch households. Data from the LISS panel is used to perform an ordered probit regression to analyze the association between traumatic events and risk attitude. For a better understanding, also the effects of the mediating factors of trauma (recency, severity and frequency) on risk aversion are analyzed.

The preliminary analysis suggests that individuals who experienced trauma display higher risk aversion than those that have not. Exploring the different types of traumatic events, the results show that individuals are more likely to be risk averse if they have experienced a life-threatening illness or death of a loved one. With regard to the mediating factors of trauma, it seems that they only play a role for some traumatic events. For the event of parents that separated or divorced, frequency has relatively a big effect on risk aversion. This trauma only has an effect on the risk attitude if this is more frequently experienced. Moreover, the more often individuals experienced their parents separating and/or divorcing, the more likely they become more risk averse. The effects of the following findings are very small, but touches upon the role of the other mediating factors. Recency seems to be a contributing factor for death of a loved one and/or death of a child. The more recent this event was experienced, the more likely the individual has a higher level of risk aversion. These found results all have the expected direction in the relationship with the life events. However, the next finding contradicts the directional hypothesis on intensity. For sexual violence, the more intense the event was experienced, the more likely they become more risk loving. A possible explanation for this finding is that victims of this trauma experience anger more strongly than fear, as angry people tend to be risk seeking (Lerner and Keltner, 2001). In overall, the role of these mediating factors seems to be ambiguous as only limited evidence is found and their significance differ for different types of life events.

A potential explanation for the current findings are that the experience of trauma can be such devastating that it induces strong emotions, which in turns can alter risk preferences. The results of this paper suggest that having an life-threatening illness or the loss of a loved one can induce these strong emotions. Future research in economics is needed whether the role of the emotional mechanism is true by incorporating variables that represent emotional states of individuals for a more accurate analysis, and investigate how different emotions have different effects on the risk attitudes. For instance, Moya (2017) used symptoms of psychological trauma as a measure for how extreme the traumatic event was experienced, and which - to a certain extent - reflect how strong the emotions were after experiencing trauma.

One of the limitations of the analysis is that the size of the sample is small for some types of traumatic events. Also, unlike previous studies focusing on subsets of the population that has experienced one collectively experienced trauma, this study covers a more heterogeneous population that experienced different kinds of trauma at different points of time. We might find more profound results if bigger samples existed for each type of traumatic events. Another limitation is the use of ordered probit regression resulting in devious interpretations of its results. The coefficient of the variable risk aversion cannot be interpreted as an exact number on itself, but an ordered outcome of the risk attitude categories. This can only give an indication how much more individuals tend to behave in a certain behavior according to the risk attitude categories. Future studies can use more straightforward measures for risk behavior, e.g. stock share in the financial portfolio (Bucciol et al., 2015).

Due to the scope of the study, some interesting components of previous related studies are not incorporated, but can be taken into account for future studies. Some psychological papers found that traumatic events encountered during childhood have bigger impact on adulthood personality and neuroticism than recent experienced traumas (Ogle et al., 2013). Kim et al. (2014) showed evidence that this is also true for risk behavior: there exists a sensitive period for risk preference formation and the effects are long lasting. Another interesting finding is that exposure to trauma yield different behaviors in the gain and loss domains (Campos-Vazquez and Cuilty, 2013; Li et al., 2011). While risk attitude is usually measured on the gain domain, it is also interesting to see how traumas influence risk attitudes on the loss domain. Aside from this research topic, it might be interesting to explore whether traumatic events have impact on other risky domains, e.g. the decision to start a new business

The results of the paper are consistent with the idea that risk preferences are not stable and exogenous, but varies over life course. Some traumatic events in the past and out of an individual's control have effect on decision-making under uncertainty later in life. The level of risk aversion tends to increase after experiencing those traumas. Providing empirical evidence, this paper contributes to the literature in behavioral economics that explores the influence of non-cognitive factors on risk-taking behavior. Moreover, not only collectively experienced major disasters but also idiosyncratic life events can shape one's risk attitude. Negative life events can also have negative economic consequences and should therefore not be underestimated, but be included into economic policy and institutional design as well.

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