





The Role of Personal Risk Experience—An Investigation of Health and Terrorism Risk Perception in Germany and Israel

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The present study examined the relationship between risk experience and risk perceptions in relation to the target (risk to the self vs. others) and for two different types of risk: acute risks (i.e., terrorist attacks) and cumulative health risks (i.e., alcohol consumption, tobacco consumption, and unhealthy eating) in two countries (Israel and Germany). An online survey ($N = 571$) was conducted to assess participants' previous personal experience with acute and cumulative risks and their personal and general risk perceptions. The results showed that personal experience with terrorism was related to increased personal and general risk perceptions, while personal experience with cumulative health risks was related to increased personal but not general risk perceptions. It is argued that an increase in risk perception with more risk experience can be explained by the amount of available information about people's personal as well as other people's risk status. The findings emphasize that the experience–risk perception relationship depends on the target of the risk and the type of risk experience.

KEY WORDS: Cumulative risk; personal experience; risk perception

1. INTRODUCTION

Personal experience of hazards, whether they are natural (such as floods) or man-made (such as terrorist attacks), should have a marked impact on perceptions of risk. Such experiences can potentially provide victims with new, vivid, and more concrete information about the hazards, which should then lead to an increased risk perception (Perloff, 1983; Weinstein, 1989). In line with this contention, Wachinger, Renn, Begg, and Kuhlicke (2013) summarized 35 studies on natural disasters and reported that people who experienced personal damage through a natural hazard had higher risk perceptions.

A positive experience–risk perception relationship was also found in other studies which examined natural events such as floods, earthquakes, tsunamis, and hurricanes (Bronfman, Cisternas, Repetto, Castañeda, & Guic, 2020; Keller, Siegrist, & Gutscher, 2006; Kung & Chen, 2012; Lindell & Hwang, 2008) and man-made disasters such as fires, explosions, traffic accidents, and terrorist attacks (Knuth et al., 2015; Koshiba & Ohtani, 2015), with small to large effect sizes ranging between d 's = 0.26–1.44. Only a relatively small number of studies found either mixed, none, or even reversed experience–risk perception relationships (Halpern-Felsher et al., 2001; Shiloh, Güvenç, & Önkül, 2007; Viscusi & Zeckhauser, 2006).

The experience of disasters such as fires, floods, or terrorist attacks entails a single, severe confrontation with a threat. In contrast to these acute, massive exposures, risky lifestyle exposures, such as alcohol or tobacco consumption, only entail minimal immediate negative consequences which accumulate slowly over time and only become severe after years

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of exposure (Slovic, 2000; Spiegelhalter, 2012, 2016). While each individual exposure may only provide limited vivid and concrete information about the negative health impact of the threat, this information accumulates over time. Thus, this cumulative type of risk experience might influence people's risk perception to a different degree than an acute risk experience. Correspondingly, ambiguous relationships between experience and risk perception were found for cumulative lifestyle-related risks. Larsman, Eklöf, and Törner (2012) reviewed 39 studies which examined lifestyle risks in adolescents (e.g., alcohol and tobacco consumption) and found positive or mixed relations in 15 studies and either no or even a negative relationship with risk perception in the other 24. No or negative relationships were also found in other studies which examined adolescents' alcohol and tobacco consumption both cross-sectionally (Halpern-Felsher et al., 2001, 2004; Lundborg, 2007) and longitudinally (Grevenstein, Nagy, & Kroeninger-Jungaberle, 2015; Morrell, Song, & Halpern-Felsher, 2010; d 's = 0.11–0.87). However, a positive relationship was reported by cross-sectional studies on tobacco and alcohol consumption in adults (Chen, Kaphingst, Tseng, & Zhao, 2016; Hahn & Renner, 1998; Weinstein, Marcus, & Moser, 2005) and adolescents (Piko & Gibbons, 2008; d 's = 0.39–1.32).

Experiences with acute and cumulative risks differ in the ways they provide information about people's personal and other people's risk status. Acute disasters such as terrorist attacks typically affect the self and others at the same time, providing information about both one's own and other people's risk status. Conversely, cumulative risks such as smoking cigarettes are predominantly informative for the person who shows the risk behavior. Acute and cumulative risks should, therefore, affect the experience–risk perception relationship differently, depending on the target (self vs. others; Renner & Schupp, 2011; Weinstein, 1980). While the experience of an acute risk should lead to an increase in risk perception for both the self and others, the cumulative experience of risk should more likely lead to an increase in risk perceptions for the self. In line with this contention, Sjöberg (1998) reported that higher alcohol consumption was associated with higher personal but not general alcohol-related risk perceptions. Van der Velde, van der Pligt, and Hooykaas (1994) showed a similar differential pattern for personal and general risk perceptions in the domain of sexual behavior and the perceived risk of an HIV infection. However, most studies have assessed only personal risk percep-

tions (see Harris, 2007; Helweg-Larsen & Shepperd, 2001). Comparably few have examined the relationship between experience and risk perceptions in dependence of the target and previous studies have predominantly assessed either acute or cumulative risks.

1.1. The Present Study

The present study examined whether the personal experience of acute and cumulative risk is related differently to personal and general risk perception. For this purpose, risk perceptions were operationalized as perceived vulnerability (Weinstein, 1980). Specifically, the study tested whether experience with acute risks (i.e., terrorism) is related to an increase in both personal and general risk perception, while experience with cumulative health risks (i.e., alcohol consumption, tobacco consumption, and unhealthy eating) is related to an increased personal but not general risk perception. The following hypotheses were tested: (1) For acute and cumulative risks, personal risk perception increases with more experience of risk. (2) Experience with the acute risk of terrorism is also related to an increased *general* risk perception. The study was conducted in two countries, Israel and Germany, which differ in their levels of exposure to terrorist attacks, with a higher exposure in Israel (START, 2020). We therefore expected that the German and Israeli samples would have different levels of experience of terrorism, and we predicted that: (3) Overall, personal and general terrorism risk perceptions are higher in the Israeli than in the German sample. Moreover, we hypothesized that: (4) Perceived personal risk is lower than perceived general risk (optimistic bias; Perloff & Fetzer, 1986; Weinstein, 1980). Moreover, differences between the Israeli and the German sample in risk perceptions and their relation to risk experience were explored. No specific hypotheses were made as, to our knowledge, the cross-national comparison of this relationship has not been studied before for Israel and Germany.¹

¹In addition, all analyses were calculated separated for gender to examine whether gender influences the relation between risk experience and risk perception. No significant differences occurred, except for terrorism experience in Germany. Women perceived a higher personal and general terrorism risk with more experience, while only personal risk perception was elevated within males. However, the separation by gender inevitably causes small group sizes, which limits the interpretation of this found effect. Therefore, these analyses were not included in the results section. However, future studies might further explore this in larger samples.

2. METHODS

2.1. Design and Participants

Data were collected as part of the Coris Study, a bilingual cross-sectional online survey that was conducted in Germany and Israel between April and December 2018. The questionnaire was initially designed in English, then translated into German and Hebrew and cross-checked by German and Israeli native speakers. The online questionnaire was programmed with Qualtrics and distributed via Facebook, the survey platforms Thesius and SurveyCircle, and student email-distribution lists. All participants gave informed consent prior to participation, and were eligible to enter a lottery after finishing the questionnaire. The study protocol was approved by the ethical review boards of the University of Konstanz [no. 12/2018] and Tel Aviv University. The procedures were performed in compliance with relevant laws and institutional guidelines. We strictly followed the German Psychological Society's guidelines,² which are translated from those of the American Psychological Association,³ and the study was conducted in accordance with the Declaration of Helsinki.

A total of 819 people viewed the first survey page (Germany: $N = 358$, Israel: $N = 461$), of which 225 were excluded because of missing data on all variables (Germany: $n = 23$, Israel: $n = 69$) or all variables relating to risk perception (Germany: $n = 41$, Israel: $n = 92$). Ten participants were excluded because their country of residence was neither Germany ($n = 4$) nor Israel ($n = 6$), and 13 Israeli participants were excluded because they were younger than 18 years old.

The final sample consisted of 571 participants (65.3% female, Germany: $N = 290$, Israel: $N = 281$). Their ages ranged from 18 to 80, with a mean age of 26.25 years ($SD = 8.46$; $Mdn = 24.00$; Interquartile Range = 7). The sample had a mean body mass index (BMI) of 23.10, ranging from 15.37 to 43.66 ($SD = 3.86$), and 91.7% had completed secondary education, of whom 46.3% also completed tertiary education (bachelor's degree or higher). The German sample matched the Israeli sample with regard to age ($t(562.09) = 0.83, p = 0.407$), BMI ($t(562) = 0.76, p =$

0.448), gender ($\chi^2(1) = 2.76, p = 0.097$), and education level ($\chi^2(2) = 1.81, p = 0.404$).

2.2. Measures

2.2.1. Terrorism Risk Perception

Personal terrorism risk perceptions were assessed by asking participants: "How would you estimate the probability that you will be personally exposed to a terrorist attack within a year?" while general terrorism risk perceptions were assessed by asking: "How would you estimate the probability that a terrorist attack will occur in Israel [Germany] within a year?". Answers were given on a seven-point rating scale ranging from 1 (very unlikely) to 7 (very likely). Both items were adapted from Kaptan, Shiloh, and Önkal (2013; see also Perloff & Fetzer, 1986; Weinstein, 1980, 1987).

2.2.2. Experience of Terrorism

Participants were asked to indicate whether they had ever experienced one or more of the following situations: (1) Being in a terrorist attack during which they were injured, (2) Being in a terrorist attack without being injured, (3) Someone close to them being killed or injured during a terrorist attack, (4) Having been in the vicinity of a terrorist attack, (5) Having been in the vicinity of a terrorist attack immediately before or after it occurred, and (6) Having almost been present at a terrorist attack. Participants were then categorized into two groups: (1) Having no experience of terrorism at all, and (2) having experienced one or multiple of the above stated situations (see Table I for sample sizes and descriptive statistics of subgroups). The item was adapted from Pat-Horenczyk *et al.* (2007).

2.2.3. Health Risk Perception

Personal health risk perceptions were assessed by three items which asked participants: "How would you estimate the probability that you will experience health problems through...?" (1) smoking, (2) alcohol consumption, or (3) unhealthy nutrition. General health risk perceptions were assessed by three items which asked participants to rate the probability that a person of a similar age and sex (i.e., their peer) would experience health problems due to the same three risks (Perloff & Fetzer, 1986; Renner, Hahn, & Schwarzer, 1996; Renner & Schupp, 2011;

²Deutsche Gesellschaft für Psychologie (DGPs); <https://www.dgps.de/fileadmin/documents/ethikr12004.pdf>; see paragraph C.III.

³American Psychological Association (2002), see paragraphs 3.10, and 8.01–8.15.

Table I. Sample Sizes and Descriptive Statistics by Target, Nationality, and Experience

	Israeli Sample					German Sample				
	n	Personal Risk Perception		General Risk Perception		n	Personal Risk Perception		General Risk Perception	
		M	SD	M	SD		M	SD	M	SD
Experience of Terrorism										
No experience	110	3.04	1.48	5.61	1.47	231	1.70	0.94	4.21	1.52
Experience	143	3.79	1.57	6.09	1.13	51	1.94	1.24	4.47	1.64
Alcohol consumption										
Abstinent	102	2.76	2.09	4.69	1.71	53	2.23	2.02	5.26	1.32
Low	65	2.66	1.76	4.23	1.64	54	2.39	1.32	5.37	1.25
Medium	45	2.51	1.41	4.29	1.44	52	3.12	1.49	5.23	1.29
High	49	3.24	1.63	3.90	1.70	113	3.88	1.55	5.01	1.44
Tobacco consumption										
Nonsmokers	209	3.35	2.51	5.89	1.31	217	1.79	1.72	5.66	1.42
≤10 cigarettes	30	3.90	1.99	5.47	1.41	34	3.76	1.83	5.53	1.40
>10 cigarettes	23	5.74	1.25	5.22	1.35	30	5.67	1.09	5.10	1.40
Unhealthy eating										
0 portions	46	4.04	1.84	4.89	1.80	46	2.80	1.54	5.54	1.28
1 portion	97	4.16	1.88	4.85	1.68	123	3.52	1.71	5.65	1.18
2 portions	57	4.37	1.71	5.19	1.51	59	3.90	1.55	5.20	1.37
≥3 portions	61	4.13	1.74	4.70	1.71	53	4.04	1.77	4.79	1.47

Weinstein, 1980, 1987). Answers were given on a seven-point rating scale, ranging from *very unlikely* to *very likely*.

2.2.4. Alcohol Consumption

Alcohol consumption was assessed via a quantity and frequency approach (e.g., Arterberry, Smith, Martens, Cadigan, & Murphy, 2014; Giese, Stok, & Renner, 2017). Participants were first asked to indicate how often they usually drink beer, wine, cocktails and liqueurs, and high-proof liquors on a six-point rating scale ranging from *daily*, *several times a week*, *once a week*, *one to three times a month*, and *seldom*, to *never*. The average amount of alcohol consumed on each occasion was then assessed on a six-point scale ranging from *1/2 a glass*, *1 glass*, *2 glasses*, *3 glasses*, *4–5 glasses*, to *more than 5 glasses*. For calculation purposes, “*more than 5 glasses*” was counted as six glasses. The number of glasses was then multiplied by the content in milliliters and percentage of pure alcohol (i.e., ethanol) in grams for each kind of drink, following the guidelines from the German Cancer Research Center (Deutsches Krebsforschungszentrum, 2017). This value was multiplied by how many times the participant indicated that they consumed alcohol each week to give a total weekly consumption of grams of ethanol, which was

used to categorize the participants into four groups for the analysis. These were: abstinent, low consumption (women: ≤ 20 g; men: ≤ 30 g), medium consumption (women: ≤ 40 g; men: ≤ 60 g), and high consumption (women: > 40 g; men: > 60 g; see Table I).

2.2.5. Tobacco Consumption

The assessment of tobacco consumption was adapted from the Konstanz Life Study (e.g., Renner, Sproesser, Klusmann, & Schupp, 2012; Sproesser, Klusmann, Schupp, & Renner, 2015). Participants stated the number of cigarettes or (water-)pipes they smoked per week, and for the analyses they were categorized into three groups: nonsmokers, participants who smoke ≤10, or >10 cigarettes per week (see Table I).

2.2.6. Unhealthy Eating

Participants were asked to record their average daily indulgence in two common unhealthy eating habits. These were eating a portion (a handful) of sweet snacks or desserts and drinking a glass of a sweetened drink (e.g., lemonade, energy drink, or soft drink), rated on a six-point scale (0, 1, 2, 3, 4, and >4; adapted from De Wit et al., 2015). Participants were then categorized into four groups by the

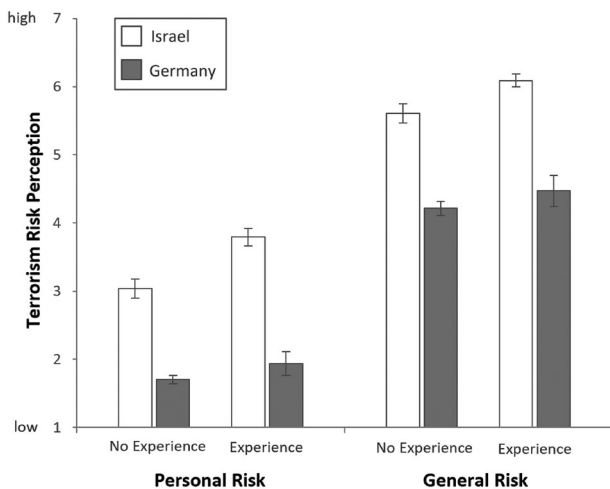


Fig 1. Mean terrorism risk perception by target, nationality, and experience.

Note: $N = 535$. Error bars show standard errors.

sum of both unhealthy eating habits (0, 1, 2, and ≥ 3 portions/glasses; see Table I).

2.3. Statistical Analyses

Mixed ANOVAs (target \times nationality \times experience) were computed to test the research questions with “target” (personal vs. general risk perception) as within factor and “nationality” (Israeli vs. German) and “experience” (different levels of prior risk experience) as between factors. The acute risk of terrorist attacks was tested using a mixed $2 \times 2 \times 2$ ANOVA. A $2 \times 2 \times 3$ ANOVA was calculated for the cumulative risk of tobacco consumption, and $2 \times 2 \times 4$ ANOVAs were calculated for alcohol consumption and unhealthy eating. Simple two-way interactions and simple main effects were calculated, as well as *post hoc* tests with Bonferroni corrections. Statistical analyses were performed using IBM SPSS (Version 25, IBM, 2017).

3. RESULTS

3.1. Experience of Terrorism and Risk Perception

The mixed ANOVA revealed a significant main effect for the factor “experience” ($F(1, 531) = 15.40, p < 0.001, \eta_p^2 = 0.03$) with $M_{no_exp} = 3.40, SD = 1.25$ versus $M_{exp} = 4.48, SD = 1.37$ (hypothesis 1, see Fig. 1). No interaction was found for “target \times experience” ($F(1, 531) = 0.65, p = 0.422$;

hypothesis 2). Thus, risk perception for both the self and others increased significantly with more risk experience. Furthermore, a significant main effect was found for the factor “nationality” ($F(1, 531) = 196.95, p < 0.001, \eta_p^2 = 0.27$) with $M_{IL} = 4.67, SD = 1.19$ versus $M_{GE} = 3.00, SD = 1.05$, indicating that on average Israeli participants showed higher personal and general terrorism risk perceptions than the German participants (hypothesis 3). The analysis also yielded a significant main effect for the factor “target” ($F(1, 531) = 989.82, p < 0.001, \eta_p^2 = 0.65$), indicating that on average participants rated the general risk of being exposed to a terrorist attack within one year as higher than their personal risk ($M_{general} = 5.03, SD = 1.65$ vs. $M_{personal} = 2.56, SD = 1.56$; hypothesis 4).

3.2. Experience with Cumulative Health Risks and Risk Perception

The results of the three mixed ANOVAs are displayed in Table II and Figs. 2–4. An increase in personal but not general risk perception with more cumulative risk experience (hypotheses 1 & 2) should be reflected in significant “target \times experience” interactions. This was found for alcohol consumption. Simple effect analyses of “experience” within “target” showed that greater experience was significantly related to an increase in personal risk perception ($M_{abstinent} = 2.58, SD = 2.08$ vs. $M_{low} = 2.54, SD = 1.58$ vs. $M_{medium} = 2.84, SD = 1.48$ vs. $M_{high} = 3.69, SD = 1.59$), but not general risk perception. For tobacco consumption and unhealthy eating, significant three-way interactions emerged for “target \times nationality \times experience.” Simple two-way interactions were then calculated to complement these interactions. Significant “target \times experience” interactions were found for tobacco consumption within both nationalities, and for unhealthy eating within the German sample. In the next step, simple simple main effects were calculated for the effect of “experience” at each level of “target” and within each level of “nationality.” For personal risk perception, significant effects of “experience” were found in both countries for tobacco consumption but only in Germany for unhealthy eating (see Table I). Moreover, significant effects for general risk perception emerged for both tobacco consumption in Israel and unhealthy eating in Germany. However, these effects were reversed compared with personal risk perception: participants reported lower general risk perception as experience increased.

Table II. Results of the Mixed ANOVAs with Health Risk Perception as Dependent Variable and with the Factors Target, Nationality, and Experience

Effect	df Effect	df Error	F	p	η_p^2
2×2×4 ANOVA for alcohol consumption					
Main effect target	1	525	470.01	< .001	.47
Main effect nationality	1	525	19.66	< .001	.04
Main effect experience	3	525	1.72	.162	-
Target × experience interaction	3	525	18.31	< .001	.10
Simple main effects experience within					
Personal risk perception	3	525	14.79	< .001	.08
General risk perception	3	525	0.54	.657	-
Nationality × experience interaction	3	525	2.91	.034	.02
Target × nationality interaction	1	525	22.81	< .001	.04
Target × nationality × experience interaction	3	525	2.07	.104	-
2×2×3 ANOVA for tobacco consumption					
Main effect target	1	537	104.78	< .001	.16
Main effect nationality	1	537	3.88	.049	.01
Main effect experience	2	537	21.98	< .001	.08
Target × experience interaction	2	537	75.42	< .001	.22
Nationality × experience interaction	2	537	4.33	.014	.02
Target × nationality interaction	1	537	3.09	.080	-
Target × nationality × experience interaction	2	537	3.71	.025	.01
Simple interactions target × experience within					
Israel	2	537	21.94	< .001	.08
Germany	2	537	91.45	< .001	.25
Simple simple main effects experience within					
Personal risk perception, Israel	2	537	12.05	< .001	.04
Personal risk perception, Germany	2	537	86.70	< .001	.24
General risk perception, Israel	2	537	6.19	.002	.02
General risk perception, Germany	2	537	2.15	.117	-
2×2×4 ANOVA for unhealthy eating					
Main effect target	1	534	213.47	< .001	.29
Main effect nationality	1	534	0.87	.352	-
Main effect experience	3	534	1.41	.239	-
Target × experience interaction	3	534	7.26	< .001	.04
Nationality × experience interaction	3	534	0.62	.602	-
Target × nationality interaction	1	534	35.21	< .001	.06
Target × nationality × experience interaction	3	534	5.38	.001	.03
Simple interactions target × experience within					
Israel	3	534	1.08	.358	-
Germany	3	534	14.70	< .001	.08
Simple simple main effects experience within					
Personal risk perception, Israel	3	534	0.58	.629	-
Personal risk perception, Germany	3	534	5.13	.002	.03
General risk perception, Israel	3	534	1.41	.239	-
General risk perception, Germany	3	534	6.10	< .001	.03

Note: ANOVA = analysis of variance.

Significant main effects for the factor “target” emerged with $M_{general} = 4.77$, $SD = 1.57$ versus $M_{personal} = 2.95$, $SD = 1.79$ for alcohol consumption, $M_{general} = 5.68$, $SD = 1.38$ versus $M_{personal} = 3.01$, $SD = 2.36$ for tobacco consumption, and $M_{general} = 5.15$, $SD = 1.52$ versus $M_{personal} = 3.87$, $SD = 1.77$ for unhealthy eating, indicating that, on average, participants rated the health risk due to cumulative

risks as higher for their peers than for themselves, which indicates the occurrence of an optimistic bias (hypothesis 4).

4. DISCUSSION

In line with previous findings on acute risk experience (e.g., Bronfman et al., 2020; Keller et al.,

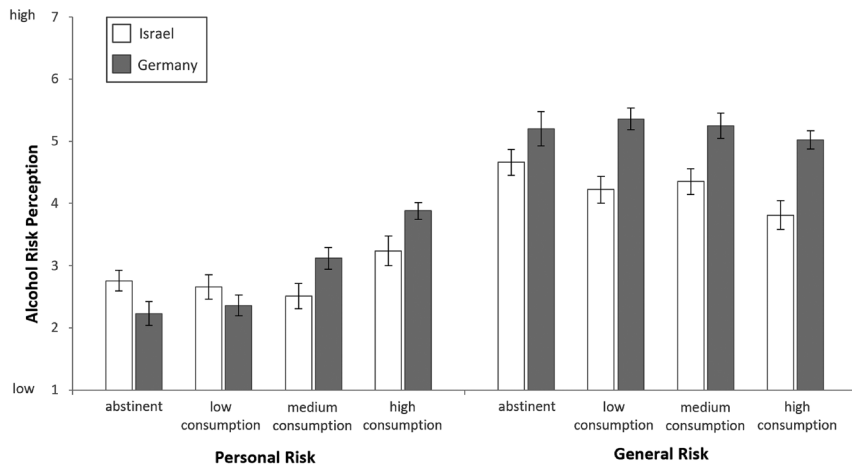


Fig 2. Mean alcohol risk perception by target, nationality, and experience. Note: $N = 533$. Error bars show standard errors.

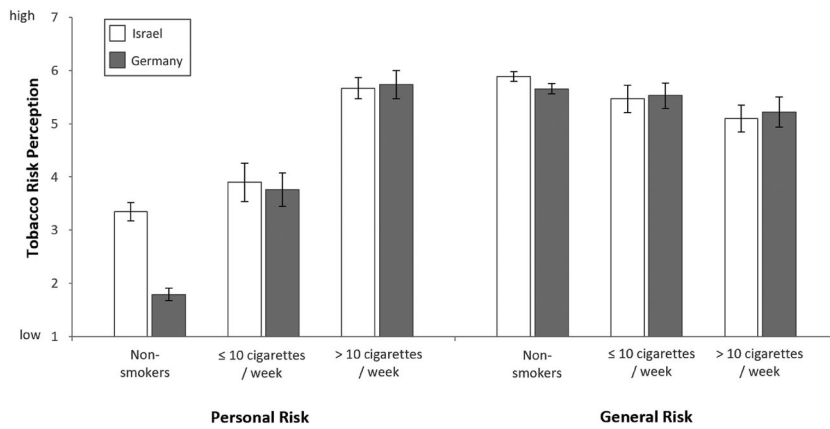


Fig 3. Mean tobacco risk perception by target, nationality, and experience. Note: $N = 543$. Error bars show standard errors.

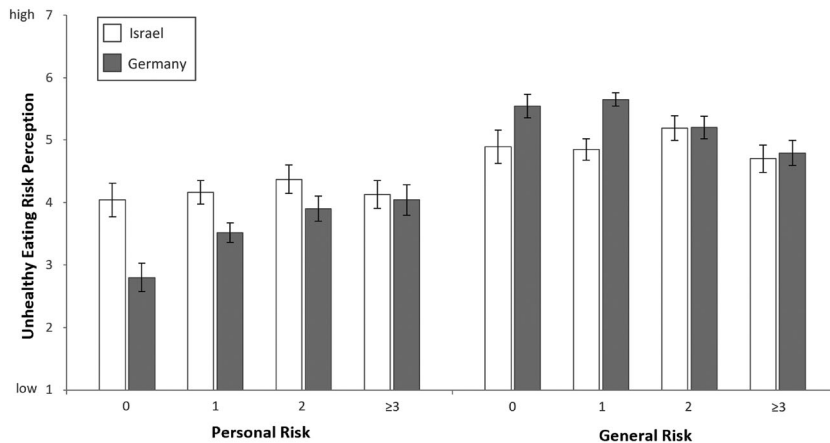


Fig 4. Mean unhealthy eating risk perception by target, nationality, and experience. Note: $N = 542$. Portions of unhealthy snacks and drinks per day. Error bars show standard errors.

2006; Knuth et al., 2015; Koshiba & Ohtani, 2015; Kung & Chen, 2012; Lindell & Hwang, 2008; Öhman, 2017; Siegrist & Gutscher, 2006), participants with personal experiences of terrorism reported increased personal and general risk perceptions (hypotheses 1 & 2). This was expected, since acute disaster risks

typically affect the self and others at the same time, and thus provide information about both one's own and others' risk status (Weinstein, 1989). More information about risk status should, in turn, result in heightened risk perceptions, since the occurrence of a risk is estimated as more likely if the risk is

easier to recall or imagine (availability heuristic; Tversky & Kahneman, 1973; see also Perloff, 1983; Sjöberg, 2000; Weinstein, 1980). Moreover, on average, Israeli participants showed higher general and personal terrorism risk perceptions than the German participants, regardless of their personal experience (hypothesis 3). These observed national differences suggest that the vastly higher number of terrorist attacks that have taken place in Israel over the past decades have resulted in a higher objective terrorism risk than exists in Germany (START, 2020). Supporting this notion, a higher proportion of Israeli than German participants reported having personally experienced terrorist attacks (56.5% vs. 18.1%). Greater experience at the community level (and thus higher risk status information) also seems to be related to higher risk perceptions, even if an individual has not personally experienced a terrorist attack. This is in line with findings from previous studies on community-level experiences of natural hazards (Becker, Paton, Johnston, Ronan, & McClure, 2017; McClure, Wills, Johnston, & Recker, 2011; Sharma & Patt, 2012; see also Weinstein, 1989).

In contrast with acute experiences of terrorism, cumulative health risk experience was found to be related to heightened personal but not general risk perceptions (hypotheses 1 & 2). Unhealthy habits such as the consumption of alcohol or tobacco are predominantly informative regarding the health risk status of the person who shows the risk behavior, but not regarding other people's health risk status. Information about one's personal health risk status should therefore result in heightened personal risk perceptions (Tversky & Kahneman, 1973; Weinstein, 1989), while general health risk perceptions should remain unaffected (Gamp & Renner, 2016). This was also shown by the present findings, which are in line with Sjöberg (1998) and van der Velde et al. (1994) who found the same differential pattern for personal and general risk perceptions with increased alcohol consumption and risky sexual behavior, respectively. Chen et al. (2016), Piko and Gibbons (2008), and Weinstein et al. (2005) also reported heightened personal risk perceptions with more alcohol and tobacco consumption, but they did not assess general risk perceptions. Other studies have reported lower general risk perceptions with more alcohol and tobacco consumption, but these did not assess personal risk perceptions (Grevenstein et al., 2015; Lundborg, 2007; Lundborg & Lindgren, 2002). At first sight, our study results seem to contradict findings from

Halpern-Felsher et al. (2001, 2004) and Morrell et al. (2010), who found a negative relationship between alcohol or tobacco consumption and personal risk perceptions. However, these studies used conditional risk assessments, meaning that the participants were asked to imagine a specific risk behavior before the risk assessment (e.g., "Imagine that [...] you smoke about 2 or 3 cigarettes each day, what is the chance that...?"; Morrell et al., 2010, p. 5). Since these scenarios uncouple the participants' risk perceptions from their own behavior they assess general rather than personal risk perception, which therefore corresponds with the results from the present study.

Overall, the present results strengthen the suggestion that it might not be the experience of a risk itself that leads to heightened risk perceptions, but the degree of vivid and detailed information gained through the experience about one's own and others' risk status (Perloff, 1983; Weinstein, 1989). Moreover, Weinstein (1989) argued that information based upon personal experience is tainted with less uncertainty than information gained in other ways, and might thus be more convincing. This line of reasoning can explain why experience with cumulative health risks is related to heightened personal but not general risk perceptions, and why a higher community-level experience of terrorism is associated with heightened risk perceptions, even if an individual has not personally experienced a terrorist attack. However, it remains unclear whether the information provided leads to heightened risk perceptions through increased availability and facilitated recall (availability heuristic; Tversky & Kahneman, 1973) or through evoked affect (affect heuristic; Finucane, Alhakami, Slovic, & Johnson, 2000; Slovic, Finucane, Peters, & MacGregor, 2002, 2004). As often discussed (e.g., Keller et al., 2006; Pachur, Hertwig, & Steinmann, 2012; Siegrist & Árvai, 2020; Terpstra, 2011), both factors can affect the relationship between experience and risk perception.

Moreover, the risks examined in this study were not only different with regard to the information provided about risk statuses, but also with regard to several other aspects. For example, acute risks compared with cumulative risks are characterized by a higher experienced severity in the moment, an immediate onset of adverse consequences, and also, especially in the case of terrorist attacks, by their perceived dreadfulness (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Slovic, 1987). The latter is associated with a lack of control, the potential to be

catastrophic, and an unequal distribution of risk and benefit. Consequently, it should be likely that the distinct characteristics of acute and cumulative risk experience influence people's risk perception to different degrees (Barnett & Breakwell, 2001; Harris, 2007; Helweg-Larsen & Shepperd, 2001; Ho, Shaw, Lin, & Chiu, 2008; Weinstein, 1980, 1989; see also Weinstein, Lyon, Rothman, & Cuite, 2000). However, future research is needed to test the found pattern in the experience–risk perception relationship for other risks apart from acute terrorism and cumulative health risks.

Analyses on the country level revealed no relationship between experience with unhealthy eating and personal risk perception in the Israeli sample. Specifically, regardless of the daily portions of unhealthy food they consumed, the Israeli participants reported personal risk perception levels that were as high as those of German participants with the highest consumption of unhealthy food. It is possible that the higher nutrition-related personal risk perceptions in the Israeli sample were elicited by differences in national guidelines regarding healthy nutrition. For example, the German nutrition society (DGE) gives quantitative recommendations regarding nutritional intake, while guidelines from the Israeli health ministry that were valid during the data collection period simply suggest eating lots of vegetables and fruits and sweet snacks and drinks only sparingly (Montagnese *et al.*, 2015). Since no specific amounts are given, Israelis might constantly have the feeling that they are not eating healthily enough, and might feel the urge to improve their diet even if they already eat healthily.

Interestingly, general risk perception for unhealthy eating in Germany and tobacco consumption in Israel was reduced with more personal experience. It is possible that the unhealthy behavior is initially triggered by a low general risk perception (Gaube, Lerner, & Fischer, 2019). Similarly, it is also possible that individuals with low tobacco consumption and healthy eating habits hold exaggerated general risk perceptions regarding these risks (Barnett & Breakwell, 2001; Karlsson, 2012). Either way, it is important to note that while general risk perceptions decreased with more personal experience, personal risk perceptions increased. Thus, other underlying mechanisms that may explain reduced risk perceptions, such as risk habituation (Brown, 2005), self-defensive denial or motivated reasoning (Ditto, 2009; Kunda, 1990), or behavior-based attitude formation (self-perception theory; Bem, 1972),

can be applied to the reduced general risk perceptions but not to the increased personal risk perceptions. Therefore, it may be concluded from the present study that based on the risk information provided, people (consciously or not) make a clear distinction between risk targets when processing the information.

Overall, personal risk was perceived as lower than general risk for all risks, which indicates an optimistic bias (hypothesis 4; Perloff & Fetzer, 1986; Renner & Schupp, 2011; Shepperd, Klein, Waters, & Weinstein, 2013; Weinstein, 1980, 1987). However, as shown by the increase in personal but not general risk perception that was found with more health risk experience, the optimistic bias decreases with experience. Again, it can be argued that more information about one's own risk status leads to more realistic risk perceptions and hence to reductions in unrealistic optimism (Cohn, Macfarlane, Yanez, & Imai, 1995; Hahn & Renner, 1998; Helweg-Larsen & Shepperd, 2001). However, if people receive information not only about a heightened personal but also about a heightened general risk status, the optimistic bias seems to remain unchanged, as shown for the risk of terrorist attacks. Nevertheless, it needs to be noted that general terrorism risk perception was operationalized as the likelihood of an attack occurring in the participant's country of residence and not as the likelihood for a peer. Thus, from a probabilistic perspective, a lower personal than general terrorism risk perception may indicate a realistic assessment. However, the pronounced difference between personal and general risk perceptions that was found in the present study may also indicate unrealistic optimism, as it may mean, for example, that one believes the chances of a terrorist attack are lower in the respective area of residence than in the country in general (see Kaptan *et al.*, 2013; Lemyre, Turner, Lee, & Krewski, 2006).

4.1. Limitations

Some limitations need to be addressed when interpreting the results of the present study. Most importantly, since the study design is cross-sectional, it does not allow for causal interpretations. While the risk experience must have taken place before the risk estimation in the questionnaire, the estimation might be the same as before the experience, and thus not be affected by it. Longitudinal study designs should be conducted to examine the effect of experience on risk perception.

Furthermore, as previously stated, the two risks investigated in the present study differ not only with regard to the information provided on personal and general risk status but also on several other dimensions, which could be accountable for the differential pattern as well. Further studies, for example with experimental designs, should therefore be conducted to examine whether different risk characteristics could also explain the differential patterns that were found for personal and general risk status.

Moreover, unhealthy eating was assessed by two items only, focusing on the consumption of unhealthy snacks and sweetened drinks. Thus, the resulting score does not represent a comprehensive nutritional pattern. The items were chosen to facilitate a cross-national comparability (see De Wit et al., 2015), as dietary guidelines between Israel and Germany differ. Nevertheless, this simplified assessment of unhealthy eating might have caused the invariant diet-related risk perceptions in the Israeli sample.

Furthermore, with a mean age of 26 years the study sample is very young, which influences the representativeness of the results. Arguably, the sample might have less experience with risks in general and suffer from fewer negative long-term health consequences resulting from cumulative health risks. Still, the finding of heightened personal risk perceptions among persons reporting unhealthier behaviors suggests that risk experience is related to risk perception even for those with less experience of negative consequences.

5. CONCLUSIONS

The findings of the present study emphasize that the experience–risk perception relationship depends on the risk target and the type of risk experience. For the acute risk of a terrorist attack, personal and general risk perceptions were elevated with prior experience. For cumulative health risks, risk experience was only related to elevated personal risk perceptions. This differential pattern can be explained by the information provided about one’s own and other people’s risk status, which ultimately influences risk perceptions. While experience of acute risks provides information about both risk statuses, cumulative health risk experience predominantly provides information about personal risk status. It is therefore important that research which examines the relationship between risk experience and risk perceptions takes both the risk target and risk characteristics into account.

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DECLARATION OF CONFLICTING INTERESTS

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

REFERENCES

- American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist*, 57(12), 1060–1073. <https://doi.org/10.1037/0003-066X.57.12.1060>
- Arterberry, B. J., Smith, A. E., Martens, M. P., Cadigan, J. M., & Murphy, J. G. (2014). Protective behavioral strategies, social norms, and alcohol-related outcomes. *Addiction Research & Theory*, 22(4), 279–285. <https://doi.org/10.3109/16066359.2013.838226>
- Barnett, J., & Breakwell, G. M. (2001). Risk perception and experience: Hazard personality profiles and individual differences. *Risk Analysis*, 21(1), 171–178. <https://doi.org/10.1111/0272-4332.211099>
- Becker, J. S., Paton, D., Johnston, D. M., Ronan, K. R., & McClure, J. (2017). The role of prior experience in informing and motivating earthquake preparedness. *International Journal of Disaster Risk Reduction*, 22, 179–193. <https://doi.org/10.1016/j.ijdrr.2017.03.006>
- Bem, D. J. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 6, pp. 1–62). New York; London: Academic Press. [https://doi.org/10.1016/S0065-2601\(08\)60024-6](https://doi.org/10.1016/S0065-2601(08)60024-6)
- Bronfman, N. C., Cisternas, P. C., Repetto, P. B., Castañeda, J. V., & Guic, E. (2020). Understanding the relationship between direct experience and risk perception of natural hazards. *Risk Analysis*, 40(10), 2057–2070. <https://doi.org/10.1111/risa.13526>
- Brown, S. L. (2005). Relationships between risk-taking behaviour and subsequent risk perceptions. *British Journal of Psychology*, 96(2), 155–164. <https://doi.org/10.1348/000712605x36703>
- Chen, L.-S., Kaphingst, K. A., Tseng, T.-S., & Zhao, S. (2016). How are lung cancer risk perceptions and cigarette smoking related?—Testing an accuracy hypothesis. *Translational Cancer Research*, 5, Suppl(5), 964–971. <https://doi.org/10.21037/tcr.2016.10.75>

- Cohn, L. D., Macfarlane, S., Yanez, C., & Imai, W. K. (1995). Risk-perception: Differences between adolescents and adults. *Health Psychology, 14*(3), 217–222. <https://doi.org/10.1037/0278-6133.14.3.217>
- De Wit, J. B., Stok, F. M., Smolenski, D. J., de Ridder, D. D., de Vet, E., Gaspar, T., ... Luszczynska, A. (2015). Food culture in the home environment: Family meal practices and values can support healthy eating and self-regulation in young people in four European countries. *Applied Psychology: Health and Well-Being, 7*(1), 22–40. <https://doi.org/10.1111/aphw.12034>
- Deutsches Krebsforschungszentrum. (2017). *Alkoholatlas Deutschland 2017*. Retrieved from https://www.dkfz.de/de/tabakkontrolle/download/Publikationen/sonstVeroeffentlichungen/Alkoholatlas-Deutschland-2017_Doppelseiten.pdf
- Ditto, P. H. (2009). Passion, reason, and necessity: A quantity-of-processing view of motivated reasoning. In T. Bayne & J. Fernandez (Eds.), *Delusion and self-deception: Affective and motivational influences on belief formation* (pp. 23–53). New York: Psychology Press.
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making, 13*(1), 1–17.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., & Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences, 9*(2), 127–152. <https://doi.org/10.1007/BF00143739>
- Gamp, M., & Renner, B. (2016). Pre-feedback risk expectancies and reception of low-risk health feedback: Absolute and comparative lack of reassurance. *Applied Psychology: Health and Well-Being, 8*(3), 364–385. <https://doi.org/10.1111/aphw.12076>
- Gaube, S., Lermer, E., & Fischer, P. (2019). The concept of risk perception in health-related behavior theory and behavior change. In M. Raue, B. Streicher, & E. Lermer (Eds.), *Perceived safety* (pp. 101–118). Cham: Springer. https://doi.org/10.1007/978-3-030-11456-5_7
- Giese, H., Stok, F. M., & Renner, B. (2017). The role of friendship reciprocity in university freshmen's alcohol consumption. *Applied Psychology: Health and Well-Being, 9*(2), 228–241. <https://doi.org/10.1111/aphw.12088>
- Grevenstein, D., Nagy, E., & Kroeninger-Jungaberle, H. (2015). Development of risk perception and substance use of tobacco, alcohol and cannabis among adolescents and emerging adults: Evidence of directional influences. *Substance Use & Misuse, 50*(3), 376–386. <https://doi.org/10.3109/10826084.2014.984847>
- Hahn, A., & Renner, B. (1998). Perception of health risks: How smoker status affects defensive optimism. *Anxiety, Stress and Coping, 11*, 93–112. <https://doi.org/10.1080/1061580980248307>
- Halpern-Felsher, B. L., Biehl, M., Kropp, R. Y., & Rubinstein, M. L. (2004). Perceived risks and benefits of smoking: Differences among adolescents with different smoking experiences and intentions. *Preventive Medicine, 39*(3), 559–567. <https://doi.org/10.1016/j.ypmed.2004.02.017>
- Halpern-Felsher, B. L., Millstein, S. G., Ellen, J. M., Adler, N. E., Tschann, J. M., & Biehl, M. (2001). The role of behavioral experience in judging risks. *Health Psychology, 20*(2), 120–126. <https://doi.org/10.1037/0278-6133.20.2.120>
- Harris, P. (2007). The impact of perceived experience on likelihood judgments for self and others: An experimental approach. *European Journal of Social Psychology, 37*(1), 141–151. <https://doi.org/10.1002/ejsp.339>
- Helweg-Larsen, M., & Shepperd, J. A. (2001). Do moderators of the optimistic bias affect personal or target risk estimates? A review of the literature. *Personality and Social Psychology Review, 5*(1), 74–95. https://doi.org/10.1207/S15327957PSPR0501_5
- Ho, M.-C., Shaw, D., Lin, S., & Chiu, Y.-C. (2008). How do disaster characteristics influence risk perception? *Risk Analysis, 28*(3), 635–643. <https://doi.org/10.1111/j.1539-6924.2008.01040.x>
- IBM. (2017). *IBM SPSS Statistics for Windows (Version 25.0)*. IBM Corp.
- Kaptan, G., Shiloh, S., & Önkal, D. (2013). Values and risk perceptions: A cross-cultural examination. *Risk Analysis, 33*(2), 318–332. <https://doi.org/10.1111/j.1539-6924.2012.01875.x>
- Karlsson, P. (2012). Personal experiences of drinking and alcohol-related risk perceptions: The importance of the subjective dimension. *Nordic Studies on Alcohol and Drugs, 29*(4), 413–428. <https://doi.org/10.2478/v10199-012-0036-5>
- Keller, C., Siegrist, M., & Gutscher, H. (2006). The role of the affect and availability heuristics in risk communication. *Risk Analysis, 26*(3), 631–639. <https://doi.org/10.1111/j.1539-6924.2006.00773.x>
- Knuth, D., Kehl, D., Hulse, L., Spangenberg, L., Brähler, E., & Schmidt, S. (2015). Risk perception and emergency experience: Comparing a representative German sample with German emergency survivors. *Journal of Risk Research, 18*(5), 581–601. <https://doi.org/10.1080/13669877.2014.910685>
- Koshiba, Y., & Ohtani, H. (2015). Public perception of physical risks: Effect of the experience of repeated explosion accidents at a chemical plant. *Open Journal of Safety Science and Technology, 5*(2), 45–54. <https://doi.org/10.4236/ojsst.2015.52006>
- Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin, 108*(3), 480–498. <https://doi.org/10.1037/0033-2909.108.3.480>
- Kung, Y. W., & Chen, S. H. (2012). Perception of earthquake risk in Taiwan: Effects of gender and past earthquake experience. *Risk Analysis, 32*(9), 1535–1546. <https://doi.org/10.1111/j.1539-6924.2011.01760.x>
- Larsman, P., Eklöf, M., & Törner, M. (2012). Adolescents' risk perceptions in relation to risk behavior with long-term health consequences; antecedents and outcomes: A literature review. *Safety Science, 50*(9), 1740–1748. <https://doi.org/10.1016/j.ssci.2012.04.009>
- Lemyre, L., Turner, M. C., Lee, J. E. C., & Krewski, D. (2006). Public perception of terrorism threats and related information sources in Canada: Implications for the management of terrorism risks. *Journal of Risk Research, 9*(7), 755–774. <https://doi.org/10.1080/13669870600924477>
- Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539–556. <https://doi.org/10.1111/j.1539-6924.2008.01032.x>
- Lundborg, P. (2007). Smoking, information sources, and risk perceptions—New results on Swedish data. *Journal of Risk and Uncertainty, 34*(3), 217–240. <https://doi.org/10.1007/s11166-007-9010-0>
- Lundborg, P., & Lindgren, B. (2002). Risk perceptions and alcohol consumption among young people. *Journal of Risk and Uncertainty, 25*(2), 165–183. <https://doi.org/10.1023/A:1020695730192>
- McClure, J., Wills, C., Johnston, D., & Recker, C. (2011). How the 2010 Canterbury (Darfield) earthquake affected earthquake risk perception: Comparing citizens inside and outside the earthquake region. *Australasian Journal of Disaster and Trauma Studies, 2*, 1–10.
- Montagnese, C., Santarpia, L., Buonifacio, M., Nardelli, A., Caldara, A. R., Silvestri, E., ... Pisanisi, F. (2015). European food-based dietary guidelines: A comparison and update. *Nutrition, 31*(7), 908–915. <https://doi.org/10.1016/j.nut.2015.01.002>
- Morrell, H. E., Song, A. V., & Halpern-Felsher, B. L. (2010). Predicting adolescent perceptions of the risks and benefits of cigarette smoking: A longitudinal investigation. *Health Psychology, 29*(6), 610–617. <https://doi.org/10.1037/a0021237>
- Öhman, S. (2017). Previous experiences and risk perception: The role of transference. *Journal of Education, Society and Behavioural Science, 23*(1), 1–10. <https://doi.org/10.9734/JESBS/2017/35101>
- Pachur, T., Hertwig, R., & Steinmann, F. (2012). How do people judge risks: Availability heuristic, affect heuristic, or both?

- Journal of Experimental Psychology: Applied*, 18(3), 314–330. <https://doi.org/10.1037/a0028279>
- Pat-Horenczyk, R., Peled, O., Miron, T., Brom, D., Villa, Y., & Chemtob, C. M. (2007). Risk-taking behaviors among Israeli adolescents exposed to recurrent terrorism: Provoking danger under continuous threat? *American Journal of Psychiatry*, 164(1), 66–72. <https://doi.org/10.1176/ajp.2007.164.1.66>
- Perloff, L. S. (1983). Perceptions of vulnerability to victimization. *Journal of Social Issues*, 39(2), 41–61. <https://doi.org/10.1111/j.1540-4560.1983.tb00140.x>
- Perloff, L. S., & Fetzer, B. K. (1986). Self–other judgments and perceived vulnerability to victimization. *Journal of Personality and Social Psychology*, 50(3), 502–510. <https://doi.org/10.1037/0022-3514.50.3.502>
- Piko, B. F., & Gibbons, F. X. (2008). Behavioral and psychosocial influences of risk perception among Hungarian adolescents. *International Journal of Public Health*, 53(3), 131–138. <https://doi.org/10.1007/s00038-008-7054-9>
- Renner, B., Hahn, A., & Schwarzer, R. (1996). *Risiko und Gesundheitsverhalten. Dokumentation der Messinstrumente des Forschungsprojektes "Berlin Risk Appraisal and Health Motivation Study" (BRAHMS)*. Freie Universität Berlin.
- Renner, B., & Schupp, H. T. (2011). The perception of health risks. In H. S. Friedman (Ed.), *The Oxford handbook of health psychology* (pp. 637–665). Oxford: Oxford University Press.
- Renner, B., Sproesser, G., Klusmann, V., & Schupp, H. T. (2012). Die Konstanzer Life-Studie. *Adipositas: Ursachen, Folgeerkrankungen, Therapie*, 6(2), 123–124. <https://doi.org/10.1055/s-0037-1618783>
- Sharma, U., & Patt, A. (2012). Disaster warning response: The effects of different types of personal experience. *Natural Hazards*, 60(2), 409–423. <https://doi.org/10.1007/s11069-011-0023-2>
- Shepperd, J. A., Klein, W. M., Waters, E. A., & Weinstein, N. D. (2013). Taking stock of unrealistic optimism. *Perspectives on Psychological Science*, 8(4), 395–411. <https://doi.org/10.1177/1745691613485247>
- Shiloh, S., Güvenc, G., & Önkal, D. (2007). Cognitive and emotional representations of terror attacks: A cross-cultural exploration. *Risk Analysis*, 27(2), 397–409. <https://doi.org/10.1111/j.1539-6924.2007.00892.x>
- Siegrist, M., & Árvai, J. (2020). Risk perception: Reflections on 40 years of research. *Risk Analysis*, 40(S1), 2191–2206. <https://doi.org/10.1111/risa.13599>
- Siegrist, M., & Gutscher, H. (2006). Flooding risks: A comparison of lay people's perceptions and expert's assessments in Switzerland. *Risk Analysis*, 26(4), 971–979. <https://doi.org/10.1111/j.1539-6924.2006.00792.x>
- Sjöberg, L. (1998). Risk perception of alcohol consumption. *Alcoholism: Clinical and Experimental Research*, 22(S7), 277s–284s. <https://doi.org/10.1111/j.1530-0277.1998.tb04380.x>
- Sjöberg, L. (2000). Factors in risk perception. *Risk Analysis*, 20(1), 1–12. <https://doi.org/10.1111/0272-4332.00001>
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280–285. <https://doi.org/10.1126/science.3563507>
- Slovic, P. (2000). What does it mean to know a cumulative risk? Adolescents' perceptions of short-term and long-term consequences of smoking. *Journal of Behavioral Decision Making*, 13(2), 259–266.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 397–420). Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511808098.025>
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis*, 24(2), 311–322. <https://doi.org/10.1111/j.0272-4332.2004.00433.x>
- Spiegelhalter, D. (2012). Using speed of ageing and “microlives” to communicate the effects of lifetime habits and environment. *British Medical Journal*, 345, Article 8223. <https://doi.org/10.1136/bmj.e8223>
- Spiegelhalter, D. (2016). How old are you, really? Communicating chronic risk through “effective age” of your body and organs. *BMC Medical Informatics and Decision Making*, 16(1), Article 104. <https://doi.org/10.1186/s12911-016-0342-z>
- Sproesser, G., Klusmann, V., Schupp, H. T., & Renner, B. (2015). Comparative optimism about healthy eating. *Appetite*, 90, 212–218. <https://doi.org/10.1016/j.appet.2015.03.008>
- START. (2020). *Global Terrorism Database*. Retrieved from <http://www.start.umd.edu/gtd/>
- Terpstra, T. (2011). Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior. *Risk Analysis*, 31(10), 1658–1675. <https://doi.org/10.1111/j.1539-6924.2011.01616.x>
- Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, 5(2), 207–232. [https://doi.org/10.1016/0010-0285\(73\)90033-9](https://doi.org/10.1016/0010-0285(73)90033-9)
- van der Velde, F. W., van der Pligt, J., & Hooykaas, C. (1994). Perceiving AIDS-related risk: Accuracy as a function of differences in actual risk. *Health Psychology*, 13(1), 25–33. <https://doi.org/10.1037/0278-6133.13.1.25>
- Viscusi, W. K., & Zeckhauser, R. J. (2006). National survey evidence on disasters and relief: Risk beliefs, self-interest, and compassion. *Journal of Risk and Uncertainty*, 33(1-2), 13–36. <https://doi.org/10.1007/s11166-006-0169-6>
- Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox—Implications for governance and communication of natural hazards. *Risk Analysis*, 33(6), 1049–1065. <https://doi.org/10.1111/j.1539-6924.2012.01942.x>
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 93(5), 806–820. <https://doi.org/10.1037/0022-3514.39.5.806>
- Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine*, 10(5), 481–500. <https://doi.org/10.1007/BF00846146>
- Weinstein, N. D. (1989). Effects of personal experience on self-protective behavior. *Psychological Bulletin*, 105(1), 31–50. <https://doi.org/10.1037/0033-2909.105.1.31>
- Weinstein, N. D., Lyon, J. E., Rothman, A. J., & Cuite, C. L. (2000). Changes in perceived vulnerability following natural disaster. *Journal of Social and Clinical Psychology*, 19(3), 372–395. <https://doi.org/10.1521/jscp.2000.19.3.372>
- Weinstein, N. D., Marcus, S. E., & Moser, R. P. (2005). Smokers' unrealistic optimism about their risk. *Tobacco Control*, 14(1), 55–59. <https://doi.org/10.1136/tc.2004.008375>