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The impact of infection risk communication format on tourism travel intentions during COVID-19

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ABSTRACT

Perceived risks and safety concerns are strong predictors of travel intentions. This research examines the effectiveness of the COVID-19 infection rate presentation format in changing respondents' risk perceptions and travel intentions to a COVID-19-affected destination. In two experimental studies conducted during the COVID-19 pandemic, participants (N = 1219) received information on infection rates in one of four mathematically equivalent formats: raw numbers, percentages, N-in-NX ratio, and 1-in-X ratio. Three distinct components of risk perception were measured: affective, analytical, and experiential. Results show that the infection rate presented using percentages increased the intention to travel compared to that presented using an N-in-NX ratio and raw numbers. Moreover, the infection rate presented using a 1-in-X ratio decreased the intention to travel compared to that presented using an N-in-NX ratio and percentages. These findings are in line with two apparently inconsistent phenomena: the ratio bias, according to which ratios with larger numerators induce a higher perceived infection risk than ratios with smaller ones, and the 1-in-X effect, according to which ratios with "1" at the numerator induce a higher perceived infection risk than ratios with other numbers at the numerator. Additionally, the effect of numerical formats on travel intentions was fully mediated by affective and analytical risk perceptions but only partially by experiential risk perceptions. Overall, the findings show the importance of the format used to present infection rates on changing individuals' travel intentions.

1. Introduction

The COVID-19 epidemic devastated the 2020 tourism industry. In the United States, the majority (70 percent) of the hotel staff was let off, with an estimated 4.6 million jobs lost (American Hospitality and Association, 2020). In Europe, the tourism business witnessed a 61 percent (1.1 billion) drop between April 2020 and March 2021 (Eurostat, 2020) compared to the 12 months before the pandemic. It is, therefore, important to investigate what strategies can be adopted to foster a prompt industry recovery in the post-COVID-19 phase.

Perceived financial, physical, social, and health risks have been suggested as important factors in tourism decision-making as tourists tend to avoid high-risk destinations in favor of low-risk ones (e.g., Sönmez & Graefe, 1998). Risk perceptions during the COVID-19 pandemic made no exception, significantly influencing tourism travel intentions (Bae & Chang, 2021; Rather, 2021). At the same time, the format used to present the risk information is acknowledged to affect risk perceptions and behavioral intentions (for a review, see Ancker et al., 2022). We, therefore, can expect an effect of the format used to convey the COVID-19 infection rate on travel risk perceptions and, thus, travel intentions.

During the pandemic, the rate of COVID-19 infection in specific locations was provided daily and was readily available to potential tourists through internet websites. For example, the CDC issued travel recommendations by providing an updated list of countries where COVID-19 risk was high, moderate, or low (https://www.cdc.gov/coronavirus/2019-ncov/travelers/map-and-travel-notices.html), and websites as the "Our world in data" (https://ourworldindata.org/explorers/coronavirus-data-explorer) and Johns Hopkins Coronavirus Resource Center (https://coronavirus.jhu.edu/map.html) offered information on COVID-19 cases at specific locations. Therefore, the rate of COVID-19 infection in a location is among the information that can potentially influence tourists' travel decisions.

Several studies show that the type of message delivered to tourists

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can influence their behavioral intentions in the post-COVID-19 period. According to Feng, Liu, and Li (2022), for example, messages with emotional appeals can increase visit intention when the country is associated with a warmth stereotype, thus promoting tourism recovery following COVID-19. Likewise, retentive advertising messages that remind visitors of the destination image can significantly increase tourists' booking intentions (Volgger, Taplin, & Aebli, 2021), and a COVID-19 risk-attenuating message frame was found to increase post-COVID-19 travel intentions (Xie, Zhang, Sam, & Huang, 2022). However, no previous study has systematically examined the effect of the numerical format of risk messages on travel intentions in the post-COVID-19 period.

This study examines the effectiveness of the COVID-19 infection rate format in changing respondents' risk perceptions and travel intentions to a COVID-19-affected destination. It further contributes to the literature by addressing the mediating influence of perceived risk in explaining the format effects on travel intentions. It also adds to the existing knowledge by empirically studying the distinct mediating effect of three different risk perception components (affective, analytical, and experiential). Furthermore, this study also examines the moderating role of worry about COVID-19 on the relationship between numerical formats and perceived risk and intentions. Importantly, it examines format effects in the context of a disease (i.e., COVID-19) that is personally relevant to participants.

2. Conceptual background and research hypotheses

2.1. Risk perception components

Risk perception is the subjective evaluation of the riskiness of various activities, substances, phenomena, or technologies (Slovic, 1987). Individual risk perceptions are prevalently informed by feelings and affect (Loewenstein, Hsee, Weber, & Welch, 2001; Slovic, Finucane, Peters, & MacGregor, 2004). The affective component of risk perception is the instinctive, emotional reaction that reflects how positive or negative something makes one feel (Loewenstein et al., 2001; Slovic et al., 2004), which is then used to make fast and intuitive decisions in a reasoning process known as the affect heuristic (Finucane, Alhakami, Slovic, & Johnson, 2000). According to this heuristic, locations associated with positive feelings are considered safe; conversely, those associated with negative feelings are judged risky (Slovic et al., 1991). Notably, when predicting actual behavior, the affective dimension of risk perception is the most predictive among the different dimensions (Ferrer et al., 2018), even when studying vacation intentions (Bae & Chang, 2021).

The second component of risk perception is the analytical evaluation of the risk, also known as deliberate risk perception (Ferrer, Klein, Persoskie, Avishai-Yitshak, & Sheeran, 2016; Slovic et al., 2004). This component is represented by the perceived probability, such as the probability of getting infected. Usually, the analytical dimension is not immediately involved in determining actual individual behavior unless one is very motivated to do so, like when confronted with a new risk or a high-stakes decision (Slovic et al., 2004).

Risk perceptions are also informed by a distinct third dimension: experiential risk perception. Experiential risk perception tackles the experiential feeling of being vulnerable and is strongly linked to sensory and physical cues of being at risk (Ferrer et al., 2016). Deciding to travel to a tourist destination for vacation might be a very experiential task, as thinking about it might elicit mental images and feelings (Bogicevic, Seo, Kandampully, Liu, & Rudd, 2019), making the experiential dimension particularly predictive in the tourism context.

Extensive research has shown, however, that the format used to present risk information influences an individual's risk perceptions (for a review, see Ancker et al., 2022).

2.2. Risk communication format

The COVID-19 risk of infection can be communicated using different formats, such as the number of confirmed cases (e.g., "As of Friday, June 3, 2022, 8:02 p.m., there are 62,515 confirmed cases in Oregon, USA"). However, the number of infections makes sense only if provided relative to a population (e.g., 62,515 confirmed cases out of 4,176 million residents). Different numerical formats can be used to convey this ratio, such as raw numbers (62,515 out of 4,176 million residents), 1-in-X ratios (1 in 67 people), N-in-NX ratios (14,970 people per one million population), and percentages (1.5% of the population). Although different formats deliver the same information, they use numbers of different magnitudes, thus conveying different psychological meanings, which significantly affect risk perceptions and intentions (Ancker et al., 2022; Oudhoff & Timmermans, 2015; Pighin, Savadori, et al., 2011; Sirota, Juanchich, & Bonnefon, 2018).

In a well-known experiment, when asked to choose whether they preferred to draw a winning red bean from a jar that contained 100 beans, of which ten were red, or another that contained ten beans, of which one was red, individuals preferred the jar with more red beans in absolute terms (Kirkpatrick & Epstein, 1992). This irrational behavior has been termed the "ratio bias" (Denes-Raj, Epstein, & Cole, 1995; Kirkpatrick & Epstein, 1992). The ratio bias has been explained as resulting from two forms of reasoning: (1) participants do not combine the ratio components (component reasoning), and (2) the numerator receives more weight than the denominator (denominator neglect) (Denes-Raj et al., 1995; Stone, Parker, & Townsend, 2018). Given that the numerator is larger in "10 in 100" than in "1 in 10," when comparing the two ratios, people sense that the event is more likely in the first instance (Denes-Raj et al., 1995). Even though the typical ratio bias is usually observed in the joint comparison of two ratios, the bias also occurs in evaluations of single ratios (although never with "1" at the numerator). For example, a hazard that kills "1,286 out of 10,000" was judged riskier than one that kills "24.14 out of 100" (Yamagishi, 1997), and a disease that kills 36,500 people every year was perceived riskier than one that kills 100 people every day (Bonner & Newell, 2008). Also, a $120 discount on an item priced at $480 was perceived as more valuable than a discount of 25% (González, Esteva, Roggeveen, & Grewal, 2016). The ratio bias explanation is based on the cognitive-experiential-self theory (CEST) hypothesis, which attributes the bias to an intuitive-experiential thinking style (Kirkpatrick & Epstein, 1992).

Although the ratio bias explanation accounts for many format effects, there is one exception: the 1-in-X effect (Pighin, Savadori, et al., 2011). The effect was first studied in a systematic way by Pighin, Bonnefon, and Savadori (2011). According to this effect, the ratios with "1" at the numerator, the 1-in-X ratios (e.g., 1 in 200), trigger a higher subjective probability than equivalent N-in-NX ratios (e.g., 5 in 1,000) or percentages (Pighin, Savadori, et al., 2011) and influence intentions accordingly (Oudhoff & Timmermans, 2015; Sirota & Juanchich, 2019; Sirota, Juanchich, & Bonnefon, 2018). For example, a 1 in 13 chance to contract malaria during a trip to Kenya persuaded more people to cancel the trip than a 10 in 130 chance (Sirota & Juanchich, 2019). Also, a 1 in 4 chance of winning a lottery was deemed higher than an equivalent 25% and convinced more participants to buy a lottery ticket in a hypothetical decision (Oudhoff & Timmermans, 2015).

Although the 1-in-X effect conflicts with the ratio bias explanation, the effect is robust across different scenarios and populations (Oudhoff & Timmermans, 2015; Pighin et al., 2015; Pighin, Savadori, et al., 2011; Sirota, Juanchich, Kostopoulou, & Hanak, 2014; Sirota & Juanchich, 2019; Sirota, Juanchich, & Bonnefon, 2018) and is not affected by people's numerical ability or age and gender (Pighin et al., 2015; Pighin, Savadori, et al., 2011; Sirota et al., 2014). The 1-in-X effect is limited to those ratios with "1" at the numerator; indeed, it disappears when "1" is substituted with a value greater than 1 (e.g., 2 or 3) (Pighin, Savadori, et al., 2011). A consistent finding of the 1-in-X effect is that it overestimates the risk compared to the objective risk (Sirota, Juanchich, Petrova, et al., 2018). To explain the effect, some have proposed an overestimation of the risk magnitude because the format would convey higher severity (Sirota, Juanchich, Petrova, et al., 2018) or ease of imagination triggered by the "1" (Oudhoff & Timmermans, 2015).

2.3. Research hypotheses

2.3.1. Effect of format on risk perceptions

This study investigated the effect of four formats (raw numbers, percentages, N-in-NX, and 1-in-X) used to convey the infection rate, as shown in Table 1. According to the ratio bias (e.g., Denes-Raj et al., 1995), formats with larger numerators will trigger a higher perceived risk than those with smaller numerators. This would imply that the rate of infection presented using raw numbers should foster a higher perceived risk than that presented using an N-in-NX ratio, which, in turn, should promote a higher perceived risk than that presented using percentages. In a recent taxonomy for classifying the evidence on ways to communicate numbers effectively, it was suggested to treat the affective perception and the perceived magnitude of the number as separate components of the perception process (Ancker et al., 2022). Consistently, we tested the format effects on the three components of risk perception separately. We hypothesized that the format effect would impact especially the affective component because this is believed to be the main element of risk perception judgments (Slovic et al., 2004). We also expected a significant role of the analytical component, given that the manipulated variable (i.e., the numerical format) is expressed through numbers, which tend to be naturally elaborated in quantities (Dehaene, 2011). Moreover, given that tourism is an experiential type of consumption (Le, Scott, & Lohmann, 2019), the experiential component could also be relevant in explaining the format's effects on risk perception. Thus, we propose that:

H1a. The rate of COVID-19 infection presented using raw numbers will foster a higher (affective, analytical, and experiential) perceived risk than that presented using an N-in-NX ratio or percentages. Moreover, the rate presented using an N-in-NX ratio will exhibit greater (affective, analytical, and experiential) perceived risk than that presented using percentages.

According to the 1-in-X effect (Pighin, Savadori, et al., 2011), the infection rate presented using "1" at the numerator should foster a higher perceived risk than that presented using an N-in-NX ratio or percentages. This occurs perhaps because the "1" at the numerator triggers an overestimation of COVID-19 infections or increases the imagination of the "one infected person". Thus we propose that:

H1b. The reported rate of COVID-19 infection presented using a 1-in-X ratio will induce a higher (affective, analytical, and experiential) risk perception than that presented using an N-in-NX ratio or percentages.

2.3.2. Effect of format on travel intentions

According to the ratio bias explanation (e.g., Denes-Raj et al., 1995), the infection rate presented using larger numerators should trigger lower travel intentions than that presented with smaller numerators, given that people avoid high-risk destinations (Sönmez & Graefe, 1998). Following this reasoning, we propose the following hypothesis:

H2a. The rate of COVID-19 infection presented using percentages will increase travel intentions compared to that presented using the N-in-NX ratio and that presented using raw numbers. Moreover, the rate presented using the N-in-NX ratios will trigger higher travel intentions than raw numbers.

Consistent with previous studies showing a 1-in-X effect on intentions (Oudhoff & Timmermans, 2015; Sirota & Juanchich, 2019; Sirota, Juanchich, & Bonnefon, 2018), we also predicted that the 1-in-X format would decrease travel intentions compared to the N-in-NX and the percentages formats because it induces an overestimation of the risk value and increases the ease of imagination of the "single person infected." Thus, we propose that:

H2b. The rate of COVID-19 infection presented using the 1-in-X ratio will decrease travel intentions compared to that presented using the N-in-NX ratio and that presented using percentages.

2.3.3. The mediating effect of risk perceptions

Why might different numerical formats elicit different travel intentions? One possibility is that numerical formats elicit different behavioral intentions because they induce different risk perceptions. Indeed, during the COVID-19 pandemic, news media exposure increased the perceived risk of COVID-19, influencing protective/preventive behaviors (Heydari et al., 2021). Perceived risk in tourism decision-making has been found to guide consumer behavior in times of crisis, such as under the risk of terrorism, natural disasters, and pandemics (George, 2003; Hall, 2002; Sonmez & Graefe, 1998). For example, when consumers evaluated destination alternatives, safety concerns directly influenced international vacation destination choices (Sönmez & Graefe, 1998).

Previous evidence of the mediating role of risk perception in explaining the effect of presentation format on intentions and behavior showed that the perceived probability of contracting malaria mediated the 1-in-X effect on the hypothetical decision to cancel a trip to Kenya (Sirota & Juanchich, 2019). Also, perceived safety and travel fear mediated the relationship between the risk message frame and travel intentions (Xie et al., 2022). Seemingly, risk perceptions mediated the effect of loss- vs. gain-framed messages on vaccination intentions (Gursoy, Ekinci, Can, & Murray, 2022).

To our knowledge, no study has examined the mediating role of COVID-19 risk perceptions in explaining format effects on tourism travel intentions. Importantly, no study has analyzed the distinct mediating role of the components of risk perceptions: affective, analytical, and experiential. In the present research, we hypothesized that the type of format used to present the rate of COVID-19 infection (X) influences travel intentions (Y) with the mediating role of affective, analytical, and experiential risk perceptions (M) (Fig. 1). All three components might

Table 1
Risk communication messages.

Formats	Risk message
Study 1	
Raw numbers	In the region where the site you're considering for vacation is located, 1,170 people out of 4,459,000 currently test positive for coronavirus.
Percentages	In the region where the site you're considering is located, 0.026 percent of persons currently test positive for coronavirus.
N-in-NX	In the region where the site you are considering is located, 26 out of 100,000 people currently test positive for coronavirus.
1-in-X	In the region where the site you are considering is located, 1 in 3,811 people is currently positive for coronavirus testing.
Study 2	
Raw numbers	According to an authoritative website, in the country where the site you are considering is located, 2,367,166 people out of 125,800,000 have tested positive for coronavirus in the past month.
Percentages	According to an authoritative website, in the country where the site you are considering is located, 1.9% of people tested positive for coronavirus in the past month.
N-in-NX	According to an authoritative website, in the country where the site you are considering is located, 1,887 people out of 100,000 have tested positive for coronavirus in the past month.
1-in-X	According to an authoritative website, in the country where the site you are considering is located, 1 in 53 people tested positive for coronavirus in the past month.

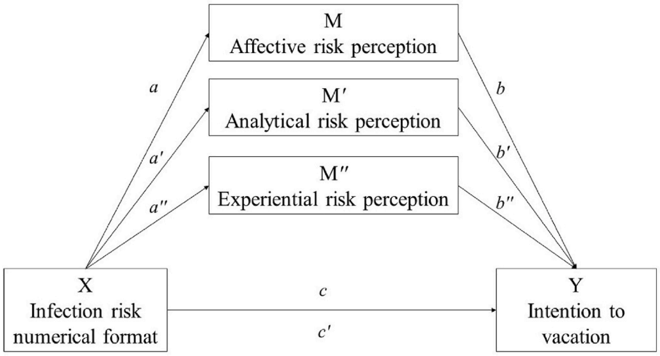

Fig. 1. Conceptual mediation models.

have a mediating role in the case of COVID-19. The affective risk component is known to be the strongest predictor of behavior (Brewer et al., 2007); thus, we expect this component to mediate the relationship significantly. The perceived probability (analytical component) was found to fully mediate the effect of the ratio format on decisions (Sirota & Juanchich, 2019); therefore, we expect a significant role of the analytical component. Moreover, given that experiences shape behavior (Heydari et al., 2021), the experiential component could also be relevant in explaining this relationship. Our hypothesis, therefore, is as follows:

H3. Perceived affective, analytical, and experiential risk mediates the effect of message numerical format in changing traveling intentions.

3. Research design

Two studies are included in this research. Both studies employed an online experimental design in which the effect of the numerical format used to present the COVID-19 infection rate (raw numbers, percentages, N-in-NX, and 1-in-X) was manipulated between subjects and tested on perceived risk (affective, analytical, and experiential) and travel intentions. The University of Trento Research Ethics Committee approved the research protocol (N. 2020–020).

4. Study 1

4.1. Design and stimuli

Italian participants, contacted through a crowdsourcing platform (prolific.co), were administered an online questionnaire programmed on Qualtrics. The questionnaire comprised four main sections (travel intentions, affective risk perception, analytical risk perception, and experiential risk perception) and a personal characteristics section. The order of the main sections was randomized between participants and the items within each section as well. The section on personal characteristics was always last. At the time of the data collection (September 2, 2020), the first COVID-19 wave had just finished, and the second one was slowly starting, with 1,009 new daily COVID-19 infections. A total of 2,07 million Italians had contracted the virus (3,4% of the population), and no one was vaccinated (vaccinations started on December 2020). Major restrictions had been lifted, and Italians could go to vacation sites and hotels. The only restriction was to wear a regular mask (not FFP2) in indoor environments and circumstances where social distance could not be observed.

All participants were instructed as follows: “Imagine you have to choose your summer vacation destination, and you are evaluating a specific location based on its safety with regard to coronavirus.” Then, they received information on the rate of COVID-19 infection according to the experimental condition they were randomly assigned to (see Table 1). The official reported rate of COVID-19 infection for a region (Emilia Romagna, Italy) at the time of the study was used.

4.2. Measures

The intention to travel to a tourist destination was measured using two items as in previous literature (Boulding, Kalra, Staelin, & Zeithaml, 1993; Xie et al., 2022). One item asked for the intention to travel: "Given the number of cases currently testing positive for coronavirus in this region and having the opportunity, how likely would you be to go on a 7-day vacation to this location in summer 2020?". A second item asked for the intention to recommend a vacation, "Given the number of cases currently testing positive for coronavirus in this region, how likely would you recommend to a relative or a friend to take a 7-day vacation to this location in summer 2020?". Answers were provided on a 7-point response scale ranging from 1 (not likely at all) to 7 (extremely likely). The two items were highly correlated ($r = 0.844$; $p < .001$), and a composite average measure was computed (Cronbach’s alpha = .916) with higher values representing a higher intention to spend a vacation in that location ($M = 3.79$; $SD = 1.59$).

A total of 13 items were formulated to measure the three risk perception dimensions: affective, analytical, and experiential (Table 2). Because items were adapted from the medical literature, the three-factor model was subjected to confirmatory factor analysis (CFA) using the maximum likelihood estimation method. Results indicated that the measurement model fitted the data quite well ($\chi^2 = 375$, df = 62, χ^2/df = 6.05, CFI = 0.951, TLI = 0.938, RMSEA = 0.090); however, two fit indices (χ^2/df and RMSEA) were below the model fit standards suggested by Hair, Black, Black, Babin, and Anderson (2010) (χ^2/df < 3, CFI >0.90, TLI >0.90, RMSEA <0.07). Following the modification indices, we deleted two items (Q2 and Q3) and re-specified the model. The new model fits the data better ($\chi^2 = 126$, df = 41, χ^2/df = 3.07, CFI = 0.984, TLI = 0.978, RMSEA = 0.058) with only one of the values of the fit indices (χ^2/df) just below the model adaptability standard (χ^2/df < 3). Table 3 shows the variable’s mean, standard deviation, composite reliability, average variance extracted (AVE), and correlations. All items were significantly linked to their corresponding latent factor ($p < .001$), with factor loadings ranging from 0.550 to 0.945 (Table 1S). The composite reliability estimates of all the constructs ranged from 0.954 to 0.784, indicating good internal consistency and reliability of the items included in each variable. A mean composite score (Table 2S) of each risk perception variable was used in the subsequent analyses.

4.3. Participants

The required sample size for an effect size of 0.17 (an average of the sizes obtained in previous studies), a probability of 0.05, and a power of 0.95 was 596 participants. We collected data from 611 participants to protect us from data losses, which fortunately did not occur. Participants were Italian residents (52% males; mean age of 27.6 years). Most of the participants were employed at the time of the survey, either with a full-time (21.5%) or part-time (17.2%) job. Education was as follows: Ph.D. (3.4%), university degree (47.3%), high school degree (48.1%), middle school (1.2%). Most of the sample had a yearly average income between €20,001 and €30,000 (24%) or between €30,001 and €50,000 (21.7%).

4.4. Data analysis strategy

Differences between conditions on the dependent variables were analyzed through between-subjects Analysis of Variance (ANOVA). When the analysis yielded significant results, Tukey’s post hoc pairwise comparisons were used to test for significant differences between levels of the condition. The jAMM: jamovi Advanced Mediation Models (Version.2.0.0) was used to conduct the simple mediation analysis to explain the relationship between the independent and the dependent variables.

Table 2
Risk perception items and dimensions.

Item	Dimension	Description	Source (*adapted from*)	Wording
Q2[a]	Affective risk perception	Perceived infection rate	Pighin et al. (2015)	How high do you rate the number of currently positive cases in this region? (1 = extremely low; 7 = extremely high)
Q6			(Ferrer et al., 2016; Kaufman et al., 2020; Sheeran, Harris, & Epton, 2014)	Given the number of cases currently testing positive for coronavirus in this region, how concerned would you be about going on a 7-day vacation to this location? (1 = not at all; 7 = extremely)
Q7				Given the number of cases currently testing positive for coronavirus in this region, how afraid would you be to go on a 7-day vacation to this location? (1 = not at all; 7 = extremely)
Q8				Given the number of cases currently testing positive for coronavirus in this region, how nervous would you be about going on a 7-day vacation to this location? (1 = not at all; 7 = extremely)
Q9		General perceived risk	Peters, Hart, and Fraenkel (2011)	Given the number of cases currently testing positive for coronavirus in this region, how risky do you consider this vacation location to be? (1 = not at all risky; 7 = extremely risky)
Q1	Analytical risk perception	Perceived probability	(Kaufman et al., 2020; Pighin, Bonnefon, & Savadori, 2011)	In your opinion, the probability of contracting coronavirus infection by going on vacation to this location for 7 days is: (1 = extremely low; 7 = extremely high)
Q3[a]		Conditional Risk Perception	Ferrer et al. (2016)	Considering the way you take care of your health, in your opinion, the probability of you contracting coronavirus infection by going on vacation to this location for 7 days is: (1 = extremely low; 7 = extremely high)
Q4			Dillard, Ferrer, Ubel, and Fagerlin (2012)	If you did not follow precautions (such as wearing a mask, maintaining social distancing, etc.), in your opinion, the probability of you contracting coronavirus infection by going on vacation to this location for 7 days would be: (1 = extremely low; 7 = extremely high)
Q5			(Ferrer et al., 2016; Kaufman et al., 2020)	Considering your lifestyle, in your opinion, the probability of you contracting coronavirus infection by going on vacation to this location for 7 days is: (1 = extremely low; 7 = extremely high)
Q10	Experiential risk perception		Ferrer et al. (2016)	How easy is it for you to imagine contracting coronavirus infection by vacationing in this location for 7 days? (1 = not at all easy; 7 = extremely easy)
Q11				How confident would you feel that you would not contract coronavirus infection by going to this location for your vacation? [REV] (1 = not at all confident; 7 = extremely confident)
Q12				You would be lying if you said, "There is no chance of me contracting coronavirus infection by going on vacation to that location for 7 days" [REV] (1 = no, I would not lie at all; 7 = yes, I would lie a lot)
Q13				If you heard that someone contracted the coronavirus infection by going to that vacation resort, how much your first reaction would be, "that could be me"? (1 = no, not at all; 7 = yes, definitely)

Notes.
[a] Denote those items eliminated from the final variables after the CFA; [REV] indicates those items that were reverse coded for analysis.

Table 3
Descriptive statistics, reliability estimates, and correlations for the study variables.

	Variables	Mean	S.D.	1	2	3	AVE
1	Affective risk perception	3.57	1.49	(.954)			.84
2	Analytical risk perception	3.66	1.22	.765***	(.813)		.62
3	Experiential risk perception	4.32	1.28	.713***	.696***	(.784)	.49

Notes: n = 604; values along the diagonal in parentheses indicate the composite reliability estimate for the scale.
***p < .001.

5. Results

5.1. Effect of numerical format on risk perceptions

The numerical format used to convey the infection rate significantly changed the perceived risk of traveling to a pandemic-affected touristic destination for vacation (Fig. 2 panels b, c, and d). The risk format significantly influenced affective, $F(3, 607) = 17.4$; $p < .001$, $\eta^2 = 0.079$, analytical, $F(3, 607) = 15.2$; $p < .001$, $\eta^2 = 0.070$, and experiential, $F(3, 607) = 9.32$; $p < .001$, $\eta^2 = 0.044$, risk perceptions. Raw numbers increased affective, analytical, and experiential risk perceptions compared to percentages, thus confirming H1a (Table 4). However, raw numbers increased affective and analytical, but not experiential, risk perceptions compared to the N-in-NX ratio format, thus partially confirming H1a. The N-in-NX ratio format did not exhibit greater (affective, analytical, and experiential) perceived risk than percentages, contrary to H1a. The results are coherent with a ratio bias explanation which assumes that participants' risk perceptions are guided by the number's face value (the magnitude) of the numerator. In the raw-numbers format, the numerator (i.e., 1,170) was greater than in the N-in-NX (i.e., 26) and percentages (i.e., 0.026) formats, and this seemed to increase affective and analytical risk perceptions. The N-in-NX format and percentages were perceived as equally risky because the respective magnitudes (i.e., 26 vs. 0.026) were likely not perceived as very different. Finally, the format effect did not affect experiential risk perception, suggesting that it may be a more robust mental construct immune to message effects.

Confirming H1b, the 1-in-X format increased affective, analytical, and experiential risk perceptions compared to percentages. Partially confirming H1b, the 1-in-X format also increased affective and analytical, but not experiential risk perceptions compared to the N-in-NX format. In line with the 1-in-X effect, the infection rate presented using a 1-in-X format seemed higher than the comparable N-in-NX format. However, this pattern was not observed for the experiential component, which was immune to the 1-in-X effect as it was to the ratio bias.

5.2. Effect of numerical format on travel intentions

The numerical format significantly changed the intention to travel to a pandemic-affected destination for vacation, $F(3,607) = 16.8$; $p < .001$, $\eta^2 = 0.077$ (see Fig. 2, Panel a). As shown in Table 4, in partial confirmation of H2a, percentages increased travel intentions compared to raw numbers but not compared to the N-in-NX format. Also, the N-in-NX format triggered higher travel intentions than raw numbers. These results are coherent with a ratio bias explanation (e.g., Denes-Raj et al., 1995), as the intention to travel was higher when the risk information

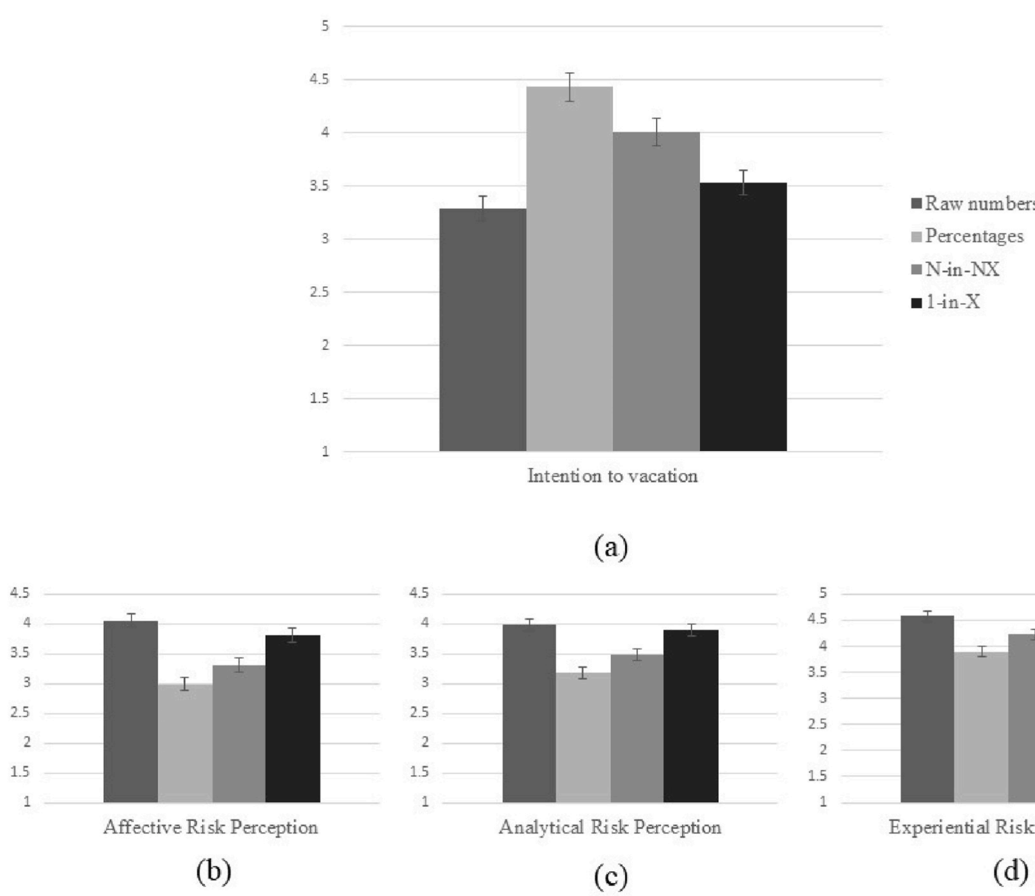

Fig. 2. Intention (a) and affective (b), analytical (c), and experiential (d) risk perceptions of taking a vacation at a pandemic-affected touristic site depending on the type of infection-risk communication format (raw numbers, percentages, N-in-NX and 1-in-X) in Study 1. Error bars represent the Standard Error (SE) of the mean.

Table 4
Descriptive statistics of the variables in the four experimental conditions and Tukey's post hoc comparisons for Study 1.

Variables	Condition	N	Mean	SD	SE	t-value		
						Percentages	N-in-NX	1-in-X
Intention to vacation	Raw numbers	168	3.29	1.56	0.120	−6.54***	−4.12***	−1.37
	Percentages	144	4.43	1.62	0.135		2.29	5.12***
	N-in-NX	141	4.01	1.47	0.124			2.75*
	1-in-X	158	3.53	1.49	0.118			
Affective Risk Perception	Raw numbers	168	4.06	1.51	0.117	6.54***	4.64***	1.58
	Percentages	144	2.99	1.30	0.108		−1.80	−4.93***
	N-in-NX	141	3.30	1.41	0.119			−3.06*
	1-in-X	158	3.81	1.48	0.118			
Analytical Risk Perception	Raw numbers	168	3.98	1.22	0.094	5.97***	3.66**	0.61
	Percentages	144	3.18	1.07	0.089		−2.19	−5.30***
	N-in-NX	141	3.49	1.20	0.101			−3.03*
	1-in-X	158	3.90	1.21	0.096			
Experiential Risk Perception	Raw numbers	168	4.58	1.25	0.097	4.75***	2.42	0.41
	Percentages	144	3.90	1.33	0.111		−2.22	−4.29***
	N-in-NX	141	4.23	1.24	0.105			−1.99
	1-in-X	158	4.52	1.19	0.095			

***p < .001; **p < .01; *p < .05.

was presented using smaller numbers at the numerators, such as in the percentages (i.e., 0.026) and N-in-NX (i.e., 26) formats, than when it was presented using larger numbers at the numerator, such as in the raw-numbers format (i.e., 1,170). Regarding the lack of difference between the N-in-NX format and percentages, we might suppose that 26 people were not perceived as significantly different from zero (i.e., 0, 026), being a relatively low frequency, after all.

In support of H2b, the COVID-19 infection rate presented using the 1-in-X ratio significantly decreased travel intentions compared to that presented using the N-in-NX ratio and percentages. By the 1-in-X effect (Pighin, Savadori, et al., 2011), this format makes the risk value seem higher and reduces the intention to travel to a high-risk destination.

5.3. Mediating effects of risk perceptions

The mediating effects were tested for the four contrasts that showed a significant difference in the previous ANOVA analyses (see Tables 3S–14S). Confirming H3, results showed that affective risk perception fully mediated the effect of numerical format (raw numbers vs. N-in-NX) on travel intentions. Instead, analytical and experiential risk perceptions only partially mediated the effect of numerical format (raw numbers vs. N-in-NX) on potential tourist travel intentions (see Tables 3S–5S). Moreover, the affective, analytical, and experiential risk perceptions only partially mediated the effect of numerical format (raw numbers vs. percentages) on travel intentions (see Tables 6S–8S). Furthermore, risk perception's affective and analytical dimensions completely mediated the relationship between numerical format (1-in-X vs. N-in-NX) and travel intentions. The experiential risk dimension, instead, only showed a partial mediation (see Tables 9S–11S). Finally, risk perception's affective, analytical, and experiential components partially mediated the relationship between the numerical format (1-in-X vs. percentages) and travel intentions (see Tables 12S–14S).

Overall, the findings indicate that the affective component of risk perception explained the format effects in two out of four cases, confirming being the prime candidate for a likely explanation of format effects. The role of the affective component in explaining format effects further supports the ratio bias explanation, which assumes that people focus on the magnitude of the numerator disregarding the denominator because they follow an intuitive-experiential thinking style as opposed to a cognitive one (Pacini & Epstein, 1999). Our data confirm this assumption showing that a smaller ratio (26 out of 100,000) increased travel intentions compared to a larger ratio (1,170 out of 4,459,000) because the former ratio induced less fear and worry (a feeling component).

Our findings also help to explain the 1-in-X effect, as they indicate that it was mediated by both the affective and the analytical components. The 1-in-X ratio influenced intentions by increasing fear and worry but also by increasing the subjective probability of infection. However, neither of the two format effects appeared to be based on the experiential component of risk perception.

6. Study 2

Study 2 aimed at confirming the format effects by generalizing them to a different infection rate, thus using different numbers. For this purpose, the official reported rate of COVID-19 infection in Japan in the month prior to the data collection (October 2022) was used (i.e., 0.019), which was higher than that used in Study 1 (i.e., 0.00026). We, therefore, hypothesized that:

H4. The format effects on behavioral intentions and risk perceptions (affective, analytical, and experiential) found in Study 1 will be replicated also for a higher rate of destination COVID-19 infection.

Study 2 further aimed at testing for boundary conditions. We investigated how worrying about COVID-19 might play a role in enhancing or attenuating the format effects. When the level of worry is high, people may be more sensitive to the numbers or certain numerical formats than when worry is low (Pighin, Bonnefon, & Savadori, 2011). Yet, the opposite might also hold true. Under strong emotional reactions, people ignore important numeric information such as probabilities (Rottenstreich & Hsee, 2001). Therefore, in Study 2, we measured people's level of worry about COVID-19 and examined the moderating effect of subjective worry on the relationship between numerical format and intentions. We hypothesized that:

H5. Subjective worry moderates the effect of numerical formats on risk perceptions and travel intentions.

6.1. Design and stimuli

Study 2 was conducted using the same procedure as in Study 1. The data was collected on October 2022 when the COVID-19 pandemic was in its third year, and many citizens had contracted the disease (38%). Most of the citizens were vaccinated (84%), and there were no restrictions. As in Study 1, participants were randomly assigned to one of four conditions that varied the numerical format: raw numbers, percentages, N-in-NX, and 1-in-X. The same introductory message was used except that the words "summer vacations" were substituted with "the next vacation". Participants received information on the officially reported rate of COVID-19 infection in Japan in the month prior to the data collection (retrieved from the Johns Hopkins Coronavirus Resource

Center online) according to the experimental condition they were randomly assigned to (see Table 1). As in Study 1, no reference to the real country or region was provided to participants.

6.2. Measures

The same measures were used as in Study 1, except that the words "summer vacations" were replaced with "the next vacation" to adapt items to the time of data collection. The two items measuring travel intentions were highly correlated ($r = 0.787$; $p < .001$), and a composite average measure was computed (Cronbach's alpha = .880). The same items as in Study 1 were used to create the affective (Cronbach's alpha = .955), analytical (Cronbach's alpha = .855), and experiential (Cronbach's alpha = .955) risk perceptions scales (descriptive statistics in Table 15S).

6.3. Participants

Participants were 608 Italian residents (59.6% male; mean age of 30 years) who did not participate in Study 1. Most participants were employed full-time (33.9%) or part-time (16.9%). Education was as follows: Ph.D. (4.1%), university degree (54.3%), high school degree (40.6%), middle school (1.0%). Most of the sample had a yearly average income between €20,001 and €30,000 (24.8%) or between €30,001 and €50,000 (24.3%).

6.4. Data analysis strategy

The same data analysis strategy was used as in Study 1, except that an ANCOVA analysis was performed to test for the moderation effect.

7. Results

7.1. Effect of format on risk perceptions

Confirming H4, the numerical format had the predicted effect on affective $F(3, 602) = 14.2$; $p < .001$, $\eta^2 = 0.066$, analytical $F(3, 602) = 16.1$; $p < .001$, $\eta^2 = 0.074$, and experiential $F(3, 602) = 3.78$; $p = .010$, $\eta^2 = 0.018$ risk perceptions (see Fig. 3 panels b, c, and d). Similarly to Study 1 and coherently with a ratio bias explanation, raw numbers (i.e., 2,367,166 people out of 125,800,000) increased affective, analytical, and experiential risk perceptions compared to percentages (i.e., 1.9%), possibly because they convey the risk using larger numbers (see Table 5). Contrary to Study 1, only analytical risk perception was higher in the raw numbers than in the N-in-NX format (i.e., 1,881 out of 100,000 people). The higher number of people (2,367,166) in the raw format numerator increased the subjective probability of getting infected compared to the smaller number of people (1,881) in the N-in-NX format, an instance of the ratio bias. The N-in-NX format also increased affective, analytical, and experiential risk perceptions compared to percentages, in line with a ratios bias explanation.

In further support of the 1-in-X effect, the feelings of fear and worry about traveling were enhanced when the destination infection rate was communicated using the 1-in-X format (1 in 53) compared to percentages (1.9%) and, limited to the analytical component, also compared to the N-in-NX format (1,881 out of 100,000 people).

Finally, the experiential component of risk perception was the least sensitive of the three components as it was influenced only by the raw numbers vs. percentages format effect, in the same direction as the other two risk perception components. A general higher experienced familiarity with the disease during this second data collection, as evidenced

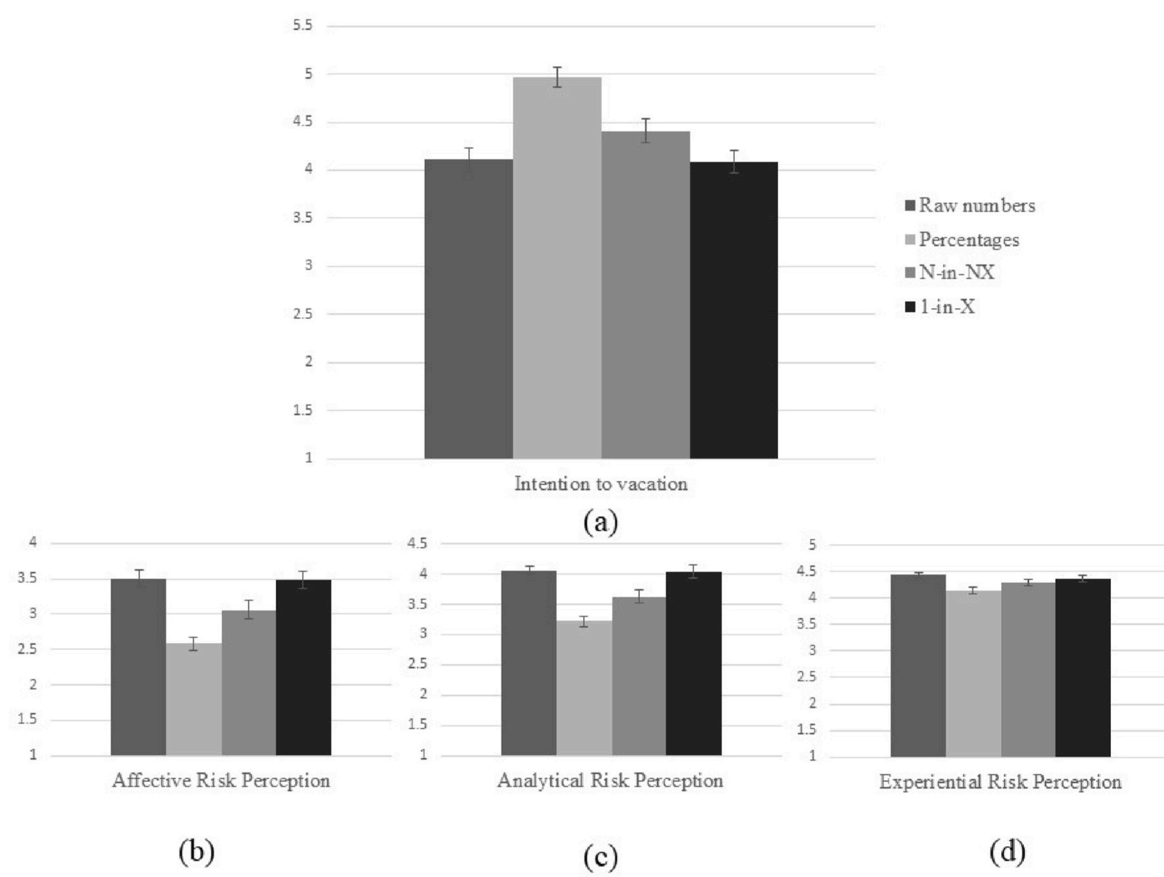

Fig. 3. Intention (a) and affective (b), analytical (c) and experiential (d) risk perceptions of taking a vacation at a pandemic-affected touristic site depending on the type of infection-risk communication format (raw numbers, percentages, N-in-NX and 1-in-X) in Study 2. Error bars represent the Standard Error (SE) of the mean.

Table 5
Descriptive statistics of the dependent variables in the four experimental conditions and Tukey's post hoc comparisons for Study 2.

Variables	Condition	N	Mean	SD	SE	t-value		
						Percentages	**N-in-NX**	**1-in-X**
Intention to vacation	Raw numbers	142	4.11	1.53	0.129	−5.21***	−1.74	0.079
	Percentages	170	4.97	1.36	0.104		3.39**	5.39***
	N-in-NX	142	4.41	1.52	0.127			1.85
	1-in-X	152	4.09	1.46	0.119			
Affective Risk Perception	Raw numbers	142	3.50	1.50	0.126	5.53***	2.55	0.06
	Percentages	170	2.58	1.28	0.098		−2.878*	−5.58***
	N-in-NX	142	3.06	1.51	0.127			−2.53
	1-in-X	152	3.49	1.52	0.124			
Analytical Risk Perception	Raw numbers	142	4.06	1.24	0.104	5.92***	2.93*	0.16
	Percentages	170	3.22	1.22	0.093		−2.86*	−5.86***
	N-in-NX	142	3.63	1.25	0.105			−2.81*
	1-in-X	152	4.04	1.30	0.105			
Experiential Risk Perception	Raw numbers	142	4.43	0.73	0.061	3.188**	1.44	0.78
	Percentages	170	4.14	0.91	0.070		−1.69	−2.44
	N-in-NX	142	4.30	0.78	0.066			−0.69
	1-in-X	152	4.36	0.78	0.063			

***p < .001; **p < .01; *p < .05.

by the higher number of infected cases among the reference population, might have induced fewer people to be "experientially" influenced by the format in deciding to travel.

The ANCOVA models with worry as a covariate (H5) showed that affective risk perceptions were significantly higher in those potential tourists who were more worried about the disease, $F(1,598) = 261.12$; $p < .001$, $\eta^2 = 0.302$, however, worry did not interact with the type of numerical format, $F(3,598) = 1.83$; $p = .141$, $\eta^2 = 0.006$, showing no moderating role. Seemingly, analytical risk perceptions significantly increased with an increase in worry for the disease, $F(1,598) = 124.47$; $p < .001$, $\eta^2 = 0.170$, but the interaction term with the type of numerical format was not significant, $F(3,598) = 0.11$; $p = .953$, $\eta^2 = 0.000$. Finally, worry significantly increased experiential risk perceptions, $F(1,598) = 118.77$; $p < .001$, $\eta^2 = 0.164$, but as for the previous components, it did not moderate the relationship between the type of numerical format and experiential risk perception, $F(3,598) = 1.20$; $p = .310$, $\eta^2 = 0.005$.

7.2. Effect of numerical format on travel intentions

The numerical format had a significant effect on travel intentions, $F(3,602) = 12.8$; $p < .001$, $\eta^2 = 0.060$ (see Fig. 3, Panel a). As shown in Table 5, confirming H4, the lowest travel intention was observed when the destination infection rate was conveyed using raw numbers (2,367,166 people out of 125,800,000), but the difference was statistically significant only for percentages (1.9%), whereas it was not for the N-in-NX format (1,881 out of 100,000 people). Contrary to H4, the ratio bias effect was attenuated in the raw numbers vs. N-in-NX comparison because values at the numerators were quite high in both conditions. Confirming H4, the difference between N-in-NX and percentages was statistically significant, showing that more people intended to travel if the destination infection rate was communicated with ratios with small numerators (percentages) rather than larger ones (N-in-NX). Partially confirming the 1-in-X effect and previous literature (Oudhoff & Timmermans, 2015), findings show that when presented through a 1-in-X format, destination infection rates induce fewer people to travel than when presented through percentages, presumably because the 1-in-X format produces an overestimation of the magnitude of the risk (Sirota, Juanchich, & Bonnefon, 2018) or ease of imagination of the "one person" (Oudhoff & Timmermans, 2015).

To test H5, participants' worry was added to the model as a covariate (ANCOVA). Results showed that the intention to travel was significantly lower in those potential tourists who were more worried about the disease, $F(1,598) = 101.18$; $p < .001$, $\eta^2 = 0.143$. However, worry did not interact with the type of numerical format, $F(3,598) = 1.12$; $p = .342$, $\eta^2 = 0.005$. Therefore, findings disconfirmed H5 and the moderating role of worry.

8. Discussion and conclusions

People deciding whether to travel for vacation might consider looking for information about the risks they could encounter at the tourist location, such as infectious disease or crime rates. This information has to be communicated using numbers. Although our mind has adapted to perceive numbers as natural quantities (Dehaene, 2011), the meaning of such a value can become obscure when numbers are in the form of ratios, such as in the case of an infection rate. In our study, the rate of COVID-19 infection was presented using different formats, which induced different risk perceptions and travel intentions. In line with a ratio bias explanation (Denes-Raj et al., 1995), when the infection rate was presented using ratios with smaller numbers at the numerator, such as percentages or an N-in-NX format (Study 1), potential tourist's worry was reduced, and their intention to travel increased. Conversely, when the same risk information was presented using ratios with larger numbers at the numerator, such as in the case of raw numbers, people's fear of getting infected increased, and consequently, their travel intentions decreased. The affective component of perceived risk fully mediated the format effect on travel intentions.

In line with the 1-in-X effect, which induces people to believe that a 1-in-X value represents a higher risk (Oudhoff & Timmermans, 2015; Pighin, Savadori, et al., 2011; Sirota, Juanchich, & Bonnefon, 2018), in the present research, we found that when the infection rate was presented in the 1-in-X format, perceived fear and subjective probability increased, and travel intentions decreased compared to other formats, such as percentages or N-in-NX ratios. Intuitive-hot (affective) and systematic-cold (analytical) risk-perception reasoning equally mediated the format effect on intentions. Overall, these results imply that different format effects rely on distinct mechanisms involving affective and cognitive elaborations of risk information.

8.1. Practical implications

Presenting the same information about risk in different ways alters people's perspectives and actions accordingly. This has important implications for managerial marketing strategy. Suppose the goal is to restore the tourism attractiveness of the location in the post-pandemic period. In that case, our results recommend reporting the infection rate using small numbers at the numerator (percentages and N-in-NX formats) but avoiding using 1-in-X formats or raw numbers, which feature large numbers at the numerator.

Our results have important implications for public health policy managers as well. During a pandemic outbreak, it might be important to limit the circulation of people in areas affected by a virus. As our study shows, potential tourists' risk awareness in a particular tourist area affected by a virus can be increased by communicating infection rates using ratios with larger numerators rather than those with smaller ones or by using ratios with the number "1" at the numerator. These two formats, indeed, were found to increase participants' awareness of risk, albeit with the counter effect of reducing the location's attractiveness.

Confirming the results of Bae and Chang (2021), our study suggests that tourists' intention to visit a destination is mediated primarily by the affective dimension of risk perception. The communication strategy of health policy managers that aims to reduce tourist inflow to infected areas should underline the affective component of possible infections. On the contrary, post-pandemic marketing activities of destination managers should be directed toward reducing the perception of fear and worry related to possible infections.

Overall, it must be said that the numerical format used to convey health information is a matter of choice. Tourism managers and policymakers should hold themselves accountable for the communication strategies they adopt, being informed by results like those offered by the present research.

8.2. Limitations and directions for future research

We explored four information formats: raw numbers, percentages, N-in-NX fractions, and 1-in-X fractions. Both practical and theoretical considerations guided our choice. These formats are a standard way of communicating numerical information, and they were examined in previous studies. However, other reporting methods for viral infection exist that use other formats, such as probabilities (e.g., 0.1) or odds (e.g., 1 to 9 odds). Future studies could investigate the effect of these alternative formats on perceived risk and travel intentions.

An additional aspect needs to be considered primarily from a health policy perspective. A related and important question is whether different formats improve the comprehension of rational number concepts, such as fractions. Several studies have highlighted that people make consistent and systematic errors when processing rational numbers (Hurst & Cordes, 2016). Therefore, further studies should also aim to understand the most effective format to improve people's understanding of risk information and promote informed tourism decision-making.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhtm.2022.12.004.

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