

Article

Development of a Scale for Measuring Cognitive Biases Related to Risk-Taking Among Firefighters: The Five Cognitive Bias Risk Scale (5 CBR-S)

Sébastien Lhardy *, Emma Guillet-Descas  and Guillaume Martinent

Laboratory of Vulnerabilities, and Innovation in Sport (EA 7428), University of Claude Bernard Lyon 1, 27–29 Boulevard du 11 Novembre, 69622 Villeurbanne, France; emma.guillet@univ-lyon1.fr (E.G.-D.); guillaume.martinent@univ-lyon1.fr (G.M.)

* Correspondence: sebastien.lhardy@gmail.com

Abstract: This study aimed to develop the Five Cognitive Biases in Risk-Taking Scale (5 CBR-S) to measure five cognitive biases associated with risk-taking: overconfidence, illusion of control, belief in the law of small numbers, escalation of commitment, and optimism. Firefighters completed a series of five questionnaires: cognitive biases related to risk-taking, emotional intelligence, self-regulation behaviors, personality traits, and mental toughness. Data were collected from two distinct samples, each consisting of 202 firefighters. A series of exploratory and confirmatory factor analyses conducted on an initial version of the 5 CBR-S with 50 items provided structural evidence supporting a 5-factor, 19-item solution. Evidence of validity and reliability for the 5 CBR-S scores was provided by examining correlations with emotional intelligence, personality traits, and mental toughness. Overall, despite certain limitations, the 5 CBR-S constitutes a robust measure, offering the advantage of highlighting the five main cognitive biases related to risk-taking. It can be used both among firefighters and in other professional contexts involving high-intensity emergency decision-making.

Keywords: overconfidence bias; illusion of control; escalation of commitment; optimism; personality; emotional intelligence; mental toughness



Academic Editor: Grant Williamson

Received: 20 February 2025

Revised: 1 April 2025

Accepted: 3 April 2025

Published: 4 April 2025

Citation: Lhardy, S.; Guillet-Descas, E.; Martinent, G. Development of a Scale for Measuring Cognitive Biases Related to Risk-Taking Among Firefighters: The Five Cognitive Bias Risk Scale (5 CBR-S). *Fire* **2025**, *8*, 147. <https://doi.org/10.3390/fire8040147>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

1.1. The Context of the Research

The firefighting profession involves an impressive variety of actions and situations to face daily. Interventions are numerous and vary in complexity, ranging from a simple, routine response to an unusual event with a higher degree of complexity [1]. In 2021, France recorded 4,055,900 emergency rescue interventions for individuals and 254,200 fire-related interventions [2]. These interventions can expose firefighters to significant physical, mental, and emotional strain, which can lead to stress and cause psychological trauma [3]. Thus, firefighters operate in an environment where taking risks is part of the job [4,5]. Cadet [6] and Cadet and Kouabenan [7] identify five characteristics of risk-taking in dynamic contexts: the multiplicity of variables, the integration of diverse information, the presence of uncertainty, objectives and constraints that sometimes make the risk acceptable, and the evaluation of short- or medium-term effects. These aspects, therefore, include individual factors, such as personality [8] or information perception and processing [9], combined with external factors, such as social and environmental influences. In this study, we will focus on risk-taking as a parameter resulting from subjective evaluations [10]. As highlighted

by Kouabenan [11], risk perception is subject to individuals' ongoing interpretation. The anchoring and persistence of certain beliefs lead to systematic judgment errors and generate new contradictory information [12]. Although firefighters may seek new experiences, they appear reluctant to take disproportionate risks [13]. However, in emergency situations, they are required to make quick decisions that can have serious consequences [14]. In this profession, risk-taking is a possibility, often tied to the willingness to help others. In this context, the risk taken in the name of public safety can be seen as heroic and justify greater recognition from society. Consequently, some people are willing to accept a certain level of risk [15]. As we have seen, if a link can be made between risk perception and risk propensity, that is, the tendency of individuals or groups to accept uncertainties or dangers to achieve a goal [16], it seems logical to examine the cognitive biases that could potentially lead to inappropriate and/or unexpected responses [17]. Indeed, two systems of thought in humans have been proposed in the literature [18]. The first system is intuitive, automatic, and unconscious and refers to heuristic reasoning (linked to cognitive biases). In contrast, the second system is analytical, conscious, and rational, and includes both logical and statistical reasoning [19]. In this article, we will focus more specifically on the first system, based on cognitive biases. A cognitive bias can be defined as a distortion or systematic deviation from a norm to which information is subjected when it enters the cognitive system or exits after the selection of information [20]. They are perceived as a simplified cognitive strategy, allowing individuals to save time and energy and make acceptable inferences [21], but this can lead to flaws in reasoning. Becoming aware of them is undoubtedly a first step toward better management. This article will specifically focus on five cognitive biases related to risk-taking.

1.2. Five Cognitive Biases Related to Risk-Taking

It is not easy to draw up an exhaustive list of all cognitive biases. Research and studies on the subject, despite commonalities, list somewhat different and varied biases depending on the authors. Hence, it is possible to identify between five and thirty-two biases. Based on the literature, five cognitive biases are particularly related to the notion of risk-taking: overconfidence bias (OC), illusion of control bias (IC), belief in the law of small numbers bias (BL), escalation of commitment bias (EC), and optimism bias (OP) [22,23]. OC seems to be one of the most studied cognitive biases. It refers to the tendency to underestimate our lack of knowledge or to think that we know more than we know. Estimates are distorted and may lead to the conclusion that the decision taken is not risky by treating their assumptions as facts. Unsurprisingly, several scholars have suggested that the OC reduces the perception of risk [22]. IC occurs when an individual overestimates their skills in situations where chance plays a major role and where skills are not necessarily the decisive factor. Such individuals believe that they can control and accurately predict the outcome of uncertain events. This leads them to underestimate the risk associated with an event and to think that their skills can overcome negative events. While overconfidence refers to an overestimation of one's resources concerning the current facts (present information), IC refers to an overestimation of one's skills to cope with and predict future events [24]. The BL is linked to the fact that an individual uses a limited quantity of information to draw definitive conclusions and, so, to an underestimation of the risk [24]. The literature suggests that the BL may affect the perception of risk during the decision-making process behind starting an action [25]. OP is the tendency to believe that one is less exposed to a negative event than other people and that things will turn out well. Three forms of this bias have been identified in the literature: positive self-evaluation, optimism about future plans and events, and optimism due to the illusion of control [26]. These positive statements partly reflect a need for self-justification to minimize uncertainty, which would thus reduce the

perceived level of risk [27]. Finally, EC is the tendency to continue an action despite a failed initial plan. The feeling of personal responsibility and the principle of self-justification towards the project encourage decision-makers to stay with the project they have chosen even though it does not pay rather than hypothesize a flaw in the initial strategy [28].

These five biases have never been studied together, although links between them have been identified. Only a few studies in the context of firefighters have examined cognitive biases and their impacts on decision-making. To our knowledge, the biases of invulnerability illusion (closely related to overconfidence bias) and optimism have been studied [29]. It, therefore, seems necessary to better understand their effects in emergency situations [30–32]. Catherwood [33] emphasizes that cognitive biases, as active factors in firefighters' decision-making, should be studied in order to minimize risks in the field.

1.3. The Present Study

This article describes the creation of a new scale for measuring five cognitive biases related to risk-taking. Two reasons led us to want to develop this measurement scale. Firstly, an increasing amount of research intersects the concepts of cognitive biases and risk-taking [34–36], but to our knowledge, none have developed a measurement scale for the five aforementioned cognitive biases related to risk-taking. Secondly, the concept of risk-taking is predominant in the literature and can lead to injuries [37]. It, therefore, seems interesting to study this concept through the lens of cognitive biases in the field of firefighting as this profession operates in an environment conducive to emergency decision-making. As such, it seems relevant to create a scale to assess the five dimensions of cognitive biases that are most related to risk-taking and apply it in the firefighting context. It is noteworthy that this scale could be used in any profession involving decision-making in dynamic situations that also involve risk-taking (e.g., corporate maintenance services or working at heights). In this article, we provided evidence for the validity of scores gathered using the Five Cognitive Biases related to Risk-taking Scale (5 CBR-S), divided into three stages: substantial, structural, and external. The first stage validates the theoretical foundations, providing the framework for the construct studied. The second stage provides evidence of factorial validity and reliability of the 5 CBR-S scores. Finally, the last stage examines whether the 5 CBR-S scores are related to other constructs according to theoretical expectations. As decision-making is influenced by psychological, cognitive, and emotional factors [38,39], emotional intelligence, personality traits, mental toughness, and risk behaviors [40–43] were selected to examine the external validity of 5 CBR-S scores.

The literature suggests that personality traits influence the likelihood of exhibiting cognitive biases during the decision-making process [42,44] and appear to be a significant predictor of risk behavior [45]. For instance, neuroticism is linked to a lack of confidence in decisions due to emotional instability and nervousness [46]. Neuroticism is negatively related to OC [43]. Extraversion, characterized by enthusiasm, optimism, sociability, talkativeness, and assertiveness [46], would lead to optimism regarding the expected performance of losing investment choices, which would be significantly related to OC [47]. Openness to experience refers to active imagination, intellectual curiosity, and aesthetic sensitivity [46]. According to Lin [48], this trait is linked to trust in others and, in certain situations, to OC. Agreeableness refers to modesty, altruism, cooperation, sympathy, and warmth [46], as does the trait of conscientiousness, which is characterized by being organized, punctual, and goal-oriented, relying solely on their own knowledge and beliefs [46]. These two traits would be positively related to OC [44].

When discussing risk-taking, we can also refer to the need for self-regulation derived from self-regulation theory [49]. Self-regulation is based on attentional processes, where self-focus could reveal a discrepancy between the ideal self and the failing self, highlighting

an affected self-esteem [50]. Consequently, to preserve self-esteem, two strategies can be implemented, allowing for sensation-seeking [51]: (a) Escape, which corresponds to a diversion of self-awareness [52] to avoid thinking about one's problems. Individuals exhibiting escape behavior tend to be anxious, depressed, and pessimistic, seeking sensations through disinhibitory activities (e.g., alcohol, drugs, and parties) [50]. (b) Compensation, which involves focusing attention on another source of self-enhancement [51]. Individuals exhibiting compensatory behavior tend to be more psychologically balanced. They seek stimulation and socially recognized validation through high-adrenaline sports, aiming to gain control over their bodies in demanding environments and ultimately compensate for personal or professional failures [50]. So, the pursuit of intense sensations could serve both as a means of escape and emotional regulation [50]. This self-regulation theory has not been studied in the firefighting world, where the constraints and difficulties encountered could also lead to escape or compensation behaviors, thereby increasing risk-taking. Accepting risk is the first step toward the voluntary action of taking a risk [53]. To our knowledge, no study has yet linked these two risk behaviors with cognitive biases.

In the operational framework of emergency services, it is also interesting to explore the roles that emotional intelligence (EI) and mental toughness can play in the adaptation process in difficult situations. Indeed, EI appears to play a central role in maintaining an optimal capacity for resilience when facing daily challenges and the resulting stressors. It is defined as the ability to accurately perceive, value, and express emotions, to access and/or generate feelings that facilitate thought, to understand emotions, and to regulate emotions in a way that promotes emotional and intellectual growth [54]. According to Armstrong, Galligan and Critchley [55], EI constitutes a prerequisite for resilience rather than simply being a component of it. An individual with high EI is, therefore, more resilient under pressure and better able to manage the demands and constraints of their environment. This idea is supported by Schneider, Lyons and Khazon [56], who show that EI supports resilience in the face of experienced stress. Similarly, Trigueros, Padilla, Aguilar et al. [57] highlight the link between EI, resilience, and adaptation to daily challenges. The literature shows the following correlations between emotional intelligence and behavioral biases (such as heuristic bias, mimicry bias, overconfidence bias, and loss aversion), which significantly and positively influence stock-trading decisions among millennial investors. In other words, millennial investors with higher levels of emotional intelligence and greater awareness of behavioral biases tend to make better decisions in stock-trading [58]. However, EI also appears to be a key resource for better responding to the demanding situations faced by emergency professionals [59,60] and improving their performance [61]. Mental toughness, on the other hand, is considered a set of values, attitudes, emotions, cognitions, and behaviors developed through experience, influencing how an individual approaches challenges, whether they are perceived positively or negatively, in order to consistently achieve their goals [62]. In the world of sports, it is strongly and negatively correlated with cognitive distortions related to social comparison and dramatization [63].

The main objective of this article is to propose and validate a new measurement scale aimed at identifying the five cognitive biases most closely linked to risk-taking. To date, no specific scale has been developed to assess these biases, making this new scale particularly relevant. It could provide a concrete, operational, and usable tool in high-stakes contexts, such as firefighting. In the context of this study, we will therefore use four questionnaires covering the different aspects discussed earlier: personality, the two self-regulation behaviors (escape and compensation), emotional intelligence, and mental toughness. The questionnaires used in this study will allow us to examine the convergent validity of the scores obtained with the measurement scale in order to verify its relevance and effectiveness in identifying cognitive biases related to risk-taking.

2. Methods

2.1. Participants

The inclusion criteria for participants were to be of legal age and to be a firefighter from the SDIS (Departmental Fire and Rescue Service) of Ain. The first calibration sample consisted of 202 firefighters (69.64% male, 30.36% female, mean age: 36.09 years (18–63); SD = 9.85; seniority in their work: 1% of firefighters had between 5 and 10 years, 20% between 10 and 20 years and, 79% with 20 years or more) and was used to carry out the exploratory factor analyses. The second sample was also made up of 202 firefighters (89.53% men and 10.47% women, mean age: 45.16 years (19–62); SD = 8.07; seniority in their work: 1% of firefighters with less than 1 year of service, 11% had between 1 and 5 years, 23% between 5 and 10 years, 46% between 10 and 20 years and 19% with 20 years or more) who were not part of the calibration sample. This sample was selected to further explore the factor structure of 5 CBR-S scores using confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM). According to MacCallum, Widaman, Zhang and Hong [64], there is no guideline indicating the sample size needed to achieve small standard errors of saturation. However, solutions obtained from larger samples tend to show better stability and more accurately represent the population saturations. Henceforth, Guadagnoli and Velicer [65] recommend a sample size of 200 subjects as the minimum for saturations greater than 0.40.

2.2. Procedure

This study was carried out in accordance with international ethical guidelines and data protection conditions. Ethical approval for this study was obtained from the CNU Research Ethics Committee University STAPS of Lyon (approval ID: No. IRB00012476-28-08-337). The firefighters invited to participate in this study were given details of the participation requirements and assured of their right to opt-out at any moment. They also had access to the consent form describing the purpose of this study and its implementation. Written instructions regarding the content of the questionnaires were also provided. The instructions emphasized the confidentiality of individual responses and the need for honesty. The participants were assured that the results would be used for this study only and that their privacy would be guaranteed.

2.3. Measures

2.3.1. Development of the Preliminary Version of the 5 CBR-S

In view of the recommendations of Dunn, Bouffard and Rogers [66], a panel of experts, including four researchers' experts on cognitive processes experienced in constrained and stressful situations and/or questionnaire development, was invited to examine the preliminary version of the questionnaire. A departmental fire and rescue service referent manager was also asked to read the questionnaire to validate the understanding and consistency of each item vis-à-vis the firefighting environment. In the absence of pre-existing questionnaires, we developed each item based on an in-depth analysis of the literature and on validated definitions of each cognitive bias related to risk-taking [22,24–27]. A range of 50 items was first created, representing the five dimensions of risk-taking-related cognitive biases (i.e., OC, IC, OP, EC, and BL). A five-point Likert scale was used, ranging from (1), which does not correspond at all, to (5), which completely corresponds.

2.3.2. Questionnaires Used for the Convergent Validity of the 5 CBR-S Scores

Four questionnaires are used to provide the convergent validity of the 5 CBR-S. In this section, we highlight Cronbach's alpha (α) of each dimension. The French version of the Profile of Emotional Competence (PEC; [67]) was used to measure emotional intelligence

(EI) with 50 items, including the identification of one's own emotions ($\alpha = 0.66$), the identification of the emotions of others ($\alpha = 0.73$), the understanding of own emotions ($\alpha = 0.52$), understanding of others' emotions ($\alpha = 0.66$), expression of own emotions ($\alpha = 0.65$), listening to others' emotions ($\alpha = 0.77$), regulation of own emotions ($\alpha = 0.68$), regulation of others' emotions ($\alpha = 0.68$), use of own emotions ($\alpha = 0.63$), and use of others' emotions ($\alpha = 0.69$). Cronbach's alpha of the understanding of one's own emotions dimension is far from the standards. However, Cronbach's alpha tends to increase with an increase in the number of items [68], which has led several researchers to suggest a cut-off value of 0.60 for the 5-item subscales [69]. Other researchers preferred to further assess internal reliability using item analysis [68]. In particular, the following criteria were retained to test each item: (a) a minimum item–total correlation coefficient of $r = 0.40$ and (b) an average inter-item correlation between $r = 0.15$ and $r = 0.50$ [70]. One item–total correlation is slightly below 0.40 ($r = 0.32$). The item analysis provided evidence of the reliability of the PEC scores, as all inter-item correlation coefficients were within the norm. The French version of the Risk and Activation Inventory with 12 items (RAI; [50]) was used to assess the tendency to use two strategies related to risk: (a) escape ($\alpha = 0.68$), that is to say, the diversion of self-awareness so as to no longer think about one's problems, and (b) compensation ($\alpha = 0.74$), which consists of focusing attention on a different source of self-esteem. Individuals exhibiting compensation behavior may seek stimulation and socially recognized validation through high-adrenaline activities, with the aim of compensating for personal or professional failures [50]. The French translation of the Mental Toughness Index (MTI; [71]) measures was used to assess mental toughness and consists of 8 items covering the resources a person possesses to deal with stressors and adversities ($\alpha = 0.82$). The French version of the Big Five Inventory (BFI-fr; [72]), 45 items, was used to assess the five dimensions of personality according to the big five theoretical frameworks: agreeableness ($\alpha = 0.74$), extraversion ($\alpha = 0.80$), openness to experience ($\alpha = 0.73$), conscientiousness ($\alpha = 0.79$) and neuroticism ($\alpha = 0.80$).

2.4. Data Analyses

The construct validity and reliability of the 5 CBR-S scores were examined on two independent samples of firefighters. First, a series of EFA using Varimax rotation was carried out to discover the number of latent factors underlying the 50 initial items. The decision to eliminate an item was based on a factor loading of less than 0.40 and/or the presence of items loaded on more than one factor. The remaining data were then compared with a follow-up exploratory factor analysis. We removed 31 items that did not meet one of the two selection criteria (including seven items loading on two dimensions simultaneously), resulting in a version of 19 items. The final version from the EFA was further examined on an independent sample through CFA and ESEM using Mplus version 7.31 [73]. Several statistical indices were used to assess fit to the data: the Chi-square Statistic, the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) and its 90% confidence interval, the Standardized Root Mean Square Residual (SRMR) and Information Criteria (Akaike's Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the Bayesian Sample Size Adjusted Information Criterion (ABIC). CFI values greater than 0.90 are considered acceptable, while values greater than 0.95 are considered an excellent fit. RMSEA and SRMR values below 0.08 indicate an acceptable fit to the data, and values close to 0.05 indicate an excellent fit to the data. AIC, BIC and ABIC were used to compare the models. The reliability of the 5 CBR-S scores was then assessed using Cronbach's alpha coefficients, where values close to 0.60 or higher indicate acceptable reliability. To further assess the internal reliability of the 5 CBR-S scores, an item analysis was conducted. The following criteria were adopted to test each item: (a) a minimum

item-total correlation coefficient of $r = 0.40$ and (b) an inter-item correlation between $r = 0.15$ and $r = 0.60$ [70]. Lastly, we studied the correlations between the 5 CBR-S scores and the five other questionnaires (PEC, RAI, MTI, BFI). The correlations were interpreted using Cohen's criteria (small effect size: $r \leq 0.30$; moderate effect size: $0.30 < r < 0.50$; large effect size: $r \geq 0.50$).

3. Results

3.1. Exploratory Factor Analyses

The scree criteria and the number of eigenvalues greater than 1.0 provided strong evidence for a five-factor solution. Nevertheless, out of 50 starting items, several items did not reach a loading coefficient of 0.40 on any factor, while other items loaded on several factors simultaneously. We, therefore, re-estimated the 5 CBR-S model by systematic and sequential deletion of items, resulting in a final solution of 19 items on five factors. The first factor contained four items related to IC bias. The second factor consisted of four items highlighting OP. The third factor had four items relating to EC. The fourth factor included three items related to BL. The fifth and last factor had four items and was related to OC (see Table 1 for the wording of items). The targeted factor loadings of the final EFA model with 19 items and five factors on the calibration sample ranged from 0.48 to 0.80 (except an OC item of 0.32), whereas all the non-targeted factor loadings were equal to or lower than 0.30 (Table 1).

Table 1. A Factor Loadings, Eigenvalues, Percentage of variance, and internal Consistency of the Items of 5CBR-S on the Calibration Sample.

Items	19-Item EFA				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Over confidence Bias					
I1: I am sure of what I believe and what I can do	−0.06	0.16	−0.16	−0.12	0.71
I2: Others think of me as someone who has a lot of self-confidence	0.27	0.30	0.18	−0.05	0.32
I3: My way of seeing and doing often contributes to the success of my goals	0.15	0.30	−0.06	0.25	0.54
I4: When I am at work, I am sure of my skills and I rely above all on my experience	0.03	0.00	0.10	0.08	0.69
Illusion of control Bias					
I5: I prefer to control everything	0.76	0.08	−0.16	0.00	0.06
I6: I often tend to check what my colleagues are doing to make sure they are doing things right	0.64	−0.01	0.06	0.05	−0.02
I7: I want to control everything in my life	0.73	0.09	0.00	0.09	0.08
I8: People around me think of me as someone who needs to be in control	0.80	0.03	0.05	0.13	−0.01
Optimism Bias					
I9: I am a fundamentally optimistic person	0.00	0.80	−0.14	−0.07	0.09
I10: People who know me well think I'm an eternal optimist	0.11	0.81	0.03	0.09	0.18
I11: I tend to see the glass half empty	−0.13	0.48	−0.32	−0.10	0.11
I12: I am one of the very optimistic people, perhaps even too optimistic	0.20	0.79	0.21	0.13	0.01
Escalation of commitment Bias					
I13: In life, I find it difficult to go back, even though I know I'm wrong	0.07	−0.10	0.61	−0.01	−0.16
I14: When information doesn't go the way I want, I tend to put it aside and continue with what I'm doing	−0.03	0.24	0.69	−0.03	−0.06
I15: In a driving situation, if I am overtaking a vehicle and I see that I am too short, I will tend to accelerate	−0.09	−0.24	0.56	−0.08	0.27

Table 1. Cont.

Items	19-Item EFA				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
I16: I am one of the very committed people, sometimes even too much because I am able to go after things even if I am wrong Belief in the law of small numbers Bias	−0.01	0.00	0.68	0.16	0.06
I17: I am someone who needs a lot of information to make a decision	0.03	−0.13	−0.09	0.74	−0.18
I18: I am a very perfectionist person in the search for information	0.13	0.05	0.01	0.66	0.26
I19: I am seen as a person who likes to have very solid evidence before acting or making a decision	0.11	0.12	0.16	0.77	0.04

Note: EFA = exploratory factor analysis; 5CBR-S = Five Cognitive Bias Risk Scale; the English version is a translation which has not been analyzed. I = Item (see Supplementary Materials).

3.2. Confirmatory Factor Analyses

The goodness-of-fit indices of the five-factor CFA model ($\chi^2 = 196.78$; $p = 0.002$; $df = 142$; CFI = 0.90; SRMR = 0.065; AIC = 9429.10; BIC = 9650.75; ABIC = 9438.48; RMSEA = 0.044; 90%CI RMSEA = 0.028–0.058) and ESEM model ($\chi^2 = 109.66$; $p = 0.044$; $df = 86$; CFI = 0.91; SRMR = 0.033; AIC = 9429.33; BIC = 9836.24; ABIC = 9446.55; RMSEA = 0.037; 90%CI RMSEA = 0.007–0.056) meet the accepted standards. All the standardized factor loadings of the CFA models were significant at $p < 0.05$ (Figure 1) and greater than 0.40 (only one item presented a loading that was lower than 0.40: item 2 (I2) = 0.32) (Table 1). Furthermore, the pattern of cross-loadings observed within the ESEM analyses provided strong evidence that no cross-loading was detected for any of the 5 CBR-S items (Table 2).

Table 2. Standardized Factor Loadings (λ) and Uniqueness (δ) for Confirmatory Factor Analysis (CFA) and Exploratory Structural Equation Modeling (ESEM) Solutions of 5 CBR-S (19 Items) on the Validation Sample.

Items	CFA		Factor 1 (λ)	Factor 2 (λ)	ESEM			δ
	λ	δ			Factor 3 (λ)	Factor 4 (λ)	Factor 5 (λ)	
Escalation of commitment Bias								
Item 13	0.52	0.73	0.61	0.00	−0.07	0.06	0.02	0.61
Item 14	0.56	0.68	0.45	0.02	0.17	0.06	−0.05	0.76
Item 15	0.37	0.86	0.39	−0.01	0.06	−0.05	0.03	0.84
Item 16	0.43	0.82	0.37	0.16	0.18	−0.02	−0.02	0.80
Over confidence Bias								
Item 1	0.51	0.74	0.20	0.73	−0.03	0.11	0.08	0.41
Item 2	0.57	0.67	−0.05	0.42	0.12	0.31	−0.12	0.69
Item 3	0.56	0.68	−0.16	0.43	0.25	0.21	0.08	0.67
Item 4	0.30	0.91	0.03	0.24	0.07	0.01	0.12	0.92
Illusion of control Bias								
Item 5	0.56	0.69	0.15	0.33	0.40	−0.10	0.17	0.67
Item 6	0.31	0.90	0.18	0.12	0.22	−0.02	0.16	0.87
Item 7	0.69	0.53	0.13	0.20	0.66	0.04	0.05	0.50
Item 8	0.64	0.58	0.04	−0.00	0.72	0.04	0.11	0.46
Optimism Bias								
Item 9	0.79	0.37	0.08	0.15	−0.09	0.76	−0.07	0.37
Item 10	0.74	0.45	−0.04	0.08	0.07	0.75	−0.08	0.41
Item 11	0.48	0.77	−0.16	0.12	−0.18	0.47	−0.09	0.70
Item 12	0.75	0.44	0.12	0.09	0.12	0.75	−0.03	0.40

Table 2. Cont.

Items	CFA		Factor 1 (λ)	Factor 2 (λ)	ESEM			δ
	λ	δ			Factor 3 (λ)	Factor 4 (λ)	Factor 5 (λ)	
Belief in the law of small numbers Bias								
Item 17	0.51	0.74	0.17	−0.11	0.02	−0.13	0.58	0.58
Item 18	0.60	0.64	−0.11	0.22	0.20	−0.05	0.61	0.61
Item 19	0.74	0.45	−0.11	0.02	0.10	−0.10	0.48	0.48

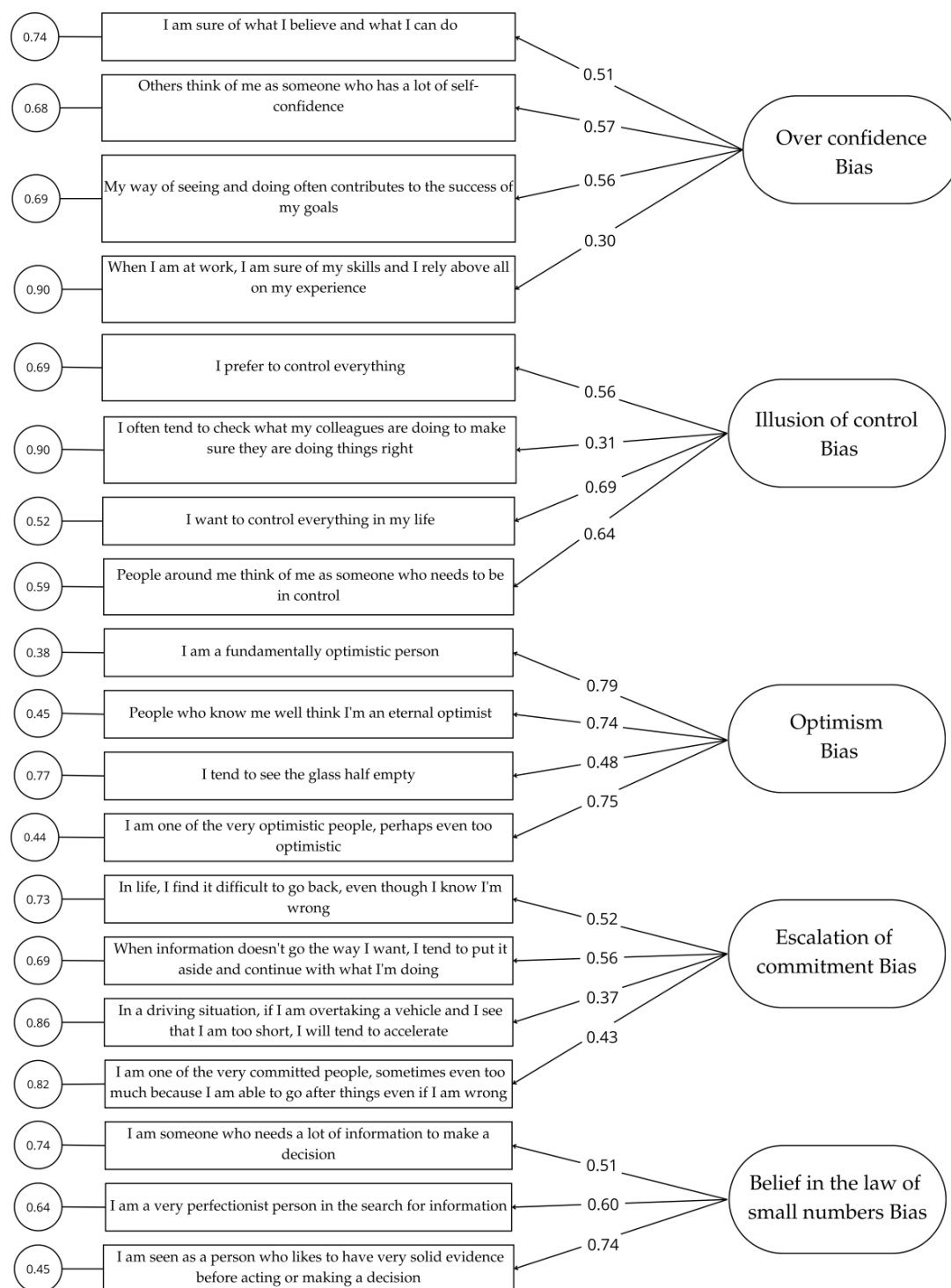


Figure 1. CFA of the 5-factor 19-item model of the 5 CBR-S. Note: The English version is a translation which has not been analyzed.

3.3. Reliability

Cronbach's α coefficients for the overall sample (calibration and validation samples simultaneously) ranged from 0.55 to 0.72 (Table 3). OC yielded the lowest score of internal reliability. Moreover, all 19 items met the internal reliability criteria of the item analysis (i.e., average inter-item correlations within the range of 0.15–0.50) [70]. The mean inter-item correlations ranged between 0.16 and 0.22 for the 5 CBR-S subscales.

Table 3. Descriptive Statistics and Spearman's Rank Correlations Between the scores of the Five Cognitive Bias Risk-Scale, the Risk and Activation Inventory, the Profile of Emotional Competence, the Mental Toughness Inventory, the Five Factors Model and the Process Communication Model.

Subscales	EC	OC	IC	OP	BL	M	SD	α
Escalation of Commitment Bias (EC)						26.39	4.68	0.62
Overconfidence Bias (OC)	0.35 *					33.08	4.05	0.55
Illusion of Control Bias (IC)	0.22 *	0.47 *				30.50	4.76	0.66
Optimism Bias (OP)	0.21 *	0.48 *	0.34 *			33.68	4.93	0.72
Belief in the Law of small numbers Bias (BL)	0.36 *	0.36 *	0.17 *	0.25 *		27.04	4.61	0.68
RAI global score	0.22 *	0.28 *	0.13 *	0.14 *	0.06	33.69	8.51	0.84
RAI (escape)	0.21 *	0.25 *	0.10	0.14 *	0.05	16.62	4.53	0.68
RAI (compensation)	0.21 *	0.27 *	0.14 *	0.12 *	0.07	17.07	4.46	0.74
identification of own emotions	−0.11 *	0.22 *	0.21 *	0.21 *	0.03	18.85	3.04	0.66
identification of others' emotions	−0.15 *	0.16 *	0.10	0.13 *	−0.07	18.32	3.17	0.73
Understanding of own emotions	−0.14 *	0.17 *	0.10	0.16 *	−0.02	18.80	2.97	0.52
Understanding of others' emotions	−0.17 *	0.13 *	0.19 *	0.17 *	−0.05	17.26	3.07	0.66
Expression of own emotions	−0.24 *	0.18 *	0.11 *	0.19 *	−0.06	15.85	3.82	0.65
Listening to others' emotions	−0.12 *	0.13 *	0.04	0.17 *	−0.16 *	18.90	3.89	0.77
Regulation of own emotions	−0.04	0.25 *	0.08	0.43 *	0.10	17.19	3.52	0.67
Regulation of others' emotions	−0.12 *	0.23 *	0.21 *	0.28 *	−0.03	17.15	3.09	0.68
Utilization of own emotions	0.02	0.14 *	0.17 *	0.16 *	0.02	16.30	3.24	0.63
Utilization of others' emotions	0.09	0.38 *	0.42 *	0.34 *	0.13 *	14.11	3.60	0.69
MTI global score	−0.07	0.33 *	0.18 *	0.41 *	0.04	45.77	4.99	0.82
Agreeableness	−0.24 *	0.02	−0.02	0.20 *	−0.19 *	42.26	4.08	0.74
Extraversion	−0.07	0.25 *	0.05	0.29 *	0.05	26.99	5.18	0.80
Openness to experience	−0.04	0.19 *	0.11	0.26 *	−0.06	34.40	5.22	0.73
Conscientiousness	−0.20 *	0.20 *	0.09	0.15 *	−0.19 *	37.02	4.47	0.79
Neuroticism	0.11 *	−0.26 *	0.04	−0.34 *	−0.10	17.90	4.97	0.80

Note: Cohen's criteria for correlations are small < 0.30; medium = 0.30 to 0.50; large > 0.50. * $p < 0.05$. (RAI = Risk and Activation Inventory).

3.4. Correlational Analyses

The results of the correlational analyses (Table 3) showed that (a) EC is significantly and positively correlated with compensation and escape ($r = 0.21$, $p < 0.05$), neuroticism ($r = 0.11$, $p < 0.05$), whereas almost all the subdimensions of EI are significantly negatively correlated with EC, as are agreeableness ($r = -0.24$, $p < 0.05$), and conscientiousness ($r = -0.20$, $p < 0.05$); (b) OC is significantly positively correlated with RAI scores ($r = 0.25$ and 0.27 for escape and compensation, respectively, $p < 0.05$), all subdimensions of EI, mental toughness ($r = 0.33$, $p < 0.05$), extraversion ($r = 0.25$, $p < 0.05$), openness to experience ($r = 0.19$, $p < 0.05$), and conscientiousness ($r = 0.20$, $p < 0.05$), and it is significantly negatively correlated with neuroticism ($r = -0.26$, $p < 0.05$); (c) IC is significantly positively correlated with compensation ($r = 0.14$, $p < 0.05$), some subdimensions of EI (i.e., identification of own emotions, understanding of others' dimensions, expression of own emotions, regulation of others' emotions, utilization of own emotions, and utilization of others' emotions), and mental toughness ($r = 0.18$, $p < 0.05$); (d) OP is significantly positively correlated with

compensation and escape ($r = 0.12$ and 0.14 , $p < 0.05$), all subdimensions of EI, mental toughness ($r = 0.41$, $p < 0.05$), agreeableness ($r = 0.20$, $p < 0.05$), extraversion ($r = 0.29$, $p < 0.05$), openness to experience ($r = 0.26$, $p < 0.05$), and conscientiousness ($r = 0.15$, $p < 0.05$), and it is significantly negatively correlated with neuroticism ($r = -0.34$, $p < 0.05$); and (e) BL is significantly and negatively correlated with listening to others' emotions, agreeableness ($r = -0.19$, $p < 0.05$), and conscientiousness ($r = -0.19$, $p < 0.05$).

4. Discussion

The purpose of this research was to develop and test the psychometric properties of a new measure of cognitive biases, the 5 CBR-S, used to detect individuals likely to be subject to five cognitive biases, which may increase the risks within a potentially hazardous profession, such as that of firefighting. The results of the psychometric evaluation of the 5 CBR-S provided encouraging findings for the substantive, structural and external stages of the validity of the 5 CBR-S scores. These results indicated that the 5 CBR-S is a promising scale for assessing cognitive bias related to risk. Exploratory and confirmatory (CFA and ESEM) factor analyses conducted on two independent samples provided evidence for the structural validity of the final version of the 5 CBR-S scores (19 items targeting the five cognitive biases of OC, IC, BL, EC, and OP). In particular, standardized factor loadings of the EFA and CFA, as well as the pattern of cross-loadings and standardized factor loadings of ESEM, offered strong evidence for the structural validity of the 5 CBR-S scores. Moreover, reliability item analyses provided further evidence of the reliability of the five dimensions of the 5 CBR-S. Otherwise, correlations between the 5 CBR-S subscales and theoretically relevant variables (EI, mental toughness, personality, and self-regulation) provided evidence for the external validity of 5 CBR-S scores. In particular, four results stand out. First, three cognitive biases (EC, OC, and OP) were significantly correlated with escape and compensation behaviors. The literature shows that sensation-seeking can be achieved using these two strategies. Firefighters pursue their profession not only out of solidarity but also for the thrill it provides [74]. Studies have shown that sensation-seeking through high-risk sports correlates with a higher incidence of accidents [50], potentially suggesting a link between these three biases (EC, OC, OP) and accident proneness among firefighters. However, self-regulation theory has not been studied in the context of firefighters, where the constraints and difficulties encountered could also lead to avoidance or compensatory behaviors and, consequently, to the acceptance of risk-taking. Accepting risk is a first step toward the voluntary action of taking a risk [53]. Secondly, significant and positive correlations were also identified between three biases (OC, IC, OP) and mental toughness. Crust [75] highlighted that mentally resilient individuals might process information differently based on their level of mental resilience, partly explaining the positive significant correlations observed in the literature between mental toughness and attitudes towards physical risk-taking [76]. Additionally, it has been suggested that highly resilient individuals may experience functional cognitive distortions, allowing them to filter, distort, or isolate incoming information, thereby representing it as less threatening [26], explaining the significant correlation observed in the present study between mental toughness and these three cognitive biases. Thirdly, EI was significantly and positively correlated with three biases (OC, IC, OP) and significantly negatively correlated with EC. Emotion and emotional regulation are involved in decision-making in professional contexts [40]. This is the case in the field of investment, where EI and OC significantly and positively influence stock trading decisions among millennial investors [58]. EI seems to be a key resource for fostering resilience and even a prerequisite [55] for reducing stress and effectively adapting to complex and demanding contexts. These two dimensions are essential strengths for firefighters to possess and develop as they enable better responses to the demanding situa-

tions faced by emergency professionals [59,60] and improve their performance [61]. This positive correlation with three cognitive biases related to risk-taking highlights the idea that heuristic reasoning is neither good nor bad when applied in appropriate situations [77]. The significant correlations between EI and cognitive biases related to risk-taking require further exploration, as it would open avenues for improving emotional regulation techniques through the enhancement of awareness of cognitive biases. Fourthly, significant and positive correlations emerged between extraversion, openness to experience, conscientiousness, and the OC and OP biases. These findings align with the existing literature documenting associations between OC and several personality traits grounded within the FFM (extraversion, openness to experience, and conscientiousness) [42–44,48]. They are also in line with the link between extraversion and optimism [47]. Previous studies on firefighters' personalities have shown mixed results. One study found that firefighters score high on the sensation-seeking facet of the extraversion trait [78], as well as high scores on openness to experience [79]. Conversely, another study highlights that firefighters are characterized by a lack of fear and low scores in openness to experience [80].

While these findings are encouraging, several limitations warrant acknowledgement, and directions for future research should be outlined. The 5 CBR-S scale represents an initial step in developing a tool to measure cognitive biases related to risk-taking. To further examine the validity and reliability of 5 CBR-S scores, it may be beneficial to conduct future research among samples from firefighters in other French regions facing different constraints, such as the elite Paris Fire Brigade or Marseille's marine firefighters. Expanding this tool to other high-risk occupations, such as those in industrial or real estate sectors where safety hazards are significant, could also be valuable. This could apply, for instance, to maintenance technicians or personnel working at heights. This study encourages future research to use this scale to detect and monitor the five cognitive biases related to risk-taking. The aim of this tool is to facilitate the ongoing exploration of cognitive biases in operational contexts, where human behavior evolves in complex ways. A future perspective would involve developing a continuous training protocol aimed at raising awareness of cognitive biases. This mechanism could serve both as an upstream detection tool and a downstream monitoring tool after training to verify whether participants improved their ability to identify their cognitive biases in risk-taking. Therefore, the training should be designed to take into account the pressures individuals face during their interventions. It should enable firefighters not only to recognize the presence of cognitive biases in their thought processes but also to learn to manage their emotions better. Ultimately, an improvement in managing stress factors is expected, which could reduce anxiety and promote a greater sense of perceived control [81].

5. Conclusions

The 5 CBR-S may be a robust measure of five key cognitive biases related to risk-taking (OC, IC, BL, EC, and OP) among firefighters and other professionals likely to make decisions in high-intensity, mental and physical emergency situations. This short, quick, cost-effective, and non-invasive measure could help detect risk-related biases, allowing for greater awareness of their impact on daily life. Finally, it seems promising to continue exploring the connections between personality (based on FFM) and cognitive biases related to risk-taking. This would inform training programs to raise awareness of their existence.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/fire8040147/s1>, Table S1. 50 original Items with the English translation.

Author Contributions: Conceptualization, S.L., E.G.-D. and G.M.; methodology, S.L., E.G.-D. and G.M.; formal analysis, S.L. and G.M.; investigation, S.L.; writing—original draft preparation, S.L.; writing—review and editing, S.L., E.G.-D. and G.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Approval ID: No. IRB00012476-28-08-337.

Informed Consent Statement: The firefighters invited to participate in this study were given details of the participation requirements and assured of their right to opt-out at any moment. They also had access to the consent form describing the purpose of this study and its implementation. Written instructions regarding the content of the questionnaires were also provided. The instructions emphasized the confidentiality of individual responses and the need for honesty. The participants were assured that the results would be used for this study only and that their privacy would be guaranteed.

Data Availability Statement: The original contributions presented in this study are included in this article; further inquiries can be directed to the corresponding author.

Acknowledgments: The authors would like to express their gratitude to the SDIS of Ain, Commander Sébastien Gobert and all the firefighters who participated in this research.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

EC	Escalation of Commitment Bias
OC	Overconfidence Bias
IC	Illusion of control Bias
OP	Optimism Bias
BL	Belief in the law of small numbers bias

References

1. Gnacinski, S.L.; Ebersole, K.T.; Cornell, D.J.; Mims, J.; Meyer, B.B. The Psychology of Firefighting: An Examination of Psychological Skills Use Among Firefighters: 2956 Board# 271 May 29, 2: 00 PM-3: 30 PM. *Med. Sci. Sports Exerc.* **2015**, *47*, 812.
2. Sapeur-pompiers de France [Internet] 2023. Available online: www.pompiers.fr (accessed on 13 December 2024).
3. Bernabé, M.; Botia, J.M. Resilience as a mediator in emotional social support's relationship with occupational psychology health in firefighters. *J. Health Psychol.* **2016**, *21*, 1778–1786. [CrossRef] [PubMed]
4. Desmond, M. Becoming a firefighter. *Ethnography* **2006**, *7*, 387–421.
5. Bel-Latour, L.; Granié, M.A. The influence of the perceived masculinity of occupation on risk behaviour: The case of firefighters. *Saf. Sci.* **2022**, *150*, 105702.
6. Cadet, B. Traitements de l'incertitude dans l'évaluation des risques. *Bull. Psychol.* **2001**, *54*, 357–367.
7. Cadet, B.; Kouabénan, D.R. Évaluer et modéliser les risques: Apports et limites de différents paradigmes dans le diagnostic de sécurité. *Trav. Hum.* **2005**, *68*, 7–35.
8. Friedberg, E. Organisation. In *Traité de Sociologie*; Boudon, R., Ed.; Presses Universitaires de France: Paris, France, 1992; pp. 351–388.
9. Omodei, M.; McLennan, J.; Reynolds, C.; Cumming, C. Understanding how even good firefighters may sometimes make unsafe decisions: Using a Human Factors Interview Protocol as a field investigation. *Aust. J. Psychol.* **2005**, *57*, 240.
10. Jones, D.N.; Paulhus, D.L. Introducing the short dark triad (SD3): A brief measure of dark personality traits. *Assessment* **2014**, *21*, 28–41.
11. Kouabénan, D.R. Role of beliefs in accident and risk analysis and prevention. *Saf. Sci.* **2009**, *47*, 767–776. [CrossRef]
12. Tversky, A.; Kahneman, D. Judgment under uncertainty: Heuristics and biases. *Science* **1974**, *185*, 1124–1131. [CrossRef]
13. Gomez, A.G. *A Descriptive Analysis of Antecedents of Risk-Based Decision Making in Firefighting*; University of Wisconsin—Madison: Madison, WI, USA, 2008.
14. Mondragon-Gilmore, J. *Firefighters and the Experience of Increased Intuitive Awareness During Emergency Incidents*; Pacifica Graduate Institute: Carpinteria, CA, USA, 2014.

15. Martinez-Fiestas, M.; Rodríguez-Garzón, I.; Delgado-Padial, A. Firefighter perception of risk: A multinational analysis. *Saf. Sci.* **2020**, *123*, 104545.
16. Starr, C. Social benefit versus technological risk. *Read. Environ. Impact* **1974**, *165*, 78.
17. Kinsey, M.; Gwynne, S.; Kuligowski, E.; Kinatader, M. Cognitive biases within decision making during fire evacuations. *Fire Technol.* **2018**, *55*, 10.
18. Crosskerry, P.; Singhal, G.; Mamede, S. Cognitive debiasing, origins of bias and theory of debiasing. *BMJ Qual. Saf.* **2013**, *22*, 58–64. [[CrossRef](#)]
19. Houdé, O. *Apprendre à Résister: Pour Combattre les Biais Cognitifs*; Flammarion: Paris, France, 2022.
20. Le Ny, J.F. Biais. In *Grand Dictionnaire de la Psychologie*; Larousse: Paris, France, 1999.
21. Barabel, M.; Meier, O. Biais cognitifs du dirigeant, conséquences et facteurs de renforcement lors de fusions-acquisitions: Synthèse et illustrations. *Revue Financ. Contrôle Strat. FCS* **2022**, *5*, 5.
22. Kannadhasan, M.; Aramvalathan, S.; Pavan Kumar, B. Relationship among cognitive biases, risk perceptions and individual's decision to start a venture. *Decision* **2014**, *41*, 87–98.
23. Garrett, N.; Gonzalez-Garzon, A.M.; Foulkes, L.; Levita, L.; Sharot, T. Updating beliefs under perceived threat. *J. Neurosci.* **2018**, *38*, 7901–7911.
24. Simon, M.; Houghton, S.M.; Aquino, K. Cognitive biases, risk perception, and venture formation: How individuals decide to start companies. *J. Bus. Ventur.* **2000**, *15*, 113–134.
25. Busenitz, L.W.; Barney, J.B. Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making. *J. Bus. Ventur.* **1997**, *12*, 9–30.
26. Taylor, S.E.; Brown, J.D. Illusion and well-being: A social psychological perspective on mental health. *Psychol. Bull.* **1988**, *103*, 193–210.
27. Chen, Z.; Dong, J. Risk perception and entrepreneur's decision to start a venture: An empirical study from Optical Valley of China (Wuhan). In Proceedings of the Sixth Wuhan. International Conference on E-Business-Innovation Management Track, Wuhan, China, 26–27 May 2007.
28. Kelly, T.F.; Milkman, K.L. Intensification de l'engagement. *Encycl. Théories Manag.* **2013**, *1*, 257–259.
29. Gold, R.S. The link between judgments of comparative risk and own risk: Further evidence. *Psychol. Health Med.* **2007**, *12*, 238–247. [[PubMed](#)]
30. Comes, T. Cognitive biases in humanitarian sensemaking and decision-making: Lessons from field research. In Proceedings of the 2016 IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA), San Diego, CA, USA, 21–25 March 2016; Institute of Electrical and Electronics Engineers Inc.: Piscataway, NJ, USA, 2016; pp. 56–62.
31. Castañeda, J.A. The framing effect in humanitarian operations. *Decis.-Mak. Humanit. Oper. Strategy Behav. Dyn.* **2019**, 193–219.
32. Campbell, L.; Knox Clarke, P. *Making Operational Decisions in Humanitarian Response: A Literature Review*; ALNAP/ODI: London, UK, 2018; pp. 1–28.
33. Catherwood, D.; Edgar, G.K.; Sallis, G.; Medley, A.; Brookes, D. Fire alarm or false alarm? Situation awareness and decision-making “bias” of firefighters in training exercises. *Int. J. Emerg. Serv.* **2012**, *1*, 135–158.
34. Belanes, A.; Hachana, R. Biais cognitifs et prise de risque managériale: Validation empirique dans le contexte tunisien. *Int. Manag.* **2010**, *14*, 105–119.
35. Arnaud, M.; Adam, C.; Dugdale, J. The role of cognitive biases in reactions to bushfires. In Proceedings of the ISCRAM Conference Proceedings, Albi, France, 21–24 May 2017.
36. Bae, J.-H.; Park, J.-W. Research into individual factors affecting safety within airport subsidiaries. *Sustainability* **2021**, *13*, 5219. [[CrossRef](#)]
37. Turner, J.H.; Stets, J.E. *The Sociology of Emotions*; Cambridge University Press: New York, NY, USA, 2005.
38. Ricciardi, V. The psychology of risk: The behavioural finance perspective. In *Handbook of Finance: Volume 2: Investment Management and Financial Management*; Fabozzi, F.J., Ed.; John Wiley & Sons: Chichester, UK, 2008; pp. 85–111.
39. Chaffai, M.; Medhioub, I. Behavioral finance: An empirical study of the Tunisian stock market. *Int. J. Econ. Financ. Issues* **2014**, *4*, 527–538.
40. Lidén, M. Emotions and cognition in international criminal justice: An exploration from cognitive biases to emotional intelligence. *Forensic Sci. Int. Mind Law.* **2020**, *1*, 100037.
41. Gucciardi, D.F.; Jackson, B.; Hodge, K.; Anthony, D.R.; Brooke, L.E. Implicit theories of mental toughness: Relations with cognitive, motivational, and behavioural correlates. *Sport. Exerc. Perform. Psychol.* **2014**, *4*, 100.
42. Durand, R.B.; Fung, L.; Limkriangkrai, M. Myopic loss aversion, personality, and gender. *J. Behav. Financ.* **2019**, *20*, 339–353.
43. Ahmad, F. Personality traits as predictor of cognitive biases: Moderating role of risk-attitude. *Qual. Res. Financ. Mark.* **2020**, *12*, 465–484. [[CrossRef](#)]

44. Durand, R.; Newby, R.; Tant, K.; Trepongkaruna, S. Overconfidence, overreaction, and personality. *Rev. Behav. Financ.* **2013**, *5*, 104–133. [\[CrossRef\]](#)
45. Engelberg, E.; Sjöberg, L. Money obsession, social adjustment, and economic risk perception. *J. Socio-Econ.* **2007**, *36*, 686–697. [\[CrossRef\]](#)
46. Costa, P.T.; McCrae, R.R. Four ways five factors are basic. *Pers. Individ. Dif.* **1992**, *13*, 653–665. [\[CrossRef\]](#)
47. Van de Venter, G.; Michayluk, D. An insight into overconfidence in the forecasting abilities of financial advisors. *Aust. J. Manag.* **2008**, *32*, 545–557. [\[CrossRef\]](#)
48. Lin, H.W. Elucidating rational investment decisions and behavioural biases: Evidence from the Taiwanese stock market. *Afr. J. Bus. Manag.* **2011**, *5*, 1630.
49. Carver, C.S.; Scheier, M.F. *Attention and Self-Regulation: A Control-Theory Approach to Human Behaviour*; Springer Science & Business Media: New York, NY, USA, 2012.
50. Lafollie, D.; Le Scanff, C. Détection des personnalités à risque dans les sports à sensations fortes. *L'Encéphale* **2007**, *33*, 135–141. [\[CrossRef\]](#)
51. Taylor, I.I.I.; Robert, L.; James, C. Hamilton. Preliminary evidence for the role of self-regulatory processes in sensation seeking. *Anxiety Stress Coping* **1997**, *10*, 351–375. [\[CrossRef\]](#)
52. Duval, S.; Wicklund, R.A. *A Theory of Objective Self-Awareness*; Academic Press: New York, NY, USA, 1972.
53. Bellrose, C.A.; Pilisuk, M. Vocational risk tolerance and perceptions of occupational hazards. *Basic. Appl. Soc. Psychol.* **1991**, *12*, 303–323. [\[CrossRef\]](#)
54. Mayer, J.D.; Salovey, P. What is emotional intelligence? In *Emotional Development and Emotional Intelligence: Educational Implications*; Salovey, P., Sluyter, D.J., Eds.; Basic Books: New York, NY, USA, 1997; pp. 3–34.
55. Armstrong, A.R.; Galligan, R.F.; Critchley, C.R. Emotional intelligence and psychological resilience to negative life events. *Personal. Individ. Differ.* **2011**, *51*, 331–336. [\[CrossRef\]](#)
56. Schneider, T.R.; Lyons, J.B.; Khazon, S. Emotional intelligence and resilience. *Personal. Individ. Differ.* **2013**, *55*, 909–914. [\[CrossRef\]](#)
57. Trigueros, R.; Padilla, A.M.; Aguilar Parra, J.M.; Rocamora, P.; Morales Gázquez, M.J.; López Liria, R. The influence of emotional intelligence on resilience, test anxiety, academic stress, and the Mediterranean diet. A study with university students. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2071. [\[CrossRef\]](#) [\[PubMed\]](#)
58. Rahman, A.W.; Puspita, N.V.; Yuliari, K. Emotional intelligence and behavioural biases on millennial stock trading decisions: A case study of Bibit investors. *Manaj. Dan. Bisnis* **2024**, *23*, 326–336. [\[CrossRef\]](#)
59. Peng, L.; Cao, H.W.; Yu, Y.; Li, M. Resilience and cognitive bias in Chinese male medical freshmen. *Front. Psychiatry* **2017**, *8*, 158. [\[CrossRef\]](#)
60. Munawar, M.; Sohail, T. Correlates of turnover intention among Rescue 1122 workers. *Pak. J. Appl. Soc. Sci.* **2017**, *5*, 15–31. [\[CrossRef\]](#)
61. Bellack, J.P. Emotional intelligence: A missing ingredient? *J. Nurs. Educ.* **1999**, *38*, 3–4. [\[CrossRef\]](#)
62. Coulter, T.J.; Mallett, C.J.; Gucciardi, D.F. Gucciardi. Understanding mental toughness in Australian soccer: Perceptions of players, parents, and coaches. *J. Sports Sci.* **2010**, *28*, 699–716. [\[CrossRef\]](#)
63. Dougherty, C. The Role of Cognitive Distortions in Predicting Mental Toughness in Athletes. Ph.D. Thesis, Philadelphia College of Osteopathic Medicine, Philadelphia, MA, USA, 2017.
64. MacCallum, R.C.; Widaman, K.F.; Zhang, S.; Hong, S. Sample size in factor analysis. *Psychol. Methods* **1999**, *4*, 84–99. [\[CrossRef\]](#)
65. Guadagnoli, E.; Velicer, W.F. Relation of sample size to the stability of component patterns. *Psychol. Bull.* **1988**, *103*, 265–275. [\[CrossRef\]](#)
66. Dunn, J.G.H.; Bouffard, M.; Rogers, W.T. Assessing item content-relevance in sport psychology scale-construction research: Issues and recommendations. *Meas. Phys. Educ. Exerc. Sci.* **1999**, *1*, 15–36. [\[CrossRef\]](#)
67. Brasseur, S.; Grégoire, J.; Bourdu, R.; Mikolajczak, M. The Profile of Emotional Competence (PEC): Development and validation of a self-reported measure that fits dimensions of emotional competence theory. *PLoS ONE* **2013**, *8*, e62635.
68. DeVellis, R.F. *Scale Development: Theory and Applications*, 2nd ed.; Sage Publications: London, UK, 2003.
69. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 7th ed.; Prentice Hall: Englewood Cliffs, NJ, USA, 2010.
70. Clark, L.A.; Watson, D. Constructing validity: Basic issues in objective scale development. *Psychol. Assess.* **1995**, *7*, 309–319. [\[CrossRef\]](#)
71. Gucciardi, D.F.; Hanton, S.; Gordon, S.; Mallett, C.J.; Temby, P. The concept of mental toughness: Tests of dimensionality, nomological network, and traitness. *J. Pers.* **2015**, *83*, 26–44. [\[CrossRef\]](#) [\[PubMed\]](#)
72. Plaisant, O.; Courtois, R.; Réveillère, C.; Mendelsohn, G.; John, O.P. Validation par Analyse Factorielle du Big Five Inventory français (BFI-Fr): Analyse convergente avec le NEO-PI-R. *Ann. Med. Psychol. Rev. Psychiatr.* **2010**, *168*, 97–106.
73. Muthén, L.K.; Muthén, B.O. *Mplus User's Guide. Statistical Analysis with Latent Variables*; Muthén & Muthén: Los Angeles, CA, USA, 2004.

74. Thurnell-Read, T.; Parker, A. Men, masculinities, and firefighting: Occupational identity, shop-floor culture and organizational change. *Emot. Space Soc.* **2008**, *1*, 127–134.
75. Crust, L. The relationship between mental toughness and affect intensity. *Pers. Individ. Dif.* **2009**, *47*, 959–963.
76. Crust, L.; Keegan, R. Mental toughness and attitudes to risk-taking. *Pers. Individ. Dif.* **2010**, *49*, 164–168.
77. Wegwarth, O.; Gaissmaier, W.; Gigerenzer, G. Smart strategies for doctors and doctors-in-training: Heuristics in medicine. *Med. Educ.* **2009**, *43*, 721–728. [[CrossRef](#)]
78. Salters-Pedneault, K.; Ruef, A.M.; Orr, S.P. Personality and psychophysiological profiles of police officer and firefighter recruits. *Personal. Individ. Differ.* **2010**, *49*, 210–215.
79. Dudek, B. Personality correlates of firefighters. *Psychology* **2001**, *27*, 37–48.
80. Fannin, N.; Dabbs, J.M., Jr. Testosterone, and the work of firefighters: Fighting fires and delivering medical care. *J. Res. Personal.* **2003**, *37*, 107–115.
81. Johnston, J.H.; Cannon-Bowers, J.A. Training for stress exposure. In *Stress and Human Performance*; Driskell, J.E., Salas, E., Eds.; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 1996; pp. 223–256.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.