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**DecidHealth : Psychometric validation of the IUS-12 and IUS-12-H scales on French  
healthcare professionals**

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**Competing interests:** The author(s) declare none.

**Ethical approval:** The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. We also received a favorable opinion from the CER-PN ethics committee of the University of Paris Nanterre (code: 2022-02-05).

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## Résumé

La littérature montre que l'intolérance à l'incertitude peut affecter négativement la prise de décision médicale des professionnels de santé. Cependant, il n'existe pas d'outils de mesure de l'intolérance à l'incertitude en français donc nous souhaitons valider l'Intolerance of Uncertainty Scale-12 (IUS-12) en français, ainsi qu'une version de l'IUS-12 adaptée aux professionnels de santé (IUS-12-H). Nous avons demandé à des professionnels de santé de remplir nos deux échelles d'intérêt, ainsi que des échelles connexes. Cinq cent seize professionnels de la santé ont rempli les versions françaises de l'IUS-12 et de l'IUS-12-H, et nos échelles additionnelles. Les analyses factorielles exploratoires ont montré que l'IUS-12 et IUS-12-H avaient une structure bi-factorielle comme dans l'article séminal de Carleton et al. (2007). Les versions françaises de l'IUS-12 et de l'IUS-12-H présentent des propriétés psychométriques comparables à la version originale, et peuvent donc être utilisées comme échelles de référence pour les professionnels de santé français.

*Mots-clés:* raisonnement clinique, intolérance à l'incertitude, validation psychométrique, prise de décision, évaluation, mesure

## **Abstract**

Literature shows that intolerance of uncertainty can negatively affect health professionals' medical decision-making process. However, there is no intolerance of uncertainty measurement tools in French, so this study aimed at validating the Intolerance of Uncertainty Scale-12 (IUS-12) in French, and a version of the IUS-12 adapted for healthcare professionals (IUS-12-H). We asked health professionals to complete our two scales of interest, as well as several scales covering related constructs. Five hundred and sixteen health professionals completed French versions of the IUS-12 and the IUS-12-H, and our additional scales. Exploratory factor analyses showed that the IUS-12 and IUS-12-H scales had a two-factor structure as in the seminal article of Carleton et al. (2007). The IUS-12 and the IUS-12-H French versions show psychometric properties comparable to the original version indicating that they can be used as the seminal scales for French health professionals.

*Keywords:* clinical reasoning, intolerance of uncertainty, psychometric validation, decision-making, evaluation, measurement

# **DecidHealth : Psychometric validation of the IUS-12 and IUS-12-H on French healthcare professionals**

## **Introduction**

With the COVID-19 pandemic, health care professionals (HCPs) have been brought to the forefront as central actors of our societies. Therefore, conducting studies on the medical practice of HCPs makes all the more sense as this topic deserves further investigation (Abouzeid & Sallam, 2021; Guillou et al., 2021; Kazour et al., 2017; Moghadami et al., 2021; Payan-Carreira et al., 2019; Pelaccia et al., 2014; Vital et al., 2021). Indeed, there is growing interest in medical practices and in finding factors that may impact the medical decision-making process. In this line, many recent studies have shown that medical errors are more frequent than previously thought, especially in stressful environments such as emergency rooms wherein 10% of cases patients are victims of medical errors (Riou et al., 2019).

Intolerance of uncertainty (IU) is one of these factors of interest that is gaining attention but is still under-explored (Begin et al. 2021; Bhise et al., 2018; Bloy, 2008; Charrois, 2020; Cranley et al., 2009; Cristancho et al., 2013; Farnan et al., 2008; Han et al., 2011; Ilgen et al., 2021; Motte et al., 2020; Quinlan et al., 2021; Slade et al., 2012; Vaismoradi et al., 2011). We define IU as "the tendency of an individual to consider as unacceptable the possibility that a negative event will occur, regardless of the probability of its occurrence" (Carleton et al., 2007; Birrell et al., 2011). In health contexts, uncertainty specifically refers to the state the HCP is in "when he or she is unsure of the etiological or syndromic diagnosis for a consultation, the therapy to be offered, or is unsure of his or her understanding of the patient and vice versa" (Sandid, 2016, p. 5). A significant body of empirical research has shown that uncertainty is part of medical practice, and can be encountered through different aspects such as diagnosis (*i.e.*, "is it the right one?"), treatment

(*i.e.*, "should I prescribe this one?") or the nature of the condition itself (*i.e.*, "am I sure I understand this condition?"; Abecassis, 1999; Begin et al. 2021; Bhise et al., 2018; Bloy, 2008; Charrois, 2020; Cranley et al., 2009; Cristancho et al., 2013; Farnan et al., 2008; Han et al., 2011; Ilgen et al., 2021; Moffett et al., 2021; Motte et al., 2020; Quinlan et al., 2021; Slade et al., 2012; Vaismoradi et al., 2011). IU is considered stable over time, but can be relatively modulated, particularly as it depends on situational and dispositional factors (Begin et al. 2021; Strout et al., 2018).

IU is of primary interest in the health field, as it can have negative consequences on the health decision-making process. Because highly uncertainty intolerant people may experience uncertain situations as stressful, they are bound to look for solutions to reduce this uncomfortable feeling or to get away from such situations. In particular, many studies have investigated the "premature closure" bias, which refers to promptly making a diagnosis (often based on pattern recognition), failing to consider other possible diagnoses, and prematurely stopping to gather data (Pelaccia et al., 2014). Premature closure may lead to ignoring certain data, which can obviously have an impact on the subsequent diagnosis, the chosen treatments, and therefore the patient's health condition (Begin et al., 2021; Begun & Kaissi, 2004; Bhise et al., 2018; Dugas et al., 1997, as cited in Carleton et al., 2007; Dugas et al., 2005; Grenier et al., 2005; Hicks & Kluemper, 2011, Meyer et al., 2021; Motte et al., 2020). Indeed, this can decrease the patient's satisfaction and trust in the medical system and lead to negative emotional reactions that can negatively impact the response to treatment (Meyer et al., 2021; Strout et al., 2018, as cited in Moffett et al., 2021). For practitioners, the experience of this uncertainty can be stressful, while the stress factor already weighs heavily on HCPs. As stress is for instance one of the reasons why 30% of newly qualified nurses leave the profession within 5 years, it is clear that there is a need to further investigate factors such as uncertainty that contribute to the stress of HCPs. Furthermore, with the Ma santé 2022<sup>1</sup> plan and recent

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<sup>1</sup> <https://solidarites-sante.gouv.fr/systeme-de-sante-et-medico-social/masante2022/>

legislative and regulatory developments, France is seeking to reorganize its healthcare system with a greater sharing of medical tasks between the various professions. This requires professionals to take on tasks that were not previously devoted to them, increasing the uncertainty they may feel when caring for patients. In this context, it seems all the more important to study the parameter of IU among the French population.

Given the importance of this factor, research into the relationship between clinical reasoning and intolerance of uncertainty, including its impact on medical decisions, is essential. However, the implementation and evaluation of the relevance of the action plan to modify this parameter require reliable and valid tools to assess it. Researchers commonly use the Intolerance of Uncertainty Scale to assess intolerance of uncertainty (Birrell et al., 2011; Buhr & Dugas, 2002; Carleton et al., 2007). A 27-item version (IUS-27) and a shorter 12-item version exist (IUS-12, Birrell et al., 2011; Buhr & Dugas, 2002; Carleton et al., 2007). However, no reliable and valid version of this scale exists for measuring this parameter in HCPs in France. We wanted to conduct a French psychometric validation study of the IUS-12 scale as well as a validation of a version adapted to HCPs (called IUS-12-H).

### **Aim of the study**

Our goal was to assess the validity of French versions of the IUS-12 and the IUS-12-H. Given that the IUS-12 has shown good psychometric qualities in English and that the IUS-12-H is partly based on the IUS-12 (Birrell et al., 2011; Buhr & Dugas, 2002; Carleton et al., 2007), we hypothesized that both our French versions of the IUS-12 and the IUS-12-H would show good psychometric qualities and would correlate with each other.



## **Method**

We conducted a validation study on HCPs using questionnaires including both our scales to be validated and additional scales.

### ***Participants***

For this study, we focused on HCPs as defined by the french Public Health Code<sup>2</sup>. An HCP was considered to be any person practicing a medical profession (physician, midwife, or odontologist), a pharmacy profession (private or hospital pharmacists), or a medical auxiliary profession (nurse, physiotherapist, chiroprapist, occupational therapist and psychomotor therapist, speech therapist and orthoptist, medical electroradiology manipulators and medical laboratory technician, audioprosthodontist, optician, prosthetist and orthotist, dietician, caregiver, childcare assistants, paramedics, and dental assistants).

We interrogated a convenience sample recruited using two methods: email and social networks. For the email diffusion, the study was submitted to the e-mail network of a French university laboratory comprising HCPs. The email introduced the study as being about HCPs' decision-making. It included the estimated time to complete the study and the link to the study. Following a snowball sampling, these HCPs were invited to share the study with their HCPs peers. Diffusion via social networks was conducted on Facebook and LinkedIn. The address of the online questionnaire was posted on Facebook groups for HCPs. Meanwhile, HCPs were contacted directly on LinkedIn using private messages to invite them to participate in the study and to share it with their network. We ensured that the consent of the participants was obtained and that the study complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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<sup>2</sup> As defined here :

<https://www.vie-publique.fr/fiches/37855-categorie-de-professionnels-de-sante-code-se-la-sante-publique>

For this study, we recruited 933 HCPs. Details on the professional activities of the 319 participants that filled them are provided in Table 1. Among the respondents, 417 were excluded because they did not meet our inclusion criteria (*i.e.*, because they were underaged and/or not HCPs according to our definition and/or did not fully complete more than two scales). The final sample was composed of 516 individuals ( $M_{age} = 36.72$ ,  $SD_{age} = 12.22$ , 197 women, 120 men, 2 others, and 197 who did not specify their gender), of which 319 specified their field of professional activity.

**Table 1**

*Number of health professionals by discipline and status*

*Nombre de professionnels de santé par discipline et par statut*

Discipline	Student	Professional	Total
Nurses	$N = 33$	$N = 38$	$N = 71$
Physiotherapists	$N = 22$	$N = 76$	$N = 98$
General practitioners	$N = 3$	$N = 39$	$N = 42$
Osteopaths	$N = 4$	$N = 26$	$N = 30$
Pharmacists	$N = 4$	$N = 6$	$N = 10$
Other	$N = 8$	$N = 60$	$N = 68$
Total	$N = 74$	$N = 245$	$N = 319$

## ***Instruments***

### **Intolerance of Uncertainty Scale (IUS-12) and Intolerance of Uncertainty Scale in Health (IUS-12-H)**

The IUS-12 is a 12-item scale that assesses intolerance of uncertainty. It is based on the original 27-item version developed by Freeston and colleagues (1994) for clinical assessment purposes. In this study, we will refer to the bi-factorial structure validated by Carleton et al. (2007) that includes both prospective (*i.e.*, "propensity of individuals toward active information seeking as a way to reduce uncertainty/increase certainty", factor 1, Bottesi et al., 2019) and inhibitory IU (*i.e.*, "an inhibition of actions or experience which is caused by uncertainty", factor 2, Bottesi et al., 2019, Jackson et al., 2016). Participants respond to the IUS-12 on a Likert scale ranging from "Not at all characteristic of me" (1), "A little characteristic of me" (2), "Somewhat characteristic of me" (3), "Very characteristic of me" (4), and "Entirely characteristic of me" (5). The IUS-12 theorized with a bi-dimensional structure showed good psychometric qualities and correlates with the IUS-27 (Carleton et al., 2007; Jensen et al., 2014).

To create the IUS-12-H, we took the IUS-12 items and adapted them to a medical context. Specifically, items begin with "When caring for my patients...". The IUS-12-H has the same instructions and rating system as the IUS-12.

As part of the validation process, the two scales were discussed with 7 HCPs during interviews to validate the wording of the items (*i.e.*, 2 physiotherapists, 2 nurses, 2 general practitioners, and 1 pharmacist). One of these HCPs was a native English speaker. Interviewed HCPs were to judge 1) the appropriateness of the translation (*i.e.*, is the translation common French?), 2) the relevance of the translation in a medical context (*i.e.*, do the terms reflect common medical practice?). We followed this process according to the guidelines of Bouletreau and colleagues (1999): "The translation of a questionnaire involves

two essential steps: a literal translation and an adaptation to the cultural context, lifestyle, and idioms of the target population. This second step constitutes the cross-cultural validation of the document. It is essential for items dealing with social or psychological dimensions [...] For questionnaires designed in another language and translated according to the methodology described above, the qualitative evaluation, even in the source language, is sufficient. However, the quantitative evaluation of the questionnaire still has to be carried out in the target language.". The same process was done for both IUS-12 and IUS-12-H because IUS-12-H is largely based on IUS-12 and the interviews were on our target population, so we deemed the process adequate. We expected the IUS-12 and IUS-12-H to correlate positively and the association to be strong.

### **Additional scales**

To assess the external validity of our two scales, we conducted a review to include scales measuring constructs close to intolerance of uncertainty. The scales included are the following: Physicians' Reactions to Uncertainty (PRU), Distress Tolerance Scale (DTS), Discomfort Intolerance Scale (DIS), Perceived Stress Scale (PSS10), Difficulties in Emotion Regulation Scale (DERS-16), Questionnaire sur l'Incertitude au Travail (QIT), Need for Cognition Scale (NFCO), Need For Closure Scale (NFC), and the Tolerance of Ambiguity in Medical Students and Doctors (TAMSAD). The purpose, number of items, response modality, factorial structure, and expected validity (*i.e.* convergent or divergent) of the scales is described in Table 2.

**Table 2**

*Name, authors, purpose, number of items, response modality, factorial structure and expected validity (i.e. convergent or divergent) of the additional scales*

*Nom, auteurs, objectif, nombre d'items, modalité de réponse, structure factorielle et validité attendue (c'est-à-dire convergente ou divergente) des échelles supplémentaires.*

<b>Name of the scale</b>	<b>Validated by/Version used</b>	<b>Purpose</b>	<b>Number of items</b>	<b>Response modality</b>	<b>Factorial Structure</b>	<b>Expected validity</b>
Physicians' Reactions to Uncertainty (PRU)	Sandid (2016)	This scales assesses four aspects of uncertainty in physicians	15	Participants can answer on a Likert scale ranging from "Strongly disagree" (1) to "Strongly agree" (6)	According to Sandid (2016), the scale assesses four aspects of uncertainty: anxiety about uncertainty (factor 1), worry about adverse events (factor 2), reluctance to disclose uncertainty to patients (factor 3), and reluctance to disclose medical errors to other physicians (factor 4)	Convergent
Distress Tolerance Scale (DTS)	Wagener and Blairy (2015)	This scale measures tolerance to distress	15	Answers to this Likert scale can range from "Strongly agree" (1) to "Strongly disagree" (5)	The scale measures four lower-order factors ("Tolerance", "Absorption", "Appraisal", "Regulation") and one higher-order factor ("General distress tolerance") of tolerance to distress	Divergent
Discomfort Intolerance Scale (DIS)	Wagener and Blairy (2015)	This scale measures the experienced physical	5	Responses range from "Not like me at all" (0) to "Exactly like me" (6).	The scale assesses two lower-order factors (factor 1: "Discomfort intolerance" and factor 2: "Discomfort avoidance") and one higher-order factor ("General discomfort intolerance")	Divergent

		discomfort				
Perceived Stress Scale (PSS10)	Lesage et al. (2012)	This scale estimates the amount of stress perceived by the respondent over the last two weeks, and thus the extent to which they feel that their environment was stressful during that time	10	Participants indicate the frequency experienced with the following response modalities: Never (0), Almost never (1), Sometimes (2), Quite often (3), Often (4)	The PSS consists of two factors. Factor 1 includes negatively worded items ( <i>e.g.</i> , "Were you bothered by an unexpected event?"), and Factor 2 includes positively worded items ( <i>e.g.</i> , "Did you feel that you were in control of the situation?")	Divergent
Difficulties in Emotion Regulation Scale (DERS-16)	French versions of Dan-Glauser and Scherer (2012) for the 16 items described in Bjureberg and colleagues (2016)	This scale assesses emotional regulation difficulties.	16	Items are rated from "Almost never" (1), "Some of the time" (2), "Half of the time" (3), "Most of the time" (4) to "Almost always" (5).	The scale consists of five factors: factor 1 includes items measuring lack of emotional clarity ("Clarity"), factor 2 includes items assessing difficulties in engaging in goal-oriented behaviors ("Goals"), factor 3 refers to difficulty in controlling impulses ("Impulses"), factor 4 includes items measuring rejection of emotional responses ("Nonacceptance") and factor 5 includes items referring to difficulties accessing emotional regulation strategies ("Strategies")	Divergent
Questionnaire sur	Laphorn and	This scale	30	The response	The scale includes five factors: factor 1 refers to the	Convergent

l'Incertitude au Travail (QIT, Workplace Uncertainty Questionnaire)	Hellemans (2011)	measures the perceived uncertainty in the professional environment		modalities on a Likert scale are: "Strongly Disagree" (1), "Disagree" (2), "In-between" (3), "Agree" (4) and "Strongly Agree" (5)	perception of the wearing side of uncertainty, factor 2 to the perception of the constructive side of uncertainty, factor 3 to uncertainty management through control, factor 4 to uncertainty management through reassurance and factor 5 to uncertainty management through avoidance	
Need for Cognition Scale (NFCO)	Ginet and Py (2000)	This scale measures the extent to which a person enjoys engaging in higher cognitive activities.	11	Participants respond on a Likert scale from "Completely false" (1), "Somewhat false" (2), "Somewhat true" (3) to "Completely true" (4).	This scale has a unidimensional structure	Divergent
Need For Closure Scale (NFC)	Ginet and Py (2000)	This scale measures the cognitive need to arrive at an answer, an end regarding a subject ( <i>i.e.</i> , "an individual's desire for a firm answer to a question and an aversion toward ambiguity,	15	This Likert scale ranges from "Strongly Disagree" (1), "Disagree" (2), "Somewhat Disagree" (3), "Somewhat Agree" (4)", "Agree" (5) to "Strongly Agree" (6)	This scale has a unidimensional structure	Divergent

Kruglanski & Webster 1996, p. 264, as cited in Rosen et al., 2014)

Tolerance of Ambiguity in Medical Students and Doctors (TAMSAD)	Hancock et al. (2015)	This scale assesses intolerance to ambiguity (IA), a construct close to but different from intolerance to uncertainty (IU, Rosen et al., 2014)	29	Participants can answer on a Likert scale ranging from "Strongly disagree" (1) to "Strongly agree" (5)	This scale has a unidimensional structure	Divergent
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### **Sociodemographic questionnaire**

Participants were asked to indicate their gender. Participants could choose between “male”, “female” and “other”. If it was “other”, a blank space allowed participants to fill in their gender. Participants ages were asked through an open-ended question that asked: "Please indicate your age in the box below (in numbers, *e.g.*, 32)". The following question asked participants to indicate their status (*i.e.*, student or not). If they were students, they were asked to specify their study discipline. Participants were to choose their discipline between six options: “nurse”, “physiotherapist”, “general practitioner”, “osteopath”, “pharmacist”, or “other”. If it was “other”, a blank space allowed participants to fill in their study discipline. If they were already practicing, they were asked in what discipline and for how many years. The response options for occupation discipline were the same as those for the study discipline question. Participants were asked to write the number of years of occupation in numbers, through the following open-ended question: “Please indicate the number of years you have been practicing medicine (*e.g.*, 32). This is the number of years since you graduated.”.

### ***Procedure***

The first page of the questionnaire thanked the participants for their interest and presented the study as focusing on the parameters influencing health care decision-making to develop a tool to optimize decision-making based on their answers. They were reminded of the estimated time required to complete the study, were guaranteed anonymity, and had to create a pseudonymization code. They then completed all 11 scales displayed in a randomized order. Next, participants were asked to complete several socio-demographic questions (*i.e.*, age, gender, occupation). They were also asked how they had found out about the study. The response options were the following: “by email”, “on social networks”, or “other”. If it was “other”, a blank space allowed participants to fill in how they came to know

the study. Next, participants were asked to provide their email addresses. This was intended to send them the results of the study and to be able to contact them later for a future study. The email addresses were collected through an embedded Framiform<sup>3</sup> question. Framiform is an online software that allows the collection of personal data without any third-party use. The following instruction provided participants an explanation for using this tool: "The use of the [framaforms.org](https://framaforms.org) tool allows us not to link your answers to your email address, which guarantees the strictest respect of your anonymity". The study ended with a final debriefing that thanked the HCPs for their participation, reminded them of the purpose of the study, and invited them to share the study with their peers. A contact email address was provided for any questions or comments.

### ***Statistical analysis***

We followed a three-stage analysis for all the scales in our study: 1) We ascertained the construct validity of all the scales by checking that the factorial structure observed corresponded to that described in the literature, 2) Then we tested the external validity of our scales by conducting correlational analyses, 3) And then we conducted new factor analyses with our scales and the additional scales in pairs to check the external validity (*i.e.* did the factor analyses show that the scales had different factor structures when taken in pairs). All these analyses were carried out for each scale, with the main objective of establishing the validity of the IUS-12 and the IUS-12-H.

We performed (i) exploratory factor analyses with a Promax rotation analysis. For each scale, items were reviewed. They were considered to belong to a factor when their loadings were at least 0.3 in one factor and no more than 0.2 in other factors. When an item saturated less than 0.2 in all factors, it was removed according to the step-by-step factor reduction method described by Samuels (2017), and the analysis was performed again. Then

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<sup>3</sup> <https://framaforms.org/abc/fr/>

(ii) we performed correlation matrices to establish Pearson correlation coefficients between our scales. Lastly, (iii) we conducted a new set of factorial analyses to confirm the external validity of our scales by ensuring that IUS-12 and IUS-12-H did not overlap with other scales. To do so, we conducted analyses with our scales (*e.g.*, the IUS-12) and our additional scales (*e.g.*, PRU). For the scales used to assess the divergent validity of our scales, we wanted to verify that when put together in a factorial analysis, the two factorial structures of the scales were indeed different. For the scales used to assess convergent validity, we wanted to check that the factorial structures overlapped strongly.

### ***Handling of missing data***

We decided to use imputations to manage our missing data because it may be statistically preferable to deleting data of "incomplete" participants (McNeish, 2017; Stuart et al., 2009; Xu et al., 2020). The method we found most suitable was multiple imputations as it is preferable to other imputation techniques such as mean imputation or hot-deck (Boussat et al., 2021; Houghton et al., 2019; Nassiri et al., 2018; Peyre et al., 2011, Sun et al., 2017; Xu et al., 2020). In addition, multiple imputations are often used to process data in medical research (Jamaludin et al., 2021) and statistical analyses on imputed datasets often show results comparable to those on non-imputed datasets (Cedars et al., 2020; Kolaja et al., 2021; Lovik et al., 2017; Sasaki et al., 2021). Furthermore, we observed good psychometric qualities on tools validated with an imputed dataset (Cedars et al., 2020; Moser et al., 2012).

We used the Mice (Multiple Imputation with Chained Equations) packages on the R software. Multiple imputations are a statistical technique used to simulate missing data. The first step is the simulation of several datasets, usually 5, following an appropriate model. Then, we averaged the imputed values to form a single final file on which we performed our statistical analyses (Dray, & Josse, 2015; Josse & Husson, 2011; McNeish, 2017).

## **Results**

Results of the factor analyses of the additional scales are available in Supplementary Material.

### ***Assessing construct validity using exploratory factorial analysis***

#### **IUS-12**

The seminal paper by Carleton et al (2007) describes a two-factor structure. We found this structure to explain 53% of the variance ( $\alpha = .90$ ,  $M = 2.32$ ,  $SD = .71$ ). The factor loadings ranged from 0.46 to 0.95. However, item 3 was more saturated in the factor in which it was not supposed to be (0.49 vs. 0.33). We decided to retain this bi-factorial structure. Details of the factorial structure of the IUS-12 are available in Table 3.

#### **IUS-12-H**

Again, we tested a two-factor model like Carleton et al (2007). This model explained 50% of the variance and the factor loadings ranged from 0.43 to 0.87. However, item 3 was cross-loaded and did not seem to fall more into one factor than another (factor loadings were 0.39 and 0.38). We tested this two-factor model while removing item 3. The model accounted for 51% of the variance and the factor loadings ranged from 0.42 to 0.88 ( $\alpha = .88$ ,  $M = 2.31$ ,  $SD = .67$ ). We decided to keep this bi-factorial structure without item 3. Details of the factorial structure of the IUS-12-H are available in Table 3.

**Table 3***Factorial structure of the IUS-12 and the IUS-12-H**Structure factorielle de l'IUS-12 et de l'IUS-12-H*

Item	IUS-12	
	Factor 1 (Prospective IU)	Factor 2 (Inhibitory IU)
Unforeseen events upset me greatly. Les imprévus me dérangent énormément.	.585	
It frustrates me not having all the information I need. Cela me frustre de ne pas avoir toutes les informations dont j'ai besoin.	.462	
Uncertainty keeps me from living a full life. L'incertitude m'empêche d'apprécier pleinement la vie.	.495	
One should always look ahead so as to avoid surprises. Je pense qu'il faut tout anticiper pour éviter les surprises.	.803	

A small unforeseen event can spoil everything, even with the best of planning. Je pense que même avec la meilleure des planifications, un léger imprévu peut tout gâcher.	.562	
When it's time to act, uncertainty paralyzes me. Au moment de passer à l'action, l'incertitude me paralyse.		.952
When I am uncertain I can't function very well. Lorsque je suis dans l'incertitude, je ne peux pas bien fonctionner.		.782
I always want to know what the future has in store for me. Je voudrais toujours savoir ce que l'avenir me réserve.	.648	
I can't stand being taken by surprise. Je déteste être pris.e au dépourvu.	.759	
The smallest doubt can stop me from acting. Le moindre doute peut m'empêcher d'agir.		.860
I should be able to organize everything in advance. J'aimerais être en mesure de tout organiser à	.858	

l'avance.

I must get away from all uncertain situations. .607  
J'ai besoin de me retirer de toute situation qui  
devient trop incertaine.

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IUS-12-H

Item	Factor 1 (Prospective IU)	Factor 2 (Inhibitory IU)
When caring for my patients, unforeseen events upset me greatly. Lors de la prise en charge de mes patient.e.s, les imprévus me dérangent énormément.	.422	
When caring for my patients, it frustrates me not having all the information I need. Lors de la prise en charge de mes patient.e.s, cela me frustre de manquer d'informations dont j'ai besoin.	.619	
When caring for my patients, I think that everything should be anticipated to avoid surprises. Lors de la prise en charge de mes patient.e.s, je pense qu'il faudrait tout anticiper pour éviter les	.637	

surprises.

Even with the most careful planning when caring for my patients, a small unforeseen event can spoil everything. Même avec la meilleure des planifications lors de la prise de charge de mes patient.e.s, un léger imprévu peut tout gâcher.	.441
When caring for my patients calls for action, uncertainty paralyzes me. Au moment où la prise en charge de mes patient.e.s nécessite d'agir, l'incertitude me paralyse.	.828
When I feel uncertainty regarding care of my patients, I can't function very well. Lorsque je suis dans l'incertitude dans la prise en charge de mes patient.e.s, je ne peux pas bien fonctionner.	.672
When caring for my patients, I always want to know what is going to happen. Lors de la prise en charge de mes patient.e.s, j'aimerais toujours savoir ce qui va se passer.	.744
When caring for my patients, I can't stand being	.737



taken by surprise.  
Lors de la prise en charge de mes patient.e.s, je  
déteste être pris.e au dépourvu.

When caring for my patients, the smallest doubt can  
stop me from acting. .882  
Lors de la prise en charge de mes patient.e.s, le  
moindre doute peut m'empêcher d'agir.

When caring for my patients, I would like to be able  
to organize everything in advance. .847  
Lors de la prise en charge de mes patient.e.s,  
j'aimerais être en mesure de tout organiser à  
l'avance.

When caring for my patients, I must get away from  
all uncertain situations. .727  
Lors de la prise en charge de mes patient.e.s, j'ai  
besoin de me retirer de toute situation qui  
devient trop incertaine.

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Note: Item 3 of the IUS-12-H, “When caring for my patients, uncertainty prevents me from fully enjoying my work”/ “Lors de la prise en charge de mes patient.e.s, l’incertitude m’empêche d’apprécier pleinement mon travail”, is not presented in this table as it was removed from the final model

Note: All loadings below .40 on secondary factors (*i.e.*, factors on which the item is not theoretically supposed to saturate) have not been included in the table to facilitate reading.

### *Assessing external validity using correlational analyses*

#### **IUS-12 and IUS-12-H**

The two IUS-12 factors and the two IUS-12 factors correlated positively and significantly. These correlations were very high. IUS-12 factor 1 correlated at  $r = .61$  with IUS-12-H factor 1 and  $r = .41$  with factor 2 ( $p < .000$ ). IUS-12 factor 2 correlated at  $r = .41$  with IUS-12-H factor 1 and  $r = .62$  with factor 2 ( $p < .000$ ). The main results of the correlational analyses for the IUS-12 and IUS-12-H are available in Table 4.

**Table 4***Results of correlational analyses for IUS-12 and IUS-12-H by factors**Résultats des analyses corrélationnelles pour l'IUS-12 et l'IUS-12-H par facteurs*

		PRU				DTS	DIS		PSS10		DERS-16				
		F1	F2	F3	F4	U	F1	F2	F1	F2	F1	F2	F3	F4	F5
<b>IUS-12</b>	<b>F1</b>	.44**	.37**	.19**	.11**	-.40**	.06	.19**	.34**	.30**	.28**	.28**	.31**	.19**	.39**
	<b>F2</b>	.42**	.27**	.19**	.18**	-.43**	.08	.18**	.32**	.40**	.25**	.34**	.24**	.24**	.41**
	<b>Matches our expectations</b>	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No
<b>IUS-12-H</b>	<b>F1</b>	.51**	.45**	.18**	.06**	-.33**	.00	.14*	.30**	.24**	.24**	.24**	.25**	.21**	.33**
	<b>F2</b>	.53**	.38**	.22**	.23**	-.34**	.04	.12*	.34**	.36**	.22**	.32**	.25**	.19**	.35**
	<b>Matches our expectations</b>	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No

		QIT				NFCO	NFC	IUS-12		TAMSAD
		F1	F2	F3	F4	U	U	F1	F2	U
<b>IUS-12</b>	<b>F1</b>	.64**	-.36**	.52**	.32**	-.24**	.64**	-	-	-.44**
	<b>F2</b>	.54**	-.28**	.21**	.38**	-.25**	.41**	-	-	-.44**
	<b>Matches our expectations</b>	Yes	No	Yes	Yes	No	No	-	-	No
<b>IUS-12</b>	<b>F1</b>	.46**	-.24**	.39**	.36**	-.25**	.49**	.61**	.41**	-.49**
	<b>F2</b>	.46**	-.25**	.16**	.31**	-.39**	.33**	.41**	.62**	-.48**
	<b>Matches our expectations</b>	Yes	No	Yes	Yes	No	No	Yes	Yes	No

Note: U = Unidimensional, F1 = Factor 1, F2 = Factor 2, F3 = Factor 3, F4 = Factor 4, F5 = Factor 5, C.V = Convergent Validity, D.V = Divergent Validity, \*p<.05, \*\*p<.01

## **PRU**

All four PRU factors showed significant positive correlations with the two IUS-12 factors (ranging from  $r = .11$  to  $r = .44$ ,  $p < .000$ ). PRU factors 1 and 2 had higher correlations than factors 3 and 4 (ranging from  $r = .27$  to  $r = .44$  versus  $r = .11$  to  $r = .19$ ,  $p < .000$ ). Similarly, all four PRU factors showed significant positive correlations with the two factors of the IUS-12-H (ranging from  $r = .06$  to  $r = .53$ ,  $p < .000$ ). Again, PRU factors 1 and 2 showed higher correlations than factors 3 and 4 (ranging from  $r = .38$  to  $r = .53$  versus  $r = .06$  to  $r = .23$ ,  $p < .000$ ).

## **DTS**

The DTS correlated significantly negatively with factor 1 ( $r = -.40$ ,  $p < .000$ ) and factor 2 of the IUS-12 ( $r = -.43$ ,  $p < .000$ ). Similarly, DTS correlated significantly negatively with factor 1 ( $r = -.33$ ,  $p < .000$ ) and factor 2 of IUS-12-H ( $r = -.34$ ,  $p < .000$ ).

## **DIS**

Factor 1 of the DIS correlated positively with the two IUS-12 factors, but these associations were weak and nonsignificant ( $r = .06$ ,  $p < .164$  and  $r = .08$ ,  $p < .075$ ). In contrast, factor 2 of the DIS correlated positively and significantly with the IUS-12 factors ( $r = .19$  and  $r = .18$ ,  $p < .000$ ). A similar pattern was found with the IUS-12-H. The associations remained non-significant and weak. Factor 1 of the DIS correlated positively only with factor 2 of the IUS-12-H ( $r = .04$ ,  $p < .323$ ) and did not correlate with factor 1 ( $r = .00$ ,  $p < .915$ ). But factor 2 of the DIS correlated positively and significantly with both factors of the IUS-12-H ( $r = .14$ ,  $p < .002$  and  $r = .12$ ,  $p < .007$ ).

## **PSS10**

The two PSS10 factors correlated positively and significantly with the two IUS-12 factors. The correlations ranged from  $r = .32$  to  $r = .40$  ( $p < .000$ ). Similarly, the two PSS10

factors correlated positively and significantly with the two factors of the IUS-12-H (ranging from  $r = .24$  to  $r = .36$ ,  $p < .000$ ).

### **DERS-16**

All 5 factors of the DERS-16 were significantly positively correlated with the two factors of the IUS-12. Correlations with IUS-12 factor 1 ranged from  $r = .19$  to  $r = .39$ ,  $p < .000$ . Correlations with IUS-12 factor 2 ranged from  $r = .24$  to  $r = .41$ ,  $p < .000$ . The factor that had the strongest correlation with both IUS-12 factors was factor 5 ("Strategies", with  $r = .39$  and  $r = .41$ ,  $p < .000$ ). Similarly, all 5 factors of the DERS-16 correlated significantly and positively with both factors of the IUS-12-H. Correlations with IUS-12-H factor 1 ranged from  $r = .21$  to  $r = .33$ ,  $p < .000$ . Correlations with IUS-12-H factor 2 ranged from  $r = .19$  to  $r = .35$ ,  $p < .000$ . Again, the factor that correlated the most with both IUS-12H factors was factor 5, with  $r = .33$  and  $r = .35$ ,  $p < .000$ .

### **QIT**

Factor 1, 3 and 4 of the QIT correlated significantly with both factors of the IUS-12 (respectively  $r = .64$ ,  $r = .52$  and  $r = .32$  for factor 1 of the IUS-12 and  $r = .54$ ,  $r = .21$  and  $r = .38$  for factor 2 of the IUS-12,  $p < .000$ ). Factor 2 of the QIT was significantly negatively correlated with both factors of the IUS-12 ( $r = -.36$  and  $r = -.28$ ,  $p < .000$ ). The same pattern was observed for the IUS-12-H in that QIT factors 1, 3 and 4 correlated significantly positively with both IUS-12-H factors (respectively  $r = .46$ ,  $r = .39$  and  $r = .36$  for IUS-12-H factor 1 and  $r = .46$ ,  $r = .16$  and  $r = .31$  for IUS-12-H factor 2,  $p < .000$ ). Again, QIT factor 2 correlated significantly negatively with both factors of the IUS-12-H ( $r = -.24$  and  $r = -.25$ ,  $p < .000$ ).

### **NFCO**

NFCO correlated negatively and significantly with both IUS-12 factors ( $r = -.24$  and  $r = -.25$ ,  $p < .000$ ) and both IUS-12-H factors ( $r = -.25$  and  $r = -.39$ ,  $p < .000$ ).

## **NFC**

The NFC showed positive and significant correlations with both IUS-12 factors ( $r = .64$  and  $r = .41, p < .000$ ) and both IUS-12-H factors ( $r = .49$  and  $r = .33, p < .000$ ).

## **TAMSAD**

TAMSAD was significantly negatively correlated with both factors of the IUS-12 ( $r = -.44$  for both factors,  $p < .000$ ). These significant and high negative correlations were also found with the two IUS-12-H factors ( $r = -.49$  and  $r = -.48, p < .000$ ).

### ***Assessing external validity using exploratory factorial analysis***

Overall, the scales showed a factor structure quite distinct from that of the IUS-12 and IUS-12-H. Regarding convergent validity, the IUS-12 and the IUS-12-H cross-loaded on most items. Only factor 1 of the IUS-12 was in a separate factor from the other items. For the additional scales, only the QIT showed partial cross-loading with the IUS-12. Factor 1 of the IUS-12 cross-loaded with the items of factor 3 of the QIT model that we retained during our previous analyses. Factor 2 of the IUS-12 did not cross load with the QIT. The results of these analyses are summarised in Table 5.

**Table 5***Results of the external validity factorial analyses of the IUS-12 and IUS-12-H**Résultats des analyses factorielles de validité externe de l'IUS-12 et de l'IUS-12-H*

	<b>PRU</b>	<b>DTS</b>	<b>DIS</b>	<b>PSS10</b>	<b>DERS-1 6</b>	<b>QIT</b>	<b>NFCO</b>	<b>NFC</b>	<b>IUS-12</b>	<b>TAMSA D</b>
<b>IUS-12</b>	Distinct	Distinct	Distinct	Distinct	Distinct	Partial crossloading	Distinct	Distinct	-	Distinct
<b>Matches our expectations</b>	No	Yes	Yes	Yes	Yes	Partially	Yes	Yes	-	Yes
<b>IUS-12-H</b>	Distinct	Distinct	Distinct	Distinct	Distinct	Distinct	Distinct	Distinct	Partial crossloading	Distinct
<b>Matches our expectations</b>	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Partially	Yes

Note: Distinct = Both scales have very distinct factor structures, Partial crossloading = Both scales have factor structures that crossload on some items



## Discussion

### *Overall study results*

Intolerance of uncertainty can have deleterious consequences on the medical decision-making process (Begin et al., 2021; Begun & Kaissi, 2004; Bhise et al., 2018; Dugas et al., 1997, as cited in Carleton et al., 2007; Dugas et al., 2005; Grenier et al., 2005; Hicks & Kluemper, 2011, Meyer et al., 2021; Moffett et al., 2021; Motte et al., 2020). More studies are needed to understand the link between IU and medical decisions (Brun et al., 2022). No valid and reliable scale exists to measure this parameter on French populations, and even more so on HCPs. Previous psychometric analyses were conducted on the English version of the IUS-12 (*i.e.*, one of the main scales used to measure IU) and deemed the scale to have two factors: desire for predictability (*i.e.*, needing to know what is going to happen) and uncertainty paralysis (*i.e.*, inability to act due to uncertainty, Berenbaum et al., 2008; Birrell et al., 2011). But newer analysis suggested a bi-factorial composition of the IU including prospective IU (*i.e.*, "propensity of individuals toward active information seeking as a way to reduce uncertainty/increase certainty", factor 1, Bottesi et al., 2019) and inhibitory IU (*i.e.*, "an inhibition of actions or experience which is caused by uncertainty", factor 2, Bottesi et al., 2019, Jackson et al., 2016).

To overcome this lack of reliable tools and clarify the factor structure of the IUS-12, we submitted French versions of the IUS-12 and the IUS-12-H to HCPs to conduct a psychometric validation procedure on these two scales. We recruited HCPs to answer our questionnaire, which included the IUS-12, the IUS-12-H, and scales intended to be used to establish the convergent and divergent validity of our two scales. Our psychometric analyses of the responses of 516 HCPs suggest that both scales are psychometrically valid and can be used to measure IU (with the IUS-12) and IU in the medical context among HCPs (with the IUS-12-H). The two scales correlated highly and positively with each other but diverged from

the additional scales that were used to establish their divergent validity. We conclude that both our scales have good psychometric qualities and are valid. The IUS-12 can be used to assess general IU, while the IUS-12-H can be used to measure IU in a medical professional context.

### ***Theoretical and practical implications***

Several theoretical implications are to be considered in light of our results and the factor structures found. Both the IUS-12 and the IUS-12-H had a similar factor structure to that described in the seminal article by Carleton et al (2007). However, we note that item 3 was not placed in the factor described by Carleton for the IUS-12 and that a model without this item was more satisfactory for the IUS-12-H. Therefore, this item may be removed from the IUS-12-H to ensure more satisfactory psychometric properties in the future. Regarding our factorial analyses for external validity between these two scales, we noticed that factor 1 items were included in a separate factor that did not cross load with the rest of the IUS-12-H. This could be explained by the content of the items in factor 1 which differ more from the IUS-12-H (a medical context bound measure) than the factor 2 items. Regarding the additional scales used in the study, we found the structures described in the literature for the PRU, DIS, NFCO, NFC, and TAMSAD. For the DTS, we did not find the lower order 4-factor structure described by Wagener and Blairy (2015). This is potentially due to our sample size as well as the specific population we interviewed, which may have a different distress experience than the general population. We tested different models and identified a satisfactory two-factor model but this required the removal of 6 items (*i.e.*, 40% of the scale), which did not seem acceptable to us and led us to retain the unidimensional model referring to the general factor described by Wagener and Blairy (2015). For the PSS10, a model without item 7 seemed more satisfactory. This slight difference is probably due to our sample

size and certainly does not question the structure of the scale. Similarly, for the DERS-16, the model described in the literature minus two items was more satisfactory, which in our view does not fundamentally question the validity of the structure originally described in the literature. For the QIT the mixing of some factors, the number of items that needed to be removed, and the number of models that we had to test suggest that more research is needed to determine whether this is due to our sample or whether the structure of the scale needs to be revised. Furthermore, we note that the items assessing avoidance and uncertainty of HCPs were grouped in our models, which may pave the way for a new factor structure where these items are grouped.

This study is also encouraging for many practical implications. Indeed, the IUS-12-H will now permit the measurement of IU among HCPs. In particular, this scale can be used in training courses involving HCPs with very different backgrounds and occupations. Beyond the prospects of comparison between professions, this scale offers the possibility of identifying HCPs with a high level of IU requiring remediation. This will also be an opportunity to develop and propose to HCPs pedagogical models adapted to their level of IU, without mixing in training individuals with very different levels of IU. In addition, we mentioned earlier the importance of comfort and well-being at work and how IU may impact these elements among HCPs. Following this validation, it is now possible to measure this construct and understand its impact, to determine whether it should be taken into account more fully in the professional practice of HCPs. As a result of this study, we now conceive IU, in the same way as anxiety, as a construct for which we all have a relatively modular baseline.

A more comprehensive consideration of this construct can hopefully have a positive impact on the care provided. Insofar as uncertainty can lead to inadequate care, we are pleased to know that with IU scales it is now possible to better understand how HCPs deal

with uncertainty and thus be able to identify individuals at greater risk of sub-optimal treatment issues due to poor uncertainty management.

### ***Limitations***

However, despite our encouraging results, we should not forget the limitations of our study. Firstly, the inclusion of students in our participants was arguably a choice that needed to be considered. Indeed, Stephens et al. (2022) noted that including students in a study on uncertainty tolerance may constitute a bias because their sources of uncertainty and the activities in which they occur are different. His results also show differences in the reliability of the measures between students and experts and suggest that the way these two populations conceptualize uncertainty tolerance differs. However, we found the expected structure for our scales of interest and with good reliability indicators. We can assume that this limitation had little influence on our results and that similar results would be found with a sample of confirmed HCPs only.

Another, obvious limitation in our study stems from the fact that we validated a health-oriented scale (*i.e.*, IUS-12-H) and a generalist scale (*i.e.*, IUS-12) on HCPs. This is quite relevant for the IUS-12-H, but implies that the IUS-12 has been validated on a population that is not general. It is possible that HCPs have a different level of tolerance to uncertainty and more generally a different way of dealing with uncertainty than the general population. Further studies should be conducted on a general population to confirm the psychometric qualities of the IUS-12.

Furthermore, our sampling method was based on the assumption that all HCPs should be comparable in terms of IU, so our analyses do not take into account the potential differences that may be observed in different types of HCPs. It is conceivable that IU has a different impact and implications for GPs and emergency physicians, for example (*e.g.*,

differing severity, life-threatening situations, or more trivial conditions). Future studies should compare IU scores of different medical professions to determine if there are inter-professional variations.

### ***Future research perspectives and conclusion***

It seems clear that one avenue for further research lies in comparing different types of HCPs. We did not make any assumptions about possible differences in IU levels between different types of HCPs. Future research should compare different populations to identify whether there are any specificities among different HCP types.

Other avenues for future research can be distinguished. One interesting point lies in the richness of the constructs we evaluated. We assessed a large number of constructs alongside our scales of interest to determine their psychometric validity. Table 4 reveal correlations that warrant further investigation (*e.g.*, high negative correlations between the IUS-12 and the TAMSAD, which measure constructs for which a distinction is not fully supported empirically and are considered similar or even interchangeable in the literature; Hillen et al., 2017; Rosen et al., 2014) as well as unexpected factor structure differences (*e.g.*, the PRU and the QIT, which have distinct factorial structures from the IUS-12). These points need to be clarified to better understand how these constructs relate to IU.

Lastly, we think that the most important new area of research involves the interpretation of the scores on our scales. We are aware that a framework for interpreting the score is needed and future studies will have to determine at what threshold of "score change" one can consider there has been a change in the IU of HCPs. More precisely, two questions need to be addressed: 1) At what level of "score change" between two administrations of the scales can we consider that a change has occurred for the IU construct of a given person and 2) What level of "score change" can be expected between two administrations of our scales.

To summarise, the most important area for future research is to determine the "minimal clinically important difference" (MCID; McGlothlin & Lewis, 2014) that can be expected for our scales. Indeed, if we conceptualize IU as a relatively stable but changeable trait, we should expect the scores on our scales to be able to evolve and it is important to determine at what level of "score change" we can consider that a training intended to develop tolerance to uncertainty has influenced participants for instance. With our sample, we see that the average level that can be expected on these scales is around  $M = 2.30$ , with a standard deviation of about  $SD = .70$ . The averages give us an idea of the scores that individuals might get on these scales, while the standard deviations suggest the range of score changes that can be expected with these scales. To determine the exact "minimum clinically relevant difference" an interesting approach would be to assess IU in two different groups. One group would be characterized by a high level of IU and a low level of well-being, while another group would be characterized by a low level of IU and a normal (or high) level of well-being. By comparing the scores on the IU scales of these two groups, we could gauge the level of "score change" that can be expected (*i.e.*, to what extent can IU decrease?). Alternatively, we could conduct a study on a group with high IU and a low level of well-being (time t1), then offer them training to improve their tolerance of uncertainty, and measure their IU level after the training (time t2). This would allow us to know precisely to what extent a "score change" can occur and to provide an accurate score interpretation grid for our scales. This would facilitate their use and promote the development of studies evaluating this construct in general contexts, and in medical practice.

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## Supplementary Material

### *Results of factor analysis of the additional scales*

#### **PRU**

We tested the four-factor model of the Gerrity et al., (1995) PRU scale. We observed the same structure as theirs, with all factor loadings ranging between 0.49 and 1.00. This model explained 61% of the variance ( $\alpha = .85$ ). We chose to stick to this model for further analysis.

#### **DTS**

We tested the model described by Wagener and Blairy (2015) comprising 4 lower-order factors comprised in one higher-order factor. First, we tested a four-factor model. We found a somewhat similar structure, but many items were saturated in a different factor than the one Wagener and Blairy had described as their original factor. Firstly, the “Absorption” and “Appraisal” factors were partly mixed into one factor (with factor loadings ranging from 0.53 to 0.94). We found the "Tolerance" factor (with factor loadings ranging from 0.50 to 0.98), but item 5 was missing and saturated at 0.42 in the factor mixing the "Absorption" and "Appraisal" factors. Items 11 and 12 of the “Appraisal” factor constituted a new single factor (with factor loadings ranging from 0.68 to 1.00). We partially found the "Regulation" factor, with items 8 and 13-factor loadings ranging from 0.84 to 0.97, but item 14 only loading at 0.38. Furthermore, item 7 saturated similarly in several factors, and item 6 did not saturate in any factor. This model explained 54% of the variance. To test for a unidimensional structure corresponding to the general factor described by Wagener and Blairy, we calculated the cronbach's alpha of this scale. Its value was very high ( $\alpha = .91$ ). We, therefore, decided to retain the unidimensional structure of this scale.

## **DIS**

We tested a two-factor model to compare it to the model proposed by Wagener and Blairy (2015). We observed the same two-factor structure that explained 47% of the variance ( $\alpha = .62$ ). All factor loadings ranged between 0.35 and 0.94. We retained this model.

## **PSS10**

We tested a two-factor model for comparisons with the Lesage et al. (2012) structure. This first model explained 36% of the variance and the factor loadings ranged from 0.47 to 0.76. But item 7 was cross-loaded with low values (0.31 in the factor where it should not be and 0.22 in its original factor). We tested a second model without item 7. The factor loadings ranged from 0.48 to 0.73 and it explained 37% of variance ( $\alpha = .79$ ). We retained this model.

## **DERS-16**

We tested the 5-factor model described in the literature (Bjureberg et al., 2016; Shahabi et al., 2020; Westerlund & Santtila, 2018; Yiğit & Guzey Yiğit, 2019). We found factors 1 (“Clarity”, with factor loadings ranging from 0.48 to 1.05) and 3 (“Impulse”, with factor loadings ranging from 0.61 to 1.04). We also found factor 5 (“Strategies”, with factor loadings ranging from 0.41 to 0.85). But item 10 from factor 4 (“Nonacceptance”) loaded at 0.38 into factor 5 and item 16 from factor 5 loaded into factor 2 (“Goals”) at 0.50. We found factor 2 (with factor loadings ranging from 0.71 to 0.94) plus item 16, and factor 4 (with factor loadings ranging from 0.93 to 0.94) minus item 10. This model explained 65% of the variance. We tested this 5-factor model again without items 10 and 16. The model explained 67% of the variance and we found all the factors described in the literature. The factor loadings were good (ranging from 0.48 to 1.04 for factor 1, from 0.66 to 0.90 for factor 2, from 0.60 to 1.08 for factor 3, from 0.78 to 1.05 for factor 4 and from 0.41 to 0.92 for factor 5;  $\alpha = .90$ ). We decided to retain this model.

## QIT

We tested the 5-factor model described by Laphorn and Hellemans (2011). This model explained 45% of the variance. We found factor 3 (*i.e.*, uncertainty management through control, with loadings ranging from 0.44 to 0.77) and factor 4 (*i.e.*, uncertainty management through reinsurance, with loadings ranging from 0.49 to 1.06). We also found factor 2 (*i.e.*, perception of the constructive side of uncertainty, with loading factors ranging from 0.49 to 0.75). However, item 27 is only saturated with a value of 0.30 and also saturated in factors 1 and 3 (at -0.23 and -0.21). As for factors 1 and 5, they were partly mixed. This grouping of items included all of the items in factor 5 (*i.e.*, uncertainty management through avoidance) and all of the items in factor 1 (*i.e.*, perception of the wearing side of uncertainty), minus items 1 and 11 (with loadings ranging from 0.42 to 0.84). Items 1 and 11 were grouped in a new factor comprising only them (with loadings of 0.50 and 0.82). Item 16 saturated similarly in the factor combining factors 1 and 5 and in the new factor combining items 1 and 11 (at 0.47 and 0.45). We decided to test a 4-factor model. This model explained 44% of the variance. We found factors 2 (loadings ranging from 0.49 to 0.74), 3 (loadings ranging from 0.47 to 0.74) and 4 (loadings ranging from 0.47 to 1.06). The remaining factor was a mixture of factors 1 and 5 (with loadings ranging from 0.47 to 0.77). Only item 27 remained problematic as it loaded similarly in all three factors (-0.25 for factor 1, 0.30 for factor 2, and -0.20 for factor 3). Thus, we reran our analysis using this model without item 27. We found the same structure with satisfactory saturations (between 0.47 and 0.76 for factor 1 (grouping of initial factors 1 and 5), 0.47 and 0.74 for factor 2, 0.46 and 0.73 for factor 3, and 0.47 and 1.07 for factor 4) and the model still explained 44% of the variance ( $\alpha = .82$ ). We decided to keep this model for further analysis.

### **NFCO, NFC, and TAMSAD**

For the unidimensional scales we calculated their Cronbach's alpha. All cronbach's alphas were satisfactory (NFCO:  $\alpha = .85$ ; NFC:  $\alpha = .84$ ; TAMSAD:  $\alpha = .$