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Original article

## Psychometric properties of the French version of the Herth Hope Index assessment (HHI-F)

### *Propriétés psychométriques de la version française du Herth Hope Index (HHI-F)*

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#### ABSTRACT

**Introduction.** – The feeling of hope is an important factor in the well-being and mental health of individuals. The 12-item Herth Hope Index (HHI) measures different dimensions of hope and assesses the state of motivation to overcome situations with strong stressful or life threatening factors.

**Objective.** – The aim of this study was to evaluate the psychometric properties of a French adaptation of the HHI.

**Method.** – Based on a French translation of the HHI made during a translation and counter-translation process (HHI-F), 247 higher education students completed an online survey on their mental health state during the COVID-19 pandemic, which included the HHI-F. A principal factor analysis (PCA) and several confirmatory factor analyses (CFA) were conducted to compare the structure of the HHI-F with that of the original scale. Internal consistency and convergent validity were also assessed.

**Results.** – The best model relates to a two-factor solution, corresponding to the Spanish translation of the HHI. Internal consistency was very satisfactory, with a Cronbach's alpha coefficient of .895 and a McDonald's Omega coefficient of .898. Significant correlations were observed between the HHI-F score and the Depression Anxiety Stress Scales (DASS-21), Impact of Event Scale-Revised (IES-R) and Brief Resilient Coping Scale (BRCS).

**Discussion.** – The HHI-F showed good psychometric qualities, although its structure does not fully correspond to the original version of the HHI. This scale should thus facilitate research in mental health psychology among French-speaking audiences.

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#### R É S U M É

Le sentiment d'espoir est un facteur important de bien-être et de santé mentale chez les individus. L'échelle Herth Hope Index (HHI), comportant 12 items, en mesure différentes dimensions et évalue l'état de motivation pour surmonter les situations à fortes composantes stressantes ou présentant un danger vital. Le but de cette étude est d'évaluer les propriétés psychométriques d'une adaptation française du HHI. Sur la base d'une traduction en français du HHI réalisée au cours d'un processus de traduction et de contre-traduction (HHI-F), 247 étudiants en école de santé ont complété une enquête en ligne portant sur leur état psychologique durant la pandémie COVID-19. Une analyse en composantes principales (ACP), et plusieurs analyses factorielles confirmatoires (AFC) ont été menées afin de comparer la structure du HHI-F avec celle de l'échelle originale. La cohérence interne et la validité convergente ont également été évaluées. Le meilleur modèle correspond à une solution à deux facteurs, correspondant à la traduction en espagnole du HHI. La cohérence interne est très satisfaisante, avec un coefficient alpha de Cronbach de .895 et un coefficient omega de McDonald de .898. Des corrélations significatives ont été observées entre le score du HHI-F et les échelles Depression Anxiety Stress Scales (DASS-21), Impact of Event Scale-Revised (IES-R) et Brief Resilient Coping Scale (BRCS). Le HHI-F a montré de bonnes qualités psychométriques,

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même si sa structure ne correspond pas totalement à la version originale du HHI. Cette échelle devrait ainsi faciliter les recherches en psychologie de la santé mentale auprès des publics francophones.

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## 1. Abbreviations

HHI	Herth Hope Index
HHI-F	Herth Hope Index – French
COVID-19	CoronaVirus Induced Disease 2019
DASS-21	Depression, Anxiety and Stress Scale
IES-R	Impact of Event Scale-Revised:
BRCS	Brief Resilient Coping Scale
CVI	Content Validation Index

## 2. Introduction

Hope has been recognized in all disciplines as an important and necessary motivational state for overcoming life's adversities or situations of great and imminent danger. A high level of hope even seems to be a prerequisite for better coping, effective and reflective decision making and seems to decrease associated problems such as stress, depression and related adverse effects (Nierop-van Baalen et al., 2020; Duggleby et al., 2021; Gallagher et al., 2020).

According to Herth (1990), hope is a complex, multidimensional concept. Several definitions of hope have been developed concerning different groups of people, but it still seems difficult to arrive at one definition that translates the entire meaning of hope and its relation to health, disease and health care (Cutcliffe & Herth, 2002).

Moreau (2009, p. 14) gives several definitions of the hope construct. One of them is a consensus and demonstrates the complex multidimensionality of the concept by describing the relation between this psychological state and the social, behavioural and cognitive reactions that result from it: "Hope is a positive anticipation of the future, based on mutuality of relationships with others, a sense of personal competence, coping skills, psychological well-being, meaning in life as well as a sense of possibility; the hopeful person expects to experience positive consequences".

The relation between hope and the implementation of positive strategies or the improvement of variables related to psychosocial well-being now seems to be well demonstrated in contexts of identified hazards such as war conflicts (Taha et al., 2021), environmental conflicts (Chadwick, 2015) or chronic and/or severe diseases (Robieux et al., 2018; Leite, 2020). These findings are further supported by several studies such as systematic reviews, analysing the construct validity of the HHI (Nayeri et al., 2020) as well as the evaluation of the effectiveness of hope interventions (Hernandez & Overholser, 2021) and meta-analyses (Duggleby et al., 2010, 2012) exploring hope experiences of different populations.

The beginning of the 21st century is witnessing the emergence of new threats that illustrate the vulnerability of our societies to health, industrial, natural, social or technological risks. Today's society is changing rapidly, and new challenges are being imposed on the new generation: climate change, unemployment and social protest, pandemics, technological revolution, etc.

The measurement of hope may therefore be a fundamental dimension of the mental health and/or quality of life and well-being of this population. Indeed, the measure of hope is often associated and correlated with other measures of psychological health, such as self-efficacy, optimism, anxiety, depression, problem solving (Delas et al., 2015). This measure can then be interesting in clinical practice, in the short term to detect current problems or in

the medium and long term to anticipate future difficulties. This is why we believe that the dimensions of hope should be systematically studied during mental health assessments, and that health professionals should be trained in this assessment (Viana et al., 2010).

Herth (1991, 1992) developed an instrument for assessing "hope": the Herth Hope Index (HHI). It was originally designed to evaluate hope in young people with chronic illnesses and one of the author's main objectives was to create an instrument capable of accessing the multiple dimensions of hope, while also reducing the complexity and the number of items of the other available instruments.

The HHI assesses hope through 12 items that measure 3 main dimensions related to:

1. temporality and the future (items 1, 2, 6 and 11);
2. preparation (items 4, 7, 10 and 12);
3. positive expectations and interconnection (items 3, 5, 8 et 9).

The measurement instrument uses a 4-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). The scale has an overall score ranging from 12 to 48. A higher score indicates a higher level of hope. Items 3 and 6 are reversed.

The HHI has been translated into several languages, but a validated French version does not yet exist. Nevertheless, the dimensionality of the HHI has been shown to be rather unstable in translations between cultures and different types of populations (Ripamonti et al., 2012) with factors of greater or lesser importance depending on the culture: religiosity, self-confidence or inner strength. Three studies report only 1 factor, (Geiser et al., 2015; Ripamonti et al., 2012; Soleimani et al., 2019; Viana et al., 2010), 4 studies report 2 (Benzein & Berg, 2003; Van Gestel-Timmermans et al., 2010; Wahl et al., 2004; Yaghoobzadeh et al., 2019), 5 studies suggest 3 factors (Aslan et al., 2007; Balsanelli et al., 2010; Chan et al., 2012; Herth, 1992; Hirano et al., 2007; Mousa et al., 2017), and only one study suggests 4 factors (Arnau et al., 2010) (see Table 1).

We believe that a validated French version of the HHI would be of great importance and would allow different French speaking regions around the world to better understand this complex concept and to (1) be able to reliably assess levels of hope, (2) propose strategies for strengthening hope and (3) evaluate the results of the actions taken.

A cross-cultural validation process is necessary in order to ensure the validity of the tool when translated to French. To ensure comparability between the original and the translated version, it is recommended to follow a precise translation procedure, using validation methods that have proven their usefulness and reliability (Maneesriwongul & Dixon, 2004). The convergent validity is also in the literature, the measure of hope is often associated and correlated with other measures of psychological health, such as self-efficacy, optimism, anxiety, depression, problem solving (Delas et al., 2015). For this reason, the HHI-F was compared to the following questionnaires: the Depression, Anxiety and Stress Scale (DASS-21) (Lovibond & Lovibond, 1995), the Impact of Event Scale-Revised (IES-R) (Weiss & Marmar, 1997) and the Brief Resilient Coping Scale (BRCS) (Sinclair & Wallston, 2004).

**Table 1**  
Summary of HHI translations in several languages, including Cronbach's alphas and number of dimensions found.

Author (year), places	Language of the destination	Number of dimensions/factors (with Cronbach's alpha for each factor)	Cronbach's alpha
Original version: Herth (1992), USA	English	3 (from .78 to .86 – no more information)	$\alpha = .97$
Geiser et al. (2015), Germany	Germany	3 (unknown)	$\alpha = .82$
Khater and Alkwiase (2013), Jordanie	Arabic	Not calculated (unknown)	$\alpha = .61$
Mousa et al. (2017), Egypt	Arabic	3 (unknown)	$\alpha = .78$
Chan et al. (2012)	Chinese	3 (.82, .88, .76)	$\alpha = .80$
Arnau et al. (2010)	Spanish	4 (.819, .789, .775, .736)	Described as satisfactory
Sánchez-Teruel et al. (2020)	Spanish	2 (unknown)	$\alpha = .97$
Van Gestel-Timmermans et al. (2010)	Dutch	2 (unknown)	$\alpha = .84$
Ripamonti et al. (2012), Italy	Italian	1	$\alpha = .84$
Hirano et al. (2007), Japan	Japanese	3 (unknown)	$\alpha = .89$
Ishimwe et al. (2020), Rwanda	Kinyarwanda	Not calculated	$\alpha = .85$
Wahl et al. (2004), Norway	Norwegian	2 (unknown)	$\alpha = .81$
Soleimani et al. (2019), Iran	Persian	1	$\alpha = .856$
Yaghoobzadeh et al. (2019), Iran	Persian	2 (.876, .665)	$\alpha = .70$
Viana et al. (2010), Portugal	Portuguese	1	$\alpha = .873$
Balsanelli et al. (2010), Brazil	Portuguese	3 (unknown)	$\alpha = .834$
Benzein and Berg (2003), Sweden	Swedish	2 (.89, .56)	$\alpha = .88$
Hsu et al. (2007), Thailand	Thai	Not calculated	$\alpha = .89$
Aslan et al. (2007), Turkey	Turkish	3 (unknown)	$\alpha = .75$

This study was developed in the context of a larger international study that focused on the mental health of higher education students living in Portugal and in Switzerland during the coronavirus pandemic (Querido et al., 2021).

### 3. Objectives

The present study aims at testing the validity of a French version of the HHI questionnaire, named HHI-F. The first objective is to adapt in French the HHI according to the proposed methodology by Vallerand (1989) and Gana et al. (2021). The second objective is to verify the psychometric properties of the French version of the HHI, through the measure of internal consistency with Cronbach's alphas and McDonald's omega (Hayes & Coutts, 2020), principal factor analysis (PCA), confirmatory factor analysis (CFA) and the measure of convergent validity.

## 4. Method

### 4.1. French adaptation and validation process

According to the methodology for the adaptation of measurement scales in psychology described by Vallerand (1989) and later updated by Gana et al. (2021), we followed a 5-step adaptation and validation process:

- preparation of the preliminary French version of the Herth Hope Index (HHI-F);
- back-translation from French to German;
- evaluation of the preliminary version of the HHI-F;
- back-translation from French to English;
- evaluation of the psychometric properties of the HHI-F.

### 4.2. French adaptation of the HHI

First, we contacted Dr. Herth, who is the designer of this scale, to ensure that a French translation was not available. She informed us of the use of a French (Quebec) translation but she did not have the details of the validation process of this version. We were unable to obtain this version and Dr Herth had previously given us permission to conduct research on the French translation of the HHI scale.

#### 4.2.1. Preparation of the preliminary French version of the Herth Hope Index (HHI-F)

The translation of a questionnaire involved two essential steps: a literal translation and an adaptation to the cultural context, life habits and idioms of the target population (Bouletreau & Chouanière, 1999). The HHI measurement instrument does not have a French validation, but it has a validated German translation (Geiser et al., 2015). As the School of Health Sciences Fribourg is a bilingual institution (i.e. French and German), we choose to use the German validated version of the HHI in order to translate this instrument in French.

We used a cross-cultural validation by a back-translation method (Caron, 1999; Mokkink et al., 2010). This methodology requires two steps: the preparation of a draft version and the evaluation of this draft version. Back-translation involves making a first translation into the desired language (i.e. French in our case), then (re)translating the tool into the original language by a different translator. The difference between the original version and the (re)translated version makes it possible to identify the problematic items, and the operation is repeated until a consensus is reached. The selection of the translators for the first draft version included the following criteria: expertise in mental health and teaching in both languages (French and German). We selected two independent translators with an academic background in mental health ( $n = 2$ ): a nurse specialist in mental health who is also a practitioner trainer, and a professor, PhD in medical sciences, teaching in mental health and psychiatry.

The first translator received instructions to translate the German version of the scale into French.

#### 4.2.2. Back-translation from French to German

The second translator received the translated scale in French and the instruction to (re)translate it into German. We then presented the versions to both parties in order to discuss the differences and reach a consensus. In order to check the quality of the items in the final version of the questionnaire, we conducted a double check (i.e. qualitative and quantitative). We sought to obtain from our translators both:

- a qualitative consensus that they had to judge according to a 3-point likert scale “weak, medium or strong”;
- a quantitative consensus through the Copyleaks® software.

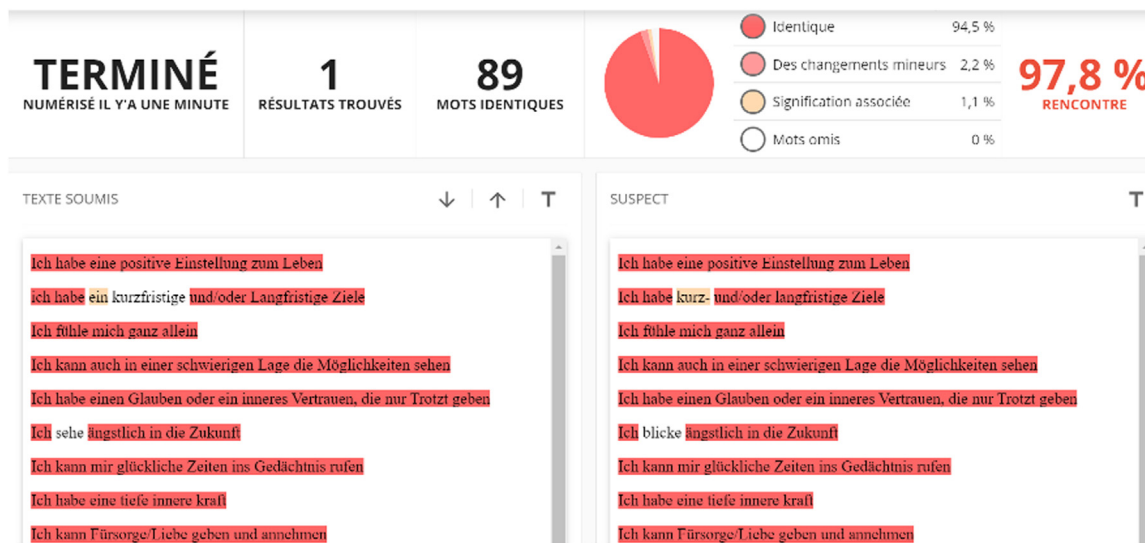


Fig. 1. Similarity analysis between the original version and the retranslation of the Herth Hope Index (HHI) questionnaire carried out by the Copyleaks software.

We corrected the content until we obtained a satisfactory agreement (strong agreement and <90% agreement) between our two experts (see Fig. 1).

In order to compare the original German HHI and our back-translation, we used the Copyleaks software. This software detects paraphrased content, compares lexical fields and textual similarities with the help of artificial intelligence (AI) based algorithms. The aim was to achieve the highest possible similarity. We set the limit of acceptability <90% similarity, while a document is considered a duplicate from 70% onwards (Calculating the similarity rate, 2020).

For this questionnaire we obtained 97.8% similarity between the original version and the (re)translation made by our 2 independent translators (see Fig. 2).

Following the similarity analysis, the two translators discussed the points of disagreement until a “strong” consensus was reached. At this stage, we had a draft version which could be evaluated by a committee of experts and then by a sample of users.

#### 4.2.3. Evaluation of the preliminary version of the HHI-F

The evaluation of the draft version was carried out in two phases. The first phase involved a panel of experts ( $n=5$ ) to validate the final translation of the questionnaire. The second phase involved end-users of the questionnaires ( $n=13$ ) to pre-test the items for comprehension.

**4.2.3.1. Evaluation by a committee of experts.** The face validity method - which we use in this section - suggests the use of experts representative of the target population (Contandriopoulos et al., 2000), chosen according to the different items assessed. We selected a committee of experts to validate the first stage of translation (preparation of the draft version). The inclusion criteria were the same as in the previous stage, i.e. they had significant expertise in the languages of translation (i.e. French and German) and strong mental health skills.

In total, five experts ( $n=5$ ) were selected: one associate professor, with a PhD in medicine and bioethics, three professors with PhD in nursing, one senior lecturer specialised in chronic diseases in geriatrics. We provided our experts with the original and the draft version and asked them whether they found the translated items problematic, insufficient or well translated and consistent. We sought to obtain a consensus from our five experts. The panel of experts then allowed us to determine which translation seemed to be the most relevant.

Table 2

Example of experts' verbalizations for the comparison of the original and the draft version.

Proposals and discussions by experts	
Item 3	
Expert 1	« Je me sens seul »
Expert 4	« Je me sens <b>tout</b> seul »
Expert 5	« J'ai un <b>sentiment de solitude</b> »
Items 4	
Expert 1	« Même dans les situations difficiles, je peux voir <b>des alternatives</b> »
Expert 2	« Même dans une situation difficile, je peux voir <b>les possibilités</b> »
Expert 4	« Même dans une situation difficile, je peux voir <b>des options</b> »
Items 5	
Expert 3	« J'ai une foi ou une confiance intérieure qui me donne <b>de l'espoir</b> »
Expert 4	« J'ai une foi ou une confiance intérieure qui ne donne <b>que du défi</b> »
Items 8	
Expert 1	« <b>J'ai</b> une force <b>intérieure</b> profonde »
Expert 2	« <b>Je dispose</b> d'une force profonde »
Items 9	
Expert 1	« Je suis capable de donner et de recevoir de <b>l'amour</b> »
Expert 2	« Je suis capable de donner et de recevoir de <b>l'attention</b> »
Expert 3	« Je suis capable de donner et de recevoir de l'amour/ <b>des soins</b> »
Expert 4	« Je peux donner et recevoir <b>des soins/de l'amour</b> »
Items 10	
Expert 1	« Je <b>sais généralement</b> dans quelle direction <b>je veux aller</b> »
Expert 2	« La plupart du temps, je sais où aller »
Expert 3	« Je sais <b>plus ou moins</b> quelle direction <b>je veux prendre</b> »
Items 12	
Expert 2	« <b>j'ai le sentiment</b> que ma vie à de la valeur et de l'intérêt »
Expert 3	« Je pense que ma vie <b>est précieuse et intéressante</b> »

The experts discussed the translations of the items. When they disagreed, they discussed among themselves until a consensus was reached. They all had to agree among themselves for the items to be accepted (see Table 2).

**4.2.3.2. Evaluation with an end-user panel.** In order to finalise the translation process, we submitted the consensus version to the end-users in order to determine which items could pose problems of comprehension. ISPOR's (International Society for Pharmacoeconomics and Outcomes Research) recommendations for this stage are to use a sample of five to eight people representing the target population, born in the target country (Wild et al., 2005).

Thirteen students from the University of Applied Sciences and Arts Western Switzerland (HES-SO), participated in this evaluation. They were asked to rate the “clarity” of all items, from 1. “The statement is unclear”, to 4. “The statement is clear”. Clarity

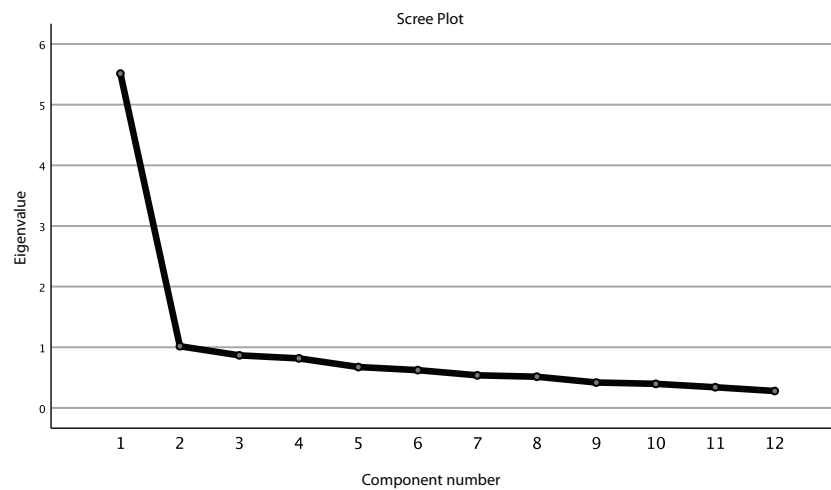


Fig. 2. HHI-F collapse plot, suggesting a two-factor structure.

Table 3

Expert ratings of the representativeness and clarity of each of the statements in the draft (average per CVI, overall average and percentage change).

Statements	Overall average 1	CVI 1	Overall average 2	CVI 2	Overall average variation	Variation CVI
1	3.85	0.85				
2	4.00	1.00				
3	3.62	0.77	3.77	0.92	0.04	0.20
4	3.31	0.77	3.38	0.92	0.02	0.20
5	3.31	0.85				
6	3.31	0.77	3.77	0.92	0.14	0.20
7	3.92	0.92				
8	3.46	0.69	3.62	0.92	0.04	0.33
9	3.77	0.92				
10	3.62	0.92				
11	3.77	0.85				
12	3.69	0.85				

concerned the form, i.e. the understanding of the questions that were asked.

We used the Content Validation Index (CVI) as a statistical model to analyse the content validity of the scale translation. According to Waltz et al. (2005), items with scores of 3 or less are changed according to the experts' suggestions and the test is retaken with the changes at T2. Furthermore, a validity index is acceptable if it is equal to or greater than 0.80.

The CVI scores were high at T1 due to the methodology already in place upstream (i.e. face validity by a group of experts). However, we had to make some changes on the form. The students brought criticisms, and proposals for change. After the changes were implemented we again proposed a version that considered the changes and proposals made by our subjects. All our results were then greater than or equal to .80 after the second test phase (i.e. T2).

In a summary table, we calculated the means at T1 and T2, as well as the CVI, the variations in the mean between the two runs and the percentage change (see Table 3). For example, item III obtained at T1  $m = 3.62$  and at T2  $m = 3.77$ , which represents respectively an CVI at T1 of .77 and which evolves to 0.92 at T2, which provides a variation in the mean of 4%, and a variation in the CVI of 20% (cf. red box).

In conclusion, the CVI allowed us to refine the analysis provided by our back-translation methodology and to adapt it to our end-users.

#### 4.2.4. Back-translation from French to English

We made sure that the translation from the HHI German version into French corresponded to the original items, by performing a new back-translation step from French into English.

Six French-English bilingual researchers, native English speakers, conducted a back-translation of the 12 HHI items. The results obtained show a satisfactory correspondence for most items between the French and English versions. For example, item 1 "I have a positive outlook towards life" was back-translated as "I have a positive view on life" or "I have a positive attitude to life". Similarly, item 8 "I have a deep inner strength" was back-translated as "I have a strong inner strength".

On the other hand, item 4 "I can see a light in a tunnel" received the furthest back-translations from the original version. The back-translations are, for example, "Even in a difficult situation, I can find other options" or "Even in a difficult situation I can find alternatives". These back-translations can be explained by the German translation of the HHI, which deliberately deviated from the language figure of a light at the end of the tunnel. The authors explain that in German, this expression is too close to near-death experiences, which could lead to confusion in the interpretation of this item, which on the contrary has a positive connotation. The authors therefore chose a freer translation, with "I can see new possibilities even in a difficult situation". In our back-translation, this is the wording that we find.

#### 4.3. Evaluation of the psychometric properties

##### 4.3.1. Procedures and participants

In order to test the consolidated translation of the HHI-F, a convenience sampling method was used. Sampling occurred within the University of Applied Sciences and Arts of Western Switzerland (HES-SO), covering the cantons of Vaud; Neuchâtel, a



**Table 4**  
Descriptive statistics of the sample.

Demographic characteristics	n (%)
Sex	
Female	161 (65.18%)
Male	86 (34.82%)
Marital status	
Single	233 (94.33%)
Married/common law	11 (4.45%)
Divorced	3 (1.21%)
Widower	0 (0%)
Education level	
Bachelor/License	227 (91.90%)
Post-grade	8 (3.24%)
Master	10 (4.05%)
Doctorat	0 (0%)
Other	2 (0.81%)
Age	
Average	23.40
Minimum	19
Maximum	49
25 <sup>e</sup> percentile	21
50 <sup>e</sup> percentile	23
75 <sup>e</sup> percentile	24
Dependent child(ren)	
Yes	7 (2.83%)
No	240 (97.17%)
Chronic illness	
Yes	16 (6.48%)
No	231 (93.52%)

French-speaking region; Fribourg; and Valais, where French is the co-official language.

The questionnaire HHI-F was completed by 396 higher education students from 5523. After deleting incomplete answers and those with a carelessness bias revealed by the two reversed items (items 3 and 6) (Weijters et al., 2013), we retained 247 participants.

Their average age was 23.32 years (min = 19; max = 49) for the women, and 23.56 years (min = 19; max = 46) for the men. There was a majority of females ( $n = 161$ ) compared to males ( $n = 86$ ). The majority were single ( $n = 233$ ) and a minority were married, in a common-law relationship ( $n = 11$ ) or divorced ( $n = 3$ ). Furthermore, most did not have children ( $n = 240$  vs. 7). We also note that the majority perceived themselves to be in good health and did not suffer from any chronic diseases ( $n = 231$  vs. 16). Most of the students were studying to obtain a bachelor's degree ( $n = 227$ ), and the rest of the sample was distributed between "postgraduate" ( $n = 8$ ), "master's" ( $n = 10$ ) and "other" ( $n = 2$ ). Finally, concerning professional activity alongside studies, the results were more mixed, with 138 students declaring that they had a job compared to 109. Demographic data are presented in Table 4.

#### 4.3.2. Measures

**4.3.2.1. DASS-21.** The Depression Anxiety Stress Scales (DASS-21) (Lovibond & Lovibond, 1995), which assesses a patient's state of depression, anxiety and stress is a three-dimensional scale with 21 items in its current version. For each item, participants are asked to position themselves on a 4-point Likert scale: 0 = Did not apply to me at all; 1 = Applied to me to some degree, or some of the time; 2 = Applied to me to a considerable degree or a good part of time; 3 = Applied to me very much or most of the time. The scores for each dimension are obtained by adding the scores ticked by the respondents for the corresponding items. Items 3, 5, 10, 13, 16, 17 and 21 are dedicated to the measurement of depression, items 2, 5, 7, 9, 15, 19 and 20 to the measurement of anxiety, items 1, 6, 8, 11, 12, 14 and 18 to the measurement of stress. According to several studies, the DASS-21 has good psychometric characteristics, especially with regard to its factorial validity (Lovibond & Lovibond, 1995; Osman et al., 2012).

**4.3.2.2. IES-R.** The Impact of Event Scale-Revised (IES-R) developed by Weiss and Marmar (1997) assesses the psychological impact of traumatic events. It consists of 22 items, on which respondents are asked to rate themselves on a 5-point Likert scale, ranging from 0 "Not at all", 1 "Somewhat", 2 "Moderately", 3 "Fairly" to 4 "Extremely". The IES-R distinguishes three dimensions: 1. reliving (items 1, 2, 3, 6, 9, 14, 15 and 20); 2. avoidance (items 5, 7, 8, 11, 12, 13, 17 and 22); 3. hyperactivation (items 4, 10, 15, 18, 19 and 21). The score for each dimension is calculated by summing the corresponding items. An overall IES-R score is also calculated by adding up all the items. The higher the score, the more severe the symptoms are considered to be.

**4.3.2.3. BRCS.** The Brief Resilient Coping Scale (BRCS) (Sinclair & Wallston, 2004) measures coping strategies. It consists of 4 items on which the patient is asked to position himself on a 5-point Likert scale, ranging from 1: "Does not describe me at all" to 5: "Describes me completely". The overall BRCS score is calculated by adding the scores of the 4 items. The higher the score, the greater the patient's resilience.

#### 4.3.3. Statistical analyses

All statistical analyses were conducted using SPSS 26 and JASP 0.16.2.

Exploratory analyses were conducted using principal factor analysis (PCA) with Varimax rotation. We choose an orthogonal rotation because it is expected that the factors are rather independent of each other. Indeed, Herth (1992) observed a strong correlation only between factor 1 and 2 ( $r = 0.42$ ), but weak correlations between factors 1 and 3 ( $r = 0.21$ ) and between 2 and 3 ( $r = 0.18$ ). In this context, the orthogonal rotation seemed the most relevant, choosing the Varimax rotation, which is very common in human and social sciences.

The internal consistency was measured with Cronbach's alphas and McDonald's omega (Hayes & Coutts, 2020). According to Nunnally (1978), the minimum acceptable coefficient should not be less than .70. For descriptive statistics and in order to evaluate a possible age and gender effects, Student's t-test and repeated measures ANOVAs were performed.

We also tested nine structural models with separate confirmatory factor analyses (CFA). For these analyses, goodness of fit was tested with Chi<sup>2</sup> test and a normed Chi<sup>2</sup>, a derived fit statistic less dependent on sample size. The normed Chi<sup>2</sup> is calculated, by dividing the Chi<sup>2</sup> index by the degree of freedom. A normed Chi<sup>2</sup> below 2 usually indicates a good model fit. Moreover, according to Schweizer (2010), we choose four other adjustment indices for the analysis: Standardised Root Mean square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Tucker-Lewis index (TLI) and Comparative Fit Index (CFI). The CFA models were assessed using the following fit indices (Hu & Bentler, 1999; Steiger, 2007): (a) Chi<sup>2</sup>/df values should be < 3; (b) SRMR and RMSEA values should be ≤ .06 and ≤ .08 for acceptable and good fit, respectively; and (c) CFI and TLI values should be > .90 and > .95 for acceptable and good fit, respectively.

Convergent validity was measured by comparing the HHI-F with the following questionnaires: the Depression, Anxiety and Stress Scale (DASS-21) (Lovibond & Lovibond, 1995), the Impact of Event Scale-Revised (IES-R) (Weiss & Marmar, 1997) and the Brief Resilient Coping Scale (BRCS) (Sinclair & Wallston, 2004).

**Table 5**  
2-factor Varimax rotation for the 12 HHI-F items.

Item	Factor	
	1. Confidence	2. Social
1	<b>0.704</b>	0.339
2	0.413	0.307
3	0.227	<b>0.607</b>
4	<b>0.715</b>	0.194
5	<b>0.794</b>	0.117
6	<b>0.630</b>	0.184
7	0.211	<b>0.719</b>
8	<b>0.725</b>	0.285
9	0.141	<b>0.813</b>
10	0.492	<b>0.553</b>
11	<b>0.611</b>	0.424
12	<b>0.574</b>	<b>0.575</b>

Bold numbers indicate an item load greater than .50 on a single factor. Bold and italic numbers indicate an item load of more than .50 on several factors.

## 5. Results

### 5.1. Exploratory study

#### 5.1.1. Principal factor analysis

A principal factor analysis (PCA) was conducted to test the construct validity of the HHI-F. The objective of the PCA is to check whether the factor structure of our translation is similar to that of the original scale (Herth, 1992).

First, we obtain a Kaiser-Meyer-Olkin (KMO) index of .912, with a highly significant Bartlett's sphericity test ( $p < .000$ ). This allows us to ensure that the HHI-F items are highly correlated with each other.

The Cattell (1966) scree test (Eigenvalues) suggests a 2-factor structure for the HHI-F (see Fig. 2). Indeed, the first two factors have an eigenvalue greater than 1, with an explanation of variance of 45.94% for the first factor, and 8.48% for the second. The third factor scores .867 and explains 7.22% of the variance. Nevertheless, after several principal factor analysis, on the one hand based on the eigenvalue, and on the other hand based on a fixed number of 3 factors to be extracted in accordance with the number of dimensions of the original HHI scale (Herth, 1992), we do not obtain radically different structures to the one obtained from a PCA based on an eigenvalue higher than 1. Indeed, only item 12 explains a third factor, the two other factors being explained by the same items as the PCA based on the eigenvalue. Therefore, we decided to keep the eigenvalue-based PCA that we describe in these results.

Table 5 shows the two-factor Varimax rotation for the 12 HHI-F items, consisting of items 1, 4, 5, 6, 8 and 11 for the first factor, and items 3, 7, 9 and 10 for the second factor. Item 12 scores almost similarly on both factors, and can therefore be classified as either. According to Nunnally (1978), items must have a weight greater than .50 to be retained in the analysis. In our case, item 2 does not reach this score for either factor 1 or factor 2 (Table 5). The items in the first factor refer to the confidence that people have in their ability to cope with life's difficulties ("Même dans une situation difficile, je peux trouver d'autres options"; "J'ai une force intérieure importante."). We therefore suggest naming this factor "Confidence". The items of the second factor refer rather to the connection to others, i.e. to the social dimension of hope ("Je me sens souvent seul."; "Je suis capable de donner et de recevoir de l'amour/des soins."). We therefore propose to call this factor "Social".

Nevertheless, we do not find the three factors that made up the original version of the HHI, which distinguishes items 1, 2, 6 and 11, items 4, 7, 10 and 12, and items 3, 5, 8 and 9. It should be noted, however, that these three factors have never been found

identically in the various translations of the HHI that have been produced (please refer to Table 1).

In our case, the factor structure of the HHI-F is quite similar to the Spanish adaptation (Sánchez-Teruel et al., 2020), which also included 2 factors with a very close distribution of items (items 1, 4, 5, 6 and 8 on factor 1, and items 2, 3, 7, 9, 10, 11 and 12 on factor 2).

#### 5.1.2. Internal consistency

The Cronbach's alpha for the HHI-F is equal to .895 and attests to good fidelity, since this score is higher than the .70 threshold recommended by Nunnally (1978). This fidelity score is however lower than the original version of the HHI, since Herth (1992) obtained an alpha of .97. However, this score is close to other translations of the HHI, such as the German (alpha = .82) (Geiser et al., 2015) or Norwegian (alpha = .81) (Benzein & Berg, 2003). No item deletion brings any really significant gain. The McDonald's omega coefficient is .898. No item deletion brings any really significant gain.

#### 5.1.3. Associations between the HHI-F scores and demographic variables

First, we focused on the overall HHI-F score. Contrary to Herth (1992), we obtained a significant difference between the score and gender ( $F(866.465) = 12.887, p < .001$ ), and the level of education followed ( $F(197.687) = 2.869, p < .05$ ). However, we did not observe a significant difference by age (Pearson correlation coefficient  $r = 0.120, p = 0.059$ ).

We also analysed the influence of other variables than those studied by Herth (1992). There was a significant difference between those with and without children ( $F(489.698) = 7.120, p < .01$ ), as was being a working student or not ( $F(429.933) = 6.229, p < .05$ ).

In a second step, we examined the scores obtained for each of the two HHI-F factors: confidence and social. We observed a significant gender difference for confidence ( $F(4.353) = 7.507, p = .007$ ), and highly significant for the social aspect of hope ( $F(8.914) = 15.530, p < .001$ ). Regarding the level of education, there was no significant difference for confidence ( $F(1.033) = 1.751, p < .157$ ), contrary to the social aspect ( $F(2.665) = 4.867, p = .003$ ). In contrast to the overall score, we observed a weakly significant correlation between age and confidence (Pearson correlation coefficient  $r = 0.132, p = 0.038$ ), but not a significant one between age and the social aspect (Pearson correlation coefficient  $r = 0.098, p = 0.125$ ).

For the additional demographic variables, we obtained moderate significant differences between those with and without children for confidence ( $F(4.444) = 7.670, p = .006$ ) and social aspect ( $F(3.053) = 5.421, p = .021$ ), as was being a working student or not for confidence ( $F(2.475) = 4.214, p = .041$ ) and social aspect ( $F(4.013) = 7.175, p = .008$ ).

### 5.2. Confirmatory study

#### 5.2.1. Confirmatory factor analysis

We first examined the psychometric property of the HHI-F by testing a two-factor CFA (Fig. 3). We used the weighted least squares (WLS) criterion for optimal estimation.

We also investigated if the two-factor structural model of the HHI-F, revealed by the PCA, corresponded to one or more translations of the HHI also including 2 factors (Spanish, Dutch, Norwegian, Persian and Swedish). Note that the internal consistency of the factor 1 (items 1, 4, 5, 6, 8 and 11) has a Cronbach's alpha score of .850, and factor 2 (items 3, 7, 9, 10 and 12) of .795. We then tested the correspondence with the original 3-factor HHI model, as well as with a one-dimensional model that other translations found (Table 6).

As shown in Table 6, the three-dimensional Herth model is not satisfactory for the indices. Therefore, the factor structure of the HHI-F does not match with the original model. The one-dimensional model, found in several translations, does not also fit

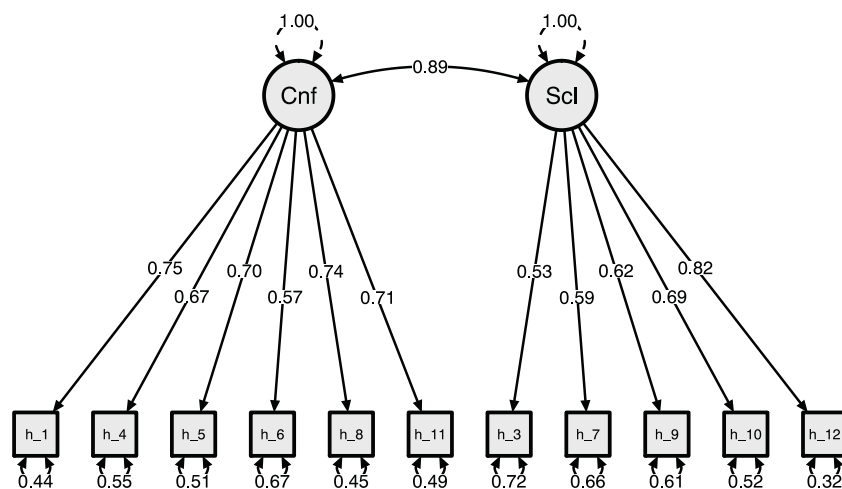


Fig. 3. Two-factor confirmatory factor analysis of HHI-F (n = 247) (Cnf = Confidence; Scl = Social).

Table 6

Fit index values for the nine different tested models.

Model	Chi <sup>2</sup>	p	ddl	Chi <sup>2</sup> /ddl	CFI	TLI	SRMR	RMSEA
Two-factor HHI-F model	102.21	<.001	43	2.38	0.943	0.928	0.047	0.076
HHI original structural model (Herth, 1992)	591.80	<.001	54	10.96	0.513	0.405	0.329	0.205
Unidimensional model (Herth, 1992)	140.47	<.001	54	2.60	0.922	0.904	0.051	0.082
Spanish (Sánchez-Teruel et al., 2020)	109.99	<.001	53	2.08	0.948	0.936	0.044	0.067
Dutch (Van Gestel-Timmermans et al., 2010)	139.42	<.001	53	2.63	0.922	0.903	0.051	0.083
Norwegian (Wahl et al., 2004)	139.62	<.001	53	2.63	0.922	0.902	0.051	0.083
Persian (Yaghoobzadeh et al., 2019)	93.64	<.001	34	2.75	0.932	0.910	0.051	0.086
Swedish (Benzein and Berg, 2003)	137.86	<.001	53	2.60	0.923	0.904	0.050	0.082

the HHI-F model either. On the other hand, we find a very satisfactory fit with the HHI Spanish translation, where all indices are superior to the other translations which also obtained two factors. We had already pointed out in the PCA that the distribution of items was almost similar between the HHI-F and the Spanish version.

5.2.2. Convergent validity

5.2.2.1. Correlation between the HHI-F and the DASS-21 scale. For the first concurrent validity study of the HHI-F, we measured the correlation between the 2 dimensions of the HHI-F and the global score, with the scores of the 3 dimensions of the DASS-21. The French version of the DASS-21 that we used is the one proposed by Ramasawmy et al. (2010). With our sample (n = 247), the Cronbach's alpha for the DASS-21 is equal to .941 and attests to very high fidelity.

The results show that all correlations are highly significant (p < .001) for all points of comparison that can be established between the HHI-F and DASS-21 scales (see Table 7).

The results seem consistent, since they indicate systematically negative correlations between the HHI-F and the DASS-21. Indeed, the higher the DASS-21 scores, the more they indicate a deteriorated state of mental health measured through the perception of depression, anxiety and stress. Conversely, the higher the HHI scores, the higher the level of hope. It therefore seems consistent that when a patient reports depression, anxiety and stress, their levels of hope for the future, preparedness and expectations are low.

5.2.2.2. Correlation between the HHI-F and IES-R Scale. For the second concurrent validity study of the HHI-F, we measured the correlation between the 2 dimensions of the HHI-F and the global score, with the scores of the 3 dimensions of the IES-R and the global score. The French version of the IES-R that we used is the one proposed by Chiasson et al. (2018). With our sample (n = 247), the

Cronbach's alpha for the IES-R is equal to .915 and attests to good fidelity.

The results show significant correlations for all points of comparison that can be established between the HHI-F and IES-R scales (see Table 7).

As in the concurrent validation with the DASS-21, all correlations between the IES-R and the HHI-F are negative. This can be explained by the fact that the more the psychological impact of the event is perceived as high by the patient and therefore traumatic, the more his hopes for the future, preparation and positive expectations decrease. These results are consistent.

5.2.2.3. Correlation between the HHI-F and the BRCS Scales. For the third concurrent validity study of the HHI-F, we measured the correlation between the 2 dimensions of the HHI-F and the global score, with the BRCS score. The French version of the BRCS that we used is the one proposed by Ionescu (2011). With our sample (n = 247), the Cronbach's alpha for the BRCS is equal to .630 and attests to low fidelity.

The results show significant correlations for all points of comparison that can be established between the HHI-F and BRCS scales (see Table 7).

The positive correlations attest to the validity of the HHI-F scale. Indeed, these results mean that the more coping strategies are developed in patients, the greater their sense of hope, which is a consistent link between these two psychological health factors.

6. Discussion

We proposed a French adaptation of the HHI hope scale, in order to promote French-speaking research on well-being and mental health, and to contribute to the cross-cultural psychometric validation of this scale. We suggested a translation methodology enriched by the use of the anti-plagiarism software Copyleaks®.



**Table 7**

Results of Pearson correlations between the 2 dimensions of the HHI-F and its overall score, and the scores of the DASS-21, IES-R and BRCS.

		HHI-F		
		Global score	Confidence	Social
DASS-21	Depression	-0.614**	-0.553**	-0.590**
	Anxiety	-0.462**	-0.407**	-0.467**
	Stress	-0.445**	-0.414**	-0.417**
IES-R	Global Score	-0.357**	-0.312**	-0.352**
	Reliving	-0.293**	-0.267**	-0.269**
	Avoidance	-0.271**	-0.229**	-0.283**
BRCS	Hyperactivation	-0.429**	-0.389**	-0.407**
		0.546**	0.573**	0.436**

\*\* Correlation is significant at the 0.01 level (2-tailed).

which allowed us to consolidate the back-translation stage. It seems to us that methods of translating measurement tools could make use of translation and textual similarity checking technologies that use powerful statistics (IA) to identify lexical fields, synonyms and syntactic contexts, etc. These tools could improve the quality of the translation phase and give additional information to the expert committee in favour or not of a consensus, and thus increase the results of the psychometric analysis.

The results we obtained do not corroborate the original 3-factor scale, but suggest a two-factor structure as in many other translations of the HHI (Benzein & Berg, 2003; Sánchez-Teruel et al., 2020; Van Gestel-Timmermans et al., 2010; Wahl et al., 2004; Yaghoobzadeh et al., 2019). Thus, we found the same distribution of items as in the Spanish adaptation (Sánchez-Teruel et al., 2020), with a consequent psychometric match. It is interesting to note that each of the factors that emerge from the HHI, groups specific items.

The first factor refers rather to the subject's perception of life in general, from an optimistic (or pessimistic) perspective. Items such as "I have a positive outlook towards life" or "I believe that each day has potential" refer to the individual's ability to project himself/herself into the future and to understand the value of his/her existence. The ability to deploy the necessary resources to achieve one's goals is also at the heart of this first dimension, with items such as "I have a deep inner strength".

The second factor seems to relate to the internal factors of the individual, such as his/her inner feelings, his/her capacity for introspection or expression of his/her emotions: "I feel all alone", "I can recall happy/joyful times", "I am able to give and receive caring/love".

These two factors correspond to the two main pillars of hope. The first as a projection of the subject towards the future and the belief in his or her skills or abilities to get there. The second refers more to the individual's intimate development and well-being.

It is also possible that our results regarding the factor structure of the HHI-F are influenced by our sample of respondents. Indeed, we deliberately interviewed higher education students who had been subjected to the measures put in place by governments to stop or slow down the transmission of the virus responsible for the COVID-19 pandemic, such as the closing of schools and the introduction of distance learning, generalised quarantine, the introduction of social distancing, the almost complete cessation of recreational and cultural activities, etc. Therefore, we did not cover the same profiles as those interviewed for the construction of the original HHI scale. Indeed, Herth (1992) had constituted a sample of patients suffering from chronic and/or acute illnesses, or in terminal phase. In our case, the students could not be considered as patients, and we only questioned them on having or not a chronic illness. Furthermore, only 16 students out of 247 (6.48%) (see Table 3) reported having such an illness. Therefore, our sample probably did not respond in the same way as Herth's sample.

The different concurrent validations we conducted obtained correlation scores that were always highly significant with the DASS-21 (Ramasawmy et al., 2010), IES-R (Chiasson et al., 2018) and BRCS (Ionescu, 2011) scales. We also found that the direction of the correlation coefficients, positive or negative, were always consistent. For example, the overall scores on the HHI-F and IES-R scales were negatively correlated with  $r = -0.357$ , indicating that the more the respondents considered that they had been impacted by traumatic events, the lower their perception of hope.

These results also allow us to validate the reliability of our translation of the HHI. Indeed, we did not obtain any discordant results that could have called into question the translation of one or more items. On the contrary, we can affirm that the HHI-F complements other scales measuring psychological health, translated and validated in French.

As we have seen previously, the majority of studies that take into consideration the measurement of hope is based on a public of people with serious health conditions or in contexts of serious events (e.g. war, chronic or acute illness, terminal phase, etc.). Our validation, with this population is therefore important for the continuation of this work and the understanding of the experience of hope. The results presented show that the HHI-F could be a valid instrument for measuring hope in the population of French speaking adults, living in the midst of different kinds of hazardous contexts, not only concerning a global pandemic and to develop interventions aiming to support them. We believe that the HHI-F can be a useful tool for research, evaluation and program development in French speaking countries.

Nevertheless, the French version of the HHI was validated in a particular context of a larger study that was aimed at exploring mental health of higher education students of the University of Applied Sciences and Arts Western Switzerland. Despite the large sample of respondents ( $n = 247$ ), this particular context may present a methodological bias, mainly in regard to students' mean age (23.40) and to the over representation of women (65,18%). Hence it would be interesting to carry out a complementary study with a wider sample of respondents in terms of age, and with a better distribution in terms of "sexual identity".

### Ethical approval and consent to participate

The ethical rules and considerations followed the international Helsinki guidelines (World Medical Association, 2013). Applications for ethical approval were obtained from the Swiss Research Ethics Committees - Swissethics (Project ID: 2020-02889).

Personal data were processed in accordance with the EU General Data Protection Regulation (RGPD2016/679) and Swiss data protection law (LPD <https://www.fedlex.admin.ch/eli/fga/2020/1998/fr>). All participants were informed: of the purpose of the study; that participation was voluntary; that they could leave the study at any

time; and, that all data would be treated confidentially. By responding and submitting the electronic survey, participants gave their consent to participate in the study. Similarly, independent informed consent was provided to students participating in the study groups, stating the same principles of anonymity and confidentiality.

The processing and analysis of the quantitative data was carried out by the research team and the management of the files is the responsibility of the principal investigator.

### Consent for publication

Not applicable.

### Availability of supporting data

The datasets and materials used and/or analysed in this study are available from the corresponding author upon request. However, this request must respect our ethical commitments to the CER-VD.

### Disclosure of interest

The authors declare that they have no competing interest.

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### Appendix 1. Final questionnaire in French (HHI-F)

	Fortement en désaccord	En désaccord	En accord	Fortement en accord
1. J'ai une vision positive de la vie.				
2. J'ai des objectifs à court et/ou à long terme.				
3. Je me sens souvent seul.				
4. Même dans une situation difficile, je peux trouver d'autres options.				
5. J'ai une foi ou une confiance intérieure qui me donne de l'espoir.				
6. Je suis anxieux face à l'avenir.				
7. Je peux me rappeler des moments heureux.				
8. J'ai une force intérieure importante.				
9. Je suis capable de donner et de recevoir de l'amour/des soins.				
10. Je sais la plupart du temps dans quelle direction aller.				
11. Je crois que chaque jour offre de nouvelles opportunités.				
12. Je sens que ma vie a de la valeur et de l'intérêt.				

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