Title: French transcultural validation of the *Compliance with Safety Behavior Scale*

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Authors : Lecours, Alexandra* [1, 2,] ; Therriault, Pierre-Yves[1, 2, 3]

1. Département d'ergothérapie, Université du Québec à Trois-Rivières

2. Laboratoire de recherche en ergologie, Université du Québec à Trois-Rivières

3. Centre for Research and Expertise in Social Gerontology (CREGÉS)

*Corresponding author : Alexandra Lecours, Alexandra.Lecours@uqtr.ca

Alexandra Lecours
Département d'ergothérapie
Université du Québec à Trois-Rivières
3351, boul. des Forges, C.P. 500,
Trois-Rivières (Québec)
Canada
G9A 5H7
Email : Alexandra.Lecours@uqtr.ca

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Abstract

BACKGROUND: Preventive behavior of workers is a major determinant of occupational health and safety performance of an organization. The measure of this concept is a challenge with French-speaking workers as there is no existing French validated tool.

OBJECTIVE: The main objective of this research was to realize a French transcultural validation of the Compliance with Safety Behavior Scale (CSBS).

METHOD: Steps of parallel translations, reverse translation and pre-test were conducted before the administration of the CSBS to 195 participants. Exploratory and confirmatory factor analyses were conducted; Cronbach's Alpha coefficients were calculated for each subscale; and intra-class correlation coefficients were calculated for each item.

RESULTS: Exploratory factor analyses support a three-factor structure explaining 53.44 % of the variance and confirmatory factor analyses validate that the measuring tool reflects three distinct factors, which are 1) compliance with safety rules and procedures, 2) participation and initiatives related to prevention, and 3) concern for social and physical environment. Results demonstrate that internal consistency is satisfying for two subscales ($0.80 < \alpha < 0.82$) and that eight items are highly reliable ($0.71 < r < 0.99$, $p < 0.01$).

CONCLUSION: The French version of the CSBS represents a valid and reliable tool allowing its use both for research and for clinical practice.

Key words: Occupational health and safety; Preventive behavior; Psychometrics; Questionnaire validation.

1. Introduction

Work injuries and work-related disorders are considered as major public health concerns in the vast majority of industrialized countries. According to the International Labor Organization, 317 million accidents occur on the job annually [1]. Constant efforts are being put in place by both governments and industries in order to improve the picture of occupational health and safety. Various modalities related to work environments, engineering equipment, management strategies or workers' training are used to reduce the frequency and severity of injuries. Since those involved are hoping for a return on investment, measuring results is an important topic to determine the effectiveness of the modalities used. As it is part of the culture of prevention of an organization, literature suggests that preventive behavior of workers is a major determinant of performance in occupational health and safety [2-4]. It is then important to be able to measure it, which is still quite a challenge, mostly with French-speaking workers as there is no existing validated tool in French. The aim of this article is to propose a French transcultural validation of a measuring tool of preventive behavior at work: the Compliance with Safety Behavior Scale [5].

Literature suggests that preventive behavior has been addressed for the first time by Heinrich in 1931 in a textbook on industrial accident prevention (Heinrich, 1931 quoted in Chhokar, 1987). At that time, preventive behavior at work was understood in a behavioral manner, reducing it to compliance with the prescribed rules and procedures. For more than 60 years, the definition has stayed almost the same and reported mainly in the sociology literature [8]. By the end of the '90s, the unidimensional definition evolved toward a more complex and sophisticated understanding [8, 9]. Thereby, it is now generally recognized that preventive behavior at work is not a unidimensional concept.

Some authors suggest that preventive behavior is consisted of two intrinsic types of behavior [8, 10-12]. These two dimensions have been demonstrated to be correlated one to each other [8]. The first type of behavior, and most common, is worker carefulness or compliance. That is compliance to apply the prescribed rules in the various work activities [8, 10-12]. These are mechanical actions that the worker has learned, like wearing personal protective equipment, for example. This type of behavior would reflect what is expected from the employee for injury prevention [4]. The second type of behavior is initiative [8] or participation [11] related to prevention. It involves the worker to think and analyze work activities in order to mobilize himself in a safe manner. Getting involved in an occupational health and safety committee or suggesting new interventions to improve prevention are part of this dimension. This dimension of preventive behavior goes beyond what is normally expected from the worker [4].

For other authors, preventive behavior of workers comes in four correlated dimensions: 1) using personal protective equipment, 2) engaging in work practices to reduce risk, 3) communicating health and safety information, and 4) exercising employee rights and responsibilities [9]. As it is classified as a compliance behavior by other authors, Burke and al. (2002) proposed that using personal protective equipment should be an independent factor because of its relative importance in general work procedures [9]. The second dimension, engaging in work practices to reduce risk is similar to initiative [8] and participation [11] related to prevention described by other authors. The third and fourth dimensions, communicating health and safety information and exercising employee rights and responsibilities, refer to aspects of the culture of prevention in a workplace more than to workers behavior [9]. The four-factor model has been supported by confirmatory factor analysis performed with the data of 550 workers.

A third model of preventive behavior has been found in the literature. Hofman and al. (2003) proposed a conception of the safety citizenship behavior [13] which has six dimensions: 1)

Helping (e.g. : helping teach safety procedures to new crew members); 2) Voice (e.g.: speaking up and encouraging others to get involved in prevention issues); 3) Stewardship (e.g.: taking actions to protect other crew members from risky situations); 4) Whistleblowing (e.g.: reporting new crew members who violate safety procedures); 5) Civic virtue (e.g.: attending occupational health and safety meetings); and 6) Initiating safety-related change (e.g.: trying to change policies and procedures to make them safer).

Finally, a recent model of workers preventive behavior proposes five dimensions: Exit, Voice, Patience, Neglect and Compliance [14]. Authors define the "Exit" as, for example, the intention to leave a dangerous situation. The "Voice" factor refers to communicating about safety concerns. An example of the dimension of "Patience" is to stick with an organization through good and bad times. The "Neglect" factor is, among others, to have unsafe behavior. Finally, the dimension of "Compliance" is defined as following safety rules.

With all these representations of preventive behavior, some measuring tools have been created and validated over the years. All scales we have found in the literature are based on an evaluation of the behavior with a Likert-type scale of frequency or level of agreement. Worker is asked to say how often he performs a behavior during his work time or how he agrees with a specific item representing a behavior.

Adriessen (1978) [12] has created a 11-item questionnaire on safety carefulness and initiative that has been administered to a sample of 207 workers, but the psychometrics properties are not available. It also was specifically designed for the construction industry.

Simard and Marchand (1994)[2] have created the Compliance (6 items) and Initiative (7 items) scales which have been validated with 1064 manufacturing workers. The reliability of these scales have been reported but are not very high (r=0,64 and r=0,69, respectively) and measures

were based on supervisors' perception of the worker preventive behavior and not on workers' own perception of their behavior [2]. These authors conducted a second study with their tools on a sample of 828 manufacturing workers and they found that compliance with safety rules may not be structured as a unitary dimension [8]. They suggested that behaviors related to each safety rules should be considered as single dimensions. However, they found that the initiative related to prevention dimension achieved a good fit and may be considered as a single dimension.

Griffin and Neal (2000) [11] developed a 12-item questionnaire to assess safety climate and also motivation and behavior of workers in relation with prevention, including compliance and participation. Their model reached a good fit and internal consistency of each scale was good ($0.86 < \alpha < 0.93$), based on a validation study of manufacturing and mining workers.

Burke and al. (2002)[9] achieved an acceptable fit for their 27-item questionnaire explaining the general safety, including workers' behavior in relation with prevenion and safety climate. The tool has been created and validated for workers in the nuclear industry.

Hofman and al. (2003) created a 27-item scale to evaluate their safety citizenship behavior among military, but they used the tool as if it measured one dimension, while their rational presented six. The internal consistency of this tool is very high in one dimension (Cronbach's alpha = 0.96).

Tucker and Turner (2011) [14] developed a 22-item scale specifically to measure young workers' preventive behavior. Confirmatory factor analysis made with data from a sample of 282 young workers supported their model. Their tool also demonstrated an acceptable internal consistency for each dimension ($0.69 < \alpha < 0.92$).

Another questionnaire is currently available to measure preventive behavior of workers. The tool is called the Compliance with Safety Behavior Scale (CSBS) and has been validated in English

only [5]. The measurement tool takes the form of a self-administered questionnaire of 11 questions. Although the tool has been validated with blue collar, the questions are written broadly enough that it is possible to apply the questionnaire to different types of occupation or employment and to workers of all ages. Items are evaluated by workers on a frequency Likert-type scale with five levels ranging from "never" to "always ", according to how often they perform the behavior. After recoding for some items that have a negative form (items 1, 8 and 9 becoming 1R, 8R and 9R), a higher score indicates a higher frequency of preventive behavior adoption. The psychometric properties of the tool have been studied in its original English version in a research including 787 workers [5]. Internal consistency obtained is satisfactory with a Cronbach's Alpha of 0.88 and item-total correlations go from 0.24 to 0.65 [5]. No other properties, such as factor structure nor test-retest reliability, have been studied in the original English version. Despite this, authors considered the measure as a single dimension. Even if the CSBS is one of the only validated tools to evaluate specifically and exclusively preventive behavior of all worker types and from the point of view of workers themselves, it lacks scientific knowledge.

The CSBS is the only measuring tool of preventive behavior at work that has been used in a research with a French Canadian population, but the methodology nor the translation protocol have not been published [15]. Authors of the study also used a 4-point rating scale instead of a 5-point rating scale, as it is specified in the original English version of the scale. However, they conducted exploratory factor analyses and their results suggested that the tool does not demonstrate a unidimensional construct. They found three specific dimensions, such as safe behavior, unsafe behavior and communication of safety risks. In light of this information, it seems to have confusion about the factor structure of the tool.

The measurement of preventive behavior of French workers is a real challenge and the only questionnaire that have been used in French, the CSBS, lacks of scientific properties, which is a constraint for French occupational health and safety professionals. Moreover, authors of the original English version of the test used it as a unidimensional construct. However, according to the literature, we hypothesis that preventive behavior is a multidimensional construct and the tool should reflect it. This study will attempt to reduce those weaknesses.

2. Aim

The main objective of the research is to realize a French transcultural validation of the Compliance with Safety Behavior Scale [5].

Specifically, the following specific objectives are pursued: 1. Produce a French validation of the CSBS following a recognized and scientifically proven method; 2. Evaluate the factor structure of the French version of CSBS; 3. Evaluate the internal consistency of the French version of CSBS; 4. Evaluate the test-retest reliability of the French version of CSBS.

3. Method

The French translation and validation process of the CSBS was conducted according to a method of double parallel translations with reverse translation [16]. This simpler method was demonstrated as valid for the preservation of the psychometric properties of a questionnaire, as compared to a more tedious method involving a review committee. Steps taken to complete the translation and validation were inspired by Corbière and Fraccaroli (2014) [17] and by Vallerand (1989) [18].

3.1 Participants

Participants were French Canadian university students currently employed full- or part-time or who have been employed in the last 12 months. Results of a recent research on workers' experiences in relation with prevention have shown that the processes were the same among younger workers in part-time employment and those of workers with more experience in full-time employment [19]. Results of the study suggest, among other things, that attitudes and predictors of experiences related to prevention were the same in both groups of workers. The authors of this study concluded that a targeted sampling on young workers did not limit the generalizability of the study results to other classes of workers. Working students are a widely used and accepted population as part of questionnaire validation studies on labor [20, 21]. Participants were asked to answer the questionnaire referring to their work experiences and not their studies.

3.2 Ethics

All subjects participated in the study freely and voluntarily. No incentive was offered. An email invitation was made to students in a variety of programs from the Université du Québec à Trois-Rivières and participants completed the questionnaire on paper or in electronic format as per their convenience. The written agreement of the authors of the original English version of the questionnaire was obtained prior to the study. The project received approval from the research ethics committee with human beings of the Université du Québec à Trois-Rivières (# CDERS-15-5-06.03).

3.3 Procedure

In order to achieve the objective 1 of the research that was to produce a French validation of the CSBS, a recognized and scientifically proven method was followed [17, 18].

Step 1: Translation from English to French

Two independent, bilingual university researchers, whose mother tongue is French, translated the original English version of the questionnaire in French, including the title, the instructions, each item and the rating scale. A translation of sense rather than a literal translation was preferred. People had both a good knowledge of the area studied; one is an occupational therapist and researcher in the field of health at work and the other is a researcher, occupational therapist and ethicist. Following these two independent translations, a synthesis of similarities and differences was made in committee by two researchers who did not participate in this first translation step. A French version of the questionnaire was established taking into account the results of the two translations.

Step 2: Reverse translation from French to English

The French version of the questionnaire created in step 1 was carried back into English by a bilingual professional in education whose mother tongue is English. This person was not familiar with the subject area to enable to highlight imperfections throughout the translation that might be present. This step aimed to ensure that the meaning of the French version complies with the original English version. If a particular item seemed problematic, the whole process had to be repeated for this item. No problematic item was found.

Step 3: Pre-test questionnaire

Nine participants completed the questionnaire in its French version. They were asked to identify if they understood the title, the instructions, each item and the rating scale of the questionnaire. If ambiguities were present, a revision of the questionnaire had to be conducted for problematic

items. An assessment of clarity on a Likert-type scale with seven levels (1 = not clear at all to 7 = entierely/completely clear) was also required for the 11 items of the test. Items that received a low rating (4 or less) were subject to changes (Vallerand, 1989). No item had been revised at this step.

Step 4: Evaluation of the psychometric properties of the French version of the questionnaire

The questionnaire was administered to 195 participants. This number is sufficient since it is generally recognized that for a factor structure to be stable, there must be at least five to ten participants per item of a questionnaire [22]. The presentation order of the questions was drawn randomly to avoid suggesting a response pattern. For 32 of these people, two administrations have been done at an interval of two weeks to carry out analyses of the test-retest reliability. Within two weeks was chosen so the time is not too long for the behaviors of the participants to change and not too short to avoid that participants will remember the answers they had written in the first administration [23].

3.4 Data analysis

To achieve the objective 2 that was to assess the factor structure of the French version of the CSBS, exploratory factor analyses were first conducted. The Maximum likelihood method of extraction was chosen because it allows for the calculation of various fit indices [22]. An Oblimin rotation was chosen because it allows for the correlation between factors [22] and literature suggests that dimensions of preventive behavior at work are correlated [8, 9]. To determine the factor solution that best explain the relationships between variables, various indices were used [22]. First, the chi-square test of the quality of the fit was observed. A non-significant test indicates that the fit is correct and that the model can replicate the covariance matrix [22].

Then, measurement of Kaiser-Meyer-Olkin (KMO) indice was observed. This is an indicator of the size of the correlations between items [24] and it indicates whether the distribution of values is adequate to perform factor analysis [25]. A result of 0.70 or higher is recommended in order to conduct factor analysis [24]. In addition, the Bartlett's sphericity test that checks the null hypothesis that all correlations would be zero was used. For its part, the determinant of the matrix must be as small as possible, but not zero [26]. Finally, the Cattell scree test was observed to objectify the variance explained by each factor.

Subsequently, the most statistically valid model was submitted to confirmatory factor analyses. In order to assess the quality of the model fit, several indices were used. The first of them was the chi-square test. A non-significant test indicates that the fit is adequate [22]. Comparative indices made index (CFI), Tucker Lewis index (TLI), the Normed fit index (NFI), and Root mean squared error of approximation (RMSEA) and P of Close Fit (pclose) were also used. It is generally accepted that a value greater than 0.90 for the CFI, the TLI and NFI is sufficient [27]. However, other authors consider that a value of at least 0.95 is preferred [28]. A RMSEA below 0.08 is admitted [29], but other authors consider that RMSEA value below 0.06 is required to be acceptable [28]. In terms of pclose, a non-significant value indicates an adequate model fit [29]. This analysis sequence involving exploratory factor analyses followed by confirmatory factor analyses was used to determine the most statistically valid model [30].

To achieve the objective 3 which was to assess the internal consistency of the French version of CSBS, correlation analyses using the Cronbach's Alpha [23] were conducted with the whole scale on the one hand, and with each of the subscales resulting from the factor analyses. It is suggested that Cronbach's Alpha coefficients should be between 0.70 and 0.90 so there is a

good homogeneity between items of a questionnaire [23]. Cross-correlations between factors and item-total correlations for each item were also observed.

To achieve the objective 4 which was to assess the test-retest reliability of the French version of the CSBS, a measure of the degree of association between the results of the two test execution times was carried out using the intraclass correlation coefficient (ICC) with a 95 % confidence interval [23, 31]. High ICC (> 0.6) represents a high fidelity [32].
Statistical analyses were conducted with the Statistical Package for the Social Sciences (SPSS) version 22.0. Confirmatory factor analyses were conducted with the AMOS software designed to work with SPSS.

4. Results

The results of this study enabled the creation of the French version of the CSBS, which is entitled *Échelle du comportement préventif au travail.*

4.1 Sample Description

Of the 195 valid questionnaires received, 12 contained missing data. The pattern of missing data was random. There were therefore 183 valid questionnaires stored for statistical analysis. The sample included 145 women (79.2 %) and 37 men (20.2 %); one person did not reveal its gender. The average age of participants was 24.19 (SD 5.24) years. The participants were currently enrolled in a university program (occupational therapy: 45.4 %, psychology/psychoeducation: 18.6 %, education: 12.6 %). The average number of hours worked per week was 16.8 (SD 10.1) hours. The main areas of employment were services (29.0 %), food (15.3 %) and trade (12.6 %).

Average scores for each statement, standard deviations as well as the item-total correlations are presented in Table 1.

Insert Table 1 here

4.1.1 Representation of preventive behavior at work

To ensure that the representation that participants had of preventive behavior at work was congruent with the definitions available in the scientific literature, they were asked, before completing the questionnaire, to answer the following question: *What does it mean for me to adopt a preventive behavior at work*? Consistently, the most frequent representations referred to the adoption of behavior complying with the safety rules and procedures and to the ability to recognize situations at risk of injury. To a lesser extent, participants also referred to the adoption of behavior allowing for working long without injury.

4.2 Factor Structure

To investigate the factor structure of this new tool, exploratory factor analyses (EFA) were first conducted.

First of all, an inspection of the data was conducted. With the observation of the correlations matrice, a high correlation (r = 0.78) was found between two variables, item 1 and item 8R. As the inclusion of these two variables in the models made problems, such as Heywood values, it has been decided to remove the item 8R as it communality was lower than the one of the item 1.

With the observation of the communalities of the variables, it was found that the item 5 had a very low communality (0.20). The inclusion of this variable make decrease the proportion of variance explained in all models, so it was decided to remove this item as it seemed to be related to another construct but preventive behavior at work.

The subsequent analyses were conducted with 9 items.

Without limiting the number of factors to be included in the analysis (the criterion determining the number of factors is based on the review of eigenvalues greater than 1), a structure of three factors is favored by examining the graph of eigenvalues. The chi-square test is satisfying ($\chi 2$ = 7,14 (df=12), p=0,85). The result of the KMO indice was 0.85 which is meritorious (> 0.80) and appropriate to conduct a factor analysis (> 0.70) [24]. In this study, the the Bartlett's sphericity test was significant ($p < 0.001$) and allowed the continuation of the analysis. This determinant of the matrix is small (0.012), but not zero, which is a good indicator of the presence of correlations between pattern sets. All these indices support the assumption that a valid factor solution may be made out of this questionnaire data. The three-factor structure founded could explain 53.44 % of the variance, which is low, but still satisfying.

When lower saturation (less than| 0.32 |) were removed from the pattern matrix [22], a simple structure was obtained; which means each item only saturates on one factor (see Table 2). It is recognized that the greater the factor loading is, the higher the item is a pure measure of the factor to which it is connected [22]. It is suggested that saturation exceeding | 0,71 | is considered excellent, saturation more than| 0.63 |is considered very good, saturation more than| 0.55 | is considered good and a saturation of | 0,45 | is considered satisfactory [33]. Table 2 shows the factor loadings of each item of the questionnaire.

Insert Table 2 here

Other analyses with one, two and four-factor models have been tested according to other theoretical definitions of the preventive behavior at work presented in the literature, but did

not permit to obtain either a simple structure, a significantly higher proportion of variance explained or good indices fit. A five-factor or a six-factor model could not have been tested in the present study because of a lack of statistical power. Results are shown in table 3.

Insert Table 3 here

To assess the fit of the model presented in Table 2, confirmatory factor analyses (CFA) were conducted and several fit indices were used. The results of the CFA confirmed the acceptability of the proposed three-factor model: $\chi 2 = 37.66$ (df = 24), p = 0.04; CFI = 0.98; TLI = 0.96; NFI = 0.94; RMSEA = 0.06; Pclose = 0.36. The model found in the EFA is confirmed by the CFA.

4.3 Internal Consistency

Scale as a whole got a Cronbach's Alpha of 0.84 (n = 183). Table 4 shows the coefficients calculated for each of the three factors or subscales of the test and the cross-correlation coefficients between factors. Results suggest that two scales reached a good internal consistency. For the third scale, the coefficient approached the lowest acceptable limit of 0.70.

Insert Table 4 here

4.4 Test-retest reliability

Analyses of test-retest reliability were conducted by calculating the ICC with a confidence interval of 95 % [31]. The lower limit of the 95 % confidence interval was calculated to take into account of the variability of the value of estimated ICC [31].

Results demonstrate that eight items were highly reliable ($0.71 < r < 0.99$, $p < 0.01$) and one item obtained a satisfactory reliability ($r = 0.49$, $p < 0.05$). Table 5 shows the ICC of each item and the lower limits of the confidence interval.

Insert Table 5 here

5. Discussion

This study attempted to develop a French transcultural validation of the Compliance with Safety Behavior Scale, a self-administered tool to measure preventive behavior of workers. As a result of this research, a reliable and valid French tool entitled *Échelle du comportement préventif au travail* was created. As validation of measurement tools is an ongoing process that refines with the accumulation of scientific evidence, a first step was made with this first and new French tool measuring preventive behavior at work.

First of all, attention was paid to ensure that the questionnaire actually measures preventive behavior, as described in the literature. Indeed, a qualitative measurement of the representation participants have about preventive behavior at work was taken. Results demonstrated that the representation of participants was consistent with the literature. Among others, participants mentioned that preventive behavior is related to safety rules and procedures, which can be likened to compliance, as described in the literature [8, 11]. While the ability to recognize situations at risk of injury described by participants referred to the dimension of initiative or participation related to prevention, as mentioned in the scientific literature. This measure of representations adds to the validity of the questionnaire, making sure of what is actually measured.

Results suggest that the questionnaire measures a three-factor model of preventive behavior, that it is possible to define as: 1) compliance with safety rules and procedures, 2) participation and initiatives related to prevention, and 3) concern for social and physical environment. Using multiple statistical tools to guide the selection of the best factor solution increased the robustness of the conclusion. Results of the EFA and of the CFA supported a good fit of the proposed model. In fact, all adjustments indices (except for the chi-square test in the CFA that is

influenced by the sample size and the correlations between the factors) allowed to be confident that the model was adequate. The indices of saturation strength indicated that two items have excellent saturation (0.79 to 0.80), five items have very good saturation (0.63 to 0.70), one item has a good saturation (0.55) and one item has a satisfactory saturation (0.50).

Results obtained by factor analyses are consistent with previous studies that stated preventive behavior is a multidimensional construct [8, 9, 11-14]. Contrary to what is suggested by the authors of the original English version of CSBS, the results of the French version, the *Échelle du comportement préventif au travail,* cannot be added just to make a single score. The tool must be used according to the three factors or subscales it assesses. The use of the questionnaire can therefore afford to quantify types of preventive behavior at work that are predominant in some workers. This information may help occupational health and safety professionals to better guide strategies to promote preventive behavior among workers.

Dimensions of the compliance with safety rules and procedures and of participation and initiatives related to prevention are consistent with dimensions found by previous studies [8, 10-12]. It then appears that these two dimensions are important concepts in the construct of preventive behavior.

However, the third dimension found in this study, which refers to concern for social and physical environment, is quite a new concept mentioned in the definition of the preventive behavior at work. As Burke and al. (2002) [9] suggested that using personal protective equipment should be viewed as a separate dimension and Marchand et al. (1998) [8] suggested that each safety procedures should be viewed as a separate dimension, we suggest that following safety rules and procedures should be viewed as a separate dimension from the behavior related to

environment. Our results suggest that behavior related to physical (e.g.: preventive maintenance of its working equipment) or social (e.g.: encourage or remember the rules to colleagues) environment act differently from other behaviors. The notion of environment in itself and its role in the preventive behavior of workers has been recognized in different working contexts [34-37]. In fact, it is now important to recognize that a worker can influence environmental safety and also that the environment can influence the safety of the worker as well. This concept is of major concern in the understanding of the construct of preventive behavior at work and should be taken into account in the measure. Previous studies have also raised the importance of adding elements on the physical and social environments to measures of preventive behavior as a predictor of performance in occupational health and safety [4]. However, our results are limited and larger studies should be undertaken to explain the influence of concern for social and physical environment of workers preventive behavior.

Analyses of internal consistency have helped to highlight that items of the tool form a coherent measure of workers' preventive behavior. The coefficient reached the expected threshold for satisfactory internal consistency (> 0.70) [23], both for the scale as a whole ($\alpha = 0.84$) and for two out of three subscales of the questionnaire (see Table 4). The Cronbach's Alpha coefficient of the third factor, which refers to concern for social and physical environment, was just below the threshold of 0.70. However, results of analyses of internal consistency by removing items one by one confirmed the relevance of each item in their scale to assess preventive behavior at work. Results of analyses of internal consistency of this study are consistent with those obtained in the validation study of the original English version of the test in which Cronbach'a Alpha was of 0.88 for the whole scale [5].

Regarding analyses of test-retest reliability, results have shown that eight items out of nine had high reliability and one item had a satisfactory reliability, at a two-week interval. The item that reached a satisfactory reliability is part of the third factor of the questionnaire, which refers to the concern for social and physical environment. This subscale did not reach a high internal consistency ($\alpha = 0.65$). A revision of the translation of this item to better reflect the construct of concern for social and physical environment could increase the reliability of the item and also of the subscale. As this dimension of the construct is new, other studies should be conducted to refine it. The test-retest reliability has not been assessed in the original English version of the questionnaire. This is then a strength in the study of psychometric properties of the French version.

6. Study limitations

One limitation of the research is the uniform and non-diversified sampling. Even if a study confirmed that a targeted sampling on young workers did not limit the generalizability of results to other classes of workers in the field of prevention [19], it would be interesting to validate the questionnaire with workers from diverse backgrounds and diverse age groups. The female gender was also predominant in this study, which may represent a bias given that female young workers are less frequently engaged in risky behavior than male young workers [38]. However, mean comparison analyses were conducted in this study and no significant difference for gender was found in any of the three subscales.

7. Conclusion

The new tool entitled *Échelle du comportement préventif au travail* is currently the only available French validated tool to obtain a quantitative measure of the workers preventive

behavior. The present study demonstrated that the measurement tool has satisfying psychometric properties, including good internal consistency, high test-retest reliability and good factor validity, supporting its use in clinical or research. As the process of validating a measurement tool is intended progressive, it would be interesting to measure, in a next step, its sensitivity to change to ensure the ability of the tool to detect a change in the presence thereof. Also, our results suggest the influence of a new dimension in the understanding of preventive behavior. This dimension, which refers to concern of the worker for social and physical environment is of major interest and should be studied in larger research. In doing so, it appears that several definitions of the concept of preventive behavior at work are present in the literature. Consensus is not currently achieved to describe dimensions of the concept. Research to clarify the understanding of the concept of preventive behavior at work should be conducted.

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Table 1

Average scores, standard deviations, item-total correlations for each item (n=183)

Items	Means	Standard deviations	Item-total correlations
1R*	3.92	0.88	0.68
2	3.63	0.93	0.74
3	3.43	1.00	0.73
4	4.16	0.99	0.58
5	4.29	0.80	0.40
6	3.68	0.97	0.60
7	4.21	0.76	0.65
8R*	3.75	0.89	0.70
9R*	3.63	0.93	0.62
10	3.69	1.11	0.65
11	3.80	0.88	0.69

* These items have been recoded because of their original negative form

Table 2

Results of exploratory factor analyses using Maximum likelihood extraction and Oblimin rotation for the three-factor model (n = 183)

Factors / Item	Factor 1	Factor 2	Factor 3
1 R	0.65		
2	0.79		
3	0.66		
4			0.50
6			0.55
7			0.63
9 R	0.65		
10		0.80	
11		0.70	

Table 3

Results of exploratory factor analyses using Maximum likelihood extraction and Oblimin rotation for different models (n = 183)

	1-factor model	2-factor model		4-factor model			
	Factor 1	Factor 1	Factor 2	Factor 1	Factor 2	Factor 3	Factor 4
Item 1 R	0.61	0.63		0.78			
Item 2	0.75	0.76		0.65			
Item 3	0.70	0.68		0.39			0.33
Item 4	0.52	0.54				0.40	
Item 6	0.52		0.51			0.49	
Item 7	0.57					0.73	
Item 9 R	0.57	0.70		0.58			
Item 10	0.60		0.91		0.78		
Item 11	0.67		0.78		0.81		
Proportion of variance explained (%)	37.88	47.87		55.61			

Table 4

Results of internal consistency analyses (cross-correlations between factors and standardized Cronbach alpha coefficients) for each subscale (n = 183)

	Compliance with safety rules and procedures	Participation and initiatives related to prevention	Concern for social and physical environments
Compliance with safety rules and procedures	α=0,80		
Participation and initiatives related to prevention	0.47*	α=0,82	
Concern for social and physical environments	0.53*	0.45*	α=0,65

* p<0,01

Table 5

Results of the test-retest reliability analyses for each item of the questionnaire (n = 32)

Item	ICC (95 %)	Lower limit of confidence interval (95 %)
1 R	0.71**	0.40
2	0.94*	0.68
3	0.84*	0.67
4	0.99*	0.79
6	0.74*	0.48
7	0.49***	-0.07
9 R	0.89*	0.75
10	0.89*	0.78
11	0.83*	0.65

*p < 0.001, ** p<0.01, *** p<0.05