Original article

Typological and factor analysis of the perceived stress measure by using the PSS scale

A. Cerclé a,b, C. Gadéa a, A. Hartmann a, M. Lourel b,*

a Laboratoire armoricain universitaire de recherche et d’études psychosociales, centre de recherche en psychologie : cognition, communication, université Rennes-2, place du Recteur-Henri-le-Moal, 35043 Rennes cedex, France
b Laboratoire de psychologie et neurosciences de la cognition et de l’affectivité, université Rouen, rue Lavosier, 76821 Mont-Saint-Aignan, France

Abstract

The aim of this research was to explore the structure of the Perceived Stress Scale (PSS) by using data analysis in order to question its theoretical and methodological bases in a critical and positive way. Unidimensional analyses and two-dimensional analyses of the scale were carried out on a sample of 600 individuals. The typological analysis of the data subsequently made it possible to cross these two analyses and revealed that the individuals who have average stress (45% of the sample) according to the traditional measure of the PSS, had very diversified profiles according to the two-dimensional analysis. Some of these profiles are not in accordance with the basic model of a discrepancy between perceived control and perceived distress. In light of the results obtained, this precise typology could be useful in the field for carrying out audits and surveys while offering new elements of observation likely to improve psychosocial interventions.

© 2008 Elsevier Masson SAS. All rights reserved.

Résumé

L’objectif de cette recherche était d’explorer, à l’aide de l’analyse des données, la structure de la Perceived Stress Scale (PSS) en vue de questionner de manière critique et positive ces fondements théoriques et méthodologiques. Des analyses uni- et bidimensionnelles de l’échelle ont été effectuées sur un échantillon de 600 personnes. Dans un second temps, l’analyse typologique des données a permis de croiser ces deux analyses et a révélé que les individus ayant un stress moyen (45% des répondants) selon la mesure classique de la PSS avaient des profils très diversifiés. Certains de ces profils peuvent être identifiés comme non conformes au modèle de base du déséquilibre entre contrôle perçu et détresse perçue. Au regard des résultats obtenus, cette typologie fine pourrait se révéler utile sur le terrain des pratiques d’audit et d’enquête en apportant de nouveaux éléments d’observation susceptibles d’améliorer les interventions psychosociales.

© 2008 Elsevier Masson SAS. All rights reserved.

Keywords: Stress measure; Perceived stress scale; Data analysis; Appraisal process

Mots clés : Mesure du stress ; Perceived stress scale ; Analyse des données ; Double évaluation

1. Introduction

In 1995, Cohen, Kessler and Underwood-Gordon proposed a synthesis of conceptualization and the stress measure, as this term had become overused and confusing in its meaning and in its measure. However, the authors note that a consensus seems to emerge to define stress as a process, which is produced in the case of a discrepancy between the demands of the environment and the organism’s capacity to respond (Lazarus, 1966; Lazarus and Launier, 1978; McGrath, 1970). Bruchon-Schweitzer (2002) likewise defends the idea that the perception of stress in the individual depends on the event, which is felt as threatening, and on the resources available (individual and social) for coping. The author’s approach (op. cit., 2002) is based on the transac-
tional viewpoint of Lazarus et al. That is, the transaction between the subject and his environment is the object of an evaluation by the subject. The latter varies depending on the psychosocial impact of the event on the subject and his well-being, but also on the individual’s capacity to cope with it. Lazarus and Folkman’s model of double evaluation (1984) (Lazarus and Folkman, 1984) is based on this. This model is composed of a primary evaluation and a secondary evaluation.

1.1. Primary evaluation

According to the authors, a situation (stressing factor) provokes a stress reaction if it is evaluated as being losing, threatening or challenging. The first evaluation depends on the perceived aspects of the situation (imminence of a painful confrontation, intensity of the stimulus, possibility of controlling the stimulus, etc.) and on the psychological structure of the individual (individual’s belief in himself and in his environment, aptitudes linked to his personality). At this point, we are talking about the primary evaluation.

1.2. Secondary evaluation

When the psychological impact of the stimulus is evaluated as motivating a coping response (in order to “cope”), the individuals evaluate their resources in order to eliminate or reduce the effects of the stressing situation: this process is called the “second evaluation”. If one perceives that coping responses are available and appropriate to the situation, the threat is then short-circuited and no stress response occurs. It must be noted that it is coping “resources” and not coping “strategies” that follow both evaluations. At this level, the stress response is only essential if the evaluated resources are inappropriate or unavailable. In other words, the evaluation of coping “resources” at this stage does not necessarily involve the development of coping “strategies”. It is important to note that it is a circuitous process, which involves a constant reevaluation of both the situation and the resources during the progression of the event (Lazarus, 1981). Thus, events considered at first as threatening can be reevaluated as harmless or conversely. Cohen et al. (1983) observe that the stress response does not only depend on the intensity and other aspects linked to the situation, but rather on the person and contextual factors. This approach emphasizes the individuals’ perception, in other words, the individuals’ interpretation of the situation and their capacities to cope with it. Hence, it is the question of “perceived stress” and the interactive approach to stress, which makes it possible to take into account the fact that the same situation can provoke very different reactions depending on the individuals. Lazarus (2000) deplores the lack of longitudinal, clinical or micro-analytical type studies, which could offer a precise view of the links between coping and stress. According to the author, the same is true in terms of adequacy between research and clinical practice concerning these subjects (stress/coping). Likewise, Cohen et al. (1983) regret, nevertheless, “the absence of an accurate psychometrical measure of perceived stress in spite of the wealth of the theoretical elements” and propose a new global measure of perceived stress, the “Perceived Stress Scale” (PSS).

The review of the literature shows how the question of stress raises numerous scientific debates, particularly concerning its measure. Our aim, although it is modest, follows this direction. We propose a study of the underlying construct of the measure of “perceived stress” by using the PSS as a tool. Our investigations are based on “inductive research” in the sense used by Benzécri (1982). The second part of our study goes deeper into this aspect of research.

2. Presentation of the PSS measuring instrument

Cohen et al. (1983) regret, however, “the absence of an accurate psychometrical measure of perceived stress in spite of the wealth of the theoretical elements” and propose a new global measure of perceived stress, the “PSS”.

2.1. Presentation of the PSS tool

The “PSS” suggested by Cohen et al. in 1983 measures the degree to which individual situations are evaluated as being stressful or more precisely, unpredictable, uncontrollable and intense (overloading in 1983, then overwhelming in 1991). Numerous authors (Averill, 1973; Cohen, 1978; Lazarus, 1966) only considered that these three aspects – unpredictability, uncontrollability and intensity – are the main components of the experience of stress. Thus, this measure is meant to be “global”, in other words, not specific to the presence or to the importance of some “events in life” which are usually measured by objective-stress scales. The authors describe it as being sensitive to chronic stress stemming from a life-time of circumstances, to stress concerning expectations with regard to future events, and also to reactions to specific events included in each scale. The studies have shown that the psychometrical properties of this tool seemed satisfactory (Bruchon-Schweitzer, 2002).

The PSS 14 tool is composed of 14 items on a five-point scale (going from “never” to “often”) (examples of items: “. . . have you ever been bothered by an unexpected event?” “. . . have you ever successfully coped with little problems and daily worries?”). The first study by Cohen et al. (1983) made it possible to show the reliability of the scores obtained with the PSS 14 tool as well as its links to the perception of events in life, and physical and depressive symptomatology. Cohen and Williamson (1988) then proceeded to a second examination of the tool by using it with 2387 respondents. The aim here was to test the invariance of the model a priori.

This study shows two factors, one explaining 25.9% of the variance and contributing very strongly to the negative items (being annoyed, being unable to control things, feeling nervous and stressed), while the other factor (explaining 15.7% of the variance), contributes strongly to the items describing positive states (succeeding in coping, coping with worries, feeling confident). Items 4, 5, 12 and 13 are more slightly correlated: 0.17, 0.33, 0.11, 0.39 respectively, and were deleted in the 10-item version (PSS 10). This factorial structure was confirmed by Hewitt, Flett and Mosher in 1992 who named these two factors
“perceived distress” and “perceived coping” respectively, and by Martin et al. (1995). Another study by Mimura and Griffiths (2004) aiming to translate the PSS from English to Japanese also shows the existence of two factors, but the results must be considered with caution due to the limited number of respondents (38 English subjects, 23 Japanese). This result is similar to the one found by Gadéa and Cerclé (2004). Effectively, these authors also found two dimensions on two different samples.

The analysis by Gadéa et al. (2004) reveals that it is necessary to delete items 12 (“. . . have you ever surprised yourself thinking about things that you had to do successfully?”) and 14 (“. . . did you ever find that the difficulties accumulated so much that you could not control them?”) in order to obtain a data adjustment for the set model a priori. This is in keeping with the thinking of Cohen and Williamson (1988) who considered the reliability of the scores obtained on item 12 to be questionable. Confirmatory analysis was done on another sample conserving the 12 items retained in the exploratory stage. Finally, in the last phase, a confirmatory factor analysis made it possible to test and compare the accuracy of the proposed factorial structures: the one stemming from the exploratory phase, the one stemming from the confirmatory phase, and the one proposed by Hewitt et al. (1992). In conclusion, the authors propose two factors, the first called “vulnerability or perceived distress”, and the second called “perceived control”, in line with the terminology of Bruchon-Schweitzer (2002, p. 289). We will use these terms for our demonstration, although they do not appear in the literature on the PSS, the different authors simply suggest the existence of negative items (probably corresponding to the first evaluation or “perceived distress”) and positive items (second evaluation or “perceived control”).

2.2. The difficulties linked to the evaluation of stress

Several authors (Dohrenwend and Dohrenwend, 1974; Moss, 1973; Rutter, 1983) attracted attention earlier to the difficulty of linking causal directions: effectively, it is difficult to determine if stress produced real negative effects in terms of mental health or if it is the contrary. In a paper published in 1985, Lazarus, DeLongis, Folkman and Gruen (Lazarus et al., 1985) defended the use of their own scale of measure, the “Hassless Scale”, which measures daily worries, in other words, “objective” stress. The authors refer to the PSS as an illustration of the “circularity and the confusion” in research. They assume that in this strategy of measure, the evaluation of perceived stress is confused with the antecedents and fails to make a contribution to knowledge. The discussion concerning several lines of thought resumes in 1995 with Monroe and Kelley Monroe and Kelley (1995), who, for example, consider that the evaluations can be influenced by variables of personality, psychopathology, an individual’s current state of mind, cognitive styles, beliefs and values. These factors can in turn be predictive of disorders. Finally, the question to ask is if the evaluation is the reflection of underlying processes, which are intrinsically responsible for bringing about a certain vulnerability to stress or if the stress evaluation is the direct determinant of vulnerability (Monroe and Kelley, 1995). To answer these arguments, Cohen et al. (1983,1995) and Cohen and Williamson (1988), by using predictive models and by controlling other indicators of psychological stress, showed that the PSS scores predict different psychological and physiological symptoms independently of the measures of psychological and physiological symptoms evaluated at the beginning. Although it is strongly correlated with depressive symptomatology, Cohen et al. (1983) concluded with the superiority of their scale as a prognostic of health compared to measures of scales of objective stress: “the PSS measures a different and independent predictive construct. The PSS can be used to determine if the “evaluated” stress is a causal factor (or vulnerability) of behavior disorders or illness”. Nevertheless, in later research, Cohen often associated different types of measure. In an abstract published in 2000 concerning the psychological stress measure, the author says that he used both the LEDS (question grid organized as semi-structured interviews) from Brown and Harris (1978), and the PSS in his studies on sensitivity to head colds, a scale of major events in life and the PSS in his work on the predisposition of children to asthma, and a scale of major events in life, the PSS, as well as a scale of negative affects in his laboratory work on long-term stability to the reaction to stress. In conclusion, Cohen suggests choosing the appropriate stress measure according to the illness (or the stage of the illness), according to the specific question asked by the researcher about the relation between stress and illness, while taking into account other practical and methodological determinants.

In their paper of 1988, Cohen and Williamson specify from the beginning that “concerning the measure of perceptions of stress, the distinction between two factors [positive and negative] is considered as non relevant”. Yet, in 1995, Cohen et al. regret the lack of “precision” in the stress measure: “unfortunately, the psychosocial models have a tendency to be vague in their predictions of particular measures that will be affected in many cases, and on the nature of the relations among these measured consequences”.

As we have seen, stress measure raises a great deal of questions. Giving a definition to stress is complicated, but it is more difficult to measure it. That is why it seems useful to offer a modest contribution that is in keeping with the research that has been carried out for many years concerning the accuracy of the PSS.

3. Empirical aims of the study

Our study will focus on the structure of the PSS 14 and is in keeping with the philosophy of “data analysis” such as it was developed by the statistician Benzécri and his collaborators beginning in the 1970s.

According to Benzécri (1982, p.76), data analysis is “the inductive research of hidden dimensions characterized by combinations of primary measures”. Benzécri (1969) writes that the plasticity of the relation between the data and the method is always considerable: the most difficult is to let it be, in other words, to let the structure emerge from the analysis. It must be noted here that “correspondence analysis” was developed at our university in Rennes as opposed to many a priori with essentially Anglo-Saxon origins. Unlike principal component analysis
(PCA), the interest of this method is to consider the lines and the columns of a table of data as objects of same nature: thus a symmetrical interpretation of all of the individuals (I) and variables (J) is made possible. Applied to quantitative variables transformed into classes (qualitative variables), this type of analysis (Multiple correspondence analysis [MCA]) can reveal nonlinear relations between the variables (Escofier and Pagès, 1998, p. 87).

In other words, in the case we are dealing with here, it refers to an approach which is based on the detailed analysis of a measuring tool, exceeding its (their) expected structure(s). The main interest of this descriptive and heuristic method is a precise vision of latent dimensions which compose not only the measuring instrument but also the cloud of points of the individuals questioned. Our study, which is applied to the field of basic university education, relies on Cohen’s et al. 14-item PSS tool.

Our method is, of course, far from being perfect. However:

- it enables one to better explore certain factorial structures frequently observed in scales, such as the “effect size” and the “Guttman effects”. By going beyond these basic observations, the method of “data reconstitution of a Guttman effect” can reveal “effects of shape” likely to enrich the researchers’ and the practitioners’ interpretation, even if these revelations disrupt the linear and one-dimensional characteristic of a tool validated in psychometry. This is in keeping with the sense of Escofier and Pagès (1998), for whom the principle of curiosity and vigilance vis-à-vis the tools is one of the strong points of the scientific method;

- to abandon the idea of a division (or of a relation of superiority) between the analyses of quantitative data (PCA) and qualitative (FAC, and MCA). For example, we will see that the individuals located near the center of the axes are not always representative of the numerical values close to the mean: an intermediate score can also result from extreme but opposite values. Thus, in climatology, town A can have the same mean annual temperature as town B, but one has a temperate oceanic climate (little annual variation in the average temperature) whereas the other has a continental climate with important ranges in temperature between hot and cold (Escofier and Pagès, 1998, p. 34). Because of the transformation of measures in reduced and centered data (case of standard PCA), the origin of the axes (0) is supposed to represent the mean of all of the scores. Thinking that the individuals located near the origin of the axes are “all” “average” individuals is often a rapid conclusion! It is true that since Claude Bernard, this mythical mean has misled more than one researcher or theorist. This brings to mind the conflicting debate between Tarde and Durkheim concerning the normal and the pathological (Cerclé, 1995);

- to offer additional information to researchers and practitioners by proposing complementary methods of processing based on standard software such as Sphinx, Modalisa and Spadt (programs: PCA, FAC, MCA, Typology “of aggregation around moving or variable centers”). Since the main concern of researchers was the validation of their scales, they too often favor the confirmatory use of PCA to the detriment of observing clouds of individuals. But only the so-called “correspondence” analyses allow a “symmetrical” interpretation of the individual sets (I) and variables (J) (Fénélon, 1981, p. 154). However, typographical analyses offer the possibility to change the measure of the scale and to go from numerical to nominal. Our aim is to show that the qualitative “and” quantitative analysis of data offer new perspectives to all who use tools of the PSS type. Moreover, this type of mixed method is presently developed under the name of “multiple factor analysis” (MFA) (Escofier and Pagès, 1998, pp. 137–138). Here we do not question the scale of measure proposed by the PSS tool (even if some different quantifications could be usefully envisaged, with the help of visual analogical scales for example) but offer the reader a “plural” statistical approach, which can be applied directly to the standard uses of the PSS.

3.1. Plural examination of the data stemming from the PSS 14

Firstly, we use two types of simple and multiple factor analyses (PCA and MCA) in considering our data successively (1) as quantitative and (2) as qualitative. This step must validate the structure of the PSS 14. If this structure is real, it would then be expressed by an “effect size” (PCA) and a “Guttman effect” (MCA). This is an exploratory and a descriptive technique, which emphasizes the development of models, which adjust the data rather than rejecting hypotheses based on a lack of adjustment. Hence, there are no tests of statistical significance, which are applied to the results of a factor analysis of data; the principal object of this technique is to produce a simplified representation of the information on the orthogonal planes within reach of our understanding. Effectively, we would be incapable of imagining the positioning of individuals and variables in a 14-dimensional space (the number of items on the PSS 14). But this simplification can also be misleading, etc., therefore, even if we show an order relationship of scale type on our data, we will not be satisfied with the factor planes provided by axes 1 and 2.

Secondly, we create interactive typologies constructed on the principle of the aggregation of “moving centers”, a method considered to be simple but statistically accurate (Benzécri, 1980, t2, p. 293; Escofier and Pagès, 1998, p. 52). These typologies not only make it possible to create distinct classes of observations aggregated around a center of gravity, but also to construct the nominal variables necessary for the Factor Analysis of Correspondence (FAC or MCA). The aim is to “project” the observations in an iterative manner in order to (1) minimize intraclass dispersion around a center of gravity (or barycenter) and (2) maximize interclass dispersion. One thus succeeds in distributing the observations in a determined set, exclusive of the classes. The taxonomic methodology explains the discontinuity (membership or not in a class) while the factor analyses produce continuous results (position on an axis and in a geometric space). The relevance of this approach is particularly essential when there is doubt concerning the reality of the continuum of measures and the existence of a total order over sets I and J.
4. Method

4.1. Population

This is a mixed sample \((n = 600)\) of a population of university students made up of 485 women (80%) and 116 men (20%). About 57% are first and second year students (L1 and L2) and 43% are third and fourth year students (L3 and M1). This sample was drawn at random based on a survey population involving 5000 students at the University of Rennes 2. This survey aimed at defining the students’ well-being, the level of perceived stress and the subjects’ behaviors (eating, risk taking, sports, etc.). The project was initiated by the president of the university, the university medical services and our research laboratory.

4.2. Material and procedure

In addition to the background variables (sex, level of studies, economic status, distance from home, etc.), our questionnaire included the PSS scale by Cohen et al. (1983) and Cohen and Williamson (1988). This is made up of 14 items on a five-point scale (going from “never” to “often”) (examples of items: “... have you ever felt that things were going as you wanted?” “... have you ever thought that you could not do all the things that you had to do?”). The psychometric properties of this instrument are satisfactory (Gadéa and Cerclé, 2004). The questionnaire was filled out individually and returned to the researcher to ensure anonymity.

5. Results

5.1. Quantitative version of the analysis: PAC and “effect size”

Firstly, we used a reencoding of the inversed items (positive items 4, 5, 6, 9, 10, 13) for this standard use of the PSS (Bruchon-Schweitzer, 2002). The correlations between the factors were established. The internal consistency of the tool was verified and is satisfactory (alpha = 0.762).

PCA applied to the two-dimensional matrix \((J \times K)\) crossing the 600 “individuals” with their score profile based on the 14 items (“quantitative variables”) shows positive correlations between the set of measures and the existence of a basic common factor explaining 39% of the total variance of the cloud, in spite of some “independence” of items 1 and 2. Axis 1 can reasonably be interpreted as a factor of the intensity of perceived stress (Graph 1).

This factorial structure (known in biometry as the “effect size”) validates empirically the function of scale commonly granted to the PSS tool.

What is an effect size? Escofier and Pagès (1998, pp. 15–16) define this type of structure as follows: “If the variables in a set of data are all positively correlated two to two, then the cloud \(N_k\) is far from the origin. The first factor axis then particularly explains the position of \(N_k\) in relation to its origin: at the same time, the projections of the variables are close to one another. This type of figure is commonly called the effect size: it corresponds to a situation in which certain individuals have small values for the set of variables, others have large values for the set of variables, finally others are in an intermediary situation between these extremes. Then, in this case, there exists a common structure to the set of variables: this is what the first principal component expresses.”

In our case, this would mean that the subjects would be situated in an organized fashion on a continuum of stress going from the most \((F1 > 0)\) to the least \((F1 < 0)\): the individuals near the origins of the axes having average perceived stress. It is often the version offered concerning the PSS: “once the control items are inversed”, all the questions are supposed to measure the increasing or decreasing intensity of perceived stress in a linear manner. A total score of perceived stress is then obtained by adding the scores associated with each item. In theory and in practice, this application gives useful information but the data processing does not stop here.

However, if the control items are not inversed, the antinomic structure of the tool (control versus distress) is verified immediately. We will use this duality later in our data processing (Graph 2).

5.2. Qualitative version of the analysis: the MCA and the “Guttman effect”

The structure of the scale of data is also confirmed by the “Guttman effect”, as shown below by applying MCA to table \((I \times J)\). In this type of figure (parabolic form of clouds I and J), the low rates of inertia of the factors do not invalidate the quality of the information furnished on the structure of the data (Escofier and Pagès, 1998, p. 206). Factor 1 opposes the forms...
Fig. 1. Theoretical reconstruction of the data in the case of a Guttman effect: our data globally verifies the theoretical expectations of the Guttman effect for planes (1, 2) and (1, 3).

of low perceived stress to the forms of high perceived stress. Factor 2 expresses an opposition between the median and the extreme scores. In theory, the “Guttman effect” shows first of all the existence of factors (F2, F3, etc.), which are different from the first axis and which are polynomial functions of F1. It is possible to imagine this structure by using a table in which the values are all lined up inside a diagonal band (Graph 3).

This type of perfect structure is possible when one has truly antinomic variables and a total order in sets I and J. But this is rarely the case, including in socio-economic surveys, which, for example, cross the level of studies with job qualifications. However, the PSS claims to explain intrinsically a total score of perceived stress by combining a measure of perceived control (seven positive items inversed) with a measure of perceived distress (seven negative items non inversed). Its formula is based on the principle (low stress = [C++ D−−] and high stress = [C−− D++]: with C expressing control and D distress. But are our observed values “exclusively” ordered on the diagonal of the table in Fig. 1?

On the other hand, the hierarchy of the proper values of factors 1, 2 and 3 is relatively “close” (9.12, 6.7, 4.2% respectively). This absence of the “elbow effect” or of “drag”, terms commonly used by statisticians (Bry, 1995, p. 45), prompts us to go beyond an analysis uniquely devoted to plane 1.2. In examining the space of factors 2 and 3, we will see that the matter is not so simple! (Graph 4).

As can be observed on the plane (2.3) the subgroup of the modalities, which express very low control (grade = 5 after inver-
Graph 4. The plane of factors 2 and 3. The polynomial function here is no longer conform to the model. The R5 coding refers to the highest scores of lack of control. It must be noted (cf. above) that the rates of inertia are not prognostics of the accuracy of the data structure in this exact case.

Table 1
Breakdown of the subjects according to dichotomous typologies.

<table>
<thead>
<tr>
<th>Typo 2 CL</th>
<th>High distress</th>
<th>Low distress</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High control</td>
<td>23.08% (63)</td>
<td>70.70% (193)</td>
<td>100% (256)</td>
</tr>
<tr>
<td>Low control</td>
<td>66.28% (173)</td>
<td>28.35% (74)</td>
<td>100% (247)</td>
</tr>
<tr>
<td>Total</td>
<td>41.43% (236)</td>
<td>47.75% (267)</td>
<td>100% (503)</td>
</tr>
</tbody>
</table>

This observation leads us to envisage:

- a difference of a psychological nature regarding the constructs which make up the tool: does perceived stress measure exactly the same thing as perceived non control?
- a threshold effect, common on the extreme levels of the so-called “Likert” scales, the grade 5 (particularly here on the control items) causing a rupture in the planned linear order;
- a compact regrouping of the other modalities which suggests a more precise exploration of the intermediary values.

From our point of view, it does not appear that the PSS tool is based on the strictly additive and linear coherence of its components. Effectively, as we have seen earlier, it is constructed from two subsets of items considered as theoretically antinomic and requiring a recoding (an inversion of the scores of the control items) in order to obtain a unidirectional measure of perceived stress. Considering the structure of our data, we decided to consider:

- that the PSS could also be considered as a two-dimensional tool. In other words, it justifies two analyses separated on two independent dimensions, C and D;
- that an analysis capable of explaining the discontinuity of the results is justified where the existence of a total order of the data does not appear to be convincing.

5.3. Typological analysis of the data

First of all, based on the separated use of the items “distress” and “control”, we carried out a PCA for each subset of items, then for the interactive typologies constructed on the principle of “moving or variable centers” (De Lagarde, 1983, pp. 137–138). The observations were broken down into dichotomous classes according to their polarities (< 0 versus > 0) on the dimensions of control and distress: four classes of individuals (C+/C− and D+/D−) were then created (Table 1).

Secondly, a typology with three classes was made based on the factorial space defined by the PCA on the recoded items of the PSS 14 (Graph 1). This classical use based on the unidimensional postulate of the PSS resulted in defining three categories of perceived stress: high/average/low. Crossed Tables 2a and 2b breaks down the observations into the classes obtained. The crossing of “unidimensional” and “two-dimensional” typologies

Table 2a
Table crossed between the unidimensional and two-dimensional typologies.

<table>
<thead>
<tr>
<th>Typo 3 stress PSS</th>
<th>Cross con dist</th>
<th>High stress</th>
<th>Average stress</th>
<th>Low stress</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control +/distress+</td>
<td>4.76% (3)</td>
<td>87.30% (55)</td>
<td>7.94% (5)</td>
<td>100% (63)</td>
<td></td>
</tr>
<tr>
<td>Control +/distress−</td>
<td>0.00% (0)</td>
<td>44.04% (85)</td>
<td>55.96% (108)</td>
<td>100% (193)</td>
<td></td>
</tr>
<tr>
<td>Control−/distress+</td>
<td>63.58% (110)</td>
<td>36.42% (63)</td>
<td>0.00% (0)</td>
<td>100% (173)</td>
<td></td>
</tr>
<tr>
<td>Control−/distress−</td>
<td>5.41% (4)</td>
<td>89.19% (66)</td>
<td>5.41% (4)</td>
<td>100% (74)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.47 (117)</td>
<td>44.76% (269)</td>
<td>19.47% (117)</td>
<td>100% (503)</td>
<td></td>
</tr>
</tbody>
</table>

The dependence is very significant (χ² = 1048.40, ddl = 12, 1–p = > 99.99%).
then makes it possible to differentiate the types, which make up the category of “average stress”.

Our sample of respondents to the totality of the PSS items are divided up as follows: one out of five individuals belong to the category of high stress or that of low stress. However, the strata of average stress include almost one out of two respondents (44.76%). As for crossing the dichotomous typologies created from the principle of two-dimensionality, we find a

The correlations between the score of uncontrollability (i.e. subscore of inversely perceived control) and the score of distress:

Graph 5.1: + 0.51
Graph 5.2: + 0.82
Graph 5.3: - 0.50

If one considers that a correlation coefficient is truly accurate from 0.6, we must note that in the total sample and in the “paradoxical” population, the liaison between the score of uncontrollability and the score of distress is close to independence.

This observation is of course accurate for the use of the PSS 14 but also for the PSS 10 applied to a sample of 203 employees of a regional hospital:

Total sample: + 0.58 (n = 203)
“Non paradoxical” sample: + 0.78 (n = 139)
“Paradoxical” sample: - 0.54 (n = 38)
high proportion of C+/D− (92%) in the “low stress” category. Ninety-four per cent of the profiles C−/D+ are observed in the “high stress” category. These results, which are not surprising, reflect the underlying two-dimensional construction of the scale and are somewhat “redundant”. However, as shown by the table below, the average stress profiles are very diversified, but it is the number of profiles C+/D+ and C−/D− (55 and 66) which are overrepresented in this category (45%). Added to the entire sample, these “paradoxical” profiles of “average stress” (C+/D+ and C−/D−) represent a quarter (24%) of the respondents. Consequently, the responses of numerous individuals characterized by an average score of perceived stress, according to the classic measure of the PSS, do not necessarily refer to the expected negative correlations on the respective dimensions of distress and perceived control: some claim high control “and” high distress while others can show a strictly opposite profile.

Moreover, the predicted effect size no longer exists for the subpopulation of the “paradoxical” type: this is shown by the PCA carried out on the stratified sample based on the created classes (Graph 5.3).

5.4. A third factor based on the “paradoxical” types of average stress

As mentioned above (Fig. 1), according to the structure of the data scale, F2 is a parabolic function of F1 and when one seeks the third axis, one obtains a fluctuation characteristic of the Guttman effect but less informative in itself (Benzécri et al., 1980, t2). In order to go further than this factorial structure, which is accurate but limited to the first two factors, it is advisable to introduce the variables stemming from the typological analyses based on a dual conception of the scale (perceived control versus perceived distress).

If one uses the nominal variables stemming from the preceding typologies in order to carry out a multiple factor correspondence analysis, one can make the hypothesis of an nth independent factor constructed on the opposition between the “paradoxical” types (C+/D+) and (C−/D−). These profiles, non-conforming to the model of discrepancy, that we refer to as “paradoxical” are, in fact, situated outside of the diagonal in the table of Fig. 1. The existence of these types makes it possible to imagine a space, which is at least three-dimensional, and the importance of other factors, which are not polynomial functions of F1, as the effects of scale (effect size and Guttman effect) suggest this from the beginning (Escofier and Pagès, 1998, p. 207) (Graphs 6 and 7).

6. The interest of a “plural” approach to the PSS

Let us recall that the cities with average temperatures can be associated with temperate or continental climates. However, the individuals characterized by a medium score on the PSS do not all follow the logic of a perfect scalogram! We will present an application of our typological method on a population of 203 employees of a regional hospital in the following tables. The interest here is to be able to cross some discrete variables such as typologies and events judged to be stressful (Table 3).

If the overrepresented work stressors (+ sign) in the “high” classes and (C− D +) are the same, some differences in the profiles of stressors according to the typology used are observed elsewhere. Without pretending to give here a definitive interpretation of the results obtained, it will be observed that when the feeling of control is deficient without the feeling of distress being necessarily high (C− D−), it is the rhythms which are overrepresented according to the frequency test applied by the Sphinx program. Hence, the stressor “rhythms” is not the prerogative of the high stress identified in accordance with transactional logic (C− D+). However, it seems to be systematically associated with the deficiency of perceived control measured by the PSS. As for the “relational” stressors, they are underrepresented (− sign) in
type ($C^− D^−$). More generally, these subjects do not appear to feel irritability or excessive nervousness. This does not mean that they feel equipped to master events! It must be noted that lack of control ($C^−$) is overrepresented (65%, chi$^2$ is very significant), in the professional category “general services”, which is not the case of indicator ($D^+$) (Graphs 8 and 9).

The observation of the factorial spaces (FAC) crossing the professions and the “reconstructed” classes of stress based on the dichotomy ($C/D$) reveals an opposition between the “paradoxical” types. This opposition clearly shows the importance of perceived control in the measures furnished by the PSS. The general service employees claim to have a lack of control but fail to mention high distress, while for nurses the feeling of control is not incompatible with that of distress. The description and the interpretation of the data become more precise by using a “plural” method of analysis. Obviously, “organizational” answers or “relaxation therapy” will not have the same impact on everyone. Can the management of stress in the professional environment do without these distinctions?

If the data from our university sample is analyzed by using standard PSS methodology, one notes that the declared “smokers” and “nonsmokers” find themselves positioned primarily on the base of the parabola of perceived stress (“average” stress). However, when dichotomous variables created from the two distinct dimensions ($C$ and $D$) are used, the existence of a second factor, which associates the lack of control to the use of tobacco, is shown. On the basis of these results, preventive strategies, which are too often limited to techniques of mind-body relaxation, could be a way to improve their treatments: for example, by working on the reinforcement of perceived control (Graph 10).

Admittedly, in addition to classical artifacts, the measures made by using a PSS scale are dependent on a “bias” other than statistics. These biases, for example, can be the result of cultural determinants linked to the identity of gender. There-

### Table 3

Breakdown of work stressors into four classes according to the typology of perceived stress (two-dimensional PSS model). The frequency was calculated using the Sphinx program.

<table>
<thead>
<tr>
<th>Two-dimensional typological stress model</th>
<th>Stressors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control+/distress+ (31)</td>
<td>The hours + (7)</td>
</tr>
<tr>
<td></td>
<td>The hierarchy + (14)</td>
</tr>
<tr>
<td></td>
<td>Others + (14)</td>
</tr>
<tr>
<td>Control+/distress− (69)</td>
<td>Others + (26)</td>
</tr>
<tr>
<td></td>
<td>The hierarchy − (21)</td>
</tr>
<tr>
<td></td>
<td>Work Rhythms − (18)</td>
</tr>
<tr>
<td>Control−/distress+ (71)</td>
<td>The hours + (18)</td>
</tr>
<tr>
<td></td>
<td>Coworkers + (19)</td>
</tr>
<tr>
<td></td>
<td>Work rhythms + (27)</td>
</tr>
<tr>
<td>Control−/distress− (27)</td>
<td>Work rhythms + (11)</td>
</tr>
<tr>
<td></td>
<td>The hierarchy − (8)</td>
</tr>
<tr>
<td></td>
<td>Coworkers − (3)</td>
</tr>
<tr>
<td>Total (203)</td>
<td>The hierarchy (70)</td>
</tr>
<tr>
<td></td>
<td>Others (70)</td>
</tr>
<tr>
<td></td>
<td>Work rhythms (69)</td>
</tr>
</tbody>
</table>
fore, the male students in our study have significantly less higher overall scores of perceived stress than the female students, but this difference is particularly susceptible to the declared level of control as our university research has shown: male subjects enhance their feeling of control even if they claim the same distress. One can suspect here the influence of cultural norms and their corollary: "social desirability".

In some cases, in which psychological pathology is involved (such as chronic alcoholism), the illusion of control “primary narcissism” can cohabit quite well with a depressive sentiment (Cerclé, 1993).

Therefore, our approach aims at describing “paradoxical” profiles without denying the interest of a standard analysis of perceived stress. The PSS scale is a “good” scale but an appreciable number of individuals slip through the net.

7. Methodological guide

The methodological table shown below can be read from left to right. In our opinion, it makes it possible to improve the descriptive and predictive profitability of the PSS tool by exploring, in a more precise manner, the category of “average stress”, which confuses the classes of subjects which non-conform to the antinomic model postulated by the authors.

<table>
<thead>
<tr>
<th>Sets of the PSS 14 items (inversed control items)</th>
<th>Descriptive methodology Producing continuous results</th>
<th>Descriptive methodology Producing discontinuous results</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCA = effect size MCA = Guttman effect</td>
<td>Typology in 3 classes on PCA (high, “average”, low perceived stress)</td>
<td>Evaluation of the structure of the scale of the PSS tool. Breakdown of the observations into 3 hierarchical classes of perceived stress. Creation of a nominal variation with 3 exclusive modalities.</td>
<td>Identification of the subpopulations conform to the antinomic model (C vs. D) of perceived stress and the “paradoxical” subpopulation (C+ D-) and (C-D-).</td>
</tr>
<tr>
<td>Subset of control items (non inversed)</td>
<td>PCA = effect size</td>
<td>Typology in 2 classes (high vs. low control)</td>
<td>C+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type non conform</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type conform</td>
</tr>
<tr>
<td>Subset of “distress” items (non inversed)</td>
<td>PCA = effect size</td>
<td>Typology in 2 classes (high vs. low distress)</td>
<td>C+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type non conform</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type conform</td>
</tr>
</tbody>
</table>

Comparison of the results obtained by using the different typologies created:

- hierarchical typology of perceived stress (3 modalities);
- dichotomous typologies;
- typologies taking into account the “conform” or “paradoxical” types.

*Cf. paragraph 4 above.*

Enrichment of the qualitative and "combined" analyses by using the new dichotomous variables created (FAC, crosstabulation, means tables...).
8. Discussion

The main objective of this study was to propose a “plural” strategy for analyzing data for a different and a refined use of the PSS tool. Of course, it would have been preferable to extend this study to a diversified population, but the method presented remains perfectly transferable and the results shown above, based on a population of 203 employees in a regional hospital, prove it. This exploratory method made it possible to show a “medium zone” which does not fall within the transactional logic of the theory of stress defined as a “discrepancy” between the primary evaluation of the threat and the secondary evaluation of the resources. Thus, how does one consider an averagely stressed individual who would have a high score of both perceived distress and perceived control according to the PSS tool? This question is of interest knowing that Cohen et al. (1986, 1995) have shown that the coping process itself – and even if it is successful – can directly cause physiological and behavioral changes susceptible to generating a risk of illness. Consequently, should the sentiment of having substantial resources really be eliminated from the evaluation of the threat in order to measure perceived stress?

Another tool susceptible to shed light on stress measure exists: the “Stress Appraisal Measure” (Peacock and Wong, 1990), which makes it explicitly possible to distinguish between processes of evaluation and processes of coping (Monroe and Kelley, 1995), and which is applied to the measure for evaluating specific stress.

Consequently, if the PSS remains a reference tool for stress measure, it may be interesting to go further than the empirical work of analysis shown here (and could be generalized to all of the studies which are confronted by the structures of scale) to raise other questions related to heuristics and the use of the PSS tool. This method is based on an unending exchange between health psychology and its applications in the field. Thus, this two-dimensional approach, which allows access to latent factors, could reveal itself as useful to an observation and a refined interpretation of results susceptible to better target the psychosocial interventions of the practitioner. In particular, the nature of the relations between the stress measure (dichotomized on the dimensions “perceived distress” and “perceived control”) and its consequences could be explored by showing inter-individual differences, be it on the level of variables such as socio-demographic, personal, coping strategies, or even other health behaviors.

In addition to these practical aspects, our method also questions the relationship between the PSS scale and the theory of psychological stress seen as a discrepancy and its underlying homeostatic references. Regarding the method, questions should also be raised concerning the questioning procedure, which is based solely on declarations induced by statements whose meaning can be perceived differently. However, these are discussions which go beyond this empirical paper essentially devoted to psychosocial “engineering” and the “correct usage” of a frequently used tool.

References


