The alexithymia construct: a reading based on Categorical Principal Component Analysis

Paola Manfredi*, Marica Manisera** and Francesca Dabrassi*

• Background

From the second half of 1940s a number of authors (Ruesch, 1948; MacLean, 1949; Marty, de M'Uzan and David, 1963; Caretti and La Barbera, 2005; Porcelli, 2008), working from different perspectives, focused on a few modalities of psychic working. They identified some characteristics, which can be considered as the forerunners of the construct of the alexithymia, as outlined in 1970 by Nemiah and Sifneos (1970): a difficulty in verbalizing feelings in many psychosomatic patients, the "immature" or "infantile personality" concept, a stimulus-bound and externally oriented cognitive style (*pensée operatoire*) and a remarkable lack of fantasy.

Nemiah and Sifneos (1970) noticed lack of fantasy life, difficulty in finding words to describe emotions and colourless communicative style in 16 out of 20 patients, affected from two psychosomatic pathologies. Sifneos (1973) coined the term "alexithymia" to describe this set of affective and cognitive characteristics.

It is important to note that, although Nemiah and Sifneos (1970) considered a quite particular small sample, whose subjects

* University of Brescia, Clinical Psychology Division, Department of Maternal-Infantile and Biomedical Technologies, viale Europa 11, 25123 Brescia, Italy.

** University of Brescia, Department of Quantitative Methods, C. da S.Chiara 50, 25123 Brescia, Italy.

were affected by two pathologies recognized as psychosomatic, not all the subjects presented the characteristics identified as facets of the construct. Really, if we assumed, in absolute terms, that the above-mentioned deficiency characteristics are all present in the alexithymic subjects, we should regard them as describing a big loss: these people would lack pleasure in social relationships; they would not be able to communicate effectively, especially with children in whom the affective message has the priority over the informative one; they would be unable to fully enjoy a work of art, would not appreciate a poem, a book, a picture; they would not know the wait of a meeting, they would not have day-dreams nor an ability to plan… They would be able to work, especially on tasks that do not require abstraction.

From the 1970s the clinical studies on alexithymia have multiplied and important correlations have been found with other important psychological constructs, like (avoidance) attachment and psychosomatic disease (Zimmermann, 1999; Taylor, Bagby and Parker, 1997; Porcelli, Zaka, Leoci, Centoze and Taylor, 1995; Porcelli, Leoci, Guerra and Taylor, 1996; Verissimo, Mota-Cardoso and Taylor, 1998; Corcos & Speranza, 2003). This fruitful productive phase has also allowed to highlight a few questions related to the same construct and/or to its associations with other psychological concepts. A few changes and/or reviews of the construct have been already absorbed in part, others still require reflections and research.

For example, the original dichotomic characteristic (of the kind "all or nothing") has left space to the idea of a trait that can be present with different intensities in different people. Moreover, some authors considered that it can affect delimited "mental areas" of a person's functioning and it can also appear at a certain point of the life as a defense mechanism, especially after painful experiences, as chronic illnesses, dialysis, transplants (Freyberg, 1977) or as a consequence of early or late psychological trauma or developmental arrest (Sifneos, 1988).

Open questions are, for example, (a) the existence of a deficit alexithymia (Bion, 1962a, 1962b; Matte Blanco and Woodhouse, 1975) or a conflictual alexithymia (Marty et al., 1963; Freyberg, 1977; McDougall, 1989) or an alexithymia combining the two aspects (Grotstein, 1997); (b) the analogies and the differences with the self-reflective function or metacognition (Fonagy, Steele, Steele and Target, 1997; Fonagy and Target, 2001).

Certainly, our aim is not to provide answers, but to contribute to this thoughtful phase with another question on the reading of the TAS-20 (*Toronto Alexithymia Scale* - Bagby, Taylor and Parker, 1994a, 1994b), the most used tool for the measurement of alexithymia. It is a self-report measure of alexithymia with a three-factor structure theoretically consistent with the construct: difficulty in identifying and distinguishing between feelings and bodily sensations, difficulty in describing feelings and externally-oriented thinking. A good internal consistency and test-retest reliability of this factor structure was obtained using confirmatory factor analysis in nonclinical and clinical samples (Parker, Bagby, Taylor, Endler and Scmitz, 1993; Bagby et al., 1994a). Because the TAS-20 is a very practical tool, it has been translated into various languages, including Italian (Bressi, Taylor, Parker, Bressi, Brambilla, Aguglia, Allegranti, Bongiorno, Giberti, Bucca, Todarello, Callegari, Vender, Gala and Invernizzi, 1996). Most of the recent works on alexithymia refer to clinical subjects with evident pathologies; fewer works focus on the distribution of the construct over nonclinical population, especially the Italian one.

In the present work we considered nonclinical subjects with the objective of (1) summarizing the 20 items of the TAS-20, by means of a statistical technique developed to deal with categorical variables, and (2) interpreting the resulting few components. For this purpose, we used Categorical Principal Component Analysis (CatPCA) (Gifi, 1990; Meulman, Heiser and SPSS Inc., 2004; Meulman, Van der Kooij and Heiser, 2004; Linting, Meulman, Groenen and Van der Koij, 2007), a recent statistical technique developed by the Gifi group of the Leiden University.

• Methods

Participants

The sample consisted of 145 undergraduate medical students (28.6% men and 71.4% women; mean age was 21.74 years, S.D.=1.48), attending the third year at the University of Brescia, Faculty of Medicine.

Measure and procedure

The TAS-20, Italian version (Bressi et al., 1996), is a self-report scale comprised of 20 items, five of which are negatively keyed. Each item is rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Congruent with the salient facets of the alexithymia construct, using factor analysis the three-factor structure emerges (Bressi et al., 1996), as pointed out in the English version: (1) factor one describes *Difficulty Identifying Feelings* and distinguishing them from bodily sensations of emotional arousal; (2) factor two expresses *Difficulty Describing Feelings* to other people; (3) factor three determines the extent of *Externally Oriented Thinking*. Therefore three scores concerning the three factors and a total score can be obtained. From the analyses made on the sample of subjects with absence of diagnosed pathologies (Bressi et al., 1996), the TAS-20 has good internal consistency (Cronbach's _=.75), and test-retest reliability over a 2-week interval (r = .86).

The participants completed the TAS-20 anonymously during the introductory Medical Psychology course under the supervision of the teacher. The beginning of the semester was chosen to avoid information given during the course and the building of possible answer expectations by the teacher affecting answers.

• Statistical analysis

We computed the percentage of missing values for each of the 20 variables. For all variables this was less than 2%. Missing values on a variable were imputed with the corresponding mode. To obtain a summary of the subjects' answers and to examine, in this way, the component structure of a latent construct or trait measured by a questionnaire, it is common practice to reduce the dimensionality of the data by identifying one or more subscales (or factors) that summarize the available variables (or items). This is often done by Principal Component Analysis (PCA). Since the TAS-20 has ordered categorical items, classical linear PCA might not be the appropriate method. Therefore we used CatPCA, which is the nonlinear equivalent of PCA, and is available in the Categories module of SPSS (Meulman et al., 2004). Since CatPCA, unlike linear PCA, does not rely on classical statistical assumptions, like (multivariate) normality and linear relationships among variables, it is particularly suited when data are from Likert-type scales, like in the TAS-20. In fact, although Likert-type scales are often treated as interval scales, this is not conceptually right: we cannot assume a priori that the data are numerical (i.e., that the distances between the categories are equal).

In CatPCA the variables are analyzed using the principal components model, and (ordered) categorical data are simultaneously transformed into quantitative data by the technique of optimal scaling (Gifi, 1990).

CatPCA finds category quantifications that are optimal in the sense that the variance accounted for in the transformed variables, given the number of components, is maximized. The optimality is a relative concept, because it is based on the minimization of a loss function, assessing the goodness of fit between the optimal quantifications and the latent trait being measured, on the basis of the data at hand. In the optimal scaling process, the optimal scaling level has to be chosen, for each variable separately (Meulman et al., 2004; Linting, Meulman, Groenen and Van der Kooij, 2007). De-

pending upon the chosen optimal scaling level, information in the original categorical data is maintained in the optimal quantifications. The evaluation of goodness of fit is based on the Total Variance-Accounted-For in the transformed variables (VAF), on its corresponding percentage (PVAF), and on a generalized version of Cronbach's a (Cronbach, 1951; Heiser and Meulman, 1994). Those indices are useful to compare solutions obtained with different numbers of dimensions and different scaling levels (for details on the choice of scaling levels in CatPCA see, among others, Meulman, Van der Kooij and Heiser, 2004; Manisera, 2006; Linting et al., 2007). One of the available scaling levels is the numerical one: choosing numerical scaling level for all variables, CatPCA results are equal to classical PCA results.

• Results

The decision on the number of dimensions (components) was very important as it is strongly related to the interpretation of results. For this decision we used the "eigenvalue greater than one" criterion and the scree test (Cattell, 1966). According to the "eigenvalue greater than one" criterion, only dimensions with an eigenvalue (VAF) greater than one should be retained. The scree test or "elbow criterion" refers to the so-called screeplot that displays the dimension number on the horizontal axis and the VAF of the dimensions on the vertical axis. The number of dimensions to choose is the number above the "elbow" in the plot. Both criteria must be used with care because, unlike in classical PCA, the solution in CatPCA (with non-numerical scaling levels) is not nested. A nested solution means that the first s eigenvalues of a p-dimensional solution with $p>s$ are equal to the eigenvalues of a s-dimensional solution.

Therefore, in CatPCA with non-numerical scaling levels one analysis with a high number of dimensions only gives an indication of the number of dimensions to use (Gifi, 1985).

We performed an initial CatPCA with the maximum num-

ber (20) of dimensions, the first six eigenvalues were more than one (4.214, 3.018, 1.842, 1.493, 1.074, and 1.021). We initially chose the spline ordinal scaling level (Ramsay, 1988) because it seems to be the more natural choice in the presence of original ordered categories, since it maintains this information in the optimal quantifications.

In the scree plot (Figure 1) we see that the "elbow" corresponds with dimension 5, suggesting four dimensions.

Because the two criteria we used gave conflicting suggestions (6 or 4 dimensions), we used a third criterion: the interpretability of the solution. We inspected the component loadings. Stevens (1992) suggested that reliable components should have a minimum of four loadings above .60. The two solutions with 4 and 6 dimensions do not satisfy such a criterion: in each solution, at least one component was composed of only one (or no one) variable with loading above .60. The need of reliable components along with the parsimony principal led us to choose the solution of the 3 dimensions. Therefore, the optimal number of dimensions to maintain in the solution was 3. The final solution showed a PVAF of 47.412% and a Cronbach's a of .942.

Once the number of dimensions to maintain in the solution has been decided, we must check the decision about the scaling level to use. To do this, we conducted four analyses in three dimensions with different scaling levels: nominal, ordinal, spline ordinal (second degree monotonic splines with two interior knots) and numerical. Table 1 shows the fit indices (PVAF and generalized Cronbach's a) for each solution.

Because we prefer the more parsimonious (restrictive) transformations, we chose the spline ordinal scaling level. The numerical scaling level would assure even more parsimonious transformations, without losing much fit (see Table 1), but we chose to not neglect the (sometimes slight) nonlinearities.

Because we chose the spline ordinal scaling level, it was not necessary to check the decision about the number of dimensions, which is interdependent with the decision on the scaling

level. In fact, we decided the optimal number of dimensions by using the spline ordinal scaling level.

The final solution is unrotated because the current version of CatPCA does not offer rotation options. Unrotated solutions can sometimes be difficult to interpret, as was the case in our study. Therefore, we used the transformed variables as input for a classical PCA (the unrotated result of this is identical to the CatPCA solution), with quartimax rotation (Neuhaus and Wrigley, 1954). According to the rotated component loadings (Table 2) we could interpret three subscales for alexithymia. In practice, we preferred to include only variables with a high loading on a scale. In this way, there are no variables that contribute to more than one scale, and this makes the interpretation of scales easier. The composition of each component is evident looking at numbers in bold in Table 2.

• Discussion

It could be argued that this study should have been conducted by using factor analysis, rather than PCA, in order to take into account the measurement errors. In the literature, the decision to use PCA or factor analysis is a much-discussed question and comparisons between the two techniques are the object of many contributions (Thompson, 2004; Russell, 2002; Ogasawara, 2000; Fabrigar, Wegener, MacCallum and Strahan, 1999; Fava and Velicer, 1992; Cliff, 1987; Gorsuch, 2003; Mulaik, 1992). The distinction between the two techniques is based on the classification of statistical models in algorithmic and stochastic models (see, for example, Carpita and Manisera, 2006). In the present work we decided to use (Categorical) PCA because the aim of submitting the TAS-20 scale is to obtain a summarizing score for each subject in order to evaluate his/her level of alexithymia. Generally, PCA is more appropriate than factor analysis when the objective is to reduce the dimensionality of the data and to construct low-dimensional indicators summarizing numerous

variables (Fabrigar et al., 1999). It is worthy to note that, under some conditions, PCA and factor analysis lead to the same results. In particular, when the number of measured variables is large, also with respect to the supposed number of latent variables, as was in this case, the differences between the two techniques are negligible (Thompson, 2004; Fabrigar et al., 1999).

In our study, we obtained a three-dimensional score for each subject; the proposed interpretation of the three subscales of alexithymia is instrumental to the reading of the scores obtained in our sample: our work does not want to substitute the credited and usual factor analyses.

Statistical analyses showed that also in our sample the three-component solution is preferred. The reading of items weighting on the three different components provided an interpretation focused on the area of affections: the component related to the cognitive style is less present (in the literature, it was represented by the externally oriented thinking).

A component of general orientation towards the feelings was identified; it is a kind of theoretical inclination defining the importance of the feelings for the subject; we could define it as the analogical component. This component was composed of the following items: item 4 ("I am able to describe my feelings easily"); item 5 ("I prefer to analyse problems rather than just describe them"); item 10 ("Being in touch with emotions is essential"); item 18 ("I can feel close to someone, even in moments of silence"); item 19 ("I find examination of my feelings useful in solving personal problems"). Every item included in this component was reverse scored.

The second component could be defined as the digital component. It highlights a greater distinction, a differentiation and also the occurrence of affective ambivalence in the feelings. This component was composed of the following items: item 1 ("I am often confused about what emotion I am feeling"); item 2 ("It is difficult for me to find the right words for my feelings"); item 6 ("When I am upset, I do not know if I am sad, frightened, or angry"); item 7 ("I am often puzzled by sensations in my body"); item 8 ("I prefer to

just let things happen rather than to understand why they turned out that way"); item 9 ("I have feelings that I cannot quite identify"); item 13 ("I do not know what's going on inside me"); item 14 ("I often do not know why I am angry"); item 17 ("It is difficult for me to reveal my innermost feelings, even to close friends").

The last component introduces the relationship and the other; the subject has to evaluate his feelings again, but in order to test the relationship. The other can be the person with whom he/she really has a relationship in his/her life (item 11: "I find it hard to describe how I feel about people"; item 12: "People tell me to describe my feelings more"; item 15: "I prefer talking to people about their daily activities rather than their feelings"), the doctor (item 3: "I have physical sensations that even doctors do not understand"), but also a cultural media, a show (item 16: "I prefer to watch 'light' entertainment shows rather than psychological dramas", item 20: "Looking for hidden meanings in movies or plays distracts from their enjoyment") because also in this situation the subject can enter a relationship with an "another thought" rather than with his own thought, with a different reading and proposal: through a show there can also be the wish or the absence of an emotionally significant meeting.

• Conclusions

It is important to note that the proposed interpretation is statistically valid for our sample of medical students: the optimality of the obtained results is strongly related to the structure existing in the dataset at hand.

We only conjecture that a reading of the three components based on the affections could better match an extensive use of the construct: in our opinion the original third dimension of the *pensée operatoire* would lead the construct to lean towards a more accentuate psychic pathology; moreover, the third dimension is the component less statistically supported (Kooiman, Spinhoven and Trijsburg, 2002).

In a next work we intend to (1) assess, on the basis of the interpretation proposed in the present work, the level of alexithymia for the 145 medical students and (2) to compare the three-dimensional CatPCA measure with the total score obtained by the use of TAS-20 like in Bressi et al. (1996).

Also, in order to extend the proposed interpretation, we intend to make reference to a more heterogeneous and larger sample and to support the exploratory analysis used in this study with a confirmatory analysis.

• Abstract

Background: From the 1970s a lot of papers referring to alexithymia have been published. They are mainly focused on clinical subjects, having clear pathologies. In the present work we preferred to consider nonclinical subjects, in particular undergraduate medical students. Aiming at studying the level of alexithymia in the sample, the 20-Item Toronto Alexithymia Scale (TAS-20, Italian version) was used. The objective of this article is (1) to summarize the 20 items, by means of a statistical technique developed to deal with categorical variables, and (2) to interpret the resulting few components. **Method**: In a single session, 145 undergraduate medical students completed the TAS-20. The answers were analysed by using Categorical Principal Component Analysis (CatPCA). **Results**: The findings indicate that three was the optimal number of components to reduce the dimensionality of the dataset at hand. **Conclusions**: The three-component indicator has been interpreted according to analogical, digital, and relationship components. The analogical component identifies a general orientation towards the feelings; it is a kind of theoretical inclination defining the importance of the feelings for the subject; the digital component highlights a greater distinction, a differentiation and also the occurrence of affective ambivalence in the feelings; the relationship component is connected with the relationship, and the other: the sub-

ject has to evaluate his feelings again, but in order to test the relationships with the other. All three components identify a general orientation towards the feelings and relationships.

Keywords: Alexithymia; Categorical Principal Component Analysis; Optimal Scaling; Relationship; Toronto Alexithymia Scale (TAS-20).

• Riassunto

Introduzione: Dagli anni Settanta ad oggi moltissimi sono stati i lavori pubblicati sull'alessitimia, soprattutto in ambito clinico con soggetti che presentano patologie conclamate. Nel presente lavoro abbiamo voluto prendere in considerazione soggetti sani, nello specifico studenti di medicina al terzo anno di corso. Al fine ultimo di studiare il livello di alessitimia presente nel campione, si è utilizzato il TAS-20 (Toronto Alexithymia Scale, versione italiana). In particolare, lo scopo di questo articolo è quello di (1) sintetizzare i 20 item del TAS-20, ricorrendo ad una tecnica statistica creata ad hoc per trattare variabili categoriali, e (2) fornire un'interpretazione per le componenti che ne risultano. **Metodo**: In una singola sessione, 145 studenti della Facoltà di Medicina hanno compilato il questionario. Le risposte sono state analizzate utilizzando la tecnica statistica dell'Analisi delle Componenti Principali Nonlineare o Categoriale (CatPCA). **Risultati**: Dalle analisi emerge che il numero ottimale di componenti per ridurre la dimensionalità dei dati a nostra disposizione è pari a tre. **Conclusioni**: La lettura degli item che maggiormente hanno pesato nelle tre differenti componenti ha dato luogo ad un'interpretazione centrata sulla tematica affettiva. Le tre componenti proposte sono quella analogica (che indica un orientamento generale nei confronti dei sentimenti), quella digitale (che indica la capacità di cogliere i diversi sentimenti e le ambivalenze affettive) e quella relazionale (che indica la capacità di cogliere i propri sentimenti nell'incontro con l'altro).

• Résumé

Introduction: Depuis les ans Soixante-dix à aujourd'hui beaucoup de travaux sur l'alexithymie ont été publiés, surtout en domaine clinique avec des sujets qui présentent pathologies acclarées. Dans le présent travail nous avons considéré des sujets noncliniques: étudiants de médecine au troisième an de cours. Pour étudier le niveau d'alexithymie présent dans l'échantillon, on a utilisé le TAS-20 (Toronto Alexithymia Scale) version italienne. Le but de cet article est, en particulier, de: 1) synthétiser les 20 items du TAS-20, en recourant à une technique statistique créé *ad hoc* pour traiter les variables catégorielles, 2) interpréter les composants qui en résultent. **Méthode**: Dans une session unique, 145 étudiants de l'Université de Médecine ont complété le questionnaire. Les réponses ont été analysées en utilisant la technique statistique de l'analyse en composantes principales non linéaires. **Résultats**: L'analyse des données indique que trois est le numéro optimal de composants pour réduire la dimension de l'ensemble de données. **Conclusions**: La lecture des items qui ont le plus pesé dans les trois composants a donné lieu à une interprétation centrée sur la thématique affective. Les trois propositions composantes sont l'*analogique*, indiquant une orientation générale vers les sentiments, une sorte d'inclination théorique, la *numerique*, indiquant la capacité de cueillir les différents sentiments et les ambivalences affectives, et la *relationnel*, indiquant la capacité a saisir les propres sentiments dans la rencontre avec l'autre.

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