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# WEIGHTED BINARY ANALYSIS

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A method to analyse a $l \times k$ matrix ($z = \| z_{ij} \|$) is introduced. The method "weighted binary analysis" has been developed in the theoretical framework of Faverge's classical binary analysis and is based on a weighted expression of distances (instead of the classical Euclidian distance). So it makes possible to take into account differences in importance, which must be given to each row and/or column in the determination of proximities or distances (as it may be the case if we are more or less confident in data or if they do not have a same importance according to a given aim). Two examples of utilization of the method are given. The first example is a fictitious example which clearly shows the effect of weights on the representation (Tab. 1 and Fig. 1). The second example is in fact a proposal of application of the method to questionnaires on attitudes and opinions. The proposal is to collect next to the score matrix z a confidence matrix c (subjects' confidences in their answers to the questions), and then to use the first dimension of the binary analysis of matrix c as weights which will affect the spatial representation of the rows and columns of z. An empirical example is given (Annexe and Fig. 2, 3, 4, and 5).

## INTRODUCTION

Classical binary analysis (Faverge, 1973, 1975) is suited to analyse a $l \times k$ matrix ($z = \| z_{ij} \|$) that may be a subjects $\times$ items matrix, a groups $\times$ questions matrix of means, a concepts $\times$ attributes matrix of means, or any matrix of which entries are values. It leads to a spatial representation of rows and columns so that the distances between rows and between columns in the space of representation are good approximations of the corresponding distances computed on the given table. So Faverge's classical binary analysis is related to Benzecri's correspondences analysis (1973) and to methods proposed by Tucker (see for example 1960). The number of dimensions of the space is as restricted as possible in order to obtain a representation which is easy to read, a representation in which collections of items, groups of subjects, structures of attributes, and so on, are easy to detect. As it is almost always the case in such analyses, each row (resp. column) has the same importance in the determination of the distances and the structure of columns (resp. rows). This is made explicit when one considers that the distance between two columns

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j and j′ (two rows i and i′) is given by the classical Euclidian distance, i.e.

$$d_{jj'} = \left[\sum_{i=1}^{l} (z_{ij} - z_{ij'})^2\right]^{1/2}$$

$$d_{ii'} = \left[\sum_{j=1}^{k} (z_{ij} - z_{i'j})^2\right]^{1/2} \qquad <1>$$

But in practice, we have sometimes good reasons to assume that different importances, or different weights, should be given to each row and/or to each column in the determination of proximities or distances. This will be the case when rows and columns (for example variables) have different importances according to a given aim or because we are more or less confident in the data related to them.

An important example of such a situation is what we call the "fiability" of questionnaires [1]. It refers to the classical situation of subjects responding to attitudes or opinions questionnaires. Observing that subjects tend to be more or less confident in their answers and that questions tend to receive more or less confident responses, one could want to weight both subjects and questions in terms of these tendencies. This is in fact an example of the general problem in which different weights could be given as well to rows as to columns [2]. An easy way to do this is to replace the traditional distance d given afore by a weighted distance δ.

The equation <1> would thus be replaced by

$$\delta_{jj'} = \left[\sum_{i=1}^{l} c_i \, (z_{ij} - z_{ij'})^2\right]^{1/2}$$

$$\delta_{ii'} = \left[\sum_{j=1}^{k} p_j \, (z_{ij} - z_{i'j})^2\right]^{1/2} \qquad <2>$$

[1] "Fiability" is built on the French word "fiabilité", we call "fiability" the fact that we can rely on data; we use the word "fiability" rather than reliability to avoid confusion with the traditional psychometrical use of "reliability".

[2] Many other examples of the necessity of the introduction of weights may be found. Let us suppose that the matrix z is a group of respondents (established on a socio-economic basis for example) × questions matrix of means. Imagine then that we want to obtain a representation of the items structure according to the population from which respondents were drawn, but that the effectives of groups are not proportional to the effectives of the population. In such a case, it is evident that knowing the effective of each group in the population and assuming that the intragroups variances are weak, we will desire to weight the rows of the matrix proportionally to these effectives in order to obtain a "representative image". Another example would be a subjects × tests matrix which we want to analyse in the field of selection problems or in those of assignment of personnel. In such cases, tests have different reliabilities or measure more or less important traits related with the requirements of the function. Here it may be necessary to give more weight to reliable tests or to important traits in order to determine the distances between subjects.

where $c_i$ and $p_j$ are the weights respectively of row i and column j. This replacement leads then to the weighted binary analysis which has been developed in the theoretical framework of Faverge's classical binary analysis. But this problem being solved, another important problem still remains: the choice of weights $c_i$ and $p_j$. In this paper, a method designed to determine and to use such weights in the "fiability" of questionnaires is proposed.

## FROM CLASSICAL BINARY ANALYSIS TO WEIGHTED BINARY ANALYSIS[3]

Let z be a $l \times k$ data matrix ($z = \| z_{ij} \|$). This matrix may be decomposed according to the Eckart and Young's theorem (1936):

$$Z = W\ G\ V'$$

where w is an $l \times l$ orthonormal matrix, v is a $k \times k$ orthonormal matrix, and G contains the principal roots $\rho_\upsilon$ as diagonal entries in the upper left-hand corner and zeros elsewhere.

Let the roots and colums of w and v (principal vectors) be ordered to that $\rho_1 \geqslant \rho_2 \ldots \geqslant \rho_v \geqslant \ldots \geqslant \rho_k$ if $k \leqslant l$ (the last term is $\rho_l$ when $k > l$).

z is then approximated by a matrix $\hat{z}$ of rank r,

$$\hat{Z} = W_r\ G_r\ V'_r$$

where $w_r$ is the first r principal vectors of $zz'$, $v_r$ is the first r principal vectors of $z'z$, and $G_r$ is an $r \times r$ diagonal matrix of the square root of the r largest principal roots of $zz'$ (or $z'z$).

The number r corresponds to the number of "factors". The larger it is, the closer $\hat{z}$ approximates z ($\rho_v^2 / \text{trace}\ (z'z)$ gives the proportion of "variance" accounted for by $\rho_v$).

Define

$$X_r = W_r\ G_r$$
$$Y_r = G_r\ V'_r$$

therefore

$$\hat{Z} = X_r\ G_r^{-1} Y_r$$

where

$$X_r = \| x_{iv} \|,\ Y_r = \| y_{vj} \| \qquad <3>$$

or in non matrix notation

$$\hat{Z}_{ij} = \sum_{v=1}^{r} x_{iv}\ y_{vj} \ /\ \rho_v$$

[3] The description of classical binary analysis (C.B.A.) is taken from Faverge, 1975a.

and we see that

$$\hat{d}_{ii'} = \left[\sum_j (\hat{z}_{ij} - \hat{z}_{i'j})^2\right]^{1/2} = \left[\sum_{v=1}^{r} (x_{iv} - x_{i'v})^2\right]^{1/2}$$

and similarly

$$\hat{d}_{jj'} = \left[\sum_{v=1}^{r} (y_{vj} - y_{vj'})^2\right]^{1/2}$$

So if we represent the rows i by points $M_i$ of which the coordinates are $(x_{i1}, x_{i2}, \ldots, x_{iv}, \ldots, x_{ir})$ in an r dimensional space, distances between two points $M_i$ and $M_{i'}$ are approximations $(\hat{d}_{ii'})$ of the distances computed on matrix Z $(d_{ii'})$. And we have a symmetric property for the columns represented by points $N_j$ of which the coordinates are $(y_{1j}, y_{2j}, \ldots, y_{vj}, \ldots, y_{rj})$.

The traditional Euclidian distance has now to be replaced by a weighted expression of the rows and columns. Let us suppose that we dispose of non negative (integer) weights $c_i$ and $p_j$.

Define the matrix $Z^o$ as follows

$$Z^o = Q^{1/2}\, Z\, P^{1/2} \qquad <4>$$

where Q contains the $c_i$'s as diagonal entries and zeros elsewhere and P contains the $p_j$'s as diagonal entries and zeros elsewhere.

From <3> we write

$$\hat{Z}^o = X_r^o\, G_r^{o-1}\, Y_r^o \qquad <5>$$

where $X_r^o$, $G_r^o$ and $Y_r^o$ are defined as before, replacing Z by $Z^o$:

$$X_r^o = \| x_{iv}^o \|,\; Y_r^o = \| y_{vj}^o \|,\; v \leqslant r$$

<4> and <5> allow us to write

$$\hat{Z} = Q^{-1/2}\, X_r^o\, G_r^{o-1}\, Y_r^o\, P^{-1/2}$$

or

$$\hat{Z} = X_r^*\, G_r^{o-1}\, Y_r^*$$

where

$$X_r^* = Q^{-1/2}\, X_r^o \text{ and } Y_r^* = Y_r^o\, P^{-1/2}$$

$$X_r^* = \| x_{iv}^* \| \text{ and } Y_r^* = \| y_{vj}^* \| \text{ where } v \leqslant r$$

In non matrix notation we may write

$$\hat{z}_{ij} = \sum_{v=1}^{r} \frac{x_{iv}^o/\sqrt{c_i} \,.\, y_{vj}^o/\sqrt{p_j}}{\rho_v^o} = \sum_{v=1}^{r} \frac{x_{iv}^*\, y_{vj}^*}{\rho_v^o}$$

Taking the $x_{iv}^*$'s as coordinates of points $M_i$ (representing the rows), and the $y_{vj}^*$'s as coordinates of points $N_j$ (representing the columns), the distances in the r dimensional space of representation between two points $M_i$ and $M_{i'}$ (resp. between two points $N_j$ and $N_{j'}$) are then approximations of the weighted distances computed on the initial matrix (the $c_i$'s and the $p_j$'s being respectively the weights of rows and columns).

We have indeed

$$\hat{\delta}_{ii'} = \left[\sum_j p_j (\hat{z}_{ij} - \hat{z}_{i'j})^2\right]^{1/2}$$

$$= \left[\sum_j p_j \left(\sum_v \frac{x^*_{iv}\, y^*_{vj}}{\rho^o_v} - \sum_v \frac{x^*_{i'v}\, y^*_{vj}}{\rho^o_v}\right)^2\right]^{1/2}$$

$$= \left[\sum_{v=1}^{r} (x^*_{iv} - x^*_{i'v})^2\right]^{1/2}$$

Practically, it is obvious that the main problem in this method concerns the choice or the construction of the weights $c_i$'s or/and $p_j$'s according to the way they affect distances (i.e. idea of lenghtening, repetition). These problems will be "metrological" problems; one must indeed dispose of unidimensional indices of importance which may be seen as multiplicative (repetitive) factors of rows and columns.

## A FICTITIOUS EXAMPLE

In order to illustrate the effects of weights on the results of a binary analysis, a small $3 \times 8$ matrix is analysed without and with the introduction of different sets of arbitrary weights. The matrix is taken from Karnas, 1975; it is a matrix of means of judgements given by 80 respondents upon three beer labels for four bipolar questions (answers were given on six graded scales) (see Tab. 1). We will consider here three analyses.

For each analysis the weights of rows are 100 but the weights of columns differ. The weights of columns appear in Tab. 1. The three W.B.A.[4] corresponding to the three sets of weights of columns give three identical representations of columns (the weights of rows are the same in the three cases) but three different representations of rows (under the effect of the columns' weights). In order to clarify the reading of results and therefore to make more explicit the role of weighting, the three representations of rows are superposed taking care that the three points of label 1 coincide (see Fig. 1). The reader will note the effect of weights : The increasing of the proximity between the points of labels 2 and 3 from analysis 1 to analysis 2 and then to analysis 3. Going back to Tab. 1, it is clear that this is caused by the greater similarity between average judgements on labels 2 and 3 for items with high weights in the three analyses than for items with lower weights in analyses 2 and 3.

[4] Weighted binary analysis.

| | questions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | feminine | masculine | natural | flavoured | table beer | cafe beer | coloured | transparent |
| label 1 (L 01) | 3.22 | 3.78 | 4.50 | 2.50 | 3.00 | 4.00 | 2.65 | 4.35 |
| label 2 (L 02) | 3.22 | 3.78 | 4.15 | 2.85 | 2.70 | 4.30 | 2.56 | 4.44 |
| label 3 (L 03) | 3.47 | 3.53 | 4.12 | 2.88 | 2.82 | 4.18 | 2.99 | 4.01 |
| weights of columns for the three cases. | | | | | | | | |
| case 1 (L 01, L 02, L 03) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| case 2 (L 01, L 02′, L 03′) | 64 | 64 | 100 | 100 | 100 | 100 | 64 | 64 |
| case 3 (L 01, L 02″, L 03″) | 16 | 16 | 100 | 100 | 100 | 100 | 16 | 16 |

TAB. 1. MEANS AND WEIGHTS FOR THE "BEER" EXAMPLE

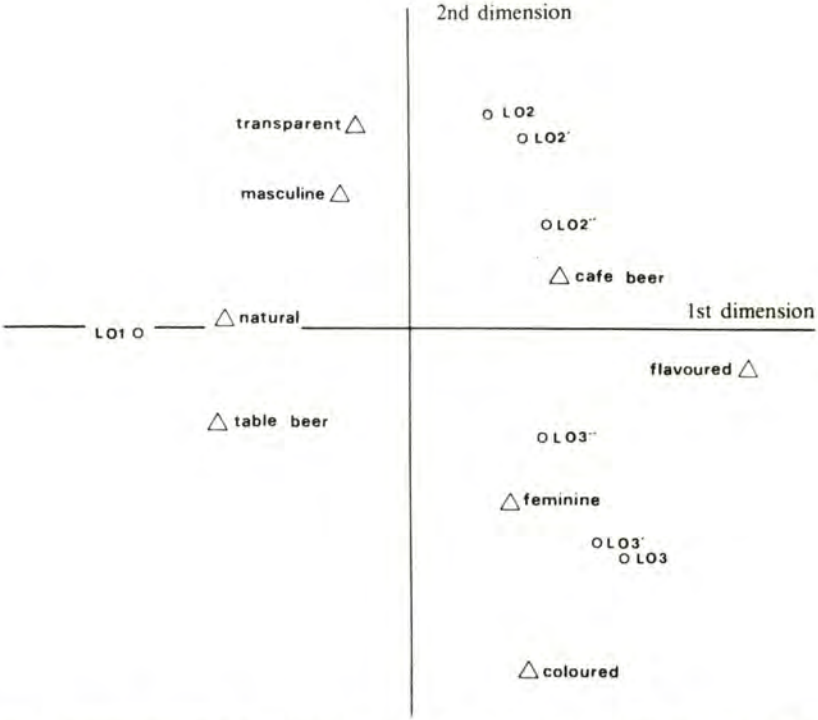


FIG. 1. "BEER" EXAMPLE: REPRESENTATION FOR THE FIRST TWO "USEFUL" DIMENSIONS OF WEIGHTED BINARY ANALYSIS. △ = question points; ○ = label points; the weights of the rows are all equal to 100.

This example shows how different interpretations are possible. Case 1 leads us to think in three diversified presentations. Case 3 induces an interpretation based on the idea of a single opposition between label 1 at the one end and labels 2 and 3 gathered at the other end.

## THE W.B.A. APPLIED TO "FIABILITY" OF QUESTIONNAIRES

The use of questionnaires is of current practice in the study of attitudes and opinions. But many remarks made by respondents to questionnaires raise the problem of what we call the "fiability" of data collected by such methods: The subjects are more or less confident in their answers and, symmetrically, these questions have a tendency to receive more or less confident responses (it must be clear that we do not use "fiability" in the sense of "sincerity"). Such a problem is well-known and many studies are devoted to the construction and selection of "good" questions (Albou, 1973; Cannel and Kahn, 1974; Davall, Bourricaud, De La Motte and Doron, 1967;

Kuncel, 1973; Mucchielli, 1968; Salengros, 1976). But most reflections on this matter lead only to tricks, rules of thumb, advices.

So, with Dubois and Burns (1975), we regret that so few research is concerned with the systematic study (from theoretical and empirical points of view) of problems related to the interpretation of items, the use of available response categories, and so on. Obviously, some studies have been done (see Kuncel, Dubois and Burns), but they have a rather small impact on the large number of studies using questionnaires.

A subject who is asked to give an answer to an item in an attitude or opinion questionnaire is more or less confident in his own answer.

It is thus possible to ask him to give, after his answer to the item, a judgement about his degree of assurance in a way quite similar to the one given by de Finetti (1965) about tests. We may ask the respondents to express these judgements either on graded scales or on continuous lines from "no assurance" to "total confidence". The data can be summarized into two matrices, a matrix Z (subjects x attitudes or opinion questions) and a matrix C (subjects x confidences in the answers to questions) [5]. The entries of matrix C, the confidences scores, may be decomposed as products of two factors: One depending only on the subject ($c_i$) and the other depending only on the question ($p_j$). According to this model, the existence of two hypothetical and unidimensional variables is assumed: On the one hand, a subject's fundamental tendency to be more or less confident in his own responses ("independently" of the question), and on the other hand, the fundamental "tendency" of a question to receive more or less confident responses. Moreover, this model also suggests an hypothesis with regard to the combination of these two variables because it assumes that one can write:

$$C = c' p$$
$$c = (c_1 \; c_2 \; \dots \; c_i \; \dots \; c_l)$$
$$p = (p_1 \; p_2 \; \dots \; p_j \; \dots \; p_k)$$

Assuming the validity of this model, one can easily compute estimations of components of vectors c and p (let us say $\hat{c}_i$ and $\hat{p}_j$) through the classical binary analysis of matrix C (we may take $x_{i1}$ and $y_{1j}$ as $\hat{c}_i$ and $\hat{p}_j$ respectively). Furthermore, this analysis allows us to check the pertinence of the model. Finally, if it appears that the model may reasonably be accepted, it will seem natural to give more or less importance to subjects and to questions according to their values on confidence variables, in order to analyse the matrix Z [6]. That will be done by using the $\hat{c}_i$'s and $\hat{p}_j$'s as weights in the W.B.A. of Z.

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[5] Let Z and C be $l \times k$ matrices.

[6] So for example, questions which receive in general confident responses will have more importance – will be more determinant – in the computations of distances between subjects than questions receiving less assured responses.

Two important remarks have to be formulated: it is clear that the limitations of the use of W.B.A. in the "fiability" problem is that it rests upon the assumption that confidence matrices are of order one. It is a strong assumption and one has to check whether, in a given case, the collected confidence data do not deviate too much from it before applying the W.B.A. However, such an assumption must be made about all the corrective variables which were introduced in order to improve questionnaires. This is the case for "social desirability", "fakability", "response styles" ... When we estimate the "social desirability" of a question, we also must assume that it is a unidimensional variable. That assumption seems very strong and, at first sight, no more acceptable than its analogue for confidence.

Nevertheless, all these variables are useful because the one order assumption, although strong, is not in most cases so irrealistic. A one order approximation of the empirical data is generally very good. This is also the case for the confidence data in our example.

Suppose we have a matrix C of confidence scores; we analyse the matrix by the C.B.A. and we conclude that a one order approximation of C is remarkably good – it explains for example 90% of total variance. The question which remains open is that any monotone growing transformation of the $\hat{c}_i$ and $\hat{p}_j$, obtained by the analysis of C, could be taken into account as weights for the W.B.A. of Z. For example, we may think that $\hat{c}_i^2$ and $\hat{p}_j^2$ should be used rather than the original $\hat{c}_i$ and $\hat{p}_j$.

Once again, this is not a singular problem; because it appears each time we want to measure psychological variables by questionnaires or tests. In fact, we believe that in the problem of "fiability", i.e. when using the confidence scores in order to "weight" subjects and items, this problem may be solved in some conventional manner.

W.B.A. in the "fiability" problem may thus be summarized as follows:

1. Recolt matrix Z of responses to questions on attitudes or opinions and matrix C of confidences in answers;
2. Analyse by C.B.A. matrix C giving estimations $\hat{c}_i$'s and $\hat{p}_j$'s, if C appears to be of order one;
3. Analyse by W.B.A. matrix Z, the $\hat{c}_i$'s and $\hat{p}_j$'s being respectively the weights of row i and column j.

## AN EMPIRICAL EXAMPLE

Sixty-seven students in psychology were asked to answer the 14 bipolar questions given in Annexe on six graded scales (matrix Z). For each question, they were also requested to give a judgement of confidence on a continuous scale of which the extremities were 0 and 100 (matrix C). The most important results reported here concern the problem of the hypothetical unidimensionality of "confidence". Two

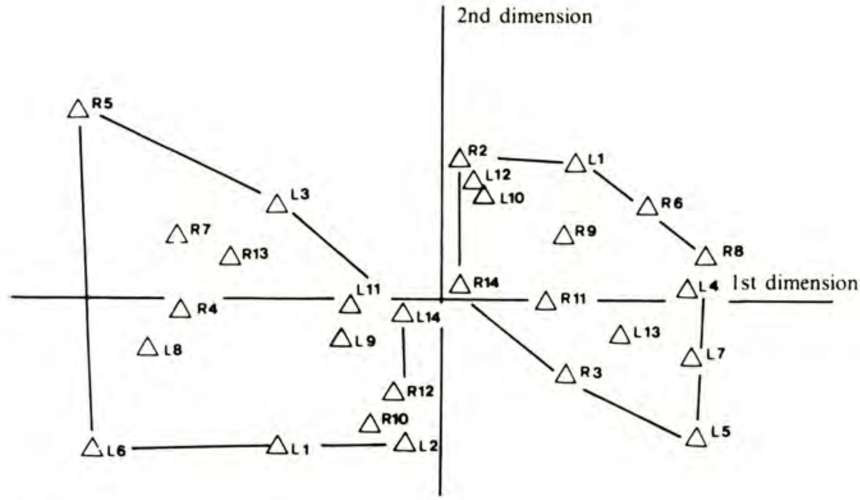


FIG 2

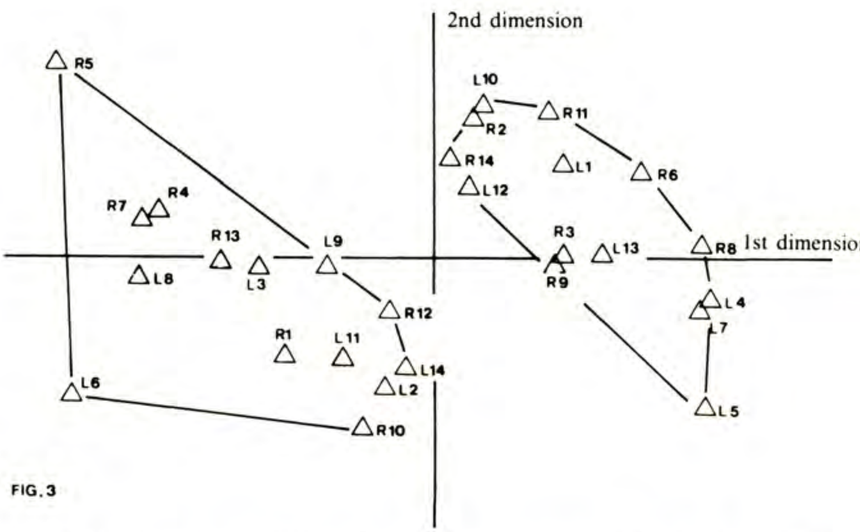


FIG. 3

FIG. 2 AND 3. QUESTIONNAIRE ABOUT STYLES: REPRESENTATIONS FOR THE FIRST TWO "USEFUL" DIMENSIONS OF THE BINARY ANALYSIS. $\Delta$ = question points. FIG. 2. USUAL CLASSICAL BINARY ANALYSIS. FIG. 3. WEIGHTED BINARY ANALYSIS. The weights of the rows are the confidence scores of the subjects.

facts are to be mentioned. First, the Kuder-Richardson coefficient (Faverge, 1964) computed for the 14 confidence scales and the 67 subjects is .86. Secondly, the classical binary analysis of the $67 \times 14$ confidence matrix reveals a first dimension which explains 90% of the total variance. These observations strongly support the model: confidence seems to be a unidimensional variable.

Taking the components of subjects and of questions in the first axis of the classical binary analysis of the matrix C (confidence matrix) respectively as $\hat{c}_i$'s and $\hat{p}_j$'s weights, we have realized the weighted binary analysis of matrix Z. In order to materialize the effects of weights on the results, we have also realized the C.B.A. of this last matrix[7]. We will only consider here the representations of questions. In both cases, the percentage of total variance explained by the first two axes (corresponding to the first two principal roots) are 45% and 12%. Fig. 2 and 3 give the representations obtained for those axes, for the two kinds of analyses.

A global examination of the two diagrams is sufficient to elucidate the effects of the introduction of weights. In the W.B.A. there is a clear tendency of the items to form two more compact and separated blocks. Considering the terms of the questions in the two groups, the so formed groups meet the pre-model on which the questionnaire was built. The questions were indeed formulated on the hypothesis of existence of two extreme behaviour styles which might be called systematic versus singular, rigid versus flexible or algorithmic versus heuristic (Karnas, 1976). Items L1, R2, R3, L4, L5, R6, L7, R8, R9, L10, R11, L12, L13, and R14 would hypothetically correspond each time to the first pole of these oppositions[8]. As the analysis is dual (binary), we may consider the subjects points in the two-dimensional space. Fig. 4 and 5 give the representations obtained respectively without the introduction of weights and with the introduction of weights. Displacements of points which will affect the characterization of subjects in terms of the two dimensions are observed. This is particularly true for some individuals.

In conclusion, when we give more weight to the respondents who are more confident in their answers, we give more credit to the hypothesis underlying the questionnaire. Naturally, all the implications of such an observation are to be analysed. The single fact that this study has delimited the conditions under which a given hypothesis, being evaluated by a questionnaire, seems to be more plausible, is a result of great interest. If it should be confirmed by other questionnaires and other subjects, it would induce new approaches in the field of questionnaires.

## CONCLUSION

This article has to be evaluated as a preliminary attempt to present concepts and a method that may be of some interest in the field of questionnaires. Many problems have still to be examined. A great

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[7] In fact, the analyses were made on the images of variables (see Faverge, 1975b).

[8] L and R refer respectively to the left and to the right sentences.

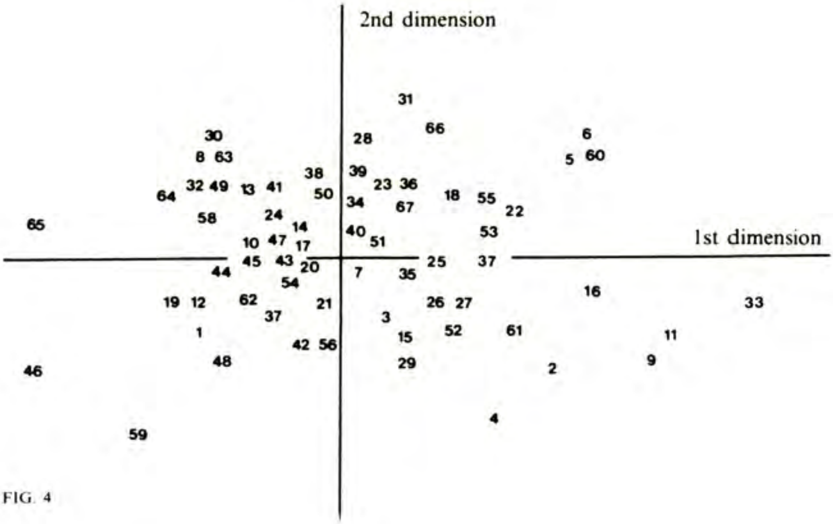


FIG. 4

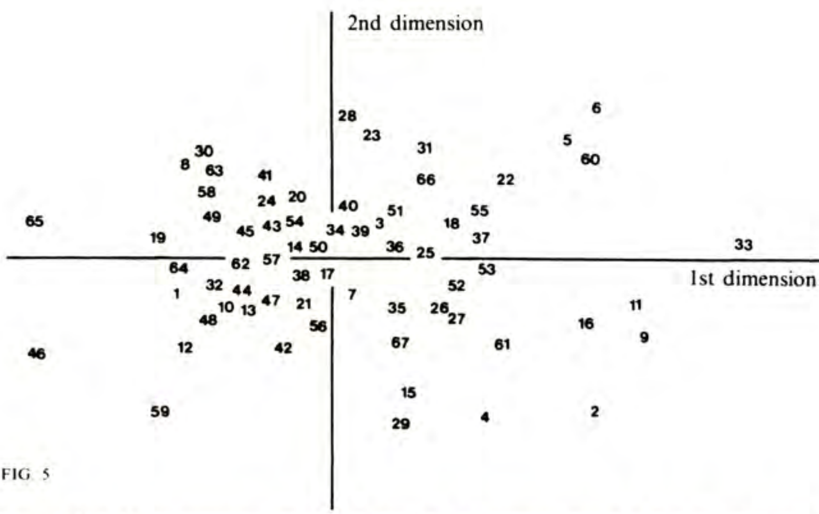


FIG. 5

FIG. 4 AND 5. QUESTIONNAIRE ABOUT STYLES: REPRESENTATIONS FOR THE FIRST TWO "USEFUL" DIMENSIONS OF THE BINARY ANALYSIS. i = subject points. FIG. 4. USUAL CLASSICAL BINARY ANALYSIS. FIG. 5. WEIGHTED BINARY ANALYSIS. The weights of the columns are the confidence scores of the questions.

deal of them are related to the hypothesis which support the weighted binary analysis. In many cases, as in the "fiability" problem of questionnaires, the most important question is about the numbers which may be regarded as weights, i.e. as values of a unidimensional variable of "importance" which may affect distances in a multiplicative manner. In the problem of "fiability" of questionnaires, the main problem is not the question of unidimensionality but the interpretation of this dimension as a real "confidence dimension". Clearly, there may be many reasons to the one order property of a confidence matrix. These reasons may be not related to the existence and the expression of an "assurance in answers" variable. Another problem is the non-uniqueness of the decomposition of the matrix of confidences. Such a question must be kept in mind. Our choice was to use the solution given by the application of the classical binary analysis to the matrix; a solution which maximizes the proportion of variance accounted for by the first dimension.

From a prospective point of view, the ideas which emerge from this study suggest some interesting extensions. For example, the concept of confidence in attitude questionnaires may lead to the elaboration of cognitive models of the response process and to characterization of subjects in terms of response-styles. From a strictly practical point of view, the method may be of interest as well in the stage of construction of questionnaire as in the interpretation of results, through the utilization of the first factor of the confidence matrix as weights which affect the spatial representation of the rows and columns of the score matrix z.

## ANNEXE

### THE QUESTIONNAIRE

| | | |
|---|---|---|
| 1. | When one is facing a series of problems, the most important thing is to seek what they all have in common. | When one is facing a series of problems, the most important thing is to find what differentiate each of them from the others. |
| 2. | I prefer games in which chance plays a role. | I prefer games in which chance does not play a role. |
| 3. | I think that a course must privilege contents. | I think that a course must privilege methods. |
| 4. | When I must find the answer to a riddle or a problem, I prefer to adopt a very systematic solving method which appears to be sure, even if it is tedious. | When I must find the answer to a riddle or a problem, I prefer to adopt a hazardous method that has a chance to lead very quickly to the solution, even if I am not sure that it will effectively lead to a solution. |
| 5. | In everyday life, when I am confronted with a problem, I prefer to seek for a durable solution even if I must leave the problem unsolved for a time. | In everyday life, when I am confronted with a problem, I prefer to solve it rapidly even if the solution is only a momentary one. |
| 6. | When I must go somewhere not knowing the way very well, I often take a short cut at the risk of taking a wrong road. | When I must go somewhere not knowing the way very well, I prefer to take principal arteries at the risk of doing a too long journey. |
| 7. | I believe that one must devote all one's energy to one single spare activity. | I believe that one must have many and different spare activities, even if one invests only a little in each of them. |
| 8. | When I am confronted with a problem, I prefer, if possible, to adopt a new solution. | When I am confronted with a problem, I prefer, if possible, to adopt a well tried solution. |
| 9. | In every day life, we must take advantage of all the events that happen. | In everyday life, the most important is to plan our activities and actions. |
| 10. | When one is faced with a problem, I think that the most important thing is to try to divide the difficulties into parts. | When one is faced with a problem, I think that the most important thing is to tackle it as a whole. |
| 11. | In general, I find that all the questions are interesting. | In general, I find that one must not dissipate one's efforts. |
| 12. | Things being what they are, I believe that teaching must first of all provide general methods of work. | Things being what they are, I believe that it is impossible to provide really general methods of work because each situation is different. |
| 13. | I prefer to be sound on the elements of a matter, even if this matter is relatively limited. | I prefer to have knowledge on plenty of matters even if my knowledge is relatively superficial. |
| 14. | I prefer a course which provides techniques which apply directly to real cases and which avoids statements which are too abstract. | I prefer a course which provides general principles and which avoids statements like "tricks of the trade". |

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