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Living Conditions, Interviewer Effects and Perceived Well-Being of the Elderly. A Multiple Correspondence Analysis Approach.

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Abstract

This paper reports on a study on quality of life of elderly people carried out in the city of Girona (Spain) in 1999. The study of the quality of life of the elderly must be based on both objective and subjective indicators along a set of relevant sub-dimensions. Most of the relevant factual and subjective items in quality of life questionnaires are qualitative and call for a multiple correspondence type of analysis. Besides, most of the questions are to some extent sensitive and therefore prone to high non-response and interviewer effects.

In this paper, drawing on the work of Escofier (1981) and Zárraga and Goitisolo (1999), we apply a variant of multiple correspondence analysis that can be implemented with ordinary principal component analysis software and that prevents non-response categories from having too high a contribution on the first dimensions. Subjective well-being questions play the role of active variables and objective well-being questions that of illustrative variables. Next, analysis of variance models are fitted to the axis scores with the interviewer and demographic variables used as predictors. Interviewer effect estimates are used to partial interviewer effects out of the axis scores.

The results show a two-dimensional solution to be appropriate. The upper right quadrant corresponds to high quality of life and the lower left quadrant to low quality of life. The solution is related in the expected way to many of the objective illustrative variables such as neighbourhood, prior occupation, income source, disablement, education, level of physical activity and housing condition.

The analysis was replicated without accounting for non-response and interviewer effects and the interpretation of the axes became much less clear.

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1 Introduction

The improvement of the quality of life (QOL) of elderly people has become one of the big challenges of most welfare states during the last decades (Abeles et al., 1994). In order to develop adequate programs to improve the elders' QOL, political and technical decisions must be very well grounded on a deep knowledge of the social reality. QOL has been often defined as a multidimensional concept, composed both of the *objective* conditions of living and of the *psychosocial* conditions of living (Fernández-Ballesteros & Macía, 1993; Fernández-Ballesteros et al., 1996; Glatzer & Mohr, 1987) across a range of relevant domains of life (Michalos et al., 2001). Consequently, good instruments for data collection and good analysis procedures are needed in order to offer decision makers a good profile of the material and psychosocial conditions of living in a community, where social action is intended with the goal of improving elderly people's QOL.

This paper reanalyses the data of a survey on QOL of elderly people carried out in the city of Girona (Spain) in 1999 (Casas et al., 2001). Most of the relevant factual and subjective items in the quality of life questionnaire are qualitative and call for a multiple correspondence type of analysis. Besides, most of the questions are to some extent sensitive and therefore prone to high non-response and interviewer effects (Groves, 1989). A modified multiple correspondence analysis is suggested in order to deal with these effects. This approach is described in Section 2 together with the data. Section 3 presents the results and Section 4 compares them with the standard multiple correspondence analysis approach. Finally, the findings are discussed in Section 5.

2 Method

2.1 Subjects and data collection

The sampling frame was the 1999 census of citizens above 65 in the city of Girona, the capital town of the north-eastern most province in continental Spain. The sample was selected by simple random sampling stratified by seven personal welfare service districts (Barri Vell, Palau, Pont Major, Sant Narcís, Santa Eugènia, Taialà, and Vila-Roja) and two groups (one group of people aged 75 and above living alone and the other group with the remaining people aged above 65). Stratification was non-proportional in order to achieve the same sampling error in all 14 strata (a maximum error of +/-6.23% for the estimation of proportions with 95% confidence). Total sample size was 2000.

Data were collected from October to December 1999 by home personal interviews with substitution by another randomly selected member of the stratum after three recalls without contacting the sampled person. This occurred in 33% of the cases.

2.2 Variables

In this article a small subset of the questions is used to create the following list of categorical variables, related to the dimensions in Fernández-Ballesteros and Macía (1993) and Fernández-Ballesteros et al. (1996). For most dimensions, both objective and subjective indicators exist, as recommended by these authors. Subjective dimensions are indicated with an "s".

Background variables:
INTERV: Interviewer, with 10 categories
DISTRICT: District, with 7 categories
GROUP: Age and living stratum (above 75 living alone vs. others)
AGE: Age, grouped into categories
GENDER: Gender
PROPDWEL: Ownership of the dwelling
OCCUPATI: Last job
INCOSOUR: Main income source
LIVEWITH: Who is living with the old person
FAMIOTHE: Other family members who are not living with the old person
ISOLPROB: Living alone and having no other family members

Dimension 1 *Objective health*
HOSPADM: Admitted to Hospital during the last year
DIFFHEAR: Hearing disablement
DIFFWALK: Using walking stick or crutches

Dimension 1s *Subjective health*
HEALPERC: Perception of general health

Dimension 2 *Autonomy*

The questionnaire included 6 items on autonomy regarding basic activities (getting up and going to bed, washing oneself, walking in the home, getting (un)dressed, going to the toilet and eating) 6 regarding instrumental activities (cooking, doing general housework, using the phone, shopping, running errands, managing one's income) and 2 regarding mobility (getting out of the house, going stairs up and down). A general index was constructed for each type of activity by assigning one point to a response "I can do it but it is difficult" two points to the response "I can't do it without some help" and three to the response "I can't do it

without a lot of help"). The indexes were categorised into two groups. The cutpoints were 6 for basic and instrumental activities and 1 for mobility activities.

DEPEBASI: Dependence on others to perform basic activities
DEPEINST: Dependence on others to perform instrumental activities
DEPEMOBI: Dependence on others regarding mobility

Dimension 2s *Autonomy perception*
ABILSELF: Feeling able to manage by oneself better or worse than others of the same age

Dimension 3 *Activity*
NODRIVE: Never driving a car
NOWALK: Never or rarely walking
NOACTI: Never practising hobbies alone
NOVIHELP: Never visiting friends or helping others
STAYHOME: Often just staying at home
NOCULT: Never going to cultural or recreational events
ASSOCIAT: Participating in associations of all types

Dimension 3s *Satisfaction with activity*
SAUSTIME: Satisfaction with the use of leisure time

Dimension 4s *Social satisfaction*

The questionnaire contained a battery of 8 LIKERT items on satisfaction with the personal relationship with neighbours, close friends, other friends, sons, daughters, sons-in-law and daughters-in-law, grandchildren, partner, other family members and other people. The items were submitted to a principal component analysis and three dimensions were interpretable and accounted for 74% of variance. Summated scales were constructed by assigning each item to the dimension with the highest loading and the resulting scores were categorised into three groups according to the 20^{th} and 80^{th} percentiles.

SATIFRIE: Satisfaction with neighbours and close friends
SATIFAM: Satisfaction with the family (couple, children and grandchildren)
SATIOTHE: Satisfaction with other people

Dimension 5 *Social support:*
WHOCALL: Who would the respondent call in an emergency
ALONLONG: Staying long alone
TADAYFAM: Talking to or meeting some family member daily
TADAYFRI: Talking to or meeting some friend or neighbour daily

The following social support variables are related to the questionnaire items on autonomy regarding basic activities instrumental activities and mobility. For each activity that the respondent can't do without some help or can't do without a lot of help, a further question was posed about who actually helps the respondent (No one, people living with the respondent, other family members, neighbours, volunteers, social services employees, someone who gets paid by the respondent).

HELPBASI: Help needed for at least one basic activity is not given by the familiy
HELPINST: Help needed for at least one instrumental activity is not given by the familiy
HELPMOBI: Help needed for mobility is not given by the familiy

Dimension 6s *General satisfaction with life:*
HAPPINES: Happiness with life as a whole
FUTUWORR: What situation is most worrying if encountered in the future
IMPOQOL: Most important thing for a good QOL

Dimension 7 *Income level*
INCOSUBJ: Perceived sufficiency of income
INCOHELP: Thinking that help needed due to disabilities can become an economic problem

Dimension 8s *Satisfaction with social services*
SATSOCSE: Satisfaction with the social services centre
SATCLIN: Satisfaction with national health clinics

Dimension 9 *Cultural resources*
EDUCATIO: Educational level attained

Dimension 10 *Objective housing quality*
PHONDWEL: Availability of phone in the home
TYPEDWEL: Type of dwelling (house or apartment)
AGEDWEL: Age of dwelling
GASDWEL: Availability of piped gas for heating, cooking, etc.
BATHDWEL: Equipment of bathroom
HEATDWEL: Type of heating
WATEDWEL: Availability of hot water
WASHDWEL: Availability of washing machine
ACCEPROB: Dwelling without elevator with entrance higher than street level

Dimension 10s *Housing quality evaluation*
CONDBATH: The bathroom has all conditions needed by the respondent
CONDKITC: The kitchen has all conditions needed by the respondent
CONDNEIG: The neighbourhood is in better or worse condition than others

The questionnaire contained a battery of 15 LIKERT items on satisfaction with some aspects of the home and the neighbourhood. The items were submitted to a principal component analysis and three dimensions were interpretable and accounted for 60% of variance. Summated scales were constructed by assigning each item to the dimension with the highest loading and the resulting scores were categorised into three groups according to the 20^{th} and 80^{th} percentiles.

SATIHOM: Satisfaction with home (quietness, temperature, lighting, cleanliness, furniture, comfort, general aspects)
SATINEIG: Satisfaction with neighbourhood (surroundings, transport, shops, parks)
SATIENVI: Satisfaction with urban environment (streets, lighting, safety, cleanliness)

2.3 A modified multiple correspondence analysis approach

The multivariate and qualitative nature of the data set makes multiple correspondence analysis (Benzécri, 1973; Lebart et al. 1977; Greenacre, 1993) a suitable tool for condensing information down to a small set of quantitative dimensions or axes. Multiple correspondence analysis is performed as a simple correspondence analysis of the complete indicator matrix. The complete indicator matrix is the data matrix obtained when each original variable is re-coded into one dummy or binary variable for each category, where "1" means that the category has been chosen by the respondent, and "0" that it has not. Thus, the number of rows in the matrix is the sample size, the number of columns is the total number of categories, the sum of each column is the frequency of each category and the sum of all rows is the number of variables.

Correspondence analysis allows researchers to treat the presence of missing values in a number of specific ways, in addition to the generally available listwise deletion and imputation methods.

The simplest way to treat missing data is to define an additional category for each variable representing data missingness and to treat the data as if they were complete. This approach is appealing when:

- Data missingness is substantively interpretable (for instance social undesirability of certain responses that are hidden as no response).
- The number of missing data is substantial (as correspondence analysis results can be disproportionately affected by categories with low frequencies). If this condition does not hold, the data missingness categories tend to dominate the first dimensions extracted, which means that these first dimensions show mainly the opposition between the subjects who respond and those who do not. One can sometimes restrict the

interpretation to the last dimensions, but often intermediate dimensions combine substantive and non-response categories.

- Data are not missing for clusters of variables simultaneously (for instance when a set of respondents with certain characteristics are asked to skip a whole battery of questions). If this condition does not hold, the data missingness categories are closely related and also tend to dominate the first dimensions extracted.

When some of the above conditions are not fulfilled, other approaches are preferable. One can analyse the so-called incomplete indicator matrix. In this matrix, a missing datum is represented by the whole set of dummy variables corresponding to the missing variable equal to zero. The sums of the rows of the matrix are not constant any more and represent the number of responses actually given by each individual. When applying simple correspondence analysis to the incomplete indicator matrix, the rows are divided by the square root of the sum[3]. This means that respondents with the most missing data have the highest weight on the result. In order to avoid this undesirable consequence, some authors have suggested to modify the simple correspondence analysis algorithm so that all observations are given the same weight (Escofier, 1981). Since in our data set we find some missing data categories which have low frequencies and are hardly interpretable or are highly correlated for several questions, this is the approach we will use.

Zárraga and Goitisolo (1999) suggested dividing the rows by the constant square root of the average number of responses over all individuals. It can be proven that the approach of Zárraga and Goitisolo (1999) is equivalent to a principal component analysis of the covariances of the incomplete indicator matrix whose columns have previously been multiplied by

$$\sqrt{\frac{N-1}{p\,N_j}} \tag{1}$$

where N is the sample size, p the number of original (not dummy) variables and N_j is the frequency (sum) of Column j. This equivalence holds because, unlike simple correspondence analysis, principal component analysis weights all cases equally. A further advantage of using principal component analysis is that this technique is available in virtually all standard general statistical software packages. The eigenvectors of this principal component analysis, when squared coincide with the absolute contributions obtained under the approach of Zárraga and Goitisolo. The subject axis scores of this principal component analysis are proportional to those

[3] If, as is sometimes done, the matrix is converted to row profiles (i.e. divided by the row sum) prior to the analysis, then the rows are multiplied instead of divided by the square root of their sum.

obtained under the approach of Zárraga and Goitisolo. The eigenvalues of this principal component analysis are related to those obtained under the approach of Zárraga and Goitisolo by a scale factor related to the average response rate[4]. More interestingly, the formula developed by Benzécri (1979) for correcting eigenvalues for deflation of percentages of explained inertia can be directly applied to the principal component analysis eigenvalues while it would have to be modified if applied to the eigenvalues obtained under the approach of Zárraga and Goitisolo. Benzécri's formula is:

$$\lambda^c = \left(\frac{p}{p-1}\right)^2 \left(\lambda - \frac{1}{p}\right)^2 \tag{2}$$

where p is the number of original (not dummy) variables, λ the raw and λ^c the corrected eigenvalues. Corrected eigenvalues are only meaningful for raw eigenvalues above *1/p*.

The contribution of the corrected eigenvalues can be assessed by expressing them as percentages of the average inertia of the cross-tabulations of all possible pairs of variables, that can be computed as (Greenacre, 1993):

$$Average \quad Inertia = \left(\frac{p}{p-1}\right)\left(\left(\sum_{j=1}^{k} \lambda_j^2\right) - \frac{k-p}{p^2}\right) \tag{3}$$

where k is the total number of categories, that is the number of columns of the indicator matrix.

In this article, we implement Zárraga and Goitisolo's idea by means of a principal component analysis of the incomplete indicator matrix modified according to Equation 1.

The variables included in the analysis are all the variables in the subjective dimensions: subjective health, autonomy perception, satisfaction with activity, social satisfaction, general satisfaction with life, satisfaction with social services and housing quality evaluation, that is 17 variables with a total of 50 categories.

2.4 Interviewer effects

Exploratory data analyses revealed that some interviewers tended to produce more positive and optimistic responses than others. The workload of interviewers was

[4] If there are no missing data, the principal component analysis of the complete indicator matrix modified according to Equation 1 are equivalent to the standard multiple correspondence analysis both regarding absolute contributions and eigenvalues, while co-ordinates are equivalent after a change of scale.

not assigned on a random basis. This means that the interviewer variable can be related to other variables, so that any relation observed between variables may be contaminated by a spurious interviewer effect.

In order to partial the interviewer effect out of the axes obtained under the modified principal component analysis described in the previous section, we fitted analysis of variance models in which the axes were dependent variables, and the interviewer variable (10 categories) and the respondent background variables DISTRICT, GROUP, AGE, GENDER, OCCUPATI, LIVEWITH and FAMIOTHE were the factors. The inclusion of background variables in the analysis of variance models is intended to rid interviewer effect estimates of the effect of non-comparable workloads. The interviewer effect estimates obtained in the analysis of variance models were then subtracted from the axis scores for the individuals. As an alternative, a multiple classification analysis (Andrews et al., 1973) could have been used and the adjusted deviations of the interviewers could have been subtracted from the axis scores. These modified scores were then standardised and can be interpreted as the scores the individuals would have if they had been interviewed by an "average" interviewer.

2.5 Co-ordinates and interpretation

The co-ordinates or projections of the categories of the original variables over the axes are the averages of the axis scores for the observations belonging to the categories and can be used to interpret the axes together with the absolute contributions. The averages are computed from the corrected scores obtained in Section 2.4.

Additionally, categories of external variables that were not included in the multiple correspondence analysis can also be projected in the same way. These play the role of illustrative variables in the sense that they can be used to assist the interpretation of the axes and to relate external variables to those included in the analysis in a condensed way. In our analysis objective QOL variables and background variables are used as illustrative and can thus be related to the axes that summarise the distribution of the subjective QOL variables. After identifying interpretable subjective QOL axes, we can also describe the high and low subjective QOL profiles of individuals by means of the categories of the illustrative variables.

3 Results

The eigenvalues corrected according to Benzécri's (1973) formula are shown in Table 1 and clearly show a two-dimensional solution accounting for 68% of the average inertia of the cross-tabulations.

Table 1: Eigenvalues above 1/p corrected according to Benzécri (1979) and percentages of average inertia.

Axis	Eigenvalue	Percentage	Cum. pct.
1	0.022568	45.33	45.33
2	0.011568	23.24	68.56
3	0.001899	3.81	72.38
4	0.000602	1.21	73.59
5	0.000395	0.79	74.38
6	0.000266	0.53	74.92
7	0.000120	0.24	75.16
8	0.000079	0.16	75.31
9	0.000023	0.05	75.36
10	0.000017	0.03	75.39
11	0.000002	0.00	75.40

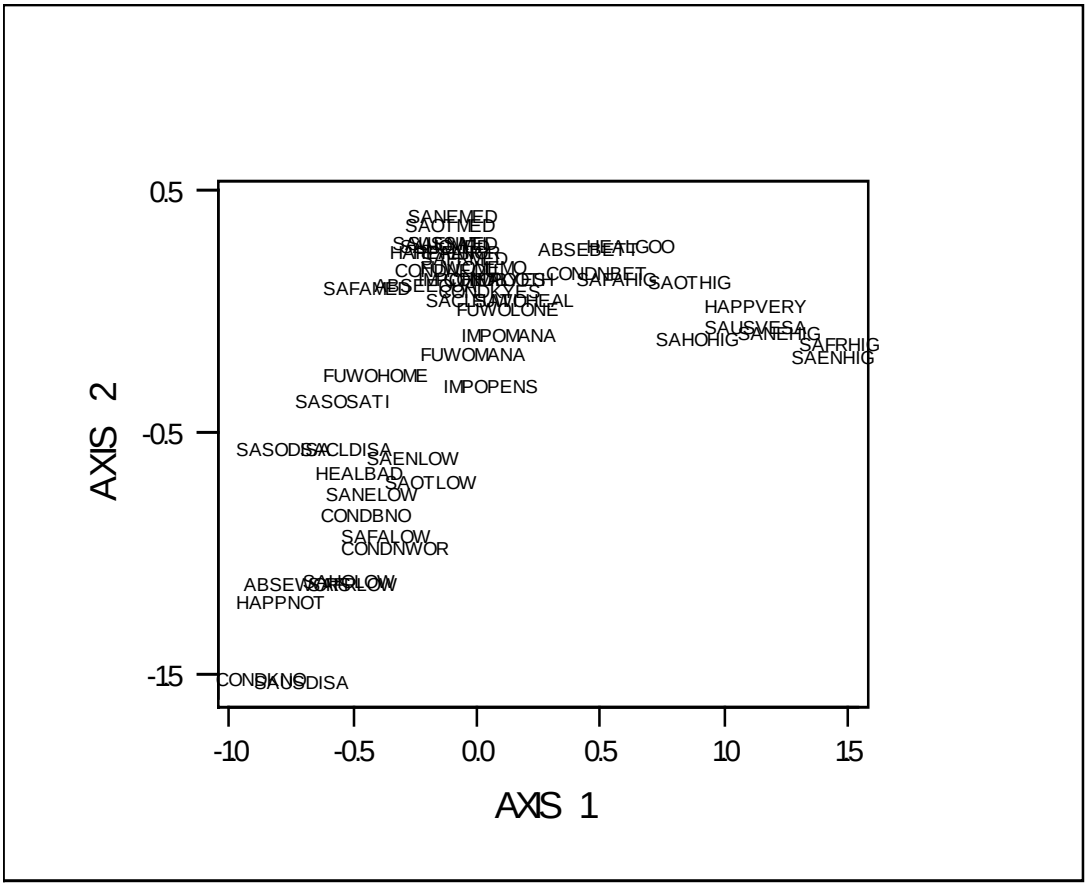

Figure 1: Co-ordinates of active categories. Corrected for interviewer effect.

Table 2: Frequencies, absolute contributions, raw co-ordinates and co-ordinates corrected for interviewer effcts on first two axes.

Category			Axis 1			Axis 2		
		Freq	Abs. cont.	Raw. coor.	Corr. coor.	Abs. cont.	Raw. coor.	Corr. coor.
HEALGOO	Good or very good health perception	529	2.57	0.57	0.62	0.17	0.13	0.27
HEALNOR	Normal health perception	918	0.30	-0.15	-0.09	1.62	0.31	0.24
HEALBAD	Bad or very bad health perception	516	0.73	-0.31	-0.48	4.36	-0.68	-0.68
ABSEBETT	Manages better than others of same age	821	2.22	0.43	0.45	0.44	0.17	0.25
ABSEEQUA	Manages about as others of same age	839	0.64	-0.23	-0.21	0.39	0.16	0.11
ABSEWORS	Manages worse than others of same age	226	0.94	-0.53	-0.73	4.76	-1.07	-1.13
SAUSDISA	Dissatisfied or neutral with l. time use	225	1.57	-0.69	-0.71	8.44	-1.42	-1.54
SAUSSATI	Satisfied with leisure time use	1389	1.41	-0.26	-0.15	2.73	0.33	0.28
SAUSVESA	Very satisfied with leisure time use	343	12.15	1.55	1.13	0.72	-0.34	-0.07
SAFRLOW	Low satisfaction with friends	180	0.56	-0.46	-0.50	7.64	-1.52	-1.13
SAFRMED	Medium satisfaction with friends	1076	0.11	-0.08	-0.06	1.39	0.26	0.22
SAFRHIG	High satisfaction with friends	201	9.06	1.75	1.47	0.52	-0.37	-0.14
SAFALOW	Low satisfaction with family	68	0.66	-0.81	-0.37	4.04	-1.79	-0.92
SAFAMED	Medium satisfaction with family	338	1.68	-0.58	-0.45	0.03	0.07	0.09
SAFAHIG	High satisfaction with family	545	2.83	0.59	0.57	0.23	0.15	0.14
SAOTLOW	Low satisfaction with other people	235	0.03	0.10	-0.18	6.89	-1.26	-0.71
SAOTMED	Medium satisfaction with other people	846	0.70	-0.24	-0.11	3.05	0.44	0.35
SAOTHIG	High satisfaction with other people	347	3.78	0.86	0.86	0.08	0.11	0.12
HAPPNOT	Not so happy with life as a whole	252	1.81	-0.70	-0.79	5.80	-1.12	-1.21
HAPPFAIR	Fairly happy with life as a whole	1313	1.24	-0.25	-0.17	1.83	0.27	0.24
HAPPVERY	Very happy with life as a whole	378	10.19	1.35	1.13	0.18	-0.16	0.02
FUWOHEAL	Worried about health getting worse	462	0.57	0.29	0.19	0.03	0.06	0.05
FUWOLONE	Worried about being alone in life	211	0.00	-0.02	0.13	0.01	0.05	0.00
FUWOMANA	Worried about no longer managing	289	0.00	0.02	-0.01	0.51	-0.31	-0.17
FUWOHOME	Worried about going to home for old p.	181	0.41	-0.39	-0.40	0.08	-0.15	-0.27
FUWOMEMO	Worried about losing memory or head	621	0.01	-0.02	-0.01	0.32	0.17	0.19
IMPOMANA	Important to manage by oneself	452	0.26	0.20	0.13	0.45	-0.23	-0.10
IMPOPENS	Important to have a good income	179	0.20	0.27	0.06	0.39	-0.34	-0.32
IMPOHEAL	Important to have a good health	1056	0.28	-0.13	-0.05	0.61	0.18	0.13
IMPOOTH	Important other things	202	0.09	0.17	0.14	0.10	0.16	0.13
SASOSATI	Satisfied with social services centre	133	0.30	-0.39	-0.55	0.13	-0.23	-0.38
SASODISA	Dissatisfied with social services centre	59	0.38	-0.66	-0.78	0.44	-0.64	-0.57
SACLSATI	Satisfied with national health clinics	1685	0.01	-0.02	-0.02	0.11	0.06	0.05
SACLDISA	Dissatisfied with national health clinics	84	0.35	-0.53	-0.52	0.48	-0.56	-0.57
CONDBNO	Bath does'nt have all conditions needed	275	0.23	-0.24	-0.45	3.84	-0.87	-0.85
CONDBYES	Bath has all conditions needed	1666	0.02	0.03	0.08	0.63	0.14	0.14
CONDKNO	Kitchen does'nt have all condit. needed	103	0.70	-0.68	-0.87	3.61	-1.38	-1.52
CONDKYES	Kitchen has all conditions needed	1858	0.05	0.04	0.05	0.18	0.07	0.08
CONDNEQU	Neighbourhood about as others	1090	0.25	-0.12	-0.12	0.92	0.21	0.17
CONDNBET	Neighbourhood better than others	536	1.91	0.49	0.48	0.04	0.06	0.15
CONDNWOR	Neighbourhood worse than others	174	0.26	-0.32	-0.33	3.15	-0.99	-0.98
SAHOLOW	Low satisfaction with home	251	1.32	-0.60	-0.52	6.87	-1.22	-1.12
SAHOMED	Medium satisfaction with home	1340	1.33	-0.26	-0.13	3.06	0.35	0.26
SAHOHIG	High satisfaction with home	353	10.90	1.45	0.89	1.03	-0.40	-0.11
SANELOW	Low satisfaction with neighbourhood	428	1.62	-0.51	-0.42	5.15	-0.81	-0.75
SANEMED	Medium satisf. with neighbourhood	973	0.70	-0.22	-0.10	4.21	0.48	0.39
SANEHIG	High satisfaction with neighbourhood	244	13.12	1.91	1.22	1.12	-0.50	-0.09
SAENLOW	Low satisfaction with environment	427	0.26	-0.20	-0.25	4.05	-0.72	-0.61
SAENMED	Medium satisfaction with environment	1238	0.54	-0.17	-0.10	2.54	0.33	0.28
SAENHIG	High satisfaction with environment	176	8.75	1.83	1.44	0.63	-0.44	-0.20

The interviewer variable is a significant predictor of both axes (p-values below 0.001) and the one with the highest contribution to the R^2 in the analysis of variance models. The R^2 for Axis 1 is 42.4% with both the interviewer and the background variables, and it drops to 5.5% with background variables alone. For Axis 2, the figures are 34.7% and 9.5%. Apart from the interviewer, the district (DISTRICT), the age group (AGE), the occupational status (OCCUPATION) and whom the person lives with (LIVEWITH) are also significant. The difference between the co-ordinates uncorrected (Raw coor.) and corrected (Corr. coor.) for interviewer effect (Table 2) also shows the magnitude of interviewer effects in our data set.

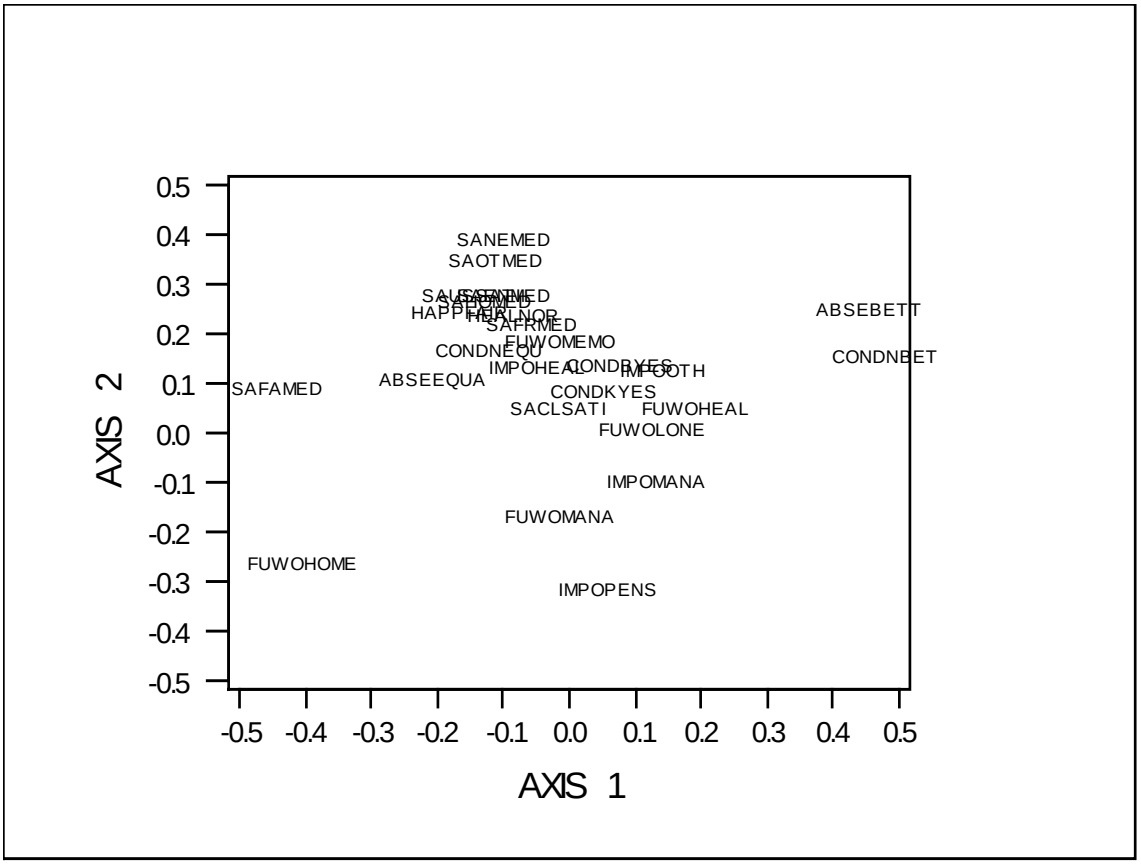

Figure 2: Co-ordinates of active categories. Corrected for interviewer effect. Enlarged central area.

The groups of variables with high contribution on the first two axes are subjective health (HEALPERC), autonomy perception (ABILSELF), satisfaction with activity (SAUSTIME), social satisfaction (SATIFRIE, SATIFAM, SATIOTHE) and housing quality evaluations (CONDBATH, CONDKITC, CONDNEIG, SATIHOM, SATINEIG, SATIENVI). Besides, the single variable

happiness with life as a whole (HAPPINES), as expected, also has high contributions. The remaining variables in the general satisfaction with life dimension (FUTUWORR, IMPOQOL), and all the variables in the satisfaction with social services dimension (SATSOCSE, SATCLIN) have minor contributions.

Figure 1 shows the co-ordinates corrected for interviewer effects. Figure 2 is an enlargement of the cramped central part of Figure 1.

The first axis can be interpreted as a high subjective QOL axis. Categories with high positive co-ordinates all indicate high perceived QOL. Categories with negative co-ordinates or co-ordinates close to zero indicate medium or low perceived QOL. Among the high positive co-ordinates are HAPPVERY (very happy), the three upper categories of the social satisfaction variables (SAFRHIG, SAFAHIG, SAOTHIG), the three upper categories of the variables of satisfaction with the home and the neighbourhood (SAHOHIG, SANEHIG, SAENHIG), SAUSVESA (very satisfied with the use of leisure time) and HEALGOO (good perceived health). The second axis can be interpreted as a low subjective QOL axis. Categories with high negative co-ordinates, most of which also have substantial negative co-ordinates on the first axis, all indicate low perceived QOL. Among the high negative co-ordinates are HAPPNOT (not so happy), the three lower categories of the subjective social satisfaction variables (SAFRLOW, SAFALOW, SAOTLOW), all low housing quality categories (CONDBNO, CONDKNO, CONDNWOR, SAHOLOW, SANELOW, SAENLOW), SAUSDISA (dissatisfied or neutral with the use of leisure time), HEALBAD (bad perceived health), ABSEWORS (ability to manage by oneself worse than other people of the same age) and all categories of dissatisfaction with social services (SASODISA, SACLDISA).

The axes are sometimes better interpreted jointly than isolatedly, that is, areas or quadrants may be more relevant than axis directions. In our case, individuals with lower subjective QOL tend to be situated in the lower left region of the graph and individuals with higher subjective QOL in the upper right region of the graph. When we plot illustrative categories on the graph, categories in those regions can be said to be associated to lower and higher subjective QOL respectively. As there are many illustrative variables in the data set, we first select those with the highest relationship to the axes. Table 3 contains the adjusted R^2 in one-way analysis of variance models in which each variable in the data set acts as factor and each axis as dependent variable. As expected, active variables tend to have two-digit R^2, except those with low absolute contributions to the axes (FUTUWORR, IMPOQOL, SATSOCSE, SATCLIN). As is always the case, the R^2 of illustrative variables are rather lower. We only consider illustrative variables with R^2 above 2% in at least one of the axes. They appear bold faced in Table 3.

The illustrative variables with high R^2 are related to economic and social status (DISTRICT, OCCUPATI, INCOSOUR, INCOSUBJ), health (HOSPADM, DIFFWALK), autonomy (DEPEBASI, DEPEINST DEPEMOBI), activity (NODRIVE, NOWALK, NOACTI, NOVIHELP, STAYHOME, NOCULT,

ASSOCIAT), social support (ALONLONG, TADAYFRI, but none of the variables of family members not helping to solve needs, probably due to the very low frequencies of the "yes" responses) and housing quality (AGEDWEL, GASDWEL, HEATDWEL, WATEDWEL)

AGE and stratum (GROUP) have low R^2, which is explained by the well-known phenomenon of optimism bias, that is, the tendency of people to give optimistic responses to direct questions referred to personal well-being (Diener, 1984; Veenhoven, 1991a, b), which specially affects the elderly. Surprisingly enough, whom the person lives with and the existence of family members (LIVEWITH, FAMIOTHE, ISOLPROB) also have low R^2.

Table 3: Adjusted R-square of axes explained by active and illustrative variables. Bold faced if higher than 2% for an illustrative variable.

Variable	Axis 1	Axis 2	Variable	Axis 1	Axis 2
DISTRICT	1.9	**6.2**	**ALONLONG**	**3.9**	1.1
GROUP	0.6	0.0	TADAYFAM	0.3	0.4
AGE	0.3	0.5	**TADAYFRI**	1.7	**4.6**
GENDER	1.3	0.4	HELPBASI	0.4	1.2
PROPDWEL	0.0	0.6	HELPINST	0.6	1.5
OCCUPATI	**6.0**	0.3	HELPMOBI	0.5	1.3
INCOSOUR	**4.8**	**2.4**	HAPPINES	34.6	22.1
LIVEWITH	1.3	0.9	FUTUWORR	2.7	7.6
FAMIOTHE	0.0	0.3	IMPOQOL	2.6	5.2
ISOLPROB	0.0	0.0	**INCOSUBJ**	**5.2**	**4.0**
HOSPADM	0.5	**2.1**	INCOHELP	0.0	0.0
DIFFHEAR	1.5	1.4	SATSOCSE	0.0	0.0
DIFFWALK	**2.7**	**4.0**	SATCLIN	6.0	3.1
HEALPERC	16.1	16.7	**EDUCATIO**	**5.5**	**2.0**
DEPEBASI	**2.1**	**3.8**	PHONDWEL	0.0	1.6
DEPEINST	**3.6**	**6.7**	TYPEDWEL	0.0	0.1
DEPEMOBI	**4.3**	**8.2**	**AGEDWEL**	0.0	**3.9**
ABILSELF	14.1	19.9	**GASDWEL**	1.4	**2.4**
NODRIVE	**3.2**	1.0	BATHDWEL	0.7	0.6
NOWALK	**4.7**	**4.9**	**HEATDWEL**	**2.2**	**2.6**
NOACTI	**3.9**	1.1	**WATEDWEL**	0.6	**2.9**
NOVIHELP	**4.3**	**3.3**	WASHDWEL	0.1	1.4
STAYHOME	**4.1**	**5.2**	ACCEPROB	0.2	0.2
NOCULT	**6.6**	**3.3**	CONDBATH	3.8	11.1
ASSOCIAT	**4.3**	0.6	CONDKITC	3.2	13.0
SAUSTIME	29.9	32.4	CONDNEIG	8.2	18.0
SATIFRIE	16.1	19.3	SATIHOM	18.5	23.2
SATIFAM	14.4	14.0	SATINEIG	19.3	21.4
SATIOTHE	13.6	25.6	SATIENVI	19.1	15.5
WHOCALL	0.8	0.8			

Table 4: Co-ordinates of illustrative categories with R^2 above 2% on at least one axis.Corrected for interviewer effect. For binary variables only one category is shown.

Category		Freq.	Axis 1	Axis 2
DISTBVEL	District Barri Vell	386	0.1817	0.0121
DISTPALA	District Palau	381	0.1427	0.1164
DISTPONT	District Pont Major	169	-0.1861	-0.5265
DISTSNAR	District Sant Narcís	354	-0.0179	0.1727
DISTSEUG	District S. Eugènia	292	-0.1228	0.0844
DISTTAIA	District Taialà	235	-0.0238	0.2100
DISTVROJ	District Vila Roja	171	-0.2647	-0.5563
OCCUBUSI	Last job business owner	110	0.4199	-0.0194
OCCUMANA	Last job manager or free-lance	98	0.4500	0.1734
OCCUTECH	Last job white collar worker	147	0.4540	0.2190
OCCUSALE	Last job clerk or salesperson	133	0.1829	0.1467
OCCUQUAL	Last job qualified blue collar	373	0.0953	0.0460
OCCUNOQU	Last job non-qualified blue collar	668	-0.1949	-0.1228
OCCUNEVE	Never worked before	433	-0.2045	0.0018
INCORENT	Main income source: rents of property	125	0.6725	0.1293
INCORETI	Main income source: retirement pension	1062	0.0844	0.0984
INCODISA	Main income source: disablement pension	126	-0.1658	-0.4646
INCOWIDO	Main income source: widow pension	399	-0.2791	-0.0875
INCOPENS	Main income source: other types of pens.	70	-0.2211	-0.3735
INCOOTHE	Main income source: other sources	33	-0.2664	-0.2739
INCONO	Main income source: no income	166	-0.1001	0.0366
HOSPAYES	Admitted to hospital	363	-0.2163	-0.2498
DIWANEVE	Never using walking stick or crutches	1615	0.0818	0.0964
DIWASTIM	Sometimes using walking stick or crutches	101	-0.3259	-0.3377
DIWAALWA	Always using walking stick or crutches	262	-0.3533	-0.4465
DEBAYES	Depends on others for basic activities	67	-0.7792	-1.0544
DEINYES	Depends on others for instrumental activities	108	-0.7929	-1.0829
DEMOYES	Depends on others for mobility	151	-0.7248	-1.0032
DRIV	Drives	394	0.3625	0.1769
NOACT	Never practises hobbies	785	-0.2446	-0.1329
NOWAL	Never or rarely walks	642	-0.3156	-0.3220
NOVIHEL	Never visits/helps others	535	-0.3436	-0.3010
STAYHOM	Often just stays at home	417	-0.3963	-0.4448
NOCUL	Never attends cultural events	1124	-0.2265	-0.1598
ASSONONE	Member of no association	1084	-0.1838	-0.0778
ASSOONE	Belongs to one association	643	0.1630	0.0856
ASSOSEVE	Belongs to several associations	261	0.3618	0.1120
ALONALWA	Always alone	415	-0.2429	-0.1996
ALONOFTE	Often alone	331	-0.1964	0.0381
ALONRARE	Rarely alone	740	0.1381	0.0686
ALONNEVE	Never alone	484	0.1425	0.0665
TAFRNO	Does not talk to friends or neighbours daily	317	-0.3008	-0.4963
INCOSATI	Satisfactory income	637	0.3657	0.1729
INCOSUFF	Barely enough income to cover expenses	928	-0.1060	0.0511
INCOINSU	Insufficient income	357	-0.3449	-0.4791
EDUCNORE	Cannot read	280	-0.3693	-0.3719
EDUCREWR	Can read and write	1049	-0.0912	0.0116
EDUCPRIM	Elementary education	304	0.1742	0.1260
EDUCSECO	Secondary education	104	0.6009	0.0468
EDUCHIGH	University degree	105	0.4256	0.1953
EDUCOTHE	Other educational levels	134	0.2515	0.1995
AGDWBE30	Dwelling aged <30	835	0.0380	0.0734
AGDW3150	Dwelling aged 31-50	579	0.0517	0.0246
AGDWAB50	Dwelling aged >50	203	-0.0290	-0.1832
GASDNOOT	No piped natural gas	670	-0.1693	-0.2133
HEATCENT	Central heating	1121	0.1205	0.1281
HEATBUTA	Butane gas stove only	317	-0.2993	-0.3037
HEATOTHE	Other types of heating	538	-0.0709	-0.0852
WATENO	No hot water	51	-0.4987	-1.0438

The co-ordinates of categories of illustrative variables with R^2 above 2% are displayed in Table 4 and in Figures 3 and 4. In order to make the table and figures more readable, only one category is displayed for binary variables.

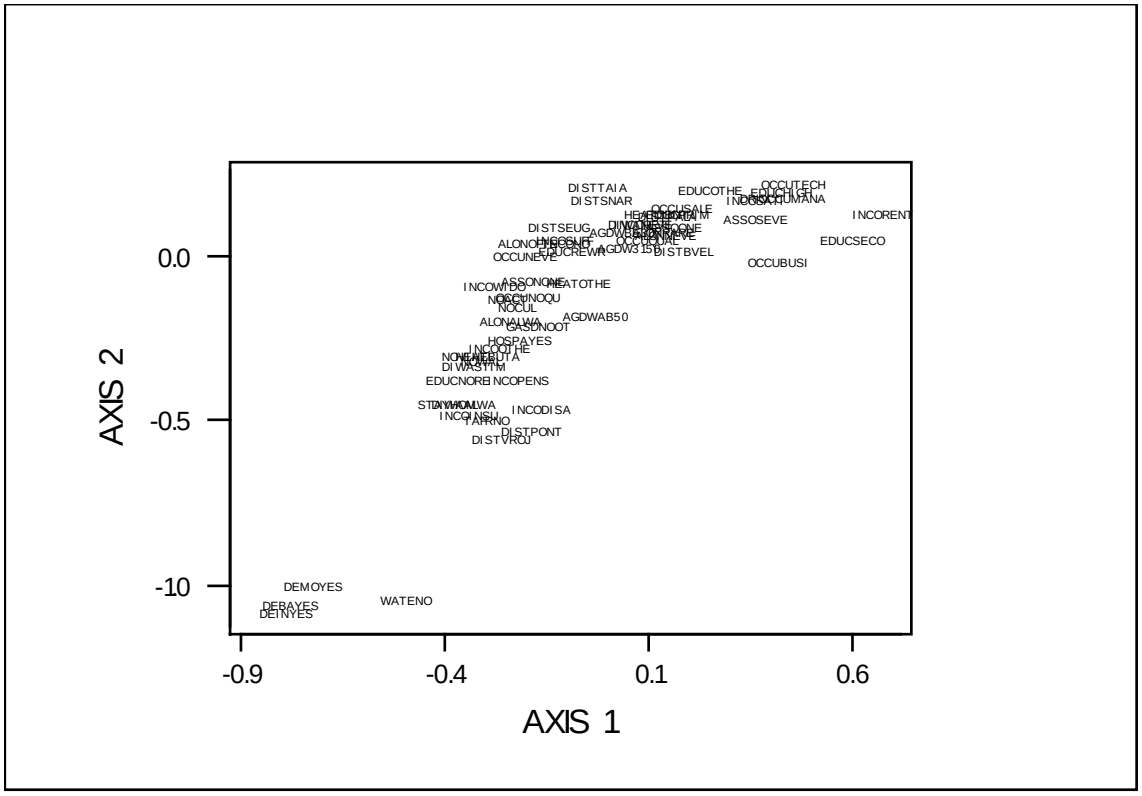

Figure 3: Co-ordinates of illustrative categories with R^2 above 2%. Corrected for interviewer effect. For binary variables only one category is shown.

The typical profile of an elderly person with low QOL can be described as that of someone living in Pont Major or Vila Roja (DISTPONT and DISTVROJ), living on a disablement pension or on other types of pension (INCODISA, INCOPENS), sometimes or always using a walking stick or crutches (DIWASTIM, DIWAALWA), needing help for basic and instrumental activities and mobility (DEBAYES, DEINYES, DEMOYES), never or rarely walking, visiting friends or helping others (NOWAL, NOVIHEL), often just staying at home (STAYHOM), not talking daily to friends or neighbours (TAFRNO), with insufficient income (INCOINSU), unable to read (EDUCNORE), with butane stove heating (HEATBUTA) and without hot water (WATENO).

The typical elderly person with high QOL can be described as someone whose last job was business owner, manager, free-lance or white collar (OCCUBUSI, OCCUMANA, OCCUTECH), living on rents of property (INCORENT), often driving (DRIV), belonging to several associations (ASSOSEVE), with a satisfactory economic situation (INCOSATI) and with secondary, higher or other educational level (EDUCSECO, EDUCHIGH, EDUCOTHE).

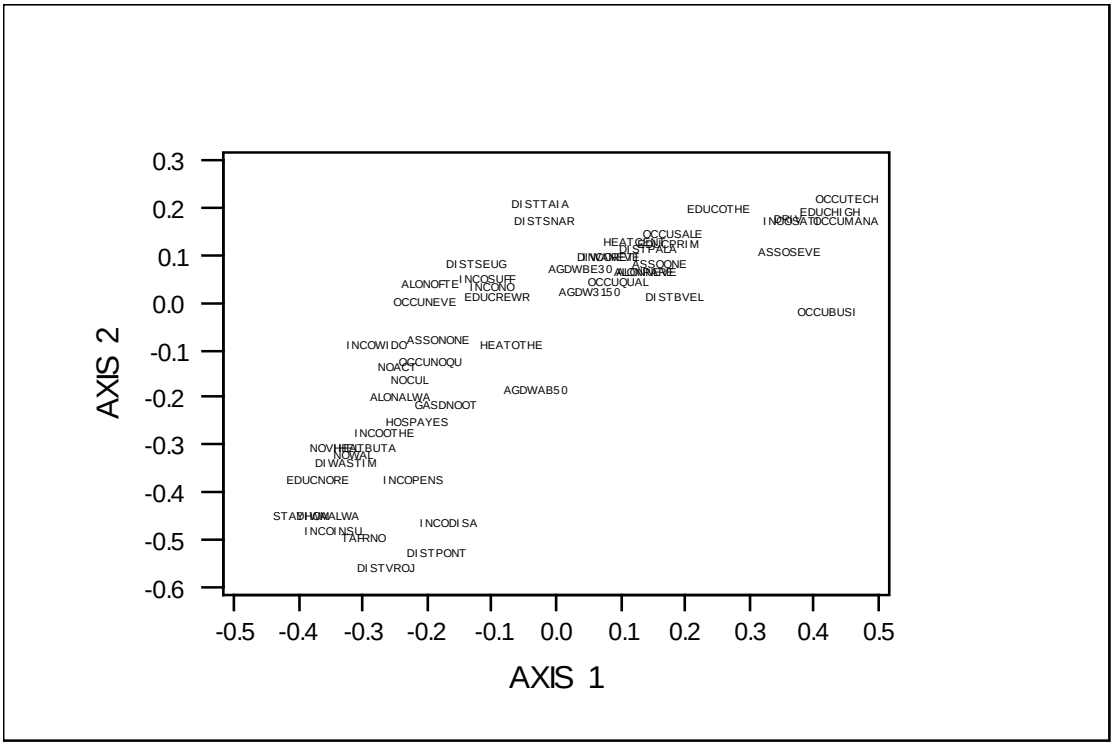

Figure 4: Co-ordinates of illustrative categories with R^2 above 2%. Corrected for interviewer effect. Enlarged central area. For binary variables only one category is shown.

4 Comparison with traditional multiple correspondence analysis

In order to evaluate the size of the differences in the results with respect to a traditional multiple correspondence analysis, we first compared a classification of respondents with and without correcting for the interviewer effect, and we next carried out a correspondence analysis with the classic missing value treatment.

In order to assess the impact of the interviewer effect on a classification of elderly people into three groups (high, medium and low subjective QOL) we performed a k-means cluster analysis (MacQueen, 1967) with the method of Forgy (1965), that involves recomputing cluster centres only at the end of each iterative step. The analysis was carried out twice, with raw and corrected axis scores of the individual respondents on the first two axes. However, the initial cluster centres were held constant for both analyses at {-1; -2} (low QOL cluster) {0; 0} (medium QOL cluster) and {2; -1} (high QOL cluster). The percentage of cases classified in the same group for both methods was 85,2%, which may not seem as bad if it was not for the fact that disagreements were quite systematic.

Table 5 shows the differences due to the correction of the data by the interviewer effect for the interviewers with the highest optimism bias and the highest pessimism bias. The table first shows the interviewer co-ordinates, quite extreme when uncorrected and relatively close to zero, when corrected. The table next shows the percentage of respondents falling into the high/low QOL clusters, for the given interviewer and for the overall sample. Before correction, the interviewer with pessimism bias has most of the respondents in the low QOL cluster and the interviewer with optimism bias has most of the respondents in the high QOL cluster. After the correction, the percentages resemble those of the overall sample.

Table 5: Interviewer profiles before and after correcting for interviewer effects.

Interviewer	Data	Interviewer Co-ordinates		Low QOL cluster		High QOL cluster	
		Axis 1	Axis 2	% Interv.	%Overall	%Interv.	%Overall
Optimism	Raw	1.67	-0.90	19.9	21.6	76.0	16.3
Optimism	Corrected	0.04	-0.09	23.1	22.0	41.2	19.1
Pessimism	Raw	0.92	-1.92	91.0	21.6	0.0	16.3
Pessimism	Corrected	0.11	-0.06	33.0	22.0	4.5	19.1

Table 6: Contributions and co-ordinates of missing value categories.

Variable	% Mis.	Axis 1			Axis 2		
		Tot. cont.	Mis. cont.	Mis. coor.	Tot. cont.	Mis. cont.	Mis. coor.
HEALPERC	1.3	4.3	1.1	1.8	2.8	0.6	-1.2
ABILSELF	5.1	8.3	4.8	1.9	4.1	2.0	-1.1
SAUSTIME	1.6	11.2	3.7	3.0	12.8	2.3	-2.2
SATIFRIE	26.7	7.1	3.0	0.7	6.9	0.0	0.0
SATIFAM	52.2	3.2	0.5	0.2	2.4	0.1	-0.1
SATIOTHE	28.2	4.6	2.4	0.6	4.6	0.3	-0.2
HAPPINESS	2.3	11.7	5.1	3.0	12.6	4.7	-2.6
FUTUWOR	11.3	3.5	2.6	0.9	1.7	0.9	-0.5
IMPOQOL	5.0	7.0	6.4	2.2	5.1	3.9	-1.6
SATSOCSE	90.3	0.6	0.1	-0.1	0.1	0.0	-0.0
SATCLIN	11.0	0.3	0.1	0.2	2.9	2.6	-0.9
CONDBATH	2.4	2.3	0.0	-0.2	1.7	0.1	-0.5
CONDKITC	1.4	3.0	0.3	0.9	0.7	0.0	-0.1
CONDNEIG	9.5	6.4	5.2	1.5	3.7	1.9	-0.8
SATIHOM	2.2	11.1	5.6	3.1	13.8	4.0	-2.4
SATINEIG	17.3	8.1	2.4	0.7	13.0	1.2	-0.5
SATIENVI	7.4	7.2	4.1	1.5	11.0	2.6	-1.1
TOTAL	16.2	100.0	47.4		100.0	27.2	

The classic missing value treatment was next performed. A missing value category was created for each of the variables and a standard multiple correspondence analysis was applied on the complete indicator matrix. The interpretation of the axes is so uninteresting from a substantive point of view that a cluster analysis is superfluous. Table 6 shows some of the results. First, the table shows the percentage of missing values per variable. Next, for each axis, the sum of the contributions of all categories of the variable, the contribution of the missing value category and the co-ordinate of the missing value category.

As expected, the first and second dimensions essentially reveal response-no response dimensions. While the overall response rate is 16.2%, the total contributions of the missing value categories are 47.4% and 27.2% for the first and the second axes respectively. Whenever the missing-value modality significantly contributes to the dimension, it always has positive co-ordinates on the first dimension and negative on the second, so that a whole quadrant of the axis space is dominated by a non-substantive category.

5 Discussion

After modifying the incomplete indicator matrix in order to avoid the undesirable effects of missing values, and after correcting the interviewer effect, the results offer us a coherent profile of QOL for the elderly population in a middle sized city, with a relatively high socio-economic status, such as Girona. The groups of variables with high contribution to elderly subjective QOL in our analysis appear to be health perception, autonomy perception, satisfaction with activities, satisfaction with the personal social support networks, evaluation of housing conditions, and happiness with life as a whole. The QOL construct shows two main dimensions: a positive one (factors contributing to increase QOL or to maintain a high level of QOL) and a negative one (factors contributing to decrease QOL or to maintain a lack of QOL).

The main objective factors related to high subjective QOL of the elderly appear to be:

- income (kind of income -related to the past professional activity- and satisfaction with income).
- activities developed (belonging to associations, driving, etc.).
- educational level.

The lack of subjective QOL is mainly related to the following objective factors:

- lack of autonomy, mainly of mobility (needing a walking stick, dependence to perform basic or instrumental daily activities, etc.).
- low income (disablement pensions, unsatisfactory income).
- poor material conditions of living (without hot water in the household, with only butane stove heating, etc.).

- few daily activities (often just staying at home, not talking daily to other people, never or rarely walking, visiting friends or helping others, etc.).
- low educational level (not able to read).
- living in a non cohesioned community.

Of course, the low intensity of daily activities is very much related to the availability of social support networks. That fact becomes more negative if it is summed up to the fact of living in a non cohesioned neighbourhood.

However, our analysis also points out some results that are not very usual in other surveys on elderly QOL. For example, whom the elder person lives with, or the fact of having or not other relatives do not seem to be very relevant for his or her QOL. These items may happen to be a clear example of the adaptability of human beings to disadvantaged conditions of living, under the bias of optimism, that has already been observed with other groups of people (Veenhoven, 1991a, b; Cummins, 1995).

Methodologically speaking, the use of principal components on the modified incomplete indicator matrix and the estimation and removal of interviewer effects has proven necessary and successful for the data of this study, as interviewer effects were very large for some of the interviewers, and missing value categories tended to obscure the interpretation of the first two axes when the traditional missing data treatment was used.

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References

[1] Abeles, R.P., Gift, H.C., Ory, M.G., and Cox, D.M. (1994): *Aging and Quality of Life.* New York: Springer.

[2] Andrews, F.M., Morgan, J.N., Sonquist, J. A., and Klem, L. (1973): *Multiple Classification Analysis.* Ann Arbor, MI: Institute for Social Research.

[3] Benzécri, J.P. (1973): *L'Analyse des Données. Tome 1. L'Analyse des Correspondances.* Paris: Dunod.

[4] Benzécri, J.P. (1979): Sur le calcul des taux d'inertie dans l'analyse d'un questionaire, addedum et erratum à. *Les Cahiers de l'Analyse des Données,* **IV**, 377-378.

[5] Casas, F., González, M., Coenders, G., Aymerich, M., Domingo, A., and del Valle, A. (2001): Indicadores sociales y psicosociales de la calidad de vida de las personas mayores en un municipio [Social and psychosocial quality of life indicators of older persons in a municipality]". *Intervención Psicosocial*, **10**, 355-378.

[6] Cummins, R. (1995): On the trail of the gold standard for subjective well-being. *Social Indicators Research,* **35**, 179-200.

[7] Diener, E. (1984): Subjective well-being. *Psychological Bulletin,* **95**, 542-575.

[8] Escofier, B. (1981): *Traitement des Questionnaires avec non Réponse, Analyse des Correspondances avec Marge Modifiée et Analyse Multicanonique avec Contrainte.* INRIA.

[9] Fernández-Ballesteros, R. and Macía, A. (1993): La calidad de vida en la vejez. *Intervención Psicosocial,* **1**, 77-94.

[10] Fernández-Ballesteros, R., Zamarrón, M.D., and Macía, A. (1996): *Calidad de Vida en la Vejez en los Distintos Contextos.* Madrid, Spain: INSERSO. M.T.A.S.

[11] Forgy, E.W. (1965): *Cluster Analysis of Multivariate Data: Efficiency versus Interpretability of Classifications.* Riverside, Ca: Biometric Soc. Meetings.

[12] Glatzer, W. and Mohr, H.M. (1987): Quality of life: concepts and measurement. *Social Indicators Research,* **19**, 15-24.

[13] Greenacre, M. (1993): *Correspondence Analysis in Practice.* London: Academic Press.

[14] Groves, R. M. (1989): *Survey Errors and Survey Costs.* New York: Wiley.

[15] Lebart, L., Morineau, A., and Tabard, N. (1977): *Techniques de la Description Statistique*. Paris: Dunod.

[16] MacQueen, J. B. (1967): Some methods for classification and analysis of multivariate observations. *Proceedings of the 5th Symposium of Mathematical statistics and Probability,* **1**, 281-297.

[17] Michalos, A.C., Hubley, A.M., Zumbo, B.D., and Hemingway, D. (2001): Health and other aspects of the quality of life of older people. *Social Indicators Research,* **54**, 239-274.

[18] Veenhoven, R. (1991a): Questions on happiness: Classical topics, modern answers, blind spots. In F. Strack and M. Argyle, et al. (Eds.): *Subjective Well-Being.* Pergamon Press, 7-26.

[19] Veenhoven, R. (1991b): Is happiness relative? *Social Indicators Research,* **24**, 1-34.

[20] Zárraga, A. and Goitisolo, B. (1999): Independencia entre las cuestiones en el análisis de tablas disyuntivas incompletas con preguntas condicionadas. *Qüestiió,* **23**, 465-488.