Fertility behaviuor and context effect: how to take into account ? Some evidences from Italian FFS data

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The multilevel approach can be a fruitful methodological framework to formulate the micro-macro relationship between individuals and their contexts. Usually, place of residence is taken as proxy for contextual effects. But, individuals can be classified at the same level in more than one way. For example, not only place of residence may be relevant, but also birthplace or household or working relations can be taken into account. Social context effects can be better identified if multiple classifications are simultaneously considered. In this sense, data do not have a purely hierarchical structure, but a cross-classified one and become very important to establish whether the resulting structure affects the covariance structure of data .
In the paper, some critical issues arising in the application of multilevel modelling are discussed and multilevel cross-classified models are proposed as more flexible tools to study context effects. A multilevel cross-classified model is specified to evaluate simultaneously the effects of women' place of birth and women's current place of residence on the choice of bearing second child by Italian women in the middle '90. Data from Italian FFS survey are used.

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1. Introduction

In the most recent social research, great emphasis has often been placed on the importance of micro-macro linkages in order to understand how the social and economic characteristics of the context to which individuals belong may affect their behaviour. The underlying general idea is that interactions between individuals and their contexts influence individual behaviours and in turn shape group characteristics and properties.

Reproductive behaviour, for instance, is a phenomenon which has given rise to a great deal of theoretical processing. Traditional theories which concentrated mainly on the impact of social and economic macro-changes on fertility (i.e. industrialisation, urbanisation and modernisation in general) have given way to a view focusing on the effects of micro-phenomena, that is, generally attributed to a set of attitudes, values and constraints which determine individual and family choices regarding procreation. More recently, in the belief that a great number of causes affect behaviour, attention has been devoted to considering the two levels (i.e. macro and micro) jointly in order to explain individual preferences. The macro level establishes a system of generally accepted "standards" within the group of people to which individuals belong and to which they generally turn, whereas the micro level defines a framework of ambitions, values and constraints, within which a woman and her partner exercise their own right of choice (Smith, 1989; Hirschman, Guest, 1990; Cott Watkins, 1990).

Many studies carried out in the 1980s on reproductive and contraceptive behaviour (largely in the rural areas of developing countries) recognize the potential importance of a wide range of community factors - characteristics of labour and the commodity market, norms concerning roles played by women and children, etc. - in influencing

women's behaviour (Casterline, 1985; Bilsborrow and Guilkey, 1987; Entwisle, Casterline and Sayed, 1989).

The main questions in analysis of the relationship between individual and context regard two aspects: *i*) detecting the amount of context contribution and its effect - direct and indirect, additive and interactive - in the total variation of individual behaviour; *ii*) identifying which macro characteristics are mainly responsible for the context effect.

From a conceptual point of view, this means introducing a multilevel approach in which individuals (the first level of analysis) are grouped in different contexts (the second level), and variables from the two levels can be jointly analysed in a unified framework. In this approach, individuals within contexts may be seen as a hierarchical structure, so that statistical tools developed for hierarchical data, such as multilevel models (Bryk and Raudenbash, 1992; Goldstein, 1993, Kreft and De Leeuw, 1998; Longford, 1993), can be used to establish effects and relationships.

The aim of the present contribution is to discuss some critical issues arising in the application of multilevel modelling in social research, to study the micro-macro linkages between individuals and the context in which they live. In particular, some considerations about a "working" definition of context as a hierarchical structure in the analysis of social-demographic behaviour are made in section 2; cross-classified structure and cross-classified multilevel models are discussed in section 3 as a means of defining context in a more flexible way. Results from a cross-classified multilevel model on analysis of reproductive behaviour in Italy are given in sections 4 and 5. In the model, the effects of women's place of birth and their place of residence as relevant context are simultaneously consider. Some concluding remarks are reported in section 6.

2. Context in the multilevel approach

The multilevel approach in the social and behavioural sciences lies on two basic conditions: *i*) data are grouped in different levels according to a hierarchical structure; *ii*) grouping cannot be ignored. To ignore group membership risks "…overlooking the importance of group effect, and may also render invalid many of the traditional statistical analysis techniques used for studying data relationships." (Goldstein, 1995: 2).

Hierarchical data structure is very common in the social sciences and several examples from a great variety of disciplines can be found (Bryk and Raudenbush, 1992; Kreft and De Leeuw, 1998; Snijders and Bosker, 1999). However, in order to understand better the kind of implications which multilevel analysis may have for the study of micro-macro relationships in social and demographic research, some remarks about the group nature that identifies second- (or higher-) level units in hierarchy must be made.

Setting out from the main applications of multilevel analysis, at least three different situations can be recognised.

1. *"Natural" Grouping*. The phenomenon under study is intrinsically hierarchical and its characteristics identify higher-level groups in a unique and natural manner. Many examples from different areas present natural clustering (Kreft and De Leeuw, 1998: 3-8): students within school in educational studies, offspring within families in inheritance studies, individual within places in geographical analysis, repeated measures within individuals in longitudinal studies, and so on. The multilevel approach by means of multilevel models is developed for analysing hierarchically structured data coming from this kind of situation.

2. *"Working" Grouping*. Correlation within some units of population is recognised on a theoretical basis, for example, from the idea that people are exposed to the same - environmental, social, economic – factors, and spatial aggregations functionally linked to the phenomenon under study can be found to define higher- level units in the hierarchy. Examples are health districts in health or epidemiological studies, or electoral constituencies in analysis of voting behaviour. In this case, hierarchy is not natural as defined above. Simply, the organisational and practical characteristics of the problem are used to take account of unit correlation.

3. *"Theoretical" Grouping.* Theory agrees on influences deriving from clustering of individuals, but groups are referred only in sociological terms without clearly defined boundaries or clear rules for the allocation of lower-level units to higher-level ones. The problem of the individual-context (or micro-macro) relationship in social research presents these features. Here, context is a very broad concept referring to many social, economic and cultural factors – values, norms, traditions – without an overall definition.

As regards applications to real problems, the third situation appears to be the weakest. Although context effects on individuals' behaviour are widely recognised by everybody, the hierarchical structure is not in fact immediately visible. It is a "latent" structure which put together individuals sharing something in common (e.g. conditions and/or experiences).

The importance of multilevel modelling in understanding context effects on social behaviour lies in the ability to specify meaningfully the latent structure of relationships which involve individuals and their environment.

In most applications, place of residence is usually taken as a proxy for context. That is, second-level units are based on territorial aggregations (see for examples Mason, Wong and Entwisle, 1983; Entwisle, Casterline and Sayed, 1989; Steele, Diamond and Amin, 1996, Diamond *et al*., 1998), with effort devoted to the choice of meaningful second-level variables to represent all the contextual factors given above.

However, such strictly geographic criteria may be too weak to take into account the complex network of relationships in which a woman, or an individual in general, is involved, especially in a developed society. Probably not a single context affecting behaviour is at work, but multiple ones. Together with place of current residence, place of birth, household and working relations also influence reproductive behaviour.

Social context effects may be better identified if different classifications relating to individual lives are simultaneously considered. That is, overcoming the very hard task of finding a working definition for "context" as in situation 3), second or higher-level units are built joining together different groups to which individuals belong: place of birth, place of residence, currently attended school, previously attended school, place of work, and so on. It appears to be a very flexible approach to apply in practical applications, at the same time allowing for the most convenient use of all available information. As far as units are classified along more than one dimension, data structure is no longer purely hierarchical, but is cross-classified, for which cross-classified multilevel models can be set out.

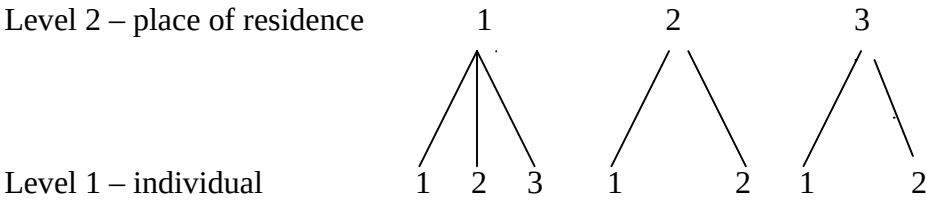
3. Cross-classified multilevel models

Following the multilevel framework, a cross-classified hierarchical structure in which multiple overlapping contexts coexist and first-level units break down along two or

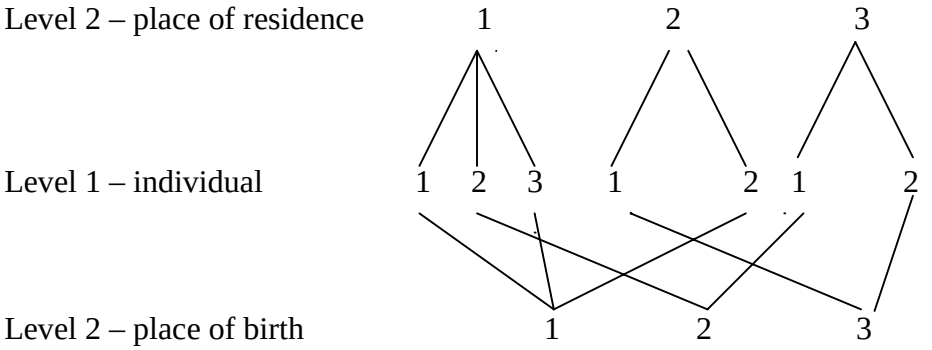
more dimensions, can be represented as an extension of the most usual two-level structure as it is shown in Figure 1 (Gould, Jones and Moon: 583).

Figure 1: Multilevel Structures

a) two-level structure



b) cross-classified structure



In a formal way, cross-classified structure can be modelled very simply (Rasbash and Goldstein, 1994) as follows:

$$y_{i(j_1 j_2)} = \boldsymbol{X}_{i(j_1 j_2)}\beta + u_{j_1} + u_{j_2} + e_{i(j_1 j_2)} \qquad [1]$$

$$\text{var}(u_{j_1}) = \sigma^2_{u_1}, \ \text{var}(u_{j_2}) = \sigma^2_{u_2}, \ \text{var}(e_{i(j_1 j_2)}) = \sigma^2_e$$

Subscript i *(= 1, ... n)* refers to first-level units, subscripts j_1 *(=1,...q_1)* and j_2 *(=1,...q_2)* refer to the two different classifications at the second level. *U* terms represent random effects from the two classifications. In model [1], the total level-2 variability is given by the sum of the separate classification variability. The above formulation may also be given for discrete response variables.

Multilevel cross-classified models may be viewed as the generalisation of purely hierarchical models, so that estimation procedure used in that framework can be efficiently used (Rasbash and Woodhouse, 1995).

In the next sections, a multilevel cross-classified model will be specified to evaluate context effects on the choice of bearing a second child within a three-year interval after the birth of the first child by Italian women in the mid-1990s. Cross-classification allows: *a)* to take into account influences coming from two different "contexts": place of childhood residence and place of current residence (if it has changed); *b)* to evaluate the importance of the two classifications in analysing reproductive behaviour.

4. Data and modelling

Actually, as from the 1980s, Italy has become one of the countries with the lowest fertility levels in the world. The Total Period Fertility Rate in the last few years has settled around 1,2 children per woman. The reduction has affected the whole country, but with great discrepancies in terms of levels, which still remain quite different between north and south, and with differing characteristics in terms of reproductive behaviour - birth order and timing – (see Table 1). Territorial differences are still of considerable importance, suggesting the relevance of cultural and social factors relating to the residential context in determining reproductive behaviour (Santini, 1995).

Two National Fertility Surveys were carried out in Italy to collect detailed information on demographic behaviour: the first one in 1979 (World Fertility Survey Project of the International Statistical Institute) and the second one between November 1995 and February 1996 (as part of the Fertility and Family Survey – FFS – Project of the European Economic Commission). Following the directions suggested by the European

TABLE 1: Women by number of children. Italy, cohorts 1920-1955 (%)

Number of children	Cohorts					
	1920	1930	1940	1945	1950	1955
Italy						
0	15.6	13.7	12.9	10.2	11.2	12.3
1	19.5	19.9	17.0	19.2	22.5	25.1
2	25.5	29.8	37.0	40.2	42.1	41.5
3+	39.5	36.6	33.1	29.7	24.1	21.1
North						
0	17.2	13.4	10.9	8.5	10.0	12.2
1	25.7	28.4	24.2	27.9	32.3	35.5
2	28.4	32.7	41.0	43.8	43.0	40.3
3+	28.8	25.4	23.9	19.8	14.7	12.0
Centre						
0	13.8	13.0	9.8	5.7	7.6	10.7
1	21.8	22.1	20.5	23.7	27.1	29.8
2	32.3	36.9	44.4	49.0	49.4	46.4
3+	32.2	28.0	25.3	21.6	15.9	13.1
South						
0	14.5	14.7	18.0	15.1	15.1	13.6
1	10.2	9.2	5.7	5.8	7.8	10.9
2	17.8	21.9	26.1	31.7	36.5	39.7
3+	57.6	54.3	50.2	47.3	40.6	35.8

Source: Sorvillo (1993)

Project, in particular the second Italian survey was planned according to three research directions: to relate the demographic life-cycles of women and men (marriages/cohabitations, pregnancies and contraception) to their educational and working histories, and to relational, cultural and territorial contexts (De Sandre *et al*., 1997). With this aim, questions at two different places of residence were asked: place of current residence and place of residence until the age of 15, both at municipality level.

The underlying idea was that cultural factors influencing behaviour, such as values, traditions and norms, develop along individual life patterns. It becomes important, even in developed countries, to consider the context in which a person lived during adolescence (if different from the current place of residence), since it probably shaped her/his mentality, customs and values, and may therefore influence life style and choices

even as an adult. To analyse “context” effects on reproductive behaviour, for example, both residential places may be considered for women who moved away from the place in which they lived until the age of 15. A different meaning may be given to the two places in terms of context effects: essentially a social-cultural one for the first place of living, as opposed to a more economic, “constraints and resources” meaning for the second one.

The design of the Italian survey considered three different populations: *a)* women aged 20-49 years (4824 interviews); *b)* men aged 20-49 years (1206 interviews); *c)* partners of interviewed women (600 interviews). A three-stage sample for the different populations was used.

In the present analysis, data from the first group – women aged 20-49 years – are considered (see Tables 2-3). In particular, only data for the 1092 (about 22% of the original sample) married or cohabiting women with one or more children who moved to a different place of residence between adolescence and the survey time were taken to evaluate context effects on the choice of having a second child within three years of the birth of the first child. As may also be seen from Table1 and Table 3, it is the choice of one child as opposed to two children which mainly differentiates reproductive patterns among Italian areas, especially for the younger generations. Further, also the timing regarding the decision to bear a second child is crucial (see Table 4). The postponement of reproductive decisions which mainly characterizes women living in the north of Italy may become definitive as time passes.

Considering only the women who moved between adolescence and the survey time, context effects on fertility behaviour may be studied by looking at both places of residence – two different contexts - available from the survey.

TABLE 2: Women by geographic area, age, and type of union (%)

Geographic Area	%
North West	33.2
North East	21.4
Centre	17.3
South and Islands	28.1
Age	**%**
20 – 29	10.1
30 – 39	41.8
40 – 49	48.1
Type of union	**%**
Married	98.1
Cohabiting	1.9

Source: Fertility and Family Survey, Italy 1995-96

TABLE 3: Women by number of children and geographic area of residence (%)

Geographic Area	*Number of children*		
	1	2	≥ 3
North West	41.0	47.2	11.8
North East	43.7	45.7	10.6
Centre	34.5	49.5	16.0
South/Islands	20.4	43.5	36.1

Source: Fertility and Family Survey, Italy 1995-96

TABLE 4: Women with two or more children by geographic area and interval between first and second child (%)

Interval	*Geographic area*					
	North West	North East	Centre	South	Islands	(size)
3 years	42.6	39.5	50.0	74.8	66.0	(2604)
5 years	44.0	40.6	50.6	77.1	70.1	(2376)

Source: Fertility and Family Survey, Italy 1995-96.
(NOTE: Percentages are calculated by dividing the number of women who had their second child 3/5 years after the first by the total number with one child only).

The cross-classified structure of data-set can be represented as in Table 5 (see also Goldstein, 1995: 114), where each x reflects a respondent.

TABLE 5: Data-set representation

	Residence up to 15 years		
Current residence	A	B	C
D	xxxx	xx	x
E		x	xxx
F	xxx		xxx

Preliminary multilevel analysis, taking as second-level units alternatively municipalities/provinces of actual residence or municipalities/provinces of residence up to 15 years, show significant results for second-level variance (Rivellini and Zaccarin, 1999). In particular, the second-level variance estimate for the current residence is always greater than the estimate for place of residence during adolescence (respectively .435 and .251). Despite some caution regarding results from the adolescent place of residence, owing to low first-level size inside second-level units, this kind of evidence shows that, for the women who moved, it is probable that not a single context is at work, but multiple ones. Instead of considering only one of the two classifications, the best choice is to formulate a cross-classified multilevel model in which the two aggregations can jointly explain reproductive behaviour; in addition, their relative contribution to total variability can be detected.

In the present formulation, a logit cross-classified multilevel model is considered:

$$logit\,(P_{i(j_1 j_2)}) = \alpha + u_{j_1} + u_{j_2} + e_{i(j_1 j_2)} \qquad [2]$$

with:

$$P_{i(j_1 j_2)} = P(Y_{i(j_1 j_2)} = 1$$

where:

$Y_{i(j_1 j_2)}$ = 1 if woman i living in place of residence j_1 who has been living in place j_2 has a second child not later than 3 years after the first child's birth;

= 0 otherwise.

As may be seen from [2], no explanatory variables are included, because the main aim in the present application was only to compare the relative partitioning of variance according to the two different classifications.

4. Empirical results

The cross-classification of the 1092 women who changed their residence after they were 15 years old produces a very sparse table, so that some hypotheses about moving effects must be introduced in order to have reasonable parameter estimates in reasonable computing time.

Italy may be subdivided into four macro geographic areas – north-west, north-east, centre, south and islands. In addition, administratively, the country is also subdivided into provinces, with provincial capitals and other towns within the province. For purposes of clarity, in the following, provincial capitals are called *major* and other towns *minor*. Looking at Table 6, three different sets of residence change are considered:

1. Every move from place of residence until 15 years of age to place of current residence are analysed, even if the new place is very close to the old one (e.g. the new town is located in the same geographical area and is of the same type, major or minor). Every time a woman moves, she may face advantages and disadvantages; she may, for instance, lose social or family networks, change her place of work, find new social services, or change her way of life. This hypothesis regards all the 1092 women.

2. Only women who moved to towns located in different geographic macro areas and/or to towns of a different kind (for example, from a north-east major town to a north-west major town, or from a north-east major town to a north-east minor town) are considered.

TABLE 6: Women who move by geographic area and type of town (major or minor) of place of residence until 15 years and current residence

Residence up to 15 ys		*Current Residence*									
		North-West		*North-East*		*Centre*		*South/Islands*			
		Major	Minor	Major	Minor	Major	Minor	Major	Minor	(Size)	%
North -	Major	**10.26**	**66.67**	3.85	5.13	2.56	2.56	1.28	7.69	(78)	7.14
West	Minor	**11.41**	**79.89**	0.54	2.17	0.54	1.63	0.54	3.26	(184)	16.85
North -	Major	2.17	**13.04**	4.35	**73.91**	-	2.17	4.35	-	(46)	4.21
East	Minor	0.72	6.52	**12.32**	**78.26**	1.45	0.72	-	-	(138)	12.64
Centre	Major	2.17	4.35	4.35	4.35	**19.57**	**50.00**	8.70	6.52	(46)	4.21
	Minor	3.39	2.54	4.24	5.08	**20.34**	**61.86**	0.85	1.69	(118)	10.81
South/	Major	5.76	**11.51**	2.16	8.63	5.04	5.76	7.91	**53.24**	(139)	12.73
Islands	Minor	7.87	**17.49**	2.04	6.12	4.37	5.83	**10.20**	**46.06**	(343)	31.41
(Size)		(71)	(295)	(40)	(191)	(60)	(131)	(55)	(249)	(1092)	
%		6.50	27.1	3.66	17.49	5.49	12.00	5.04	22.80		

Context effects are hypothesized to be similar in the major towns or in the minor towns belonging to the same macro geographic area. In this case, all moves along the principal diagonal in Table 6 are omitted and only 296 women moved in this way;

3. Only women who changed at least province are considered. This hypothesis, involving 479 women, falls in the middle of the above two and is introduced only to reduce the parallelism between the two classifications – place of residence until 15 years, and place of current residence.

According to the three hypotheses, some different specifications for second-level units j_1 and j_2 in the cross-classifications are followed in parameter estimations, as reported in Table 7.

Because of its small size, hypothesis 2) was no longer considered in the application, and the results shown in Table 8 only deal with hypotheses 1) and 3). Some general considerations may be made:

a) the results from fitting two-level models are confirmed. In more detail, the effect of current residence is always greater than that of place of residence up to 15 years;
b) from fitting the cross-classified model, context effect values of place of current residence and place of residence up to 15 years both appear to be reduced.

Note that the variance estimated by choosing place of residence up to 15 years (considered either as province or municipality) at the second level was never significant. In addition, the coefficient related to the variance of the place of current residence (province, hypothesis 1), is 18% lower than the coefficient in the two-level model. This highlights how both classifications may be correlated, obviously because of the similar geographic - territorial meaning of the two aggregations.

TABLE 7: Second level-classifications and size

Hypothesis		J_1	n_{J_1}	J_2	n_{J_2}
Hypothesis 1	n = 1092	Municipality of current residence	246	Type* of residence up to 15 ys	8
		Province of Current residence	80	Type* of residence up to 15 ys	8
	Only cells>=2 n = 697	Province of residence up to 15 ys	13	Province of current residence	44
Hypothesis 2	n = 296	Type* of current residence	8	Type* of residence up to 15 ys	8
Hypothesis 3	n = 479	Province of residence up to 15 ys	97	Province of current residence	75

*see Table 6

TABLE 8: Variance parameter estimates of logit multilevel cross-classified model. Probability of having second child within three years after birth of first child

Hypothesis		*Variance**	Description	*Estimated (se)*
Hypothesis 1	(n = 1092)	$\sigma^2_{u_1}$	Municipality of current residence	0.2835 (0.223)
		$\sigma^2_{u_2}$	Type of residence up to 15 ys	0.0857 (0.182)
	(n = 1092)	$\sigma^2_{u_1}$	Province of current residence	0.3558 (0.136)
		$\sigma^2_{u_2}$	Type of residence up to 15 ys	0
	(n = 697)	$\sigma^2_{u_1}$	Province of residence up to 15 ys	0.1018 (0.147)
		$\sigma^2_{u_2}$	Province of current residence	0.3128 (0.184)
Hypothesis 3	(n = 479)	$\sigma^2_{u_1}$	Province of residence up to 15 ys	0.0990 (0.119)
		$\sigma^2_{u_2}$	Province of current residence	0.2206 (0.146)

*binomial variance at level 1

The non-significant variances obtained in some applications may be explained by the great number of cells with a small sample size. When individual variables are introduced (data not shown), the residual partitioning of contextual variance becomes very small; the sign and values of effects are approximately unchanged compared with the results of fitting two-level models.

6. Conclusions

In the previous sections, emphasis was given to the issue of defining in a meaningful and working way the concept of "context" applied to social research in micro-macro analysis.

Studies of collective behaviour carried out on the basis of territorial data do not fail to illustrate the connections between the contextual characteristics and the human behaviour taken into consideration (Lazarsfeld and Menzel, 1961; Livi Bacci, 1977). However, it is not easy to understand the processes through which context is related to individual action: the greatest barriers are met in trying to "systematically revise the different modalities with which the grouped variables are introduced into circular causation sequences between micro and macro" (Micheli, 1991).

An apparent very flexible approach to this problem may be found in the framework of nested and cross-classified hierarchical data structures. Instead of choosing a single definition and many indicators for context characterization, different sources of aggregations – and variations - in which individuals live may be jointly considered.

From the specific results of this application of a cross-classified model to the analysis of reproductive behaviour in Italy, some points may be highlighted:

1. *Place of residence up to adolescence and place of residence at the survey time.* Results show the greater effect of place of current residence compared with place of residence until 15, although the two contextual dimensions appear to be connected and cross-classification helps to reduce total second-level variance. However, as the Italian Fertility Survey did not collect information on the timing and reason for moving, it is hard to go deeper into interpretation.

2. *Cross classified frame and micro-macro relations*. Cross-classified models allow the multiple dimensions of "contextual clustering", defined only as a complex-theoretical concept, to be formally taken into account. In this sense, cross-classified models are viewed as one way in which more flexible specifications may be defined. This frame may be a useful tool to study micro-macro interactions when the contextual level does not immediately appear as a "natural" structure.

   The multilevel approach also requires a complex, specific survey design which can help researchers to explore all possible contextual dimensions. This requirement becomes even more rigorous when cross-classification structures are considered. Technically speaking, this means that survey designs must be much more complicated, at least in order to ensure the right sample size to study hypothesized micro-macro relationships between phenomena.

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