chapter 10

The experimental approach for the meta-analysis

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In his contribution, Andrews has presented a typical non-experimental approach for the meta-analysis. In this chapter I would like to suggest the use of an experimental design. The advantages are that one knows in advance which effects are relevant and can be discussed and which are not. In fact, we can plan a study in such a way that we can determine in advance which factors are relevant.

In this contribution I do not want to go into details but will only give a rough idea of the possibilities.

BASIC CONCEPTS

In order to discuss the topic some basic concepts have to be introduced. First of all, we speak about "factors" as the variables which are seen to be independent and the scores on these variables are called "levels".

The terms "complete crossing" and "partial crossing" are used in order to indicate whether the levels of one factor are combined with all levels of the other factors or not. For example, the design problems mentioned earlier by Andrews are typical examples of partial crossings.

Furthermore, a distinction is made between "experimental factors" and "non-experimental factors". The experimental factors can be varied by the researcher whereas the non-experimental factors are not under his control. In the project discussed here, typical experimental variables are concepts and methods, while country and language are non-experimental factors.

Finally, a distinction should be made between variation *between* and *within* respondents. Certain factors can be varied for each respondent: examples are the topic and the method. Such factors produce *within* respondent variation. Other factors, such as coun-

try and the data-collection method, cannot be varied for each respondent as a respondent lives in one country and, in general, it will not be possible to ask him the same questions using different data-collection techniques. The last two factors will therefore produce *between* respondents variation.

A POSSIBLE DESIGN FOR THE META-ANALYSIS

There are of course many different possible designs which could be used. Furthermore, the number of variables in this study is very large and it is not possible to work out the final design of this study in such a short time. What I would like to do is to give an example of a possible approach to developing such a design and to give an idea of the possibilities which such a design provides with respect to the estimation of the different effects.

I have chosen a "Balanced Incomplete Block Design" as a reasonable possibility. This design is especially useful where there are a large number of experimental variables as in this research project because most relevant effects can be obtained without a complete crossing of all factors. A complete crossing of all factors would be impossible in this specific case. For other possible designs, see for example Cochran and Cox, 1957; Cox, 1958; Edwards, 1968; Kirk, 1968; Winer, 1962; Collier and Hummel, 1977.

Examples of factors which produce between respondents variation are the countries and the data-collection method. Within variance is introduced by only three different design factors in order to keep it simple. For illustrative purposes I have chosen the length of the introduction to the question, the length of the question itself and the type of response scale used. The factor "countries" has 14 levels, representing the number of countries participating in this research project. The factor "data-collection method" could, for example, have two levels: face-to-face and telephone interviewing. Consequently 28 conditions can be defined by a complete crossing of these two factors. The within respondent factors each have two levels. For the length variables the levels are short and long. For the type of scale we could also use two levels, for example, category scales versus continuous scales. On the basis of this 2 by 2 by 2 design, 8 different combinations of within respondent factors can be distinguished.

Using this design and specifying that in each study at least 4 different design methods are used, one can formulate the experimental design matrix presented in table 1.

table 1: Balanced incomplete block design with four methods per study

length of intro:		short				long				
length of question:		short		long		short		long		
type of scale:		ca	co	ca	co	ca	co	ca	co	total
		1	2	3	4	5	6	7	8	
country	data coll.									
1	1	x	x	x	x					4
	2	x	x	x	x					4
2	1					x	x	x	x	4
	2					x	x	x	x	4
3	1	x	x					x	x	4
	2	x	x					x	x	4
4	1			x	x	x	x			4
	2			x	x	x	x			4
5	1	x		x			x		x	4
	2	x		x			x		x	4
6	1		x		x	x		x		4
	2		x		x	x		x		4
7	1	x			x		x	x		4
	2	x			x		x	x		4
8	1		x	x		x			x	4
	2		x	x		x			x	4
9	1	x	x			x	x			4
	2	x	x			x	x			4
10	1			x	x			x	x	4
	2			x	x			x	x	4
11	1	x		x		x		x		4
	2	x		x		x		x		4
12	1		x		x		x		x	4
	2		x		x		x		x	4
13	1	x			x	x			x	4
	2	x			x	x			x	4
14	1		x	x			x	x		4
	2		x	x			x	x		4
total		14	14	14	14	14	14	14	14	112

It is typical of this design that the number of methods in each row is equal for each row. Each method (column) also appears with equal frequency. Even all combinations of methods occur with equal frequency. However, not all possible combinations of methods have been used in each country as this would have meant that in each country 70 combinations of 4 methods out of 8 possibilities would have to be tried for each method which is of

course impossible. In this design only two combinations are used in each country but the design allows conclusions about 8 different combinations.

With this design in each country one experiment with personal interviewing would have to be done and one by telephone and in each study 4 different methods would have to be used. If this design across countries was chosen, where each country does two studies with specific combinations of methods, then conclusions can be drawn for all possible combinations of methods. How these conclusions can be derived will be explained below.

META-ANALYSIS

The dependent variable in this study is an estimate of a validity or invalidity coefficient, or an error variance. In all cases the original variable or the square of the statistic is thus an R^2. Therefore, it might be better to apply Fishers z transformation or a logit transformation on the statistic and use the transformed scores as the dependent variable.

For each cell of table 1, a value of this dependent variable can be obtained. Analysis of variance can be used to analyze the scores. This will lead to the following result:

$$z(R^2) = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + \gamma_k$$

This allows an estimate of:
- the mean value (μ)
- the effect of the country (α_i)
- the effect of the data collection method (β_j)
- the interaction between the two ($\alpha\beta_{ij}$)
- the effect of the different methods (γ_k)

CONCLUSIONS

In this contribution, I have discussed the possibilities of experimental designs for this research project. This approach has been taken because the project still has to be designed. Therefore the data collection can be planned for more efficiency than a non-experimental design would allow.

The advantages of such an approach are that it will not be determined after the data collection is completed that very little can

be said about the effect of certain factors. In addition the different possible designs can suggest economic ways for reducing the number of studies which have to be done in order to estimate the effects.

The trade-off is that one has to spend a lot of time in designing the study. The organization of the data collection is also more detailed than in the non-experimental approach.

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