Johan van Tulder
University of Leyden*
Netherlands

2.10 The chain linked sampling technique

INTRODUCTION

In marketing, opinion and sociological research, including media inquiries, either *ad hoc* surveys or panel surveys are used to collect data. Both methods have their advantages and disadvantages. The author has developed a method which combines the advantages of the two sampling systems while mitigating some of the disadvantages. This new method is called the *Chain Linked Sampling Technique*. It will be briefly described in this paper. Subsequently, its application will be illustrated by some results of a survey involving questions relating to media.

DESCRIPTION OF THE TECHNIQUE

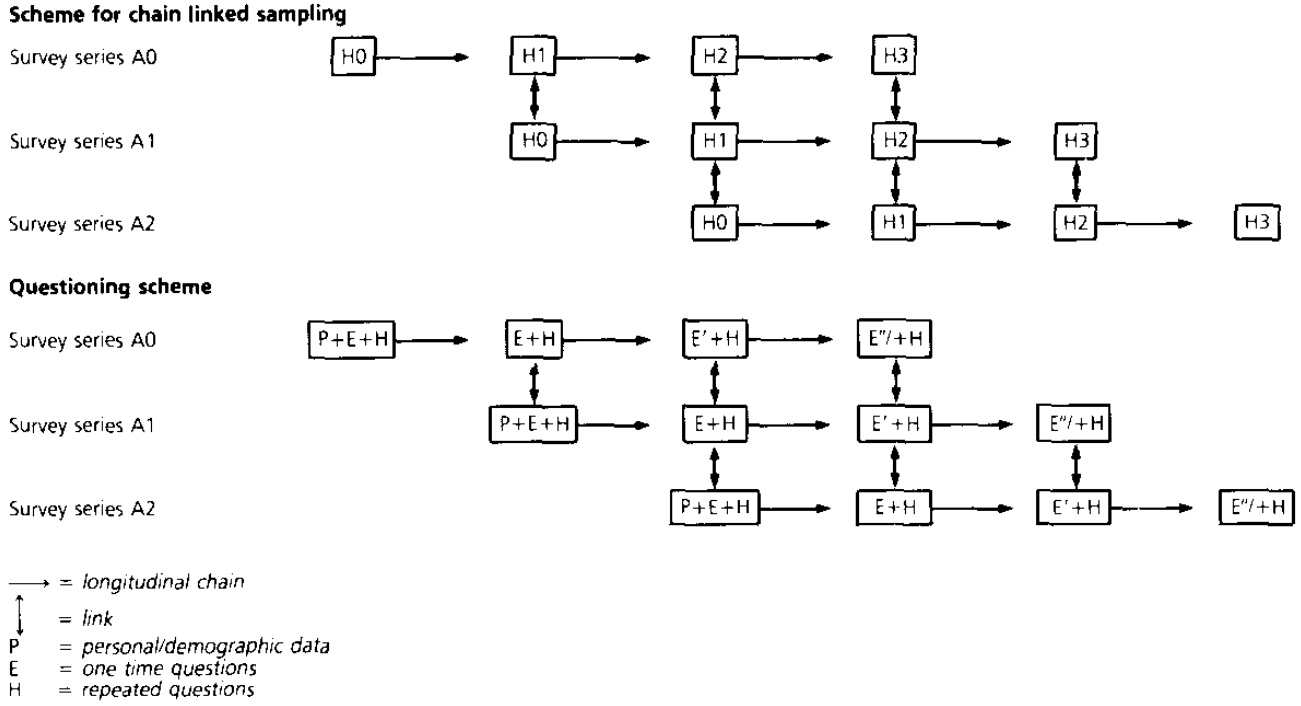
In *ad hoc* surveys, the respondent is interviewed only once. This, of course, makes it impossible to compare data collected from respondents in the course of time (no dynamic comparison). A panel technique is obviously ideal for research on a longitudinal basis, but leaves room for considerable doubt about the representativeness of the sample obtained, as the pick-up of prospective panel respondents is often very modest. The Chain Linked Sampling Technique, an important instrument in media surveys, allows dynamic comparison while offering the sampling advantages of the *ad hoc* survey technique.

In fact, respondents are interviewed several times and not continuously as in panels. While subsequent interviews are being held with the *same* respondents, fresh samples are drawn and subjected to the same procedure.

The system can be schematically outlined as in **Figure 1**.

* *Professor van Tulder is Scientific Adviser, nv v/h Nederlandse Stichting voor Statistiek.*

FIGURE 1



2.10 The chain linked sampling technique

This is how the system operates:

The first survey (H0) is the basic or 0 survey. Every respondent in this basic sample will be interviewed again several times (eg in surveys H1 and H2). In the subsequent surveys, a number of questions are repeated (H) and a number of questions changed (E). The first survey includes demographic questions and any questions which may be necessary to establish a typology, etc.

Of course there will be a certain extent of non-response in the first survey and also in the subsequent surveys with the same people. No replenishment for the non-response takes place, but a provision is made for it by *simulation and segmentation techniques*.

In the course of the survey, new links can be added to the chain. A number of questions will be asked only in H0, but not in the subsequent surveys H1, H2, etc. They are the questions required for analysis or typology. They are also questions in respect of which no change in the respondents' answers can be expected. Some other questions (H) will be repeated in subsequent surveys.

In H1, a linking is made with H0 through the same link of the chain (ie the fresh part of the sample). This linking is effected primarily with a view to the P (personal/demographic) and E (one time) questions, to check for the representativeness of the response at time H1. H0 (the first survey) is split into two groups: respondents who were interviewed a second time and respondents who were not. The latter group will be added to the first group after segmentation and simulation. Only then will the answers to questions raised in both surveys (0 and 1) be compared (static and dynamic comparative analysis). This procedure can be repeated in further surveys, H2 . . . Hx.

If in the first phase, one or several links are added to the sample, the composition of group A1/H0 must be compared with the composition of group A1/H1. Also, the results of the H questions have to be compared to detect whether any bias has resulted from questioning people a second time.

Provided the samples are sufficiently large, dynamic analysis of sub-groups among the population can be made for H0/H1, H1/H2, etc.

The Chain Linked Sampling Technique is particularly suitable for the following types of jobs:

(**a**) cases where some trend has to be followed over a relatively short period (eg one year) and where the costs do not warrant the construction of a normal panel.

(**b**) cases requiring long-term flexibility in that questions, sample sizes, etc, can be varied.

(**c**) the examination and elimination of panel bias.

(**d**) surveys requiring a high initial response (eg 70%, which is normal for proper sample surveys, but much higher than for panels).

Summarising, the Chain Linked Sampling Technique can be said to have the following advantages: fair sample of households; fair sample of individuals; check on the interviewing position; and, the likelihood of respondents' being influenced is relatively small.

Some additional advantages are: the possibility of respondents' 'preparing' answers only exists with respect to the third interview (in fact, subsequent interviews are not announced); dynamic analysis is possible, though to a limited extent; good flexibility in the number and type of questions as well as the sample size in the course of time; and, the system lends itself perfectly to experiments.

Some drawbacks: interim reporting is limited in view of the relatively small number of respondents in surveys in which all interviews are spread over one year; and, depending on the length of intervals between two interviews, it may be necessary to rely on the medium-term memory.

SOME RESULTS OF A SURVEY INVOLVING QUESTIONS RELATING TO MEDIA

Survey method

The survey was carried out using the NSS Chain Linked Sampling Technique. Interviews were held orally on the basis of a questionnaire. A compulsory selecting method was used to designate the member of each household who was to be interviewed.

Survey periods

The first survey took place in the period between 9 and 14 July 1979. About five weeks later, in the period between 14 and 21 August, the second survey was held. The third survey was carried out between 17 and 22 September 1979.

It should be noted that in view of the survey periods, the results shown in the tables below may have been influenced by the fact that many people were about to go on holiday when first interviewed, and had just come back from holiday when the second interview took place.

Sample analysis

THE FIRST INTERVIEW

A sample of 587 households, representative of the Dutch population, was selected for the first interview. Visits to those households resulted in 474 completed interviews (81%) (**Table 1**).

After the questionnaires had been received, some biases in the sample composition according to the variables sex and age with respect to the Dutch population aged 18 and above, were eliminated as far as possible by weighting. The number of respondents after weighting was 477.

2.10 The chain linked sampling technique

TABLE 1

Questionnaires sent to interviewers	587
Interviews completed	474
Non-response	113
ie, the respondent was out on three occasions	46
refusal	49
the address given was wrong (shop, office, etc)	18

THE SECOND INTERVIEW

The addresses of the 474 respondents in the first survey were sent to interviewing staff for a second survey about five weeks after the first interview. The results of the second interview are shown in **Table 2**.

THE THIRD INTERVIEW

The addresses of the 378 respondents in the second survey were sent to interviewing staff for a third interview about four weeks after the second interview had been held. The results obtained are shown in **Table 3**.

SAMPLE COMPOSITION IN THE FIRST, SECOND AND THIRD SURVEYS

In **Table 4**, the composition of the three samples according to sex, age and region is shown.

With respect to the second and third surveys, the sample composition before and after simulation is stated. The column headed 'absolute numbers before simulation' states the number of interviews actually held. The 378 second interviews held and 315 third interviews held (which numbers are unweighted) were raised to the initial number of 474 by segmentation and simulation.

Some results of the survey

Tables 6 to **13** at the end of this paper list the results of response to questions relating to media, in particular as to whether certain magazines were read or were not read, and if so, how they were obtained.

In this latter respect, a sub-division was made into primary acquisition (subscription, separate issues) and, secondary acquisition (from third persons or in a reading case).

The numbers corresponding to the three survey periods are juxtaposed in the tables so as to allow a static comparative appraisal, as well as the variations in results obtained in the second survey in relation to the first, the third in relation to the first and the third in relation to the second surveys.

The magazines selected for this purpose were *Margriet* (**Tables 6–9**), a women's weekly magazine, and *Panorama* (**Tables 10–13**), a weekly magazine for the family.

An analysis of the outcome shows that a configuration of numbers which does not seem to vary considerably throughout the three survey periods, conceals a pattern indicating a fair amount of individual changes. There are even shifts from primary to secondary acquisition and vice versa.

The numbers of respondents reading or not reading *Margriet* and *Panorama* can be summarised as in **Figure 2**.

So, for *Margriet* the change of 4% between the second and third surveys is significant (alpha = 0.05). For *Panorama* the 5% change first–second is significant.

In both cases, however, the systematic changes do not exceed about a quarter of the total changes (4% as against 16% and 5% as against 19%). This means that

TABLE 2

	No	%	%
Total number of addresses available	474		100
Not handled (owing to illness or holiday of the interviewer)	17		4
Handled	457		96
Respondents having moved since the previous interview	4		1
Correct addresses	453	100	95
Second interviews held	378	83	80
Non-response in the second interview	75	17	15
ie the respondent was out			
on three occasions	40	9	8
refusal	35	8	7

TABLE 3

	No.	%	%
Total number of addresses available	378		100
Not handled (owing to illness or holiday of the interviewer)	12		4
Handled	366		96
Respondents having moved since the previous interview	2		1
Correct addresses	364	100	95
Third interviews held	315	87	83
Non-response in the third interview	49	13	12
ie, the respondent was out			
on three occasions	35	10	9
refusal	13	3	3
deceased	1	–	–

2.10 The chain linked sampling technique

TABLE 4
Composition of samples in the first, second and third surveys

			Second survey				*Third survey*			
	First survey		*Response*		*non-response*		*Response*		*non-response*	
	No	*%*	*No*	*%*	*No*	*%*	*No*	*%*	*No*	*%*
Sex										
Male	237	50	189	49	48	50	153	48	36	55
Female	240	50	193	51	47	50	164	52	29	45
Age										
18 to 24 years	79	17	60	16	19	20	49	15	11	17
25 to 34 years	108	22	82	22	26	27	68	22	14	22
35 to 39 years	49	10	42	11	7	7	37	12	15	8
40 to 49 years	67	14	59	15	8	8	52	16	7	10
50 to 59 years	71	15	53	14	18	20	48	15	5	8
60 to 64 years	31	7	24	6	7	7	17	5	7	10
65 years and above	72	15	62	16	10	11	46	15	16	25
Region										
North	55	12	42	11	13	14	28	9	14	21
East	88	18	65	17	23	24	49	15	16	25
West	224	47	176	46	48	50	143	45	33	51
South	110	23	99	26	11	12	97	31	2	3
Total number of respondents										
(Weighted)	477		382		95		317		65	
(Unweighted)	474		378		96		315		64	

even at intervals as short as five weeks between measurements, changes occur which are quite significant and sometimes systematic.

At an interval of ten weeks, the total shifts are found to be 24% for *Margriet* and 19% for *Panorama* (both unsystematic).

As regards the constant numbers, percentages are as follows:

Margriet: 1 → 2: 83% 2 → 3: 81% 1 → 3: 76%

Panorama: 1 → 2: 84% 2 → 3: 86% 1 → 3: 81%

1 → 2 multiplied by 2 → 3 yields 67% and 72% respectively. As the actual percentage 1 → 3 for both magazines exceeds the theoretical percentage, the number of occasional readers may be assumed to have been relatively large in the period concerned.

Table 5 lists the numbers of readers and non-readers of a large number of magazines.

From the table one can read that, for example, 47% of respondents replied in at least one interview that they had read at least six out of 12 issues of *Panorama* in the previous period. 22% gave the same reply in all three interviews. This is just under 50%. Similar results were obtained for magazines such as *Margriet*, *Libelle* and *Story*, while the percentages were lower or much lower for other magazines.

The above examples inevitably provide a very incomplete picture of the possible applications of the NSS Chain Linked Sampling Technique. To begin with, several other analyses can be carried out on the data collected, for example the very important analysis of shifts in the readership. What magazine is being read instead of what other magazine? This obviously is a great help in clarifying the market picture.

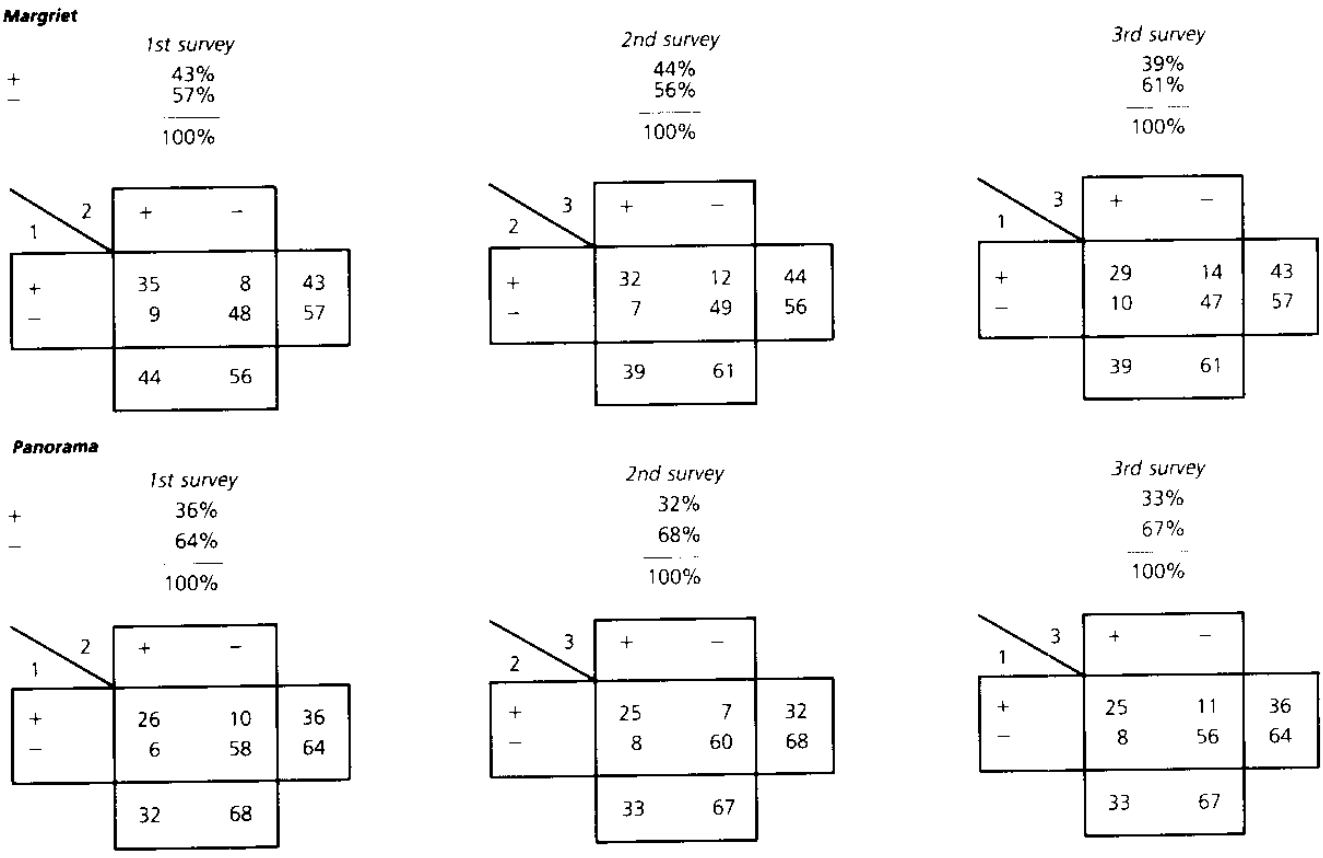
The survey was limited in yet another respect. In fact, the questions relating to media were very few. A large-scale survey will, of course, include all the questions which are currently incorporated in media surveys, so as to allow both static and dynamic comparative analysis.

TABLE 5
Readers and non-readers of certain magazines throughout the three survey periods

+ : *reads the magazine* — : *does not read the magazine*

1st interview	+	+	+	+	−	−	−	−	
2nd interview	+	+	−	−	+	+	−	−	
3rd interview	+	−	+	−	+	−	+	−	
	%	%	%	%	%	%	%	%	%
Margriet	26	9	3	6	5	4	4	43	100
Libelle	22	5	3	6	5	4	6	49	100
Story	19	4	1	6	6	6	4	54	100
Viva	3	2	1	3	2	4	2	83	100
E Magazine	3	3	2	4	1	2	2	83	100
Haagse Post	2	1	1	2	1	2	1	90	100
Vrij Nederland	5	1	.	3	1	1	1	88	100
Nieuwsnet	1	–	–	1	–	1	..	97	100
Panorama	22	4	3	7	3	3	5	53	100
Nieuwe Revu	14	5	2	4	5	2	4	64	100
Privé	13	4	2	8	5	4	6	58	100
Weekend	8	1	3	4	4	3	3	74	100

FIGURE 2



For the six diagonals (+ −)//(− +) the values of the chi square are respectively: 0.19 – 5.81 – 3.45 ‖ 4.26 – 0.34 – 3.04.

2.10 The chain linked sampling technique

Another asset is that the proposed research method allows reporting in the same way as it is done in the National Inquiry on Press Media. Thus, continuity is ensured unless the questions are changed.

Complementary analyses of many kinds can be carried out as well.

Some possible variations

We shall now discuss some items that may be important in the application of the Chain Linked Sampling Technique in media research.

Through the linking method, the survey procedure can be adjusted at any point in time. The design permits a check on the changes in results.

Such changes can always be analysed as variations in a current survey pattern, ie in a survey in course of completion.

VARIATIONS IN THE QUESTIONNAIRE

Questions can be added or reformulated at any time. If a check is required, it can be carried out simply by not implementing the variation in a number of links and subsequently making a comparative analysis.

VARIATIONS IN PRODUCT DATA

In multi-media surveys involving a large number of product data, questions relating to such products can be spread over the first, second and third interviews, in particular if the purchasing frequency is high and if there is no need to question a respondent several times about the same product. This also applies to durable consumer goods. Of course, different products, for example seasonal articles, can be included as the survey continues.

VARIATIONS IN THE SIZES OF LINKS

At certain times of the year, a larger number of interviews may have to be held than at others. This can be done easily by adding extra links.

VARIATIONS IN INTERVALS BETWEEN LINKS

These may be of particular interest. In fact, by taking short intervals for some links and longer or even very long intervals for others, positions at more than three points in time can be compared in the dynamic analysis. Different intervals may also be selected for the summer and winter periods. The system allows such variations without any difficulty.

VARIATIONS IN THE MEDIA

These raise no problem either. The media can be adjusted to the current situation in every new link. In addition, certain media can be included in every interview (three times for every respondent) and others in two interviews only. Needless to say that such variations require the necessary care in multi-media surveys, since it must remain possible to interlink different media at any time.

VARIATIONS IN THE NUMBER OF ADDITIONAL RESPONDENTS WITHIN THE HOUSEHOLD

In surveys involving interviews with more than one member of a household, the second person may be an interchangeable person in the first, second and possibly the third interviews. Other constructions are conceivable as well.

VARIATIONS IN SAMPLE STRATIFICATION

In regional surveys, disproportionate stratification of samples may be necessary. This can be achieved without much difficulty unless the number of additional interviews in a limited area is extremely high. The system also permits temporary variations in sample stratification with a view to carrying out an experiment or a thorough seasonal analysis.

VARIATIONS IN DATA COLLECTION TECHNIQUES

There are several data collection techniques which can all be tried out experimentally. One method consists in leaving behind a little diary after the first interview. The diary is collected when the second interview is held. Another possibility is to collect extra information by telephone from certain target groups.

2.10 The chain linked sampling technique

TABLE 6

Question: On this card you will find a list of magazines. Please state whether you read or inspect any of them regularly, ie at least six out of 12 issues.
Question: Does your household subscribe to any of the magazines listed, ie is the magazine always delivered by mail or by a delivery man?
Question: Of which of the magazines listed did you buy one or several separate issues yourself in the past two weeks?
Question: And which of the magazines do you obtain otherwise?

All respondents – 9–14 July, 14–21 August and 17–22 September 1979.

Separate results of the first, second and third surveys

	1st survey total	2nd survey total	3rd survey total	2nd survey response	2nd survey non-response	3rd survey response	3rd survey non-response
				Absolute numbers			
Margriet							
Readers*	207	211	187	174	37	129	58
Non-readers	270	266	290	208	58	188	103
Total	477	477	477	382	95	317	161
*** Method of acquisition**							
Primary	111	100	94	80	19	64	30
Secondary	97	111	94	94	18	65	29
Total	208	211	188	174	37	129	59
				As percentage of the number of respondents per category			
Margriet							
Readers*	43	44	39	46	39	41	36
Non-readers	57	56	61	54	61	59	64
Total	100%	100%	100%	100%	100%	100%	100%
*** Method of acquisition**							
Primary	23	21	20	21	20	20	19
Secondary	21	23	19	25	19	21	18
Total	44%	44%	39%	46%	39%	41%	37%
Number of respondents							
(Weighted)	477	477	477	382	95	317	161
(Unweighted)	474	474	474	378	96	315	159

2.10 The chain linked sampling technique

TABLE 7
First survey × second survey

All respondents - 9 14 July and 14-21 August 1979
First survey

	Margriet		*Method of acquisition**		*Total numbers for the second survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Second survey					
Margriet					
Readers*	167	44	90	78	211
Non-readers	40	226	21	19	266
Total	207	270	111	97	477
*** Method of acquisition**					
Primary	80	20	(70)	10	100
Secondary	87	24	21	(67)	111
Total	167	44	91	77	211
			As percentage of the number of respondents per category		
Second survey					
Margriet					
Readers*	81	16	81	80	44
Non-readers	19	84	19	20	56
Total	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	39	7	(64)	11	21
Secondary	42	9	18	(69)	23
Total	81%	16%	82%	80%	44%
Total numbers of the first survey					
(Weighted)	207	270	111	97	477
(Unweighted)	211	263	114	98	474

2.10 The chain linked sampling technique

TABLE 8
Second survey × third survey

All respondents 14–21 August and 17–22 September 1979
Second survey

	Margriet		*Method of acquisition**		*Total numbers for the third survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Third survey					
Margriet					
Readers*	153	35	79	74	187
Non-readers	58	231	21	37	290
Total	211	266	100	111	477
*** Method of acquisition**					
Primary	83	11	(70)	14	94
Secondary	70	25	9	(60)	94
Total	153	36	79	74	188
			As percentage of the number of respondents per category		
Third survey					
Margriet					
Readers*	72	13	79	66	39
Non-readers	28	87	21	34	61
Total	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	39	4	(70)	13	20
Secondary	33	9	9	(53)	19
Total	72%	13%	79%	66%	39%
Total numbers of the second survey					
(Weighted)	211	266	100	111	477
(Unweighted)	211	263	100	111	474

2.10 The chain linked sampling technique

TABLE 9
First survey × third survey

All respondents – 9-14 July and 17–22 September 1979
First survey

	Margriet		*Method of acquisition**		*Total numbers for the third survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Third survey					
Margriet					
Readers*	139	48	78	61	187
Non-readers	68	222	33	36	290
Total	207	270	111	97	477
*** Method of acquisition**					
Primary	75	20	(63)	11	94
Secondary	65	28	16	(50)	94
Total	140	48	79	61	188
			As percentage of the number of respondents per category		
Third survey					
Margriet					
Readers*	67	18	71	63	39
Non-readers	33	82	29	37	61
Total	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	36	7	(57)	12	20
Secondary	32	11	14	(51)	19
Total	68%	18%	71%	63%	39%
Total numbers of the second survey					
(Weighted)	207	270	111	97	477
(Unweighted)	211	263	114	98	474

2.10 The chain linked sampling technique

TABLE 10

Question: On this card you will find a list of magazines. Please state whether you read or inspect any of them regularly, ie at least six out of 12 issues.
Question: Does your household subscribe to any of the magazines listed, ie is the magazine always delivered by mail or by a delivery man?
Question: Of which of the magazines listed did you buy one or several separate issues yourself in the past two weeks?
Question: And which of the magazines do you obtain otherwise?

All respondents – 9–14 July, 14–21 August and 17–22 September 1979

Separate results of the first, second and third surveys

	1st survey total	2nd survey total	3rd survey total	2nd survey		3rd survey	
				Response	Non-response	Response	Non-response
				Absolute numbers			
Panorama							
Readers*	174	152	157	128	25	107	50
Non-readers	303	325	320	254	70	210	111
Total	477	477	477	382	95	317	161
*** Method of acquisition**							
Primary	62	41	37	37	4	27	9
Secondary	112	111	122	91	21	81	42
Total	174	152	159	128	25	108	51
				As percentage of the number of respondents per category			
Panorama							
Readers*	36	32	33	33	26	34	31
Non-readers	64	68	67	67	74	66	69
Total	100%	100%	100%	100%	100%	100%	100%
*** Method of acquisition**							
Primary	13	8	8	10	4	9	6
Secondary	23	24	25	23	22	25	26
Total	36%	32%	33%	33%	26%	34%	32%
Number of respondents							
(Weighted)	477	477	477	382	95	317	161
(Unweighted)	474	474	474	378	96	315	159

2.10 The chain linked sampling technique

TABLE 11
First survey × second survey

All respondents – 9–14 July and 14–21 August 1979
First survey

	Panorama		*Method of acquisition**		*Total numbers for the second survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Second survey					
Panorama					
Readers*	125	27	39	86	152
Non-readers	49	276	23	26	325
Total	174	303	62	112	477
*** Method of acquisition**					
Primary	34	7	(26)	8	41
Secondary	91	20	13	(78)	111
Total	125	27	39	86	152
			As percentage of the number of respondents per category		
Second survey					
Panorama					
Readers*	72	9	63	77	32
Non-readers	28	91	37	23	68
	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	19	2	(42)	7	8
Secondary	53	7	21	(70)	24
Total	72%	9%	63%	77%	32%
Total numbers for the first survey					
(Weighted)	174	303	62	112	477
(Unweighted)	179	295	66	113	474

2.10 The chain linked sampling technique

TABLE 12
Second survey × third survey

All respondents - 14–21 August and 17–22 September 1979
Second survey

	Panorama		*Method of acquisition**		*Total numbers for the third survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Third survey					
Panorama					
Readers*	118	39	30	88	157
Non-readers	34	286	11	24	320
Total	152	325	41	112	477
*** Method of acquisition**					
Primary	32	5	(21)	11	37
Secondary	87	35	10	(77)	122
Total	119	40	31	88	159
			As percentage of the number of respondents per category		
Third survey					
Panorama					
Readers*	78	12	74	79	33
Non-readers	22	88	26	21	67
Total	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	21	2	(52)	9	8
Secondary	57	10	24	(70)	25
Total	78%	12%	76%	79%	33%
Total numbers for the second survey					
(Weighted)	152	325	41	112	477
(Unweighted)	156	318	44	112	474

2.10 The chain linked sampling technique

TABLE 13
First survey × third survey

All respondents – 9 14 July and 17–22 September 1979
First survey

	Panorama		*Method of acquisition**		*Total numbers for the third survey*
	*Readers**	*Non-readers*	*Primary*	*Secondary*	
			Absolute numbers		
Third survey					
Panorama					
Readers*	118	39	37	81	157
Non-readers	56	264	25	31	320
Total	174	303	62	112	477
*** Method of acquisition**					
Primary	30	7	(22)	8	37
Secondary	90	32	16	(74)	122
Total	120	39	38	82	159
			As percentage of the number of respondents per category		
Third survey					
Panorama					
Readers*	68	13	61	72	33
Non-readers	32	87	39	28	67
Total	100%	100%	100%	100%	100%
*** Method of acquisition**					
Primary	17	2	(36)	7	8
Secondary	52	11	26	(66)	25
Total	69%	13%	62%	73%	33%
Total numbers for the first survey					
(Weighted)	174	303	62	112	477
(Unweighted)	179	295	66	113	474