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1. Introduction

Social and demographic surveys generally use interviews as a major tool of measurement. With increasing sophistication of modern society, and increasing fear of people of invasion of privacy, more and more difficulty is being experienced in interviews. Such difficulty is particularly serious when questions asked in a survey are considered personal and sensitive. Ironically, many of the contemporary sociodemographic problems for which surveys are attempted are sensitive; e.g., criminal abortion, teenage pregnancy, pre-marital or extra-marital sexual relationship, deliquency, truancy, use of drugs and crime.

Epidemiological and health surveys may encounter similar difficulties because of social stigma attached to some specific health conditions: leprosy, tuberculosis, alcholism and psychiatric conditions, just to mention a few.

To overcome such difficulties and to enlist greater cooperation from the respondents, Warner in 1965 developed an innovative survey technique which he called the "randomized response technique" (RRT). (1) Considerable theoretical work and some field studies of limited scope have since been undertaken by various investigators in the United States (2) and elsewhere. (3)

The RRT, although promising as an innovative survey technique, does have an inherent weakness; its efficiency of estimate is substantially lower than that of a conventional survey of comparable scope asking direct questions.

The authors have undertaken a series of studies including field tests to improve the efficiency of the RRT, and one of the models proposed is the multiple trial per respondent.(4) Theoretically speaking, the number of trials per respondent can be increased indefinitely so that the variance of estimate is reduced to that of a similar survey asking direct questions. In practice, such an increase can be done only at the cost of compromising the confidentiality of the respondent's identity; her cooperation, therefore, might deteriorate. As a solution to the above dilemma, the multiple answer model has been developed which has been given a code name of Hopkins RRT Model II. (5)

Other works of the authors on the subject include the development of two discrete quantitative models, which have been coded Hopkins RRT III (6) and IV (7).

Field studies to test the feasibility of these models have since been undertaken, and the current paper presents the experience with use of the multiple answer model in the field.

2. The Study

The field study was conducted in Taichung, Taiwan, during August 1973. One local area in Taichung City, the South District (urban), and another in the adjacent county, Wu-feng township (semi-urbanized) were purposely selected for the study. From the former area, a total of 180 married women, age 20-44 were randomly chosen, and from the latter, the sample size was 173. Successful interviews were conducted for 150 women in each of the study areas.

In addition, 53 names of women who were known to have had an induced abortion during the past 12 months were provided by an Ob-Gyn doctor in Taichung City, who is a close associate of the authors. All of these women lived in the city. By matching with respect to age and parity, 53 "matches" were chosen from among a list of postpartum women in the city. The names of the abortees and the matches were then mixed and randomly assigned to the interviewers who were kept "blind" as to who were known abortion cases and who were the matches. A total of 45 successful interviews were conducted in each group.

The randomizing device used in the field trial contained 50 balls of identical size; 15 red and 35 white ($\underline{p} = 0.3$). It is designed in such a way that five balls will drop into the neck at each trial. Each respondent was asked to repeat the procedures three times; it was a three-trial of five answer model (Figure 1).

3. The Results

The results of the study, the proportion of the respondents who were estimated to have had an abortion (abortion rate), and the standard errors of estimates are shown in Table 1.

It will be noted that the estimated abortion rates obtained with the multiple answer RRT model in the South District and Wu-feng Towhsnip combined, varied from 22.5% in the first trial to 35.8% in the third. The standard errors of estimates also varied from 3.54% to 3.90%. By pooling the results of three trials, the estimated abortion rate was 27.8%, with the standard error being substantially reduced to 2.83%.

The pooled estimate of 27.8% is roughly comparable to the rate obtained by the Taoyuan RRT Study, and is significantly higher than the rates obtained by any of the island-wide KAP surveys conducted previously. At the 1973 islandwide KAP survey, a highest abortion rate of 19.5% was obtained; this, however, was significantly lower than the pooled estimate obtained with this RRT model (p < 0.005).

The abortion rate obtained from the 45 known abortion cases was 75.0%. Although its

95% confidence interval failed to comprise the expected value of 100%, it came close to it. An earlier study in Taoyuan revealed that women, not infrequently, failed to report the abortion experienced during the past three months correctly. There were errors, both in reporting the timing of abortion and in reporting of the abortion event itself.

It can be seen that the efficiency of this multiple answer model is significantly higher than the conventional RRT model used under the Taoyuan RRT Study in which the single trial RRT model was used.

Further analyses on the differential abortion rates by selected demographic variables, such as urban-rural, age and parity, agreed with expectation except that the correlation between abortion rate and education appeared to be negative; women of no formal education showing the highest abortion rate (Table 2). This rather unexpected result was caused partly by the difference in age composition and partly due to a smaller sample size in each category. A study of larger scale should be undertaken for more conclusive results.

Immediately after the RRT trials, a post-RRT interview was conducted on each respondent by asking nine questions about her impression of the RRT. The results indicated that the RRT is feasible and procedures can be understood by most of the respondents (Table 3). Also, with this device, most of them indicated willingness to respond truthfully to a question which is far more sensitive than a question on induced abortion (Table 4).

Surprisingly, although close to 90% of the respondents said they felt that there might be a gimmick in the RRT, only 20% of them indicated that more than half or most of their neighbors and friends would feel that there is a gimmick (Table 5). One possible explanation of this inconsistency of response is the ambiguity in the wording of the question in Chinese language; the question may be interpreted as asking if there is some "mechanism which is inducing or soliciting the respondent to answer truthfully" and some respondents might think that the RRT, indeed, is a device to induce people to answer honestly.

4. Discussion

The interest of social researchers in randomized response technique seems to have increased recently. Some epidemiologists have also started exploring the feasibility of its use in various health and epidemiological surveys.

The RRT, has also invited some skepticism from other researchers. Some of their reservations, however, are based not so much on their experience with, but rather on their perception of, the utility of the technique. A few stories have also been circulated about unsatisfactory experiences with the use of RRT. While theoretical development of the RRT is being continuously pursued, efforts for improvement of the feasibility of the technique is called for.

Adequacy of interviewers is particularly critical in conducting surveys with the RRT. If interviewers are ill-trained and ill-prepared, if they themselves do not understand and are unconvinced of the technique, they will not be able to secure good cooperation from the respondents. The surprisingly high "non-response rate" experienced by the Taoyuan study (3), we suspect, was due partly to this factor. In the current field study, there was little difficulty reported by the interviewers in securing the full cooperation of the respondents.

Unsatisfactory experience has also been reported from some investigators with regard to use of the two unrelated question RRT model. Although the latter model is generally considered more efficient than a corresponding related question model, formulation of an adequate innocuous question is harder than one might expect. Asking, for example, "Were you born in April?" type of question is unsatisfactory because some respondents might fear possible revelation of sensitive information. Similarly, a question such as, "Was your mother born in April?" may not work simply because not all the respondents would remember the birthdays of their mothers. Another criticism is that more information may be lost rather than gained by use of RRT because the information obtained cannot be correlated, for example, with the individual's characteristics. This is true, but this fact provides the basic argument for use of RRT in protection of privacy. This weakness of RRT, however, is not critical; it is always possible to analyze the data based on smaller groups of specific characteristics.

There are a number of ways by which RRT can be made more feasible. Careful selection of the sensitive problem for study with RRT, careful formulation of the sensitive and innocuous questions, better method of presenting and administering the RRT questions, and use of less sophisticated randomizing devices are some of such possibilities. RRT may also be used, not to "replace", but rather to "supplement" the direct questioning.

The RRT is developed on the basic assumption that when the respondent's anonymity is assured, the respondent will be more willing tc answer a sensitive question truthfully. This assumption is logical but needs more empirical evidence for support. There may be considerable variation in the response pattern to RRT's among people of different cultural or educational backgrounds, calling for more field tests in various countries.

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Figure 1. The Randomizing Device for the Multiple Answer RRT Model: Hopkins RRT II

TABLE 1

Proportion of Married Women of Childbearing Age in Taiwan Who Have Had Abortion: Comparison of the Results Obtained with RRT (Multiple Answer RRT Model and

Single Trial of Conventional RRT Model) and Direct Questioning

	Type of Survey	Proportion Having Had Abortion (%)	S. E. (%)	Sample Size	Year of Survey	Type of Survey	
Rar	ndomized Response Technique:						
1.	Multiple Answer Model: Taichung * (1) South District & Wu-feng Combin	ned:					
	(a) First trial	22.5	3.54	300	1973	Two townships	
	(b) Second trial	24.8	3.62		11	Married Women(MW)20-44	
	(c) Third trial	35.8	3.90	11	"		
	(d) Pooled results: 3 trials	27.8	2.83	"			
	(2) Known Abortion Cases: 3 trials	75.0	5.42	45	"	Women who are known to have had an abortion	
	(3) Matches of the Known Abortion						
	Cases: 3 trials	36.0	5.16	45	"	Matches of the above known abortion cases	
2.	Single Trial Model: Taoyuan	28.2	4.69	692	1971	One County, MW 15-49	
Dir	ect Questioning:						
1.	Island-wide KAP III	13.8	0.68	2558	1970	Taiwan, MW 15-44	
2.	Island-wide KAP IV	19.5	0.53	5588	1973		
3.	Taoyuan Abortion Study:						
	(a) Repeated Interview:				,		
	At Round 1	8.4	0.64	1861	1970	One County, MW 15-49	
	At Round 8	14.0	0.83	1737	1971		
	(b) One-Shot KAP	12.7	1.00	1102	1971	11 11 11 11	

* The current study

TABLE 2

Proportion of Respondents Who Have Had Abortion Estimated by the Multiple Answer RRT Model and the Standard Error of Estimates by Selected Demographic Variables South District and Wu-feng Township, Taichung, Taiwan

	Demographic Variable	Sample Size	Proportion Who Have Had An Abortion (町)	S. E.
Α.	Urban-Rural:			
	Urban [*] Semi-rural	150 150	0.360 0.195	0.0319 0.0279
в.	Age Group:			
	24 - 25 - 34 35 +	47 137 116	0.110 0.255 0.370	0.0428 0.0312 0.0364
c.	Number of Live Birt	hs:		
	0 - 1 2 - 3 4 +	44 134 122	0.045 0.285 0.350	0.0351 0.0323 0.0352
D.	Education:			
	No Formal Primary Jr. High +	63 186 	0.325 0.270 0.240	0.0484 0.0271 0.0504
	Total	300	0.278	0.0283

Note: Results of three trials combined

* South District of Taichung City

** Wu-feng township of Taichung County

TABLE 3

Difficulty or Ease in Understanding the RRT Procedures by Respondents Themselves and their Perception of Understanding of Neighbors/Friends by their Level of Education (In Percentage)

	Level of Education			
Understanding	No Formal	Primary	Jr. High +	Total
		Respondents	s Themselves	
Very easy	9.2	31.4	44.5	29.3
Easy	50.6	58.4	51.8	55.3
Difficult	25.3	6.6	3.6	10.1
Very Difficult	14.9	3.5	0.0	5.3
		Neighbors a		
ill be understood by:				
Almost all	12.6	38.9	62.6	38.1
More than half	47.1	50.9	32.5	46.2
Less than half	28.7	5.8	1.2	9.8
Very few	9.2	4.0	2.4	4.7
Don't know	2.3	0.4	1.2	1.0
lotal	100.0	100.0	100.0	100.0

Note: Total number of respondents was 396

TABLE 4

Feeling Safe to Answer a More Sensitive Question Such as Committing a Crime with the RRT

	Level of Education			
Response	No Formal	Primary	Jr. High +	Total
		Responder	nts Themselves	
Absolutely safe	47.1	52.7	62.7	53.5
Will respond after some				
hesitation	18.4	19.9	27.7	21.2
Will not take the risk	33.3	27.4	9.6	25.0
Don't Know	1.1	0.0	0.0	0.3
		Neighbors	and Friends	
Most will	21.8	30.5	36.1	29.8
More than half	23.0	27.9	37.3	28.8
Less than half	19.5	13.7	10.8	14.4
Very few	33.3	23.0	10.8	22.7
None	1.1	4.4	2.4	3.3
Don't know	1.1	0.4	2.4	1.0
Total	100.0	100.0	100.0	100.0

		Level of Education			
Response	No Formal	Primary	Jr. High +	Total	
		Respondent	s Themselves		
Yes	87.3	88.1	90.4	88.4	
No	12.7	11.9	9.6	11.6	
		Neighbors	and Friends		
Most	4.6	8.4	3.6	6.6	
More than half	13.8	12.8	14.5	13.4	
Less than half	23.0	18.6	13.3	18.4	
Very few	34.5	45.6	54.2	44.9	
None	18.4	12.8	13.3	14.1	
Don't know	5.7	1.8	1.2	2.5	
Total	100.0	100.0	100.0	100.0	

Do You Feel That There is a Gimmick in the RRT Method?

TABLE 5

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